

Cover Crop Termination

For Small Farms and Gardens



United States
Department of
Agriculture

Natural Resources Conservation Service



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Cover Crop Termination: Introduction

Living cover crops improve soil health, but in most cases, they need to be terminated before planting vegetables as to not outcompete the crop for nutrients, water, and sunlight. However, terminated cover crops also benefit the garden. Their nutrients return to the soil and become available for future crops. Their biomass can be used as mulch to suppress weeds and retain soil moisture well into the growing season. Termination methods that require little or no soil disturbance can keep weed seed buried and protect soil health.

This document discusses termination methods and considerations. Different cover crop species are better adapted to certain termination methods. Some species die in the wintertime, or “winterkill.” Some species survive the winter and have a growth spurt in the spring before producing grains or flowers. Some methods take into account the size and maturity of the species as well as the equipment on-hand. There are multiple ways to kill a cover crop, and sometimes a combination of methods is best. Options discussed include winterkill, mow or cut, crimp, tarp, solarization, mulch, tillage, and chemical.

Refer to the USDA-NRCS “Indiana Cover Crop Tool for Small Farms and Gardens” for a table that indicates which termination methods are appropriate for each cover crop in Indiana’s climate..



Overwintering cereal rye



Winterkilled oats vs. overwintering mix



Crimson clover blooming in spring

| Species | Type | Life Cycle | Winter Survival | Termination Methods | | | | | Growth Height | C:N at Maturity |
|----------------------------|----------------|-----------------------|-----------------|---------------------|---------|---------|-------|------|---------------|-----------------|
| | | | | Freeze | Tillage | Mow Cut | Crimp | Tarp | | |
| Barley | Grass | Winter Annual | Expected | | • | • | • | • | Medium-Tall | 30:1 |
| Buckwheat | Nonlegume Forb | Summer Annual | Never | • | • | • | | • | Medium | 20:1 |
| Clover, White/Dutch/Ladino | Legume | Short-Lived Perennial | Expected | | • | • | | • | Short | 15:1 |

Cover Crop Termination: Winterkill



Fall planted oats and field peas



Winterkilled cover crop mix



Early vs. late planted biomass



Mulch residue raked into the pathway between lettuce beds

Winterkilled cover crop species are not expected to survive freezing temperatures or frost. Many of these species, such as oats, field peas, and oilseed radishes, can be planted in the fall to provide soil health benefits and soil coverage through winter. There is a suite of summer cover crops that will also winterkill, including buckwheat, sorghum sudangrass, and sunn hemp, among others.

Winterkilled cover crops planted earlier in their seeding windows have more time to grow before dying and will often produce more biomass and mulch.

In the spring, the top growth of many winterkilled cover crops like oats, peas, and radish are easy to manage. The mulch can be left in place, raked into the pathways, or composted, depending on goals.

In a changing climate, if a warm Indiana winter does not fully terminate the cover crop, resort to other termination methods. Some species have varieties that are more susceptible to winter termination or winter survival.



Cover crop residue raked into the pathway and beds prepared with a layer of compost

Cover Crop Termination: Winterkill



Oats in fall



Oats in early spring



Oilseed radishes in fall



Oilseed radishes in early spring

Species with higher carbon to nitrogen ratios like maturing oats will generally produce longer lasting mulches that protect the soil further into spring. Cover crops such as field peas or radishes have lower carbon to nitrogen ratios and decompose more quickly and lead to bare soil if not mixed with a species like oats. Sorghum sudangrass, a summer cover crop, can gain an immense amount of rigid biomass before dying in winter. The species and rates of cover crops chosen for a winterkill mix, in addition to their growth duration, will impact the type of residue left behind.



Sorghum Sudangrass

Cover Crop Termination: Mow or Cut



Flail mower on walk-behind tractor

Mowing or cutting is a viable termination method with some limitations. Additional measures such as tarping or solarization may be required to fully terminate the cover crop and any weeds. Mowing the cover crop once and then again a week later can also increase effectiveness.

Also referred to as “chop and drop” in a no-till garden, the crop residue can be left on the soil surface as a mulch. The smaller pieces can also facilitate tillage by making the vegetation easier to incorporate into the soil.



Chop and drop with a sickle

Termination success is dependent on timing. Cutting at flower, anthesis, milk stage, or dough stage is the most effective time to terminate. Cutting early can result in cover crop regrowth. Cutting late may allow the cover crop to have set seed and potentially become a weed itself.

Choosing species that have similar bloom times helps, but bloom time can be variable and dependent on varieties and climate. In an ideal world, cereal rye is undergoing anthesis or pollen shed at the same time the hairy vetch is in full flower. Crimson clover often blooms before hairy vetch.



Cereal rye anthesis (foreground) and hairy vetch flowering (background)



Hairy vetch (left) and crimson clover (right)

Cover Crop Termination: Crimp



High biomass mix of cereal rye and legumes



High biomass mix of cereal rye and legumes



Crimped

Crimping entails knocking down the cover crop flat to the ground. Preferably, the method pinches the stem in multiple locations to prohibit water flow through the plant. Like cutting, the optimal time to crimp a cover crop is the flower, milk stage, or dough stage. The cracked stems and precise growth stage increase termination success, but additional measures such as a tarp or extra mulch can help ensure a full termination.



Terminated and cereal rye mulch residue

Cover Crop Termination: Crimp

Methods to crimp a cover crop are diverse. If the crimped cover crop will be tarped, pressing the cover crop over to the ground may be sufficient. Without additional measures, extra care should be taken to crack the stems at the appropriate growth stage.

Pushing the cover crop down in one direction can help leave a more manageable mulch when planting a crop.

In a small garden, a tool could be as simple as one's foot. Growers are also using "foot stompers" created from t-posts or angle irons attached to a board with ropes on each end so that a duo can stomp in unison. Weighted rollers, walk-behind tractor implements, and even the bucket of a tractor are all methods that growers employ to effectively crimp a cover crop.

Cereal rye and similar grasses are the most conducive cover crop species to crimp. Legumes are often noted as "crimpable" but heavy equipment is sometimes needed to truly break their stems. In small-scale agriculture, legumes are difficult to fully terminate through crimping alone. If legumes are added to a cereal rye cover crop mix, anticipate the need for additional termination measures such as tarping.

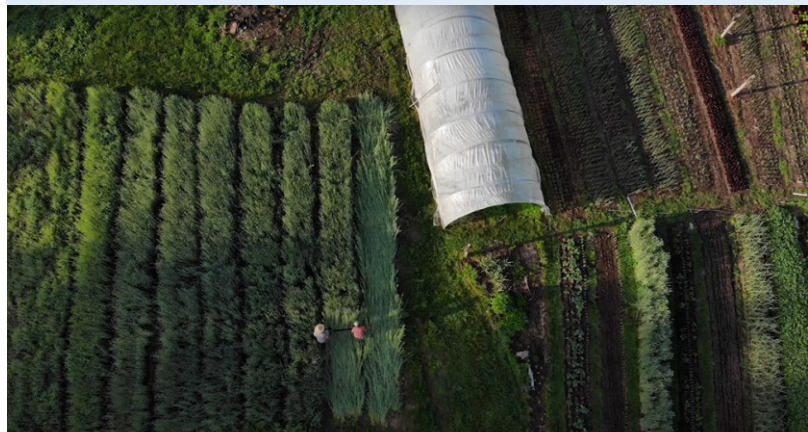
If there is a need to terminate early, a young cereal rye cover crop that is less than two feet tall may not be rigid enough to crimp. In this situation, mowing or cutting and then tarping may be favorable. Pressing the cover crop over and covering with a tarp can also work, though the cereal rye may want to stand back up and not stay flat on the soil surface underneath the tarp.



Crimping by foot



"Foot stomper"



"Foot stomper"

Photo by NoTillGrowers



Rolling cover crops

Cover Crop Termination: Timing for Mowing, Cutting, and Crimping

Termination of a cover crop by mowing or crimping is most effective when the cover crop is utilizing its energy for reproduction rather than vegetative growth. If attempting to terminate too early without any supplemental measures like tarps, cover crops may survive and continue to grow. If attempting to terminate too late, the plant may have set seed and transferred valuable nutrients to those seeds, instead of being contained in the plant matter which will return to the soil through decomposition.

The general guideline to terminate the cover crop when it is anthesis, the period of time when the flower fully open. Crimson clover and buckwheat are great examples. Hairy vetch is most effectively crimped or mowed during full flower after the first pods appear. For a cereal grain like cereal rye, the best time for termination is when pollen is shedding on the grain head.



Hairy vetch



Buckwheat



Cereal rye



Crimson clover

Termination Method: Tarps

Tarps can be used to supplement mowing, cutting, or crimping to ensure a fuller termination of the cover crop and weeds. After the cover crop is mowed or crimped, an opaque tarp is placed on top of the crop residue to block sunlight and prevent regrowth. The tarp can then be removed once the cover crop is dead. This process is also referred to as occultation. [Bulletin #1075, Tarping in the Northeast: A Guide for Small Farms](#), is an excellent resource for additional information and grower case studies.

Common materials include black silage tarps or thick landscape fabric. Tarps can be susceptible to high winds, so anchors such as sandbags, tires, cinder blocks, or step-in fence posts are used to hold them in place.

In general, a tarp will fully terminate a cover crop in approximately 25 days in spring. The duration needed varies based on a number of factors. Less time is needed when temperature is higher, and vice versa when the temperature is cooler. Duration needed is also species specific. Cereal rye takes longer than legumes. Perennial weeds take longer than cereal rye. If the cover crop is mowed or crimped at full flower and tarped, the duration needed may be less than if crimped and tarped before flower. Mowing and tarping very young vegetative cover crops can also accelerate termination.

Tarps can be especially useful when a cover crop mix contains species with different bloom times or if the cover crop needs to be terminated before reaching the flowering stage. For example, if a target planting date for a crop is May 15, a tarp can be placed a month prior, with the understanding that the cover crop may not have produced as much biomass and mulch.



Tarping



Tarping



Getting there



Ready and planted to tomatoes

Cover Crop Termination: Tarps



Early spring tarping of a winterkilled cover crop to terminate remaining weeds



Perennial weed after tarping



Perennial weeds removed after tarping

Cover crops are excellent at smothering weeds, but consistent 100% control is not the norm. A tarp not only ensures that the cover crop will be fully terminated, but it also helps terminate weeds that do not winterkill or cannot be terminated by cutting or crimping. The strategic combination of cover crops and tarps can provide long-lasting weed suppression in a vegetable rotation.

Note that some perennial weeds may need longer tarping periods to completely terminate. Perennials such as dandelions, burdock, and rhizomatous grasses may not be terminated at all. After removing the tarp, persistent perennial weeds may be more visible in contrast to the other dead, brown residue and can be dug out of the bed.

Weed seeds may also germinate under the tarp and terminate, except for some species that need light to germinate such as crabgrass and purslane. Remember that tillage after tarp removal may bring weed seeds closer to the soil surface and encourage germination.

If the goal is to mow or cut an overwintered high biomass cover crop in spring, scout for weeds in the months leading up to termination and spot weed where necessary. If there is a substantial amount of weeds within a cover crop and spot weeding is not feasible, consider tarping the bed before the weeds set seed in order to prevent future issues.

Keep in mind that extended periods of tarping may have negative impacts on soil organic matter. Tarping dry soil can also have negative impacts on soil life. Irrigate or allow for a rain prior to tarping to ensure adequate moisture.

Cover Crop Termination: Solarization

Solarization can be used to supplement mowing or cutting in order to accelerate the termination of certain cover crops. After the cover crop is cut or mowed, clear plastic can be placed on top of the crop residue to intensify the heat to burn the plant. The plastic can then be removed once the cover crop is dead.

Common materials include clear sheets of plastic, such as used high tunnel covers or large sheets of 4 mil. construction plastic.

In general, solarization is more effective on tender crops like oats and legumes, as opposed to vigorous grasses like cereal rye, sorghum sudangrass, or annual ryegrass.

The effectiveness of solarization depends on the air temperature and intensity of sunlight. Typically, two to three sunny days in June to August is used to kill cover crops. Check roots and stems to ensure no new growth has occurred. Cool, cloudy days may not be sufficient.

Solarization attempts in early spring when the weather is cool can result in a greenhouse effect and actually accelerate cover crop or weed regrowth, which could potentially be used as a stale seed bed tactic if followed with tarping or another form of weed management.

Intense heat can kill micro-organisms and therefore damage soil health. If using this technique, be conscientious to not overheat the soil for long periods. Growers advise that 14 days can severely damage biology but that negative soil health effects can occur with even less time.



Solarization of mowed oats and field peas



Solarization of mowed oats and field peas

Cover Crop Termination: Mulch Up

Mulch can be used as a supplemental tool for cover crop termination. After mowing, crimping, or tarping, mulches like straw, hay, compost, leaf mold, or others can be applied to provide enhanced weed suppression. Materials like cardboard and newsprint can also be added to the mulch layer to enhance termination. The idea is to block light from reaching the soil and cover crop residue in order to prevent weed seed germination and decrease the chance of cover crop regrowth via photosynthesis.

Like a tarp, mulching can also be used to terminate a cover crop earlier than the anthesis stage. However, the thickness of the mulch and its ability to block light will determine its effectiveness.

The vigor of the cover crop species is a factor. Cereal rye and other grass cover crops can continue growing if mowed or crimped before flower. A thick layer of straw might be able to stop the growth but is not considered a dependable tactic. On the other hand, the same technique can prove effective with tender cover crops like hairy vetch or crimson clover, especially with an added layer of newspaper below the straw. It is beneficial to wait 10 or more days after implementing this method before opening transplant holes through the mulch, as the cover crop may not have fully terminated and can regrow via the introduced light.

Scale is also a consideration. Weeding any regrowth is more feasible in a smaller garden than in a large market garden. Mulching methods can be favorable on constructed raised beds if tarps are not practical due to issues with anchoring.



Newspaper and hay applied to cut crimson clover



Straw applied to cut hairy vetch



Compost and straw applied to cereal rye that was mowed before anthesis (foreground)

Cover Crop Termination: Tillage

Tillage is a termination method in which the cover crop is incorporated into the soil, commonly referred to as “green manure.”

Tillage may need to be repeated multiple times in order to fully terminate a cover crop. The growth state of a cover crop can also affect the ability for the cover crop to regrow after tillage. Cereal rye, for example, has a greater tendency to regrow if tilled when it is less than 12 inches tall.

Mowing a cover crop first produces smaller pieces of vegetation which facilitate tillage. Some growers with smaller tillage equipment mow the cover crop, tarp for a period of time to allow for the material to further breakdown, and then till. Some growers rake the cover crop top growth off the bed before tillage. Note that mowed cover crops, especially if mature, can wrap in a tiller.

SARE’s Managing Cover Crops Profitably guide, table [4B “Potential Disadvantages”](#), has information on each cover crop’s ability to be terminated through tillage. Consult this table as well as each cover crop’s individual chapter for additional guidance on tillage.

Note that if soil conditions are too moist or too dry, tillage can cause damage and compaction.



Mowed and tilled cover crop



Cut with a string trimmer and incorporated with a pitchfork



Incorporating a cover crop like hairy vetch with a pitchfork only once may not fully terminate it

Cover Crop Termination: Chemical

For chemical termination, consult Purdue Extension's guidance entitled "[HO-50-W: Terminating Cover Crops, Successful Cover Crop Termination with Herbicides](#)" or contact Purdue Extension for additional assistance.

PURDUE UNIVERSITY

PURDUE EXTENSION
WS-50-W

TERMINATING COVER CROPS

Successful Cover Crop Termination with Herbicides

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Cover crops have become a major topic for producers who want to capitalize on government conservation payments and incorporate sustainable agriculture practices into crop production acres. Cover crops can decrease soil erosion, enhance soil quality and nutritive value, and help improve air and water quality. Cover crops are unique in that most are planted primarily for these benefits and are not harvested for their seed, fruit, or forage (some are partially grazed or used as forage). Instead, cover crops are terminated before planting production crops.

Those who would like to use cover crops in their production systems have many factors to consider including how the cover crop will be terminated. If not terminated properly, cover crops have the potential to become weeds in the production crop and can slow soil drying and warming in the spring. Many cover crop species have characteristics that make them both desirable as cover crops and troublesome weed species. Weedy cover crop escapes not only affect the current production crop, but also can produce seeds and establish a seed bank that will produce future weed problems.

This publication describes how producers can effectively terminate cover crops with herbicides to prevent them from becoming weeds in production crops.

Termination Methods

The four common methods of terminating cover crops are: winterkilling, tilling, mowing, and applying herbicides.



Oats can be an effective cover crop.

Each method has its disadvantages and limits. For example, winterkill (the cover crop is terminated by a hard freeze) is only applicable to certain crops and climate regions; mowing is limited to certain cover crops and crop growth stages. Tillage can be expensive and can negate the benefits of the cover crops, as well as the benefits of minimum/no-till production systems. Many factors also limit herbicides — and they may be completely prohibited in organic cropping systems. When selecting an herbicide program for termination of a cover crop, consider:

- The cover crop species.
- The cover crop growth stage.
- Other weed species present.
- The production crop to be planted.
- The weather conditions at application.
- The type of herbicide used.

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Cover Crop Termination: Examples of Techniques for Walk-Behind Tractors

Growers are continually making advancements in how to effectively terminate cover crops. Here are some grower-tested methods to consider.

Flail Mow

- Make a high pass
- Make a low pass close to the soil surface
- Tarp
- If no tarp, wait a week, and mow again to improve termination

Flail Mow and Rotary Plow

- Flail mow growing bed
- Rotary plow walkway soil onto beds
- Tarp

Crimp

- Knock cover crop over with unengaged flail mower or unengaged power harrow
- Tarp

Clobber Method

- Knock cover crop over with power harrow with PTO engaged and tines set several inches above the soil
- This method pinches the stems to increase termination effectiveness
- Tarp



Flail mowed cover crop

This YouTube video by No-Till Growers demonstrates different methods that can be used to terminate cover crops: <https://youtu.be/O6-IYSxbbuE>



Source: No-Till Growers: No-Till Cover Crop Termination for Small-Scale Agriculture

Cover Crop Termination: High Biomass Residue

The cover crop species and method of termination both impact the type of mulch left behind. Knowing the desired amount and type of residue can drive the decision on what species or mix of cover crop to plant and how best to terminate it.

Cover crops with higher carbon to nitrogen ratios will produce longer lasting residues that are slower to decompose. Great examples are maturing cereal rye and sorghum sudangrass. These cover crop species can produce a lot of biomass. Species with low carbon to nitrogen ratios will produce residues that will decompose more quickly. Great examples are legumes such as hairy vetch and crimson clover. Cover crop species within a mix may contain a diversity of C:N ratios. Upon removing a tarp from a mix of crimped cereal rye and hairy vetch, the cereal rye's sturdy stems may be abundant, whereas the hairy vetch's brittle plant matter is well on its way in the decomposition process.

A mowed cover crop creates smaller pieces of vegetation which are more readily decomposed into the soil. A crimped cover crop stays in-tact and often decomposes more slowly.

As soil health increases, the biology of the soil becomes more active. Increased activity from decomposer microorganisms can result in quicker decomposition of cover crop residue and mulches. Higher temperatures and sufficient moisture will also increase decomposition rates.



Cut vs. crimped cereal rye



Mowed vs. crimped cereal rye

Crop planting and weeding strategies and techniques should be adapted to high residue mulches. Weed suppression can be significant in these systems, but for weeds that do arise, tools like tine rakes or hoes are not viable when the soil is covered with hardy mulches. Anticipate scouting for weeds and manually pulling.

Cover Crop Termination: Soil Moisture

A maturing cover crop, especially a vigorous one like cereal rye, needs water to grow and produce grains or flowers. The cover crop can be terminated in a way to manage soil moisture. In areas with limited moisture, one can terminate growth of the cover crop sufficiently early to conserve soil moisture for the subsequent crop. In areas with potential excess soil moisture, allow the cover crop to grow as long as possible to maximize soil moisture removal. If too dry, a soil depleted of moisture can be replenished through irrigation.

Tarping dry soil over extended periods of time can be detrimental to soil life. Irrigate or allow for rain before tarping to ensure adequate soil moisture.

Though cover crops can at times draw moisture out of the soil, the cumulative impact of conservation practices like cover crops, mulching, and minimizing disturbance improve soil health, water infiltration, and water holding capacity. A garden bed with a terminated cover crop mulch will retain soil moisture as compared to a hot, bare soil.

Cover Crop Termination: Allelopathy and Nutrients

Some cover crops produce allelopathic compounds that are capable of acting as a natural herbicide towards other plants. This phenomenon can benefit gardens by inhibiting the germination or growth of weeds.

Cover crop species known to produce allelopathic effects include but are not limited to cereal rye, sorghum sudangrass, and buckwheat. Varieties within these species, as well as their growth states, may also impact the potency of the chemical.

While of benefit to reducing weeds, allelopathy can also impact small-seeded vegetables. Wait 20 days after incorporating a cover crop with tillage before seeding small-seeded vegetables. Transplants, larger seeds, and legumes are less susceptible.



Cover crops in raised beds

Nutrient management should be considered when using cover crops. Legumes provide nitrogen to the following crop, yet high biomass covers like a mature cereal rye can reduce short-term nitrogen availability in the soil. Consider crop needs when planting into high biomass residue or adjust fertilization accordingly. Contact your local Soil and Water Conservation District for more information.

Cover Crop Termination: Termination Timing Table

| Typical termination stages for common fall-planted cover crops in Indiana. Timing is variable due to variability in climate, soils, and cover crop varieties. | | | | | |
|--|------------|-------|-------|-----|------|
| Cover Crop | Winter | March | April | May | June |
| Oats | Winterkill | | | | |
| Field Peas | Winterkill | | | | |
| Oilseed Radish | Winterkill | | | | |
| Crimson Clover | Flower | | | | |
| Hairy Vetch | Flower | | | | |
| Cereal Rye | Anthesis | | | | |

| Examples of termination method timing for overwintering fall-planted cover crops in Indiana | | | | | |
|---|---------------------|-------|-------|-----|------|
| Cover Crop | Winter | March | April | May | June |
| Crimson Clover | Mow > Mulch Up | | | | |
| Hairy Vetch | Mow > Tarp | | | | |
| Cereal Rye | Crimp > Tarp | | | | |
| Cereal Rye + Legumes Mix | Crimp or Mow > Tarp | | | | |
| | Crimp or Mow > Tarp | | | | |