Cover crops following wheat and other short season crops in Wisconsin: Selection and management guidelines

Following harvest of winter wheat or other short season crops in Wisconsin, if not planted to alfalfa, these fields are often left fallow. However, with more than 40 percent of the growing season remaining, planting a cover crop may be a good option. While the economics may not always be clear, many farmers are looking to cover crops to keep the soil covered, recycle and/or fix nutrients, suppress some of the weeds that may otherwise grow, and improve soil health and functioning with additional organic matter. Producing supplemental forages, managing field nutrient budgets and meeting conservation requirements are other objectives for which cover crops can provide value. Cost of seed, planting, termination and other management has to be weighed against expected short and long term benefits. Risk of cover crop failure or possible negative impact on the primary crop(s) must also be considered.

General considerations

- All of the following cover crop choices can be seeded with light tillage or no-till planting. However, good seed to soil contact at the appropriate depth for the species is essential for good germination and establishment. With the investment in time and money required, use only seed that has been tested and tagged from a lab using Association of Seed Analysts standards.

- Competition from volunteer or re-seeded grain from the combine can sometimes present a challenge. If this is expected, it may be advantageous to allow growth of the volunteer grain to begin and apply a non-selective herbicide before planting the cover crop. This, however, may delay cover crop planting beyond the desired window. Alternatively, plant the cover crop as soon after grain harvest as possible to help with competition.

- Dry soil can limit success with summer-seeded cover crops. August is the most variable month for precipitation during the growing season. Carefully consider planting into dry soil if rain is not in the forecast.

- Before planting the cover crop, review the crop rotational restrictions associated with any herbicides used in the field within the last year to 18 months. This is particularly important if the cover crop might be harvested as feed for livestock. Rotational, or planting interval, restrictions are listed on the herbicide product’s label. For example, a commonly used wheat herbicide has a planting interval restriction of four months for radish and nine months for clovers.

- The choice of which cover crop(s) depends on objectives and needs, and also capabilities in terms of planting, management and termination. Although all of the following options can provide soil cover for erosion protection, weed suppression and soil improvement, each are particularly well-suited to specific objectives.
LEGUMES

nitrogen fixation

Legumes such as berseem clover, crimson clover or field pea (annual) as well as medium red clover (perennial) will accumulate biologically-fixed nitrogen (N) as they grow. They have also been shown to take-up significant amounts of plant available N. Some of the N is released back into the soil after the legume plants die or are terminated. How much N becomes available for use by a following crop will depend on the amount of biomass produced and environmental factors affecting the rate of decomposition and N-release. Research trials attempting to measure N credits to a following crop (usually corn) from annual clovers are limited, and their results are variable. Some trials in the upper midwestern U.S. and Ontario suggest up to a 40 lb N credit from berseem or crimson clovers and/or a yield benefit to the following corn crop. Others have observed neither. The pre-sidedress soil nitrate test may be useful for fine-tuning N needs for corn following annual clovers for the given situation. Nitrogen credits from medium red clover are more established, particularly when planted early in the season (frost

The annual legumes will grow quickly when planted in mid-summer if moisture is sufficient. Plant annual legumes as cover crops from July 15 to August 15 in southern WI or until August 5 in the north. Medium red clover can be seeded after wheat harvest but is best when companion seeded early in the spring. A common method for medium red clover establishment is frost seeding, or broadcast seeding into fall-established wheat early the following spring. All are good choices for a wheat-corn-soybean grain crop rotation. Medium red and berseem clovers are also harvestable as hay or forage prior to a killing frost.

Use pre-inoculated seed (current year) or inoculate with a product containing the appropriate Rhizobium bacteria (species and strain) for the legume species to optimize nitrogen fixation and growth.

FIELD PEAS

A large-seeded, cool season annual that is best companion-seeded with a spring cereal grain to encourage climbing and minimize lodging. Pea small grain mixtures can also be harvested as forage, yielding 1-3 TDM per acre, with slightly higher forage quality and palatability than small grain forage alone.

Seeding rate*: 30-40 lb Trapper field peas in a mix with 20-30 lb oats or barley for cover only; 50 lb Trapper field peas in a mix with 30-45 lb oats or barley for forage production.

*Seed size varies considerably among varieties (Trapper is larger than many with fewer seeds per pound).

Depth: Seed the peas (or the mix) ½ inch deep

Peas will fix most, but not all, of the N required for optimum growth. Apply 15-30 lb supplemental N to optimize biomass production (2-3.5 TDM per acre). Nitrogen credits to a following crop are minimal. Credit 20 lb N per acre if the peas have reached near-maturity.

Inoculate seed with *Rhizobium leguminosarum biovar viciae* (R. viciae)

BERSEEM CLOVER

A fast-growing, true annual clover that will winter-kill with 1½-2 tons of dry matter (TDM) per acre biomass production possible. However, growth and N accumulation may be limited under dry conditions. Berseem clover has an upright growth habit and has been observed to produce more resilient soil cover into the following spring than crimson clover.

Seeding rate: 10-12 lb per acre alone; 6-8 lb in a mix with 15-30 lb per acre oats or barley. The higher rates of small grains may reduce clover growth.

Depth: ¼ inch

Inoculate seed with *Rhizobium leguminosarum biovar trifolii* (R. trifolii)

CRIMSON CLOVER

A southern U.S. adapted winter annual that may or may not over-winter in Wisconsin. Expect 1-2 TDM per acre by fall. Crimson is slightly more tolerant of dry conditions than berseem but is more sensitive to lower pH. It has a more prostrate, lower growing habit, so is more suited to grazing than mechanical harvest if forage is desired. Crimson grows fast in spring by adding biomass and N accumulation, if it survives the winter.

Seeding rate: 10-12 lb per acre alone; 6-8 lb per acre in a mix with 15-30 lb oats or barley

Depth: ¼ inch

Inoculate seed with *Rhizobium leguminosarum biovar trifolii* (R. trifolii)

In the seeding year, crimson clover is not competitive with weeds, cereal grains or brassicas. However, a recent trial in eastern WI has shown good results with a mix of 6 lb per acre crimson + 6 lb per acre berseem. This mix combines the upright habit of berseem clover with the prostrate growth of crimson clover and appears to be more competitive with weeds than either clover species alone. This mix with crimson also lowers the cost compared with berseem alone.

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Inoculate seed with *Rhizobium leguminosarum biovar viciae* (R. viciae)
MEDIUM RED CLOVER (MRC)
A short-lived perennial that is best companion planted with spring cereal grains or frost seeded (March-April) into fall established cereal grains. The early-planted MRC will establish but stay small until after grain and straw harvest in July or August. It will then take off running and is less susceptible to dry conditions or competition from weeds or volunteer grain. Frost seeding has some risk and variability of results. Success is dependent on having freeze-thaw conditions after complete snowmelt, as well as good broadcast delivery of the seed to achieve an even distribution with good seed to soil contact; 2 TDM per acre biomass or forage can be expected and 60-80 lb N can usually be credited for a following year’s corn crop. Optimum management of the cereal grain crop is required to prevent clover competition.

Seeding: Broadcast MRC at 10-12 lb per acre in early spring during freeze-thaw periods when cracks and crevices form at the soil surface. Or, seed with a drill at 8-12 lb per acre to a depth of 1/4 inch into a firmed (packed) seedbed.

Inoculate seed with Rhizobium leguminosarum biovar trifolii (R. trifolii)

Management and termination: Clip (mow or flail shred) or harvest clover after flowering in early September to stimulate new growth and control any weeds. MRC will over-winter and will grow fast the following spring. It is usually best to terminate with herbicide in the fall. A combination of glyphosate and 2,4-D, or other growth regulator herbicide applied by October 15 in southern Wisconsin is usually effective. Some regrowth may occur in spring. Tillage alone will take two or more passes to control prior to planting a subsequent crop. Some re-growth will likely occur.

The fibrous root structures of cereal grains and forage grasses improve soil structure and may help alleviate compaction

CEREAL GRAINS
FORAGE GRASSES
reliable mid-late summer cover and optional forage potential

OATS, BARLEY, SPRING TRITICALE (spring grains) will grow rapidly in late summer and continue until a hard freeze. They will usually not over-winter in Wisconsin. These crops are often the best choice as a lower-cost sequentially seeded soil cover, or if fall-harvested forage is the main goal – particularly if manure is to be applied. They are more forgiving of temporary dry conditions than legumes as they will grow longer into the fall. Oats and barley have had equal yields in several fall forage trials (1-3 TDM per acre) at University of Wisconsin with spring triticales slightly lower.

Planting date: July 20 to August 15 (August 1 target)

Seeding rate: 40-60 lb per acre for a cover crop, 75-100 lb per acre for forage

Depth: Drill 1-2 inches deep or broadcast and lightly till-in

For optimal growth, apply 40-60 lb N, (for forage, add 20 lb P₂O₅ & 90 lb K₂O)

WINTER RYE can be planted August-September for a late summer and over-winter cover. Stem elongation will not occur without vernalization (cold temperatures). Planted in August, rye will produce a thick cover, but usually less than 1 TDM biomass before winter dormancy. It will grow rapidly in early spring. Terminate rye as a cover crop by late April before it grows too large. Rye can create soil conditions requiring extra care when planting the subsequent crop. Rye also releases allelopathic compounds that have sometimes shown toxicity to alfalfa seedings following rye forage harvest or cover crop termination.

Seeding rate: rye for cover at 40-60 lb per acre; 80-100 lb per acre for early spring forage

Depth: Drill 1-2 inches deep or broadcast and lightly till-in

For optimal growth, apply 40-60 lb N, (for forage, add 20 lb P₂O₅ & 90 lb K₂O)

Terminate before rye reaches 4 inches in height

ANNUAL RYEGRASS (ARG) is not a true annual but is considered not cold tolerant. It has rapid growth with good biomass production when summer-seeded on most soil types. When planted in summer or fall, it will develop a shallow, fibrous root system desirable for erosion control. ARG can be a good compliment for brassicas and/or annual clover. Though a somewhat popular and economical cover crop, planting ARG is discouraged due to concerns with its potential to become a difficult to control weed. It can overwinter in the Midwest with mild conditions. It can be a prolific seed producer in the seeding year, and several glyphosate resistant biotypes have been identified. If it over-winters, it can be difficult to control with herbicides.

Seeding rate: 15-25 lb per acre alone or 8-15 lb per acre in a mix with brassicas or clovers

Depth: 1/4-1/2 inches deep

Avoid allowing ARG go to seed. If ARG over-winters, an intensive control protocol should be followed:

Cover crop planting note:
Carefully consider planting into dry soil if rain is not in the forecast!
Spray early when annual ryegrass is 4-6 inches tall and is actively growing with warm conditions

- Use 0.75-1.125 lb acid equivalent/acre glyphosate (for example, 32 oz Roundup PowerMAX)
- Add 8-16 oz 2,4-D if broadleaves are present (be aware of rate-based planting interval restrictions)
- Use the recommended ammonium sulfate (AMS) volume to lower pH of spray water (pH <5)
- Apply 15-20 gpa spray volume with medium droplet nozzles for good penetration
- Spray by 3 pm (> 4 hours sunlight remaining after spray application)

2) The fibrous root structures of cereal grains and forage grasses improve soil structure and may help alleviate compaction.

3) Planting a multi-species mix that includes a grass, legume and brassica may achieve an ecological synergy that includes enhanced biological and physical benefits to soil health. Scientific substantiation, thus far, is minimal.

DAIKON RADISH (e.g., Tillage, Groundhog, Nitro, oilseed or forage radish) is a fast growing edible root vegetable capable of producing a girthy taproot that can extend several feet deep if planted in July or August. Daikon radishes selected as cover or forage crops are often touted to alleviate soil compaction by ‘bio-drilling’ down through compacted layers within the crop root zone. Observations suggest, however, radish root growth can be restricted by compaction zones. Radish roots often follow the path of least resistance, finding an existing root or earthworm channel (bio-pore) to navigate downward. This may or may not offer soil health benefits unique to radish (or other brassica) root growth. Observations also suggest the girthy growth of radishes can have a loosening effect at the soil surface that can cause conditions susceptible to gully erosion. It is, therefore, recommended if radish is planted, it should be in combination with a cereal grain or a forage grass to help hold the soil.

Radishes and other brassicas release bio-toxic metabolites upon decomposition in soil, which have shown modest suppressive effects on certain weed, insect and parasitic nematode pests. These chemical compounds include glucosinolate and biologically active sulfur containing thiocyanates, which are also associated with the sulfurous odor given off by radishes during decomposition. No research-based weed or disease management guidelines have been developed. Radishes have been shown to be good scavengers of residual soil nitrate, but measured N release to a following crop has been variable.

For optimal growth, apply 40-60 lb N from fertilizer, manure or legume credits

Depth: ¼-½ inches deep

OTHER BRASSICAS: TURNIPS, RAPESEED will have similar tap-rooting to radish, with less volume. They can, generally, be substituted for radish. Rape should be planted at seeding rates similar to radish, but turnips should be about half (2-4 lb per acre in a mix). Turnips will have more tuber-like growth at the soil surface and are better suited to late summer and fall grazing. Turnips may over-winter and do not produce the odors of radish upon decomposition.

Requires 40-60 lb supplemental N

Depth: ¼-½ inches deep

BRASSICAS AND MIXTURES

possible multi-species benefits for soil health

Research is very limited in terms of the soil health benefits that accrue from planting particular species of cover or green manure crops. Some general principles with merit:

1) Species with high biomass potential will add more organic material and recycle more nutrients.

The season (July). Radishes are fast growing with competitive, leafy top growth. Mixes must consider compatible species and modest radish seeding rates.

Possible mixes and seeding rates for radish plantings:

3-6 lb per acre radish in a mix with 20-30 lb per acre oats or spring barley
3-6 lb per acre radish in a mix with 35 lb field peas and 20-30 lb per acre oats or spring barley
3-6 lb per acre radish in a mix with 6-8 lb berseem clover and 10 lb annual ryegrass
3-6 lb per acre radish in a mix with 6-8 lb berseem clover and 15-30 lb barley

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