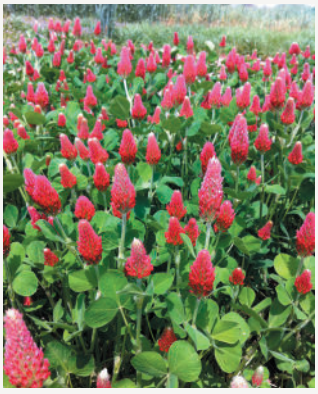
Cover Crops for Weed Management: Establishment

Overview

- Timely cover crop establishment allows for the higher biomass production and ground cover necessary to suppress weeds. Weather, primarily temperature and precipitation, though unpredictable, has a major effect on cover crop establishment and growth.
- Planting method and seed quality are two factors a farmer can control that contribute to successful cover crop establishment. Test seed for germination and screen for weed seed to avoid potential contamination.
- Along with planting date and method, seeding rate is an important management factor to consider in cover crop establishment.
- Herbicide carryover from the previous crop can interfere with cover crop establishment. For more information on the effect of herbicide residues, see the Take Action fact sheet "Cover Crops for Weed Management: Herbicide Persistence and Carryover to Cover Crops."



Figures 1 and 2. Cereal rye established in Ohio (left) and a crimson clover stand in Missouri. Photo credit: Dr. Mandy Bish, University of Missouri (right).

Cover Crop Planting Date

- The planting date that will maximize weed suppression is highly dependent on cover crop species.
- Cover crop planting date will also depend on location, crop rotation, tillage system and weather.
- Grass species such as cereal rye and wheat have a relatively flexible planting window and can tolerate planting dates after harvest.
- Species that winter kills, such as forage radish, should be planted in late summer to early fall to produce sufficient biomass and ground cover before the first frost. Brassica and legume species require planting by early fall to establish before winter.
- Brassica and legume species may benefit more from earlier planting dates than winter-hardy grass species, and winter-hardy grass species can dominate late-planted species mixes.
- Earlier planting dates can increase the biomass of fall-planted winter annual cover crops, but this does not always translate to greater weed suppression.

Before Harvest

- Planting methods such as interseeding or aerial seed application (broadcast) allow for establishment prior to cash crop harvest.
- Cover crops can be established before crop canopy closure when sunlight still reaches the soil surface to facilitate germination but should be planted late enough that they don't compete with the cash crop.
- Cover crops can also be established after canopy closure and before harvest. Farmers can broadcast seed into soybeans around leaf drop or into corn nearing maturity.

After Harvest

- Cover crops planted after cash crop harvest can be drilled into no-till ground with cash crop residue, into a prepared seedbed or broadcast on the soil surface.
- Depending on crop rotation, some cover crop species can also be established in early spring or summer. In cool regions, some species (such as red clover) can be frost

Figures 3 and 4. Cereal rye drilled in late September (left) and late October before no-till soybeans in Ohio. Photo credit: Alyssa Essman, The Ohio State University.

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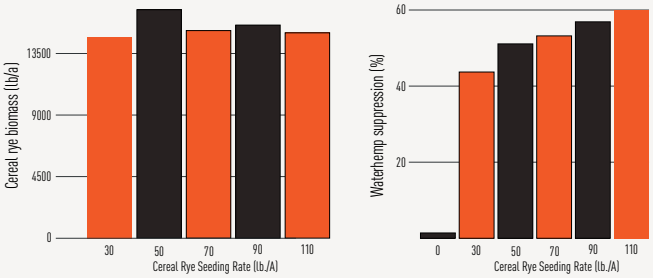
seeded into small grains. Freeze-thaw cycles draw the seed into the soil.

- Spring-planted cover crops can work in rotation when planted before late-season field or vegetable crops. These generally produce less biomass and are less reliable for weed suppression if terminated in late spring before corn or soybean planting.
- Summer annual cover crops are less common but can also be planted in the spring and grown to suppress weeds over the summer between successive cash crops.
- Cover crops can be drilled into small grain stubble after harvest in the summer or early fall. This allows for a longer period of biomass accumulation before winter and is especially suitable for species that frost kills, such as oats and forage radish.
- **Planting date** studies from various regions have shown earlier planting dates may be more beneficial in some regions than others:
  - Two studies in the **mid-Atlantic** found:
    1. Planting cereal rye in mid-September led to more biomass production and reduced weed density in no-till soybeans compared to planting in mid-October.[1]
    2. When planted from August to October, cereal rye and rye mixed with hairy vetch produced more biomass at earlier planting dates, which resulted in greater reduction in weed density in no-till soybeans.[2]
  - Two studies in the **Midwest** found:
    1. Cereal rye planted in late September accumulated more fall and spring biomass versus rye planted in late October, but horseweed densities in no-till soybeans were similar between planting dates.[3]
    2. Grass cover crops can reduce weed biomass, but growing season constraints can result in variable effects on weed suppression.[4]
- **Bottom Line —** Cereal rye planted by mid-to-late October in the Midwest is generally sufficient to produce the biomass and ground cover necessary to optimize weed suppression. Earlier planting dates may be especially beneficial in other regions, such as the mid-Atlantic.
- The effect of planting date on the level of weed suppression provided by cover crops also depends on the life cycle and growth habits of target weed species.

Cover Crop Seeding Rate

- Similar to planting date, cover crop seeding rate is largely dependent on cover crop species and location. Seeding rates should be adjusted based on planting method and expected termination timing. Broadcast seeding requires higher rates than drilled as a result of higher seed loss and reduced seed-to-soil contact. Delaying spring termination increases biomass production and could justify the use of lower seeding rates.
- Seeding rates for Brassica and legume cover crop species are often lower than rates for grass cover crops, and rates for winter-killed grains are often higher than winter-hardy grains. Seeding rates of each species in a mixture are also usually reduced relative to rates of monocultures.
- **Seeding rate** studies from various regions have shown a variety of benefits based on cover crop species used.
  - Three studies in the **mid-Atlantic** found:
    1. Lower seeding rates of aggressive grass species in mixtures can be sufficient to aid in weed suppression[5] without outcompeting other species in the mix.[6]
    2. Increasing seeding rates of cereal rye above the lowest rate, 80 lbs./A, did not increase biomass production but did further reduce weed biomass.[7]
  - Three studies in the **Midwest** found:
    1. A higher rye seeding rate can increase fall and spring biomass in the Midwest, but there was no difference in horseweed density between the 45 and 90 lbs./A seeding rates in no-till soybeans.[3]
    2. Similar horseweed suppression was provided by a wheat and cereal rye cover crop drilled at 60 and 120 lbs./A before no-till soybeans.[8]
    3. There was no difference in cereal rye biomass, soybean stand or soybean yield following different seeding rates of rye. Waterhemp suppression in this study was more consistent when rye was seeded at rates over 50 lbs./A. Slight differences in waterhemp suppression were likely due to increased ground cover at higher seeding rates, not differences in biomass.[9]
  - One study in five states across the **eastern U.S.** found:
    1. Hairy vetch biomass was maximized at seeding rates of 4-9 lbs./A in the southern states and at rates of 13-18 lbs./A in the northern states. Location and climate are important factors in seeding rate selection.[10]



Figures 5 and 6. The effect of cereal rye seeding rate on biomass at the time of soybean planting (left) and control of waterhemp 28 days after soybean planting in Columbia, Missouri (2018, 2019 and 2020). From Bish et al. 2021.[9]

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- **Bottom Line —** Results of cover crop seeding rate studies across various regions suggest that above 50 lbs./A, adjusting the seeding rate of cereal rye may have less of an effect on weed suppression than planting date or planting method.

Cover Crop Planting Method

Drilling

- Direct seeding with a grain or seed drill is the most reliable and popular method of cover crop planting. Drilling ensures uniform seed-to-soil contact, allows for better control of spacing and depth, and is less variable than other methods such as broadcasting. As a result, germination is maximized, and stands are generally more uniform.
- Drilling often takes place after cash crop harvest. Cooler regions in the U.S. have a short window following corn or soybean harvest when cover crops can be drilled. This narrow window is often too late for timely establishment of sensitive small-seeded broadleaf species such as hairy vetch and crimson clover. Cold-tolerant species such as cereal rye and winter wheat can be drilled following harvest in many regions and produce considerable biomass the following spring.

Broadcast

- Cover crop seed can be broadcast onto the soil directly with high-clearance ground equipment, aerially or with a fertilizer application. This allows cover crops to establish earlier than when drilled after cash crop harvest, potentially improving biomass production of species that are not cold tolerant and reducing post-harvest fieldwork.
- Cover crops should be broadcast when soil moisture is adequate for germination and establishment; otherwise, the seed is vulnerable to desiccation. Predation by birds and rodents is also a risk to broadcast plantings.
- Aerially applied cover crop seed is at a higher risk of seed loss. Seeding rates for broadcast cover crops should increase about 20% relative to drilled cover crops based on species and regional recommendations.
- Light seed incorporation can improve germination and stand establishment of broadcast cover crops by improving seed-to-soil contact.

Interseeding

- Cover crops can be interseeded before harvest to establish the stand earlier, which can be beneficial in regions where there is a short planting window. Cover crops can be broadcast interseeded or drilled using specialized high-clearance interseeders either before or after canopy closure.
- Interseeding with a drill improves seed-to-soil contact and confines the cover crop seed to the spaces between rows. This enhances stand uniformity and reduces the number of seeds lost in corn whirls or to pest predation or desiccation.
- Selecting compatible herbicides is critical when planning management of this method, as interseeded cover crops are at increased risk of herbicide carryover injury.
- **Planting method** studies from various regions have shown regional differences in weed suppression and biomass development.
  - One study in the **Midwest** found:
    - Annual ryegrass and oilseed radish were broadcast interseeded in corn from V2 to V7 without reductions in yield. Fall cover crop biomass was highest when cover crops were seeded early, but annual ryegrass spring biomasses were similar among interseeding timings. Interseeding cover crops did not reduce summer annual weed pressure.[11]
  - One study in the **mid-Atlantic** found:
    - Cover crops can be interseeded in corn at the V5 to V7 growth stages without yield penalties. Drill-interseeding can increase fall cover crop biomass production, but there was little to no difference in terms of weed suppression compared to broadcast planting.[12]
- **Bottom Line —** Results of planting method studies across various regions suggest that drilling cover crops leads to more uniform cover crop stands than broadcasting, but the effects on weed suppression are variable even within the planting method.

Figure 7. Interseeding cover crops into V5 corn in the mid-Atlantic. Photo credit: Dr. John Wallace, Penn State University.

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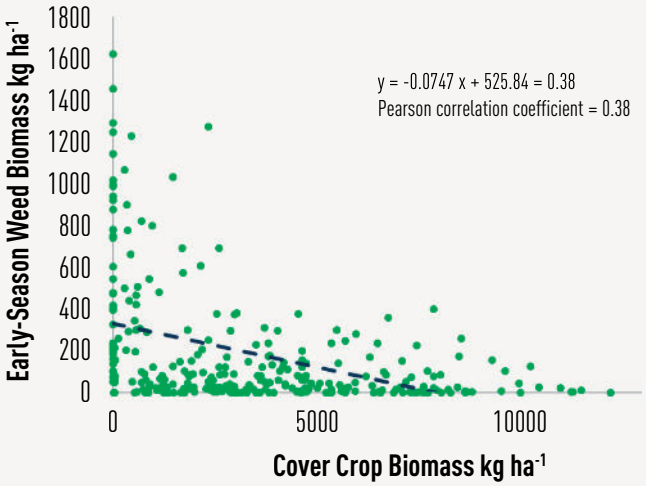

Figure 8. Early-season weed biomass is reduced by increasing levels of cover crop biomass, but this effect diminishes beyond 4,500 lbs./A. From Hodgskiss 2020.[13]

Summary

- Biomass and ground cover are two main drivers of weed suppression by cover crops. Planting date and planting method are important management factors that influence cover crop biomass. These factors as well as cover crop seeding rate also influence ground cover.
- Uniform cover crop stands can generally provide more uniform weed suppression, as patchiness can create variability in weed pressure within a field. Managing cover crops with uniformity as a consideration can improve consistency of weed suppression.
- In general, weed biomass decreases as cover crop biomass and ground cover increase (figures 8 and 9). Above 4,500 lbs./A, increases in cover crop biomass have little additional effect on weed biomass.

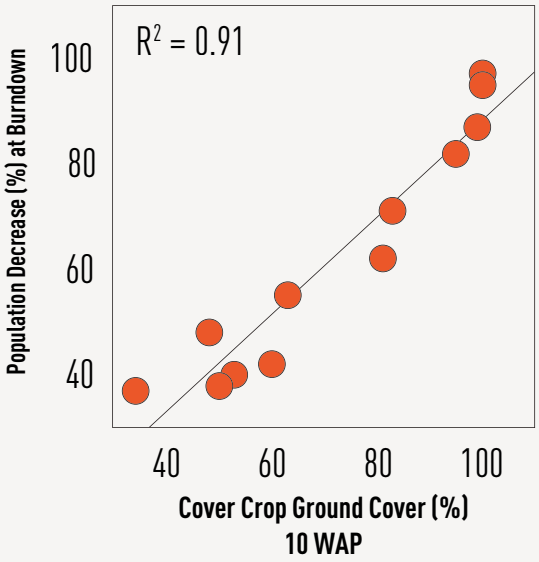

Figure 9. Horseweed density decreases as late fall cover crop ground cover increases 10 weeks after planting. From Wallace et al. 2017.[14]

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