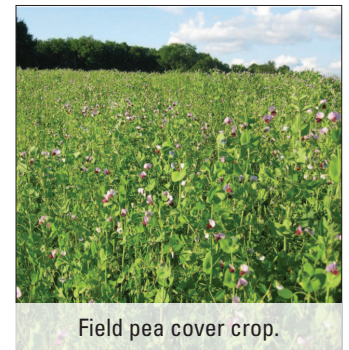


# Managing Winter Cover Crops in Corn and Soybean Cropping Systems

In recent years, interest in adding cover crops to corn and soybean cropping systems has increased as their potential benefits have become more widely recognized. Most of these benefits are realized over time as their ongoing use improves soil quality and function (Table 1). Thus, cover crops are best viewed as a long-term investment in soil productivity.

**Table 1.** Potential benefits of cover crops.

Potential Benefit	Description
Retain Soil Nutrients	Cover crops scavenge soil nutrients as they grow and ultimately release them for following crops to use. This reduces the potential for nutrient losses, especially N.
Prevent Soil Erosion	Cover crops help hold soil in place, reduce crusting and protect against erosion due to wind and rain.
Build Soil Organic Matter	Cover crop biomass contributes to soil organic matter, which helps to improve soil structure, water infiltration, and water-holding and nutrient-supply capacity.
Break Soil Compaction	Cover crop roots can act as “living plows”, breaking-up compacted soil layers. Cover crop shoots can also help protect the soil from the impact of heavy rains.
Add Nitrogen (N)	Leguminous cover crops fix N as they grow. This N mineralizes after the cover crop is terminated and becomes available for use by future crops.
Conserve Soil Moisture	Cover crop residues increase water infiltration and limit soil evaporation. This helps to reduce moisture stress during drought conditions.
Suppress Weeds	Cover crops shade the soil, which can reduce weed germination and growth. Some cover crops also have an allelopathic effect on weeds.
Provide Additional Forage	In some areas, it may be possible to graze, hay or chop cover crops before terminating in the spring.



**Brassica** cover crops have grown in popularity recently due to their ability to provide many of the same benefits as grasses but with residues that break down more rapidly in the spring. Certain brassicas are also becoming well known for their ability to produce a large taproot that is effective at breaking soil compaction. Common brassicas include canola, mustards, forage radish and turnip. Like most legumes, brassicas must be planted earlier than cereals in order to successfully establish and provide maximum benefits. Many brassica cover crops winterkill in locations with sub-freezing temperatures, which helps accelerate residue decomposition in the spring.

## Pure Stands vs. Mixtures

Mixtures of cover crops are often superior to a single species. Grass-legume mixtures combine the benefits of both – quick soil cover and N scavenging by grasses and N additions by legumes. Disadvantages of mixtures can include increased seed cost and more complicated management.



## Cover Crop Selection - Grasses, Legumes, Brassicas

**Grasses**, including winter cereals such as rye, wheat, barley and triticale, are the most widely used cover crops in corn and soybean cropping systems. Winter cereals are typically planted in late summer through late fall and produce a small to moderate amount of root and above-ground biomass before going dormant in the winter. Vigorous growth resumes in early spring, and large amounts of biomass are produced by mid to late spring. Some growers prefer non-winter-hardy cereals like oats, which establish rapidly in the fall but winterkill and leave behind little residue to manage in the spring. Annual ryegrass is another option if spring residue levels are a concern.

**Legumes** are valued as cover crops primarily for their ability to fix nitrogen (N). Common legumes include hairy vetch, field pea, lentil, crimson clover, red clover and berseem clover. Legumes can be seeded in early summer through early fall but in many regions must be planted earlier than cereals to survive the winter. The amount of N added by legumes varies among species but is directly proportional to the amount of biomass produced. For this reason, spring management of legume cover crops can involve a trade-off between early corn planting and waiting for more biomass and N production by the legume.

## Cover Crop Establishment

Establishment is one of the primary management challenges associated with the use of winter cover crops in corn and soybean cropping systems. The best method for seeding winter cover crops depends largely on the time of seeding, but type of cover crop and farming operation considerations are also important. The most common methods and equipment for seeding into corn and soybeans are described below. With all equipment, consult the owner’s manual, equipment dealer and cover crop seed dealer for specific equipment settings and seeding rate recommendations, especially when seeding mixtures.

**Grain drills** are a reliable method for seeding cover crops after grain crop harvest. Many grain drills include legume and fertilizer boxes that facilitate planting mixtures.

**Broadcast seeding** followed by shallow incorporation or rolling are often used after grain crop harvest. Cover crop seed can be broadcasted using an air seeder or mixed with fall fertilizer and applied with a floater. Check seed distribution to help ensure even stands. Increase seeding rates for broadcast vs. drill seeding, though this varies by species.

**Row-crop planters** can be an efficient method for seeding cover crops but require additional attachments for the smaller seeds. Seeding rates can be reduced by up to 50% for a row crop planter compared to a drill due to superior seed-to-soil contact, depth control and seed spacing. Special seed plates (e.g., grain sorghum plates) and brushes are often required if the row-crop planter is set up for larger corn and soybean seeds.

**Aerial or high-clearance seeding** equipment is required to seed cover crops into standing crops. Aerial seeding using an aircraft modified with a seed disperser has gained popularity in recent years because it can cost-effectively seed many acres in a timely manner. Some growers have converted high-clearance spraying and detasseling equipment into cover crop seeders. Aerial and high-clearance methods require higher seeding rates compared to other establishment methods; in some cases, 50% more seed is recommended relative to drilling.

**Manure slurry seeding** involves mixing cover crop seed with liquid manure and applying it in the fall. Moisture and nutrients in manure promote rapid cover crop growth, which in turn prevents loss of manure N. This method is generally best suited for grasses, which are well adapted for establishing quickly and scavenging manure nutrients in the fall.

### Cover Crop Termination

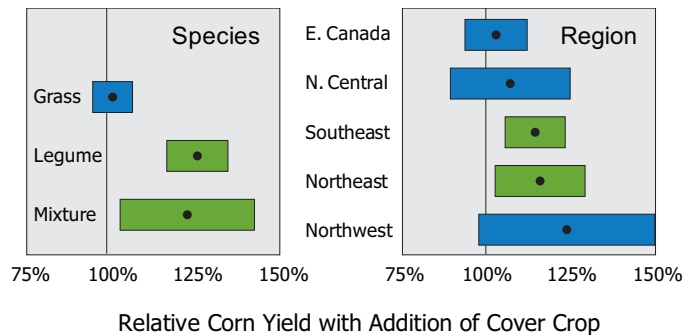
Terminating cover crops is usually accomplished by winterkilling, tilling, mowing or herbicides. Each method has advantages and limitations. For example, winter-killing is only applicable to certain cover crops. Similarly, while tilling legumes can help increase N availability, it is less desirable for grasses that produce much greater quantities of low-N biomass. Due to simplicity and efficacy, many growers prefer to terminate cover crops using herbicides. Consider the following when terminating cover crops with herbicides:

- For best control, spray the cover crop before it begins reproductive growth.
- Avoid spraying translocated herbicides on cloudy or cold days, which slow or stop cover crop growth and uptake.
- In most areas of the Corn Belt, it is recommended that spraying occur two to three weeks prior to grain crop planting.
- Consult herbicide labels for information on efficacy and plant-back restrictions.

### Cover Crop Effects on Corn and Soybean Yields

A review of 37 cover crop trials conducted in the U.S. and Canada revealed broad trends regarding the impacts of cover crops on corn yield (Figure 1). Generally, legume cover crops and grass-legume mixtures are more likely to have a positive effect on corn yield than grasses alone. While not universal, this likely holds true across a range of locations and management scenarios. Grass residues break down more slowly in the spring and are more likely to interfere with early corn growth than legume residues, which break down rapidly. Legumes also add N so are more likely to have a direct, positive effect on corn growth and yield.

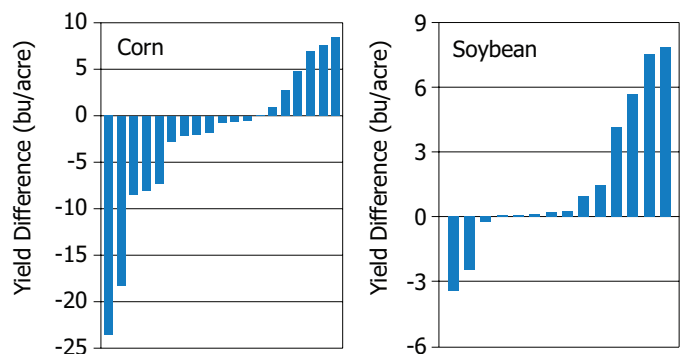
Regional differences in corn yield response to cover crops highlight the importance of soil and climatic factors. Cover crops are more likely to have a positive effect on corn yield in southern and eastern locations than in the North. This is likely



**Figure 1.** Corn yield response to winter cover crop based on cover crop species and region. Black points indicate average yield response, and bars represent yield response range. Results are adapted from Miguez and Bollero (2005).

a result of more mild spring conditions in the South and East, which reduce the risk of delayed cover crop termination and interference with early corn growth. Lower soil organic matter levels in these areas can also be improved by cover crops.

The effects on yield of specific cover crops often vary by location and differ between corn and soybeans. For example, a four-year, on-farm study in Iowa demonstrated that a cereal rye cover crop was more likely to benefit soybeans than corn in this region (Figure 2).



**Figure 2.** Corn and soybean yield response to a cereal rye cover crop in a four-year, on-farm trial in Iowa. Each bar represents the cover crop yield effect at one location in a single year. Results are adapted from Carlson, 2013.

### Conclusions / References

For best results, cover crops must be managed intensely. Begin by identifying a management goal such as increasing soil organic matter or improving spring weed suppression. Start out by testing a cover crop on a single field, and expand as you gain management experience.

Carlson, S. 2013. Winter rye cover crop effect on grain crop yields: Year 4. Practical Farmers of Iowa. Ames, IA.

Miguez, F.E. and G.A. Bollero. 2005. Review of corn yield response under winter cover cropping systems using meta-analytic methods. *Crop Science*. 45:2318-2329.

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