

Managing risk when using herbicides and cover crops in corn and soybean

Lizabeth Stahl, Extension Educator – Crops

BACKGROUND

As more farmers look to plant cover crops in their corn and soybean fields, the question “What should I do about my herbicide program?” often arises. There is not a one-size-fits-all answer to this question, and unfortunately there are many unknowns.

One challenge when adding cover crops into a corn and soybean production system is that herbicides with residual activity may interfere with the establishment and growth of cover crops. Residual herbicides, however, are a key weed management tool, especially in the management of herbicide-resistant weeds and when combatting weeds with extended emergence patterns like waterhemp.

A KEY FIRST QUESTION - WILL THE COVER CROP BE GRAZED OR HARVESTED FOR FEED OR FORAGE?

If the answer is “yes”, then any rotational or plant-back restrictions listed on the label **MUST** be followed. The herbicide label is a legal document and instructions must be followed to avoid violation of federal law. Many herbicides have rotational restrictions, which specify the length of time until a crop can be planted in the same field after application. Rotational restrictions are placed on herbicide labels to protect the food chain from pesticide residues and/or the succeeding crop from injury. If a rotational restriction is not listed for a particular cover crop, the rotational restriction listed for “other crops” must be followed.



More farmers are seeding cover crops into corn and soybean. Annual rye, radish, turnips and hairy vetch were broadcast-seeded into this field around the V7 stage of corn.

Useful resources listing the rotational restrictions of many corn and soybean herbicides include the following publications:

- “Herbicide Rotation Restrictions in Forage and Cover Cropping Systems” (http://ipcm.wisc.edu/download/pubsPM/Herbicide-Rotation-Restrictions_FINAL.pdf), by University of Wisconsin Extension (June 2014)
- “Herbicide Use May Restrict Grazing Options for Cover Crops” (<https://store.extension.iastate.edu/Product/Herbicide-use-may-restrict-grazing-options-for-cover-crops>), by Iowa State University Extension (December 2016)
- “Herbicide Options for Planting Forage Cover Crops after Corn and Soybean” (<http://cropwatch.unl.edu/2016/herbicide-options-planting-forage-cover-crops-after-corn-and-soybean>), by University of Nebraska-Lincoln (March 2016).

As always, refer to the product label for the most up-to-date information.

There is more flexibility if the cover crop will not be grazed or harvested. The farmer assumes all risk of injury to the cover crop if label restrictions aren't followed, but there would be no legal issue of trying to sell an "adulterated crop", since the cover crop is not entering the food or feed chain.

SIX CRITERIA TO CONSIDER IF THE COVER CROP WILL NOT BE GRAZED OR HARVESTED

If the cover crop will not be grazed or harvested and the cover crop is not listed on the herbicide label, consider the following six criteria to help reduce the risk of crop injury while increasing the potential for successful cover crop establishment:

1) How sensitive is the cover crop to herbicide carryover?

Several universities have been conducting research to address this question. Results of research conducted by the University of Missouri from 2013 - 2015, looking at the general sensitivity of cover crops to carryover from a number of common preemergence and postemergence herbicides, is summarized in Figure 1. Of the cover crops evaluated, they found Tillage Radish® was the most sensitive to herbicide carryover, while cereal rye and hairy vetch were the least sensitive. Similarly, in greenhouse trials conducted by Iowa State University Extension to simulate herbicide carryover in the field, Hartzler and Anderson found that radish was the most sensitive of the cover crops evaluated while cereal rye was the most tolerant (Table 1).

Researchers at Purdue University have also been studying the impact of herbicide carryover on cover crops, and results to date are summarized in Figure 2. Johnson and Legleiter report that, in general, residual herbicides with grass activity can interfere with the establishment of some grass cover crop species, in particular smaller-seeded ryegrass

species. They also report that residual herbicides in the site of action group 2 (ALS inhibitors), group 5 (triazine family), group 14 (PPO inhibitors) or group 27 (pigment inhibitors) can interfere with the establishment of some broadleaf cover crop species.

If little is known about a species' sensitivity to the herbicides used or you cannot find information on a particular cover crop species, information on a close relative can give you a "guesstimate" of sensitivity. Planting a mixture of grass and broadleaf cover crops may also help increase the odds of successful establishment of at least one species in the mix.

- **Herbicide carryover injury on cover crop species is going to vary from year to year**, largely due to rainfall and time of application
- **General order of sensitivity of the cover crops evaluated to herbicide carryover, from greatest to least sensitive:** Tillage Radish > Austrian winter pea > crimson clover = annual ryegrass > winter wheat = winter oats > hairy vetch = cereal rye
- **Soybean herbicide treatments evaluated that were most injurious to cover crops:** fomesafen (Flexstar/Prefix), pyroxasulfone (Zidua), imazethapyr (Pursuit), acetochlor (Warrant), sulfentrazone (Authority products)
- **Corn herbicide treatments evaluated that were most injurious to cover crops:** topramezone (Impact), mesotrione (Callisto, Halex GT, etc.), clopyralid (Stinger, SureStart), isoxaflutole (Balance Flexx), pyroxasulfone (Zidua, etc.), nicosulfuron (Accent Q, etc.)

Fig. 1: Summary of research evaluating the sensitivity of fall-seeded cover crops to postemergence corn and soybean herbicides in Columbia, MO (2013-2015).

Source: University of Missouri, Kevin Bradley, 2016: <http://weeds.cscience.missouri.edu/extension/pdf/cover%20crop%20carryover.pdf>.

Rotational restrictions listed on the label must be followed if the cover crop will be grazed or harvested. If the cover crop will NOT be grazed or harvested, a farmer has more flexibility. In this case, however, the farmer assumes all risk of injury to the cover crop if label restrictions are not followed.

Table 1: Relative tolerance of several cover crop species to herbicides commonly used in corn and soybean production. Injury potential ratings are based on greenhouse trial.

HERBICIDE	CEREAL RYE	OAT	HAIRY VETCH	LENTIL	RADISH
CORN PRODUCTS					
----- INJURY POTENTIAL ¹ -----					
ATRAZINE 90DF	2	2	2	2	2
DUAL II MAGNUM	2	1	1	1	1
BALANCE FLEXX	1	1	2	2	3
CALLISTO	1	1	1	2	2
LAUDIS	1	1	2	2	2
CORVUS	2	2	2	2	3
HORNET WDG	1	1	3	3	3
SOYBEAN PRODUCTS					
CLASSIC	1	1	1	1	2
PURSUIT	1	1	1	1	2
PROWL H ₂ O	2	2	1	1	1
REFLEX	1	1	1	1	2

¹Injury Potential: 1=little or no risk; 2=some risk depending upon herbicide rate and environmental factors; 3=high potential for injury affecting cover crop establishment.

Source: Iowa State University Extension, Hartzler and Anderson, 2015: <http://www.weeds.iastate.edu/mgmt/2015/CCherbicides.pdf>.

2) How long can I expect the herbicide remain active in the soil?

Herbicides can vary greatly in their persistence (length of time they remain active in the soil). If a product has soil activity, consider the half-life (the time it takes for 50% of the active ingredient to dissipate) of all active ingredients when evaluating risk to later-planted cover crops. Herbicides with soil activity and a relatively long half-life include: Atrazine (60 days), Authority (32 to 302 days), Capreno (50 to 120 days), Classic (40 days), Corvus (50 to 120 days), Flexstar (100 days), Stinger (in Hornet and SureStart, 40 days), Pursuit (60-90 days), and Python (in Hornet and SureStart, 14 to 120 days). (Source: “Common Corn and Soybean Herbicides, Estimated Half-Lives, Cash Crop Restrictions and Their Potential to Injure Fall Cover Crops”, Penn State Extension, Curran and Lingenfelter, 2012, available at:

<http://extension.psu.edu/plants/crops/soil->

[management/cover-crops/herbicide-persistence/herbicide-carryover-table](http://extension.psu.edu/plants/crops/soil-management/cover-crops/herbicide-persistence/herbicide-carryover-table)).

Many factors, however, influence herbicide persistence. Soil pH, organic matter, cation exchange capacity, and clay content can increase herbicide persistence. Microbial activity also has a significant impact on herbicide persistence, and is the dominant mechanism of herbicide breakdown or degradation in the soil. Conditions favorable for microbial activity such as warm temperatures, adequate soil moisture, aerobic conditions, good fertility, and medium pH will favor herbicide breakdown. Herbicide degradation rates will generally increase with increases in temperature and moisture, while cool, dry conditions tend to slow degradation. As a result, dry and/or cool conditions the summer after herbicide application can increase injury risk to a fall-seeded cover crop.

Corn Herbicides:

- Pyroxasulfone (Zidua) and metolachlor (Dual, etc.) can hinder ryegrass establishment.
- Atrazine or simazine at > 1 lb/A will be problematic for legumes and mustards unless rainfall is high.
 - <0.75 lb/A may allow for establishment of most legume cover crops, mustards, and annual ryegrass.
- Atrazine at <1 lb/A can allow cereal grain establishment
- Mesotrione (Callisto, Lumax, Lexar, etc.), flumetsulam (Python), and clopyralid (Stinger, Hornet, SureStart) can be problematic for legumes and mustards like canola and forage radish.

Soybean Herbicides:

- Chlorimuron (e.g. Classic), Imazethapyr (Pursuit), and fomesafen (Reflex, Flexstar) could be a problem for fall-seeded legume or mustard covers including radish. However, establishment of cereal grains should be OK.

Fig. 2: Summary of research to date by Purdue Extension on the establishment of cover crops following the use of residual herbicides.

Source: Purdue Extension, Johnson and Legleiter, 2015: <https://ag.purdue.edu/btny/weedscience/Documents/covercropcarryover.pdf>

3) When was the herbicide applied and when do I plan to seed the cover crop

Much of the University research conducted to date looking at the sensitivity of cover crops to residual herbicides has been done with fall-seeded cover crops. One can expect that the longer the time period between herbicide application and cover crop seeding, the lower the risk of injury to the cover crop. As more farmers look at interseeding cover crops into standing corn and soybean, even more attention should be paid to persistence of the herbicide and cover crop sensitivity to the herbicides applied. Early interseeding of cover crops shortens the time window between herbicide application and cover crop seeding which may significantly limit herbicide and cover crop choices. Non-residual herbicides may result in the best chance for successful establishment when interseeding a cover crop, but the potential short and long-term risks of reduced weed control should be considered.

4) Should I use a reduced rate of herbicide?

Reducing herbicide application rates to help reduce the risk of injuring a cover crop is a potential option, but this is not a recommended practice. Sub-lethal doses select for tougher-to-control weeds and can result in poor weed control that can impact cash crop yields and future weed control if weed escapes go to seed, replenishing the weed seedbank. Using the full-labeled rate of an herbicide is also a key tactic in the prevention and remediation of herbicide-resistant weeds. As previously discussed, many factors impact herbicide longevity in the soil, so using a reduced rate of herbicide could result in poor weed control but enough residual activity to hinder establishment and growth of a sensitive cover crop anyway. Considering the extent of herbicide-resistant weed populations in many fields across the state, it can be a risky proposition to potentially sacrifice long-term weed control by reducing herbicide application rates of residual herbicides.

5) Should I increase my cover crop seeding rate?

The question often arises regarding the possibility of increasing cover crop seeding rates if herbicide carryover is a concern. Increasing the seeding rate of the cover crop is a potential option to consider if the cover crop is marginally sensitive to the herbicide used. There are no guarantees, however, that a higher seeding rate would result in a higher stand of cover crop if the cover crop is sensitive to the herbicide used. Higher seeding rates will also result in higher cover crop seeding costs. Factors that influence the longevity and activity of the herbicide in the soil (as described previously) will influence how successful this tactic might be.

6) Can I use a postemergence herbicide after interseeding my cover crop into corn or soybean early in the season?

No one wants to spend the time and money to interseed a cover crop early in the season to then end up killing it unintentionally with an herbicide used for weed control in corn or soybean. To best manage risk if you wish to apply an herbicide after interseeding a cover crop, only select an herbicide and cover crop combination that is allowed on the herbicide label, and follow any application restrictions listed on the label.

SUMMARY

Paying careful attention to herbicide labels, cover crop selection, research results, and the timing of herbicide application and seeding can help increase your odds of successful incorporation of cover crops into a corn and soybean system.

For more information on crops, visit:
www.extension.umn.edu/crops.

Document Reviewed by Jeff Gunsolus, Extension Agronomist – Weed Science, and Jill Sackett Eberhart, Extension Educator – Ag Production Systems.

Photo credit: Lizabeth Stahl, University of Minnesota Extension

Product names are listed for reader convenience. Inclusion is not intended as an endorsement while absence does not imply disapproval.