Cover Crops for Weed Management: Species Selection

Overview

- Cover crops are grown in rotation with cash crops during periods when a field would otherwise be fallow. Most cover crops in the United States are seeded after cash crop harvest, but they can also be interseeded or broadcast before harvest.
- Most often utilized for their ecological benefit to the cropping system, cover crops can also be grazed or harvested, assuming herbicide rotation restrictions are followed, or grown for seed. Some herbicides allow cover crops to be fed to cattle, while others don't.

Cover Crop Benefits

- Reduce erosion and protect soil from wind and rain.
- Build organic matter and biodiversity in the soil.
- Decrease nutrient loss from leaching and runoff.
- Improve infiltration of water into the soil profile.
- Provide habitat for beneficial insects and fungi.
- Suppress weeds.

Species Selection

- When planning for cover crops in a rotation, it is important to first identify goals of using the cover crop. Species selection will largely depend on the desired outcomes. There is often more than one reason a grower decides to use cover crops. In this case, it's helpful to make a list of priorities and select a species or mix of species that addresses the primary goals of cover cropping.
- The main objectives for cover cropping may vary based on conditions at different field sites, crop rotation sequence, length of growing season and time of year. Although many species have overlapping benefits, a primary objective of fixing nitrogen, for example, may ultimately lead to a different species than aiming to suppress weeds.
- Much like contributing to a 401(k), the benefits of cover crops are compounded and accumulate with increasing value over time.

Weed Suppression

- Weed suppression is one of the most highly reported reasons growers use cover crops, second only to soil health.
- As herbicide-resistant weeds become an increasing concern, cover crops can be an additional tool for implementing integrated pest management strategies. By reducing the size and number of weeds present at the time of the POST application, cover crops can reduce the selection pressure on effective herbicide sites of action, which could delay the development of resistance.
- Cover crops compete with weeds for resources such as light, nutrients and water. Some cover crop species produce high levels of biomass capable of physically suppressing the germination and growth of weeds. Allelopathy, or the effect of phytotoxic compounds created by some cover crops, may play a role in suppressing small-seeded weeds.

Biomass Production

- In general, weed suppression by cover crops increases as biomass levels and ground cover increase. Different species have different biomass production potentials.
- Termination timing is one of the most important factors in determining biomass production. The later a cover crop is terminated, the more biomass is produced.
- Planting a crop just before or after cover termination leads to a reduced rate of biomass degradation.
- Biomass production is also dependent on environmental factors such as soil fertility and soil moisture.

Species Impacts

- Species selection is one of many management strategies that can impact a cover crop's ability to suppress weeds. Some species, such as legumes and brassicas, are most beneficial when planted early after small grain or corn

Figure 1. Soybeans growing through cereal rye residue in Ohio. Photo credit: Alyssa Essman, The Ohio State University.

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silage harvest and can provide suppression of fall emerging weeds. Other species like rye and wheat can be planted later, after corn or soybean harvest, and can provide weed suppression of late fall or spring emerging weeds.

Other Factors

- Cover crop management also influences its potential to suppress weeds. Beyond species selection, cover crop seeding rate, planting method, and termination timing and method can all impact the efficacy of cover crop weed suppression.
- The life cycle, time and length of emergence, seed size and other characteristics of the target weed also influence the weed suppression potential of cover crops.
- Other factors that can impact the effectiveness of a cover crop to suppress weeds include carbon-to-nitrogen ratio, species variety/cultivar, growing degree days, soil fertility, weather/precipitation and corresponding herbicide program.

Cover Crop Species

There is a wide array of species available to choose from when planning cover crop management.

Cereal Rye (Secale cereale L.)

- Cereal rye, or winter rye, is capable of producing high levels of biomass. This biomass production allows cereal rye to be very competitive with weeds. Studies in states across the Midwest and Great Lakes regions have demonstrated the potential for cereal rye to reduce weed density and size.
- Cereal rye is winter-hardy in many cold regions and can be seeded later in the fall than other species. Rye growth can be slow in the fall relative to spring, but it generally shades the soil more quickly than other grass cover crop species due to its flat fall growth habit.
- Most cereal rye biomass production occurs in the spring. As a result, cereal rye is especially effective at suppressing spring-emerging winter and summer annuals.

Wheat (Triticum aestivum L.)

- Wheat is grown as a cash crop in many regions but can also serve as a simple and effective cover crop. Wheat is easier to establish and terminate than many other species. Growers interested in cover crops but apprehensive about the weedy potential of other species may find wheat to be an ideal place to start.
- Wheat has a slower maturation and reduced biomass production potential than some other grass cover crop species.
- Studies in the Midwest have shown that winter wheat can suppress weeds, but not always to the same extent as species such as cereal rye or other IPM practices such as residual herbicides. Winter wheat has worked well as a cover crop when used with herbicides in the Pacific Northwest, where wheat is a common crop and volunteer rye is a major concern.

Oats (Avena sativa L.)

- One of the advantages of using oats as a cover crop is quick establishment and growth. Oats can produce considerable biomass in short growing seasons. Because of this, oats are capable of suppressing winter annual weeds if planted early in the fall after small grain harvest.
- Studies in the mid-Atlantic and Midwest found that oats grown after wheat harvest can produce large amounts of biomass and reduce weed emergence and biomass; however, this effect can be moisture dependent.
- Oats can winterkill in many regions (i.e., USDA hardiness zone 5 and above, as well as some areas of regions 6 and 7). This reduces their effectiveness in suppressing weeds when planting is delayed due to late harvest or weather conditions in these regions.

Barley (Hordeum vulgare L.)

- Like wheat, some growers are familiar with barley, as it is also grown as a grain crop in some regions. However, it is often less reliable for weed suppression.
- Barley can serve as a quick source of biomass, especially when grown in USDA hardiness zones 8 and warmer. Variability in biomass production can lead to unpredictable effects on weed suppression.
- In cooler regions, barley is often less winter-hardy than wheat or cereal rye and can be less competitive than other grass cover crops.

Annual Ryegrass (Lolium multiflorum Lam.)

- Annual ryegrass can be difficult to terminate and has a high potential to become a weed or develop herbicide resistance. Despite popularity in some regions in the U.S., it is generally not recommended for use as a cover crop by weed scientists.
- Annual ryegrass is capable of rapid establishment and growth, which allows it to aid in early-season weed control.
- A study in the Midwest found that winter annual weed suppression by annual ryegrass was higher than with legume or brassica species, roughly equivalent to winter wheat, but lower than cereal rye or cereal rye and hairy vetch. In that study, annual ryegrass was not able to suppress summer annual weeds as effectively as cereal rye alone or when mixed with hairy vetch.
- In the Midwest, annual ryegrass has been used successfully for interseeding, alone or in species mixes. It can be planted between rows of corn at the V3 to V6 stages without reducing corn yield.

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Crimson Clover (Trifolium incarnatum L.)

- When planted in the fall, crimson clover is slower growing than some other species. Legumes in general need to be planted in early fall to establish before winter. This makes crimson clover less effective at suppressing winter annual weeds when planting is delayed. When allowed to resume growth in the spring, crimson clover can aid in suppressing summer annual weeds.
- Studies in the Midwest found that crimson clover was capable of reducing the density of winter annual weeds with timely establishment, but not to the extent of other species, such as cereal rye. In the Great Lakes region, studies have illustrated that crimson clover can be difficult to establish when planted after a typical corn or soybean harvest, or when interseeded.
- Adding crimson clover to a mix with grass species can provide increased ecosystem services while improving weed suppression potential.

Hairy Vetch (Vicia villosa Roth)

- Hairy vetch is capable of high biomass production in the spring relative to other legume cover crop species. Studies in the mid-Atlantic have shown that weed suppression is higher under live hairy vetch than dead residue.
- In the mid-South, one study found that vetch was able to suppress weeds when combined with cereal rye, but not alone. Similarly, a study in the Midwest found that a hairy vetch cover crop could reduce weed biomass, but not to the same extent as rye. Like crimson clover, weed suppression by hairy vetch might be optimized in a mixture with a grass species.
- Hairy vetch can produce up to 25% hard seed. It can become a weedy concern, especially in the production of small grains.

Balansa Clover (Trifolium michelianum L.)

- Balansa clover can survive in cool regions up to USDA hardiness zone 5 and should be planted late summer to early fall.
- Balansa clover can produce robust growth and biomass with timely establishment. It has a hollow stem, which allows for successful termination by roller-crimping. Performance relative to other clover species is largely dependent on variety and location.

Figure 3. Cover crop species mix. Photo credit: Dr. John Wallace, Penn State University.

Austrian Winter Pea (Pisum sativum L.)

- Austrian winter pea (also known as field pea) can produce considerable biomass even in cool, wet conditions.
- Like other legumes, Austrian winter pea can provide some winter annual weed suppression relative to untreated conditions, especially when planted with cereal rye or another grass species.

Forage Radish (Raphanus sativus L.)

- Forage radish (also known as tillage or daikon radish) establishes quickly in the fall and can aid in winter annual weed suppression, but winter kills at the first frost in cooler regions.
- Like legumes, brassica species need timely fall planting to ensure establishment.
- Studies in the Midwest and mid-Atlantic found that weed suppression by early-planted radishes can be considerable for winter annual weeds. Mixing with overwintering species can improve summer annual weed suppression.

Species Mixes

- Cover crop species can be planted in mixes of two or more species in order to capture a wider range of ecological benefits. Mixes that include winter-hardy species require a plan for spring termination. For the purposes of weed suppression, studies have found that species mixtures are usually not better than a monoculture of a highly effective species.

Summary

- Cover crops can be a useful tool for practicing integrated weed management. Studies show that cover crops can be used in conjunction with other weed management tools, such as herbicides, to provide effective weed control. Weed suppression provided by cover crops can vary based on management, as well as location and weather.
- When selecting a cover crop species for the purpose of weed suppression, species that produce high levels of biomass and provide maximum ground cover are the most effective.
- If the primary objective of cover cropping is weed suppression, cereal rye is considered the gold standard in many regions. Cereal rye has been shown to be the key contributor to weed suppression, even in multiple-species mixes. If a grower has multiple objectives, a species mix that includes rye may be the most beneficial.

For more information and links to additional resources, visit IWillTakeAction.com.

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