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Cover Crops As A Weed Management Tool

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Summary

Cover crops can be an effective strategy to control or suppress weeds. To maximize cover crop benefits for weed management, farmers need to consider cover crop species selection, cover crop planting method and timing, termination timing, and termination method. This article discusses considerations to maximize weed management benefits from cover crops.

What is a "cover crop"?

There are multiple definitions for "cover crop". In general, a cover crop is any plant that is grown when the ground would otherwise be fallow (bare). A cover crop is generally not harvested but rather is grown for the other benefits it can provide to a cropping system (sometimes referred to as ecological services). Some farmers do graze cover crops or harvest them for forage or seed.

Why grow a cover crop?

Cover crops provide many potential benefits to an agroecosystem. They cover the soil, decreasing erosion. They add carbon to the soil, increasing organic matter and improving soil health. They take up N and P that would otherwise run off or leach into bodies of water. They help suppress weeds. They also provide habitat and food for wildlife and beneficial insects.

Are there any risks or other unwanted effects associated with cover crops?

Cover crops may provide overwintering habitat for insects or serve as a host for some diseases. Some cover crops are difficult to terminate, such as rapeseed. Incomplete termination may cause issues with planting or competition with subsequent crops, and may allow cover crops to set seed resulting in future weed problems. Carefully choose each species planted as a cover crop.

IMPORTANT CONCEPTS FOR MANAGING THIS TOOL

A. What impacts do cover crops have on weeds?

How do cover crops contribute to weed management?

Cover crops contribute to weed management at multiple points in their life cycle. Preparing the field for cover crop planting, such as with a burndown herbicide or tillage, kills weeds. When cover crops are actively growing, they compete with weeds for space, light, nutrients, and water, depriving weeds of needed resources. Cover crops alter the environmental conditions at the soil surface, which can prevent or delay germination of some weed species. Certain cover crop species release compounds that inhibit weed seed germination or kill weed seedlings (allelopathy). These compounds persist for one to two weeks after termination. The same methods that terminate a cover crop, such as herbicide application or tillage, will also kill weeds. Finally, the cover crop mulch smothers weeds by creating a physical barrier and blocking light.

How do cover crops assist in herbicide resistance management?

Cover crop use, in combination with other weed control methods, adds diversity to a weed management program. The more diverse a weed management program is, the less reliant it is on one or a few herbicides, and the less likely herbicide resistance is to develop or spread.

Why is it said that cover crops "suppress" weeds rather than "control" weeds?

Control refers to methods that kill weeds, such as herbicides or tillage. Cover crops, however, compete with weeds for resources needed for growth (light, water, nutrients) and weed growth is reduced. The reduced weed growth in turn prevents weeds from decreasing cash crop growth and yield. This is why we say cover crops "suppress", rather than "control" weeds. Cover crops can alter the soil environment and reduce weed germination and emergence. As a result, there are fewer weeds as well.

- **What indicates that a cover crop is contributing to weed suppression?**

  Relative to fallow or no cover crop, delays in weed emergence, fewer weeds emerge, and reduced weed size all indicate that cover crops are contributing to weed suppression. Delayed weed emergence, reduced weed numbers, and smaller weeds result in fewer seeds and subsequently fewer weeds in the future. Practically speaking, researchers most often use change in weed density or biomass production to quantify cover crop impact on weeds.

- **What weeds are good targets for suppression by cover crops?**

  Winter annual weeds, including horseweed/marestail, are good candidates. In addition, small-seeded summer annual weeds such as pigweeds are good targets. Perennial weeds such as Johnsongrass or pokeweed are typically not suppressed by fall-planted cover crops.

- **Can perennial weeds ever be suppressed with cover crops?**

  Cover crops, in conjunction with other weed control tactics such as mowing, can be used to address perennial weed infestations. This tactic is more common in organic systems, which do not have herbicide options, because it often means taking a field out of cash crop production for a season to plant and manage the cover crop to suppress the problem weeds. For example, Canada thistle may be managed by planting a summer annual cover crop like Sudangrass, then mowing it (and the weeds in it) several times over the summer.

B. What should we do to establish a good cover crop for weed management?

It is crucial to have a good cover crop establishment when weed management is the main goal. A good, well-established cover crop stand promotes biomass production, which is the key to weed management. Drilling is the most effective method to seed cover crops and achieve a maximum cover crop emergence. However, there is limited time in some cropping rotations after cash crop harvest but before the start of cold weather to plant a cover crop and get it established. Corn and soybean growers often struggle to get a cover crop planted or find themselves limited to only cold tolerant species. However, interseeding (either with a specialized drill, an air seeder, or seeded with airplanes) can expand the cover crop planting window by allowing a grower to plant before cash crop harvest. Interseeder drills are typically used after the crop is well established until the crop reaches canopy closure; while air seeding can occur much later (up to harvest). In both cases, the cover crop sprouts and then grows very little until after cash crop harvest, when the amount of light reaching the cover crop increases. Some cover crops are more shade tolerant than others and thus are a better choice for interseeding.

An interseeder working in corn at V5 stage.

C. For weed management, are all cover crops created equal?

- **How do we select the best cover crop for weed suppression?**

The best cover crop species for weed suppression are those that establish easily, grow quickly, rapidly shade the ground, produce large amounts of biomass, and have lasting residue that acts as a mulch after the cover crop has been terminated. In general, grass cover crop species suppress weeds better than legumes. Cereal rye, winter wheat, and oats are some of the best grass cover crops for weed suppression. Farmers wanting to both fix nitrogen and suppress weeds with their cover crop should consider a grass plus legume mixture. Hairy vetch or crimson clover are good choices for legumes to provide weed suppression in the spring. However, most legumes are not effective for many winter annuals weeds because they do not produce high amounts of biomass until spring. Therefore, they are often paired with a winter cereal or forage radish to provide winter annual weed suppression. Forage (or oilseed) radish can provide good weed suppression of winter annual weeds when planted in the fall. These radishes are often included in mixtures because of the vigorous growth and ability to suppress weeds.

Hairy vetch cover crop in PA. Picture: Sjöerd Duiker, Penn State University

Does weed suppression by cover crops vary by region?

Yes. Latitude affects the development of different cover crop species. Altitude can also contribute to growth differences, even at the same latitude, because temperature patterns are different at different altitudes. When seeded in the southern US, cereal rye can be influenced by the higher average annual temperatures, affecting biomass production and consequently, weed suppression. In contrast, northern latitudes usually favor large biomass accumulation that contributes to weed suppression.

Differences in soil quality and structure across regions also contributes to differences in cover crop development.

Are cover crop mixtures better than monocultures?

Cover crop mixtures can provide more benefits than monocultures, but they can also be more difficult to manage. For example cereal rye plus hairy vetch mixture can provide both excellent weed suppression for winter and summer annual weeds as well as add N to the system (because vetch fixes N). However, when terminating a cereal rye plus hairy vetch mixture you have to account for both species when deciding when and how to terminate it. If you want to roller-crimp the rye plus vetch mixture, you need to do so at vetch flowering, which is later than normal for cereal rye.

Cover crop mixtures need to be well balanced to prevent one species from outcompeting the others and failing to produce the expected benefits. Picture: Claudio Rubione

D. Does cover crop biomass matter for weed suppression?

- **How much cover crop biomass is needed to suppress weeds?**

Weed suppression from cover crops increases as biomass increases. Research conducted across the mid-Atlantic US shows that significant weed suppression from cereal rye was consistent at mulch biomass of 7000 lb/acre or higher when no other weed control tactic was used. However, this finding is not consistent across other climates and soils. Preliminary data from a USDA-ARS Area-Wide weed project

shows that significantly less biomass (up to 2500 lb/acre) is providing weed suppression in the North-Central region. Weed suppression is being evaluated in studies across a range of environments to answer this question.

How does cover crop management affect weed suppression?

Cover crop biomass is the key factor driving weed suppression. Early planting produces more biomass and delivers better weed suppression than late-planted cover crops. In a 2011 study in Pennsylvania, a cereal rye cover crop planted on August 25 produced almost 2500 lbs/acre more biomass on average than cereal rye planted on October 15. Termination timing is perhaps even more crucial for weed suppression. Cereal rye terminated at the tillering stage has much lower biomass and consequently less weed suppression than terminating at heading. Delaying cover crop termination until close to cash crop planting gives the cover crop additional time to accumulate biomass, key to suppressing weeds through competition and then as a mulch.

If, for any reason, seeding were delayed, would an increase in seed density compensate for the potential loss of biomass due to late planting?

The answer to this question depends on both the latitude of the farm and the cover crop species in question. Cover crop biomass is determined by planting and termination dates as well as seeding rate. Early termination of a cover crop in the spring reduces the risk of the cover crop interfering with the planting of the following cash crop but also decreases the amount of biomass a cover crop can produce and thus decreases spring/summer weed suppression potential. Seeding rate by planting date research is ongoing in many regions of the US.

E. How do I terminate my cover crop for weed suppression?

- **How should I terminate my cover crop?**

The choice of cover crop termination method depends on cover crop and cash crop, available equipment, and goals. Cover crop termination methods fall into three general categories: winterkill, chemical, or mechanical methods.

See GROW Bulletin 02 “Considerations for Terminating Cover Crops for Weed Management” for more information.

Roller-crimper. Picture: Bill Mason, MD farmer.

What is "planting green"? Is it better for weed management?

"Planting green" is a term used to describe the practice of planting a cash crop into a living cover crop. The cover crop is then terminated after planting, usually not more than one week after cash crop planting. Termination methods are limited when planting green, as the method chosen cannot interfere with the recently planted cash crop.

In terms of weed management following the cover crop, planting green can allow cover crops to gain more biomass and increase weed suppression. That extra biomass often provides additional benefits such as the opportunity to plant sooner in a wet spring and a thicker mulch layer that can better conserve soil moisture later in the season. In addition, delaying termination date will delay decomposition of the cover crop mulch, prolonging weed suppression.

F. How do I prevent cover crops from becoming future weeds?

What do you mean, "Cover crops can become weeds"?

Although cover crops can provide many benefits to a cropping system as mentioned above, they can also act like weeds. Remember that a weed is any plant growing where it is not wanted. Cover crops seeded before the cash crop is well established can result in plant competition for resources and potentially reduce cash crop yields.

Cover crops can become weeds when hard seed lingers in the soil after planting and sprouts while a cash crop is growing. Hairy vetch is well known for its hard-seed characteristics. Cover crops can become weeds if they are allowed to go to seed. Buckwheat, oats, rye, and radishes are known to volunteer in the following cash crop. Cover crops can also become weeds if they are not successfully terminated (killed) prior to cash crop planting. Annual ryegrass, hairy vetch, and some mustards/radishes can be difficult to terminate in the spring.

Keep in mind that herbicide resistance has been documented in some cover crops, notably annual ryegrass. When relying on herbicides to terminate a cover crop, be prepared to use a second termination method (or herbicide) if the first fails. Likewise, mechanical termination using a roller-crimper must be done at the correct cover crop life cycle stage, or the cover crop may not be fully killed.

What cover crop species are least likely to become weeds?

Cover crop species least likely to become weeds are those that do not have a hard seed, are winterkilled, or are easily terminated in the spring before they can set seed. Examples include fall-planted oats and phacelia.

What species are most likely to become weeds?

The cover crop species most likely to become weeds are those that have hard seed (hairy vetch), that grow and set seed quickly (such as buckwheat), and those that are difficult to control (such as rapeseed). Hard-seeded cover crops may not germinate within the cover crop growing season. Rather they may germinate in subsequent cash crops and become weeds. Cover crops that are difficult to control may survive termination potentially leading to interference with planting the cash crop, competition with the cash crop, and produce seed resulting in future weed problems. Note that difficulty in control is often dependent on the control options in the rotational crop. For instance, volunteer cereal rye is relatively easy to control in corn or soybeans, but very difficult to control in winter wheat.

What are the best methods to prevent cover crops from becoming weeds?

Use the appropriate method and timing to terminate cover crops in the spring. For example, while glyphosate alone can terminate most grass cover crops (such as cereal rye), many legume cover crops require a tank mixture such as glyphosate plus 2,4-D or dicamba.

Be prepared to make a second pass or use a second method if the initial attempt at terminating a cover crop is not successful, or be prepared to control the cover crop (now weed) in the cash crop.

Choose cover crops that fit your cropping system. Farmers who grow small grains may choose a legume like crimson clover rather than hairy vetch because hairy vetch is difficult to control in small grains, while crimson clover is easier to control and poses less risk of contaminating the harvested small grains. If delayed cash crop planting is a concern, do not plan to terminate the cover crop with a roller-crimper. This method requires the cover crop to reach the reproductive stage and in turn, it can prevent timely cash crop planting.

Cover crops that are a concern in rotational crops should be managed to avoid seed set. For example, buckwheat should be terminated soon after bloom, which can occur within six weeks of planting the buckwheat. Avoid planting radish too early in the fall (in warm climates) that it has time to set seed before it will winter kill.

G. Do cover crops make economic sense as a weed management tool?

There are costs associated with cover crops such as seed, planting and termination. However, growers who adopt cover crops long-term or are facing challenges such as soil compaction or herbicide-resistant weeds can see the value of the cover crops overcome those costs. Weed suppression benefits of using cover crops can include a reduced number of herbicide passes and decreased weed seed contamination of the harvested grain.

This article ("Cover Crops Earn their Keep Combating Herbicide-Resistant Weeds"), based on a SARE Technical Bulletin, will explain how much a cover crop can pay and how to get the most of your cover crop.

H. Are cover crops compatible with other IWM tactics?

Cover crops are well adapted for fitting into a IWM approach for many agronomic crops.

Cover crops work well with most crop rotations. While no one cover crop species is suited for all environments, in most situations there is a compatible specie(s) with both the crop rotations and environment. Late-harvested crops may have a limited number of adapted species compared to early-harvested crops, but alternative seeding methods (such as aerial seeding) may provide more cover crop options.

Cover crops residues are compatible with most herbicides used for preemergence or postemergence weed control. There has been concern about cover crop residues interfering

with residual herbicides reaching the soil surface. However, it seems that high levels of cover crop residues generally prevent weed seedling emergence to compensate for any herbicide that is "tied up" by the residues. Cover crop residues often slow weed growth providing a wider application window for postemergence treatments.

Conventional cultivators will not work with most cover crop residues. However, high-residue cultivators are able to handle substantial amounts of cover crop residue. These cultivators have a single wide sweep that undercuts weeds and leaves the residue on the soil surface. The sweep is designed to operate one to two inches below the soil surface, slicing weeds just below the soil surface. So these types of cultivators are typically used later than most S-tine units that are designed to uproot and dislodge small weed seedlings.

Cover crop residues can provide habitat for rodents and invertebrates that often feed on weed seeds deposited on the soil surface.

Farmers interested in strategic tillage to address weed problems may be able to incorporate cover crops to reduce the impact on soil health. In some regions, fall tillage could be used immediately after harvest and have enough time to get a cover crop established. The cover crop can reduce wind and soil erosion and start to develop soil structure lost due to tillage.

Cover crops are compatible with other tactics and strategies such as harvest time weed seed control, scouting, and prevention. Additional research is needed to understand weed emergence under different cover cropping practices to determine the best time to implement many of these compatible practices with cover crops.

Cover crops are not compatible with the use of flame weeding. However, they are compatible with most integrated weed management strategies. Therefore, while cover crops may not be a "stand-alone" tactic for weed management they fit very well as part of an integrated approach.

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