

TERMINATING COVER CROPS

Successful Cover Crop Termination with Herbicides

Authors:

Travis Legleiter
Bill Johnson
Tom Jordan
Kevin Gibson



Photos by
Corey Gerber
Purdue Extension

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.

Cover Crop Species

The *Midwest Cover Crops Field Guide* (Purdue Extension publication ID-433) splits cover crop species into three categories: grasses, legumes, and other non-legume broadleaves (the guide is available from the Education Store, www.the-education-store.com).

Cover crop systems that contain only grass species or only broadleaf species can be terminated using selective grass or broadleaf herbicides. However, producers will often grow combinations of grass and broadleaf species from the three groups together to receive the maximum benefits that each group presents. Successfully terminating a mixed cover crop that contains grasses and broadleaves will require a nonselective herbicide such as glyphosate, glufosinate (Liberty®), or paraquat (Gramoxone®).

While it is possible to combine a selective grass herbicide and selective broadleaf herbicide to terminate a mixed crop, this practice is not advisable because combinations can be antagonistic. Combining glyphosate with either 2,4-D or dicamba can ensure more complete termination of broadleaf species than spraying glyphosate, 2,4-D, or dicamba alone.

Effective herbicide control of grasses and broadleaves varies by species. You should always consult a weed control guide or herbicide label to ensure the herbicide will be effective on a particular cover crop species. See Species-specific Recommendations (page 4) for herbicide programs for some common cover crops. For details about weed control, consult the *Weed Control Guide for Ohio and Indiana* (Purdue Extension publication WS-16-W) available from the Education Store, www.the-education-store.com.

Cover Crop Growth Stage

The growth stage and height of the cover crop at the time of termination is critical in determining what herbicide and rate will be most effective. Crops that are bolting, jointing, or producing reproductive structures can be difficult to control with herbicides and may require other termination methods. Always take cover crop heights into consideration because taller, more mature plants may require greater herbicide rates than smaller, less mature plants.



Annual ryegrass is a cover crop that can become an aggressive weed.

Other Weed Species Present

One of the potential benefits of cover crops is that they can suppress some winter annual weed species. However, poor cover crop stands, unintended winterkill, and seed contamination can make room for weed species to infest cover crops.

Before choosing an herbicide to terminate a cover crop, carefully consider all the plant species that are present — including cover crops and weeds. Decide on an herbicide plan before planting or seeding the cover crop, and then amend the plan according to any additional weed species that occur.

Production Crop to Be Planted

When considering a cover crop and termination plan, consider the production crop you will plant after the cover crop. Many herbicides persist in soil and plant residues, which can harm or kill the following production crop.

When planning an herbicide termination program, use only herbicides that are labeled for burndown or preplant applications with the production crop you will plant. Be sure you also observe planting restrictions. For example, there is a 14-day restriction when planting soybean after using high rates of 2,4-D in your cover crop termination program. Table 1 lists the planting restrictions for corn and soybean planting for selected herbicide products.

Table 1. Corn and soybean planting restrictions for herbicides used to terminate cover crops.

Active Ingredient	Trade Name	Planting Restriction ¹	
		Corn	Soybean
atrazine	AAtrex®	NR	10 months
S-metolachlor + glyphosate	Sequence®	NR	NR
atrazine + S-metolachlor + glyphosate	Expert®	NR	10 months
glyphosate	Roundup®, Touchdown®, others	NR	NR
paraquat	Gramoxone®	NR	NR
2,4-D ester		NR	0.5 lb ai/A: 7 days 1.0 lb ai/A: 14 days
dicamba	Clarity®	NR	8 fl oz/A: 14 days 16 fl oz/A: 28 days
fomesafen + glyphosate	Flexstar GT®	10 months	NR
chlorimuron + tribenuron	Canopy EX®, Cloak EX®	10 months	1.1-2.2 oz/A: 7 days 2.3-3.3 oz/A: 14 days
chlorimuron + thifensulfuron	Synchrony XP®	10 months	NR
chlorimuron + metribuzin	Canopy®, Cloak DF®	10 months	NR
chlorimuron + thifensulfuron + flumioxazin	Envive®	10 months	NR
chlorimuron + flumioxazin	Valor XLT®	10 months	NR
chlorimuron + sulfentrazone	Authority XL®	10 months	NR
chloransulam	FirstRate®	9 months	NR
chloransulam + sulfentrazone	Authority First®, Sonic®	10 months	NR
chloransulam + flumioxazin	Gangster®	9 months	NR
saflufenacil ²	Sharpen®	NR	≤1 oz/A: NR >1 oz/A: 14 days
saflufenacil ² + imazethapyr	Optill®	8.5 months	NR
saflufenacil ² + dimethenamid-P	Verdict®	NR	5 oz: NR 5-10 oz/A: 4 months >10 oz/A: 9 months
saflufenacil ² + dimethenamid-P + imazethapyr	Optill PRO®	8.5 months	NR

¹NR=no planting restrictions — this herbicide may be applied up to crop planting.

²Saflufenacil products being applied to coarse soils with ≤2% organic matter should be applied 30 days prior to soybean planting.

Weather Conditions at Application

Environmental conditions affect herbicide applications, and unfortunately, these are factors that producers cannot control or predict. Typically, cover crop terminations take place in the early spring, so while the exact weather may vary, conditions tend to be cold to mild with variable cloudiness and high moisture.

Take these typical weather conditions into account when planning an herbicide termination program — cool, cloudy conditions slow the rate that herbicides kill plants. The effect of temperature is especially striking with translocated herbicides, because plants must be actively growing to move the herbicide to its site of action. Wet soil can also keep sprayers out of fields, which delays applications and allows cover crops to reach undesirable heights and growth stages.

Type of Herbicide Used

Herbicides are generally divided into two groups: contact or translocated.

Contact herbicides are not transported throughout the plant, so they only affect the parts of the plant they come into contact with. This can be an advantage because the cooler temperatures won't limit herbicide activity; however, a successful application will require complete foliar coverage. Complete coverage will be especially difficult in mixed cover crop stands because of the different plant sizes and shapes.

Translocated herbicides are transported in plants to their growing points and sites of action. These herbicides rely on plants' transport systems to gain access to the site of action — this eliminates the need for complete application coverage. However, as mentioned earlier, the rate that translocated herbicides kill plants depends on the plants' metabolism, which is slower during spring's typically cooler temperatures.

Species-specific Recommendations

A large variety of cover crop species are available and recommended for specific cropping systems, soil types, and regions. This section provides herbicide termination recommendations for the cover crop species most commonly recommended in Indiana.

Annual Ryegrass

Annual ryegrass (*Lolium multiflorum*), also called Italian ryegrass or common ryegrass, has become a very popular cover crop throughout the Midwest. Do not confuse annual ryegrass with cereal rye (*Secal cereal*). Annual ryegrass can be an ideal cover crop because of its ability to rapidly germinate in the fall, grow aggressively in the spring, and add substantial root and forage mass to the soil profile.

However, this plant's aggressive and competitive nature makes it a potential weed problem in production crops. The introduction of annual ryegrass as a cover crop in Indiana and the possibility of it escaping as a weed is a concern. Annual ryegrass has established itself as a weed in orchards, vineyards, and grain crops throughout the western and southern United States and is recognized by multiple scientific weed societies as an invasive weed species. Annual ryegrass is also able to quickly adapt to herbicide selection pressure. The international weed survey (Heap 2012) reports herbicide-resistant annual ryegrass populations in ten states and across six herbicide modes of actions.

While you should take care when planning the termination for any cover crop, you should be especially vigilant when planning a termination application for a cover crop that includes annual ryegrass. Follow these guidelines for successful termination of annual ryegrass cover crops:

- Apply herbicides when annual ryegrass plants are no taller than 6 inches.
- Increase the herbicide rate if applying to annual ryegrass that is taller than 6 inches.
- Make all efforts to terminate the annual ryegrass crop prior to jointing.
- Use translocated herbicides to achieve complete ryegrass termination, including the plant's underground reproductive structures.

Table 2 provides annual ryegrass control ratings for selected herbicides.

Table 2. Annual ryegrass response to corn and soybean burndown herbicides.¹

Active Ingredient	Trade Name	Annual Ryegrass Control ²
atrazine	AAtrex®	5
S-metolachlor + glyphosate	Sequence®	6
atrazine + S-metolachlor + glyphosate	Expert®	6
glyphosate	Roundup®, Touchdown®, others	7
paraquat	Gramoxone®	6
fomesafen + glyphosate	Flexstar GT®	7
paraquat + atrazine ³		7

¹Control scale: 8-9=good. 6-7=fair. 5-0=poor.

²Annual ryegrass control numbers derived from *Chemical Control of Weeds for Kentucky Grain Crops* (University of Kentucky Extension publication AGR-6). All herbicides applied at a standard rate typical for a corn or soybean burndown. To attain additional control, raise the herbicide rate to the maximum feasible labeled rate.

³Paraquat+atrazine is not available as a prepackaged herbicide. The treatment listed is a tank mix at standard rates.

Cereal Rye and Oats

Two popular grass species used as cover crops are cereal rye and oats. These grass species are less competitive than annual ryegrass and more readily controlled by burndown herbicides.

Glyphosate (4.5 lb ae/gal formulation) at a rate of 22 fl oz/A will effectively control both species up to 18 inches tall, although applications should be made to smaller plants when possible and prior to the boot stage. Tank mixes of glyphosate plus 2,4-D, chlorimuron, chloransulam, atrazine, or saflufenacil can also be applied for additional control of other cover crop species (specifically broadleaf species) and will provide residual activity against summer annual broadleaf weeds. The nonselective herbicides paraquat and Liberty® will also control cereal rye and oats, but may not be as effective as glyphosate under spring weather conditions.

Crimson Clover and Austrian Winter Peas

Crimson clover and Austrian winter peas are two popular legume species used as cover crops that typically do not winterkill and require a spring termination. Escapes and failed control of crimson clover and Austrian peas have been documented as rare, so they pose less threat as potential weed species in production crops than annual ryegrass.

Herbicide control data for these two species are limited; however, cover crop guides advise that herbicides easily control crimson clover and winter peas. Standard rates of glyphosate, 2,4-D, and combinations of glyphosate and 2,4-D should achieve acceptable termination of these cover crops species.

Producers considering cover crops need to consider a variety of factors when planning an herbicide termination application. Producers should keep the following factors in mind: cover crop species, other weed species present, cover crop growth stage, herbicide plant back restrictions, and spring weather conditions. The benefits of a cover crop can be quickly negated if producers fail to properly manage cover crops and allow weedy escapes, especially with cover crops species like annual ryegrass.

References and Citations

- Heap, I. The International Survey of Herbicide Resistant Weeds. Online. January 27, 2012. Available at www.weedscience.com.
- Justice, G., T. Pepper, J. Solie, and F. Epplin. 1994. Net Returns from Italian Ryegrass (*Lolium multiflorum*) Control in Winter Wheat (*Triticum aestivum*). *Weed Sci.* vol. 8 pp 317-323.

Kladivko, E., et al. 2012. *Midwest Cover Crops Field Guide*. Purdue Extension publication ID-433. Available from the Purdue Extension Education Store, www.the-education-store.com.

Kladivko, E. 2011. Cover Crops for Modern Cropping Systems. Online. January 19, 2012. Available at www.ag.purdue.edu/agry/extension/Documents/CoverCropsOverview.pdf.

Liebl, R. and A.D. Worsham. 1987. Interference of Italian Rygrass (*Lolium multiflorum*) in Wheat (*Triticum aestivum*). *Weed Sci.* vol. 35 pp 819-823.

Loux, M.M., et al. 2012. *Weed Control Guide for Ohio and Indiana*. Purdue Extension publication WS-16-W. Available from the Education Store, www.the-education-store.com.

Monsanto Company. 2009. Roundup WeatherMax® herbicide label.

Sustainable Agricultural Network. *Managing Cover Crops Profitably*, third edition. 2007. Sustainable Agricultural Network, Beltsville, MD. Handbook Series Book 9. Online. Available at mysare.sare.org/publications/covercrops/index.shtml.

University of Kentucky Cooperative Extension Service. 2011. *Weed Control Recommendations for Kentucky Grain Crops*. University of Kentucky Cooperative Extension publication AGR-6.

Find more publications in the *Terminating Cover Crops* series at the Purdue Extension Education Store: www.the-education-store.com.

Reference in this publication to any specific commercial product, process, or service, or the use of any trade, firm, or corporation name is for general informational purposes only and does not constitute an endorsement, recommendation, or certification of any kind by Purdue Extension. Individuals using such products assume responsibility for their use in accordance with current directions of the manufacturer.

PURDUE AGRICULTURE

New 04/12

It is the policy of Purdue University that all persons have equal opportunity and access to its educational programs, services, activities, and facilities without regard to race, religion, color, sex, age, national origin or ancestry, marital status, parental status, sexual orientation, disability or status as a veteran. Purdue University is an Affirmative Action institution. This material may be available in alternative formats.