Cover Crops as a Weed Management Tool

The use of cover crops in agriculture has many agronomic and economic benefits as well as challenges. In some agricultural areas, such as the Chesapeake Bay, cover crop use has been supported by funding to help increase water quality and reduce nutrient runoff and leaching during non-cropping months. According to the 2017 Census of Agriculture, cover crop acreage increased about 50% from 2012 (10 million acres) to 2017 (over 15 million acres).[1]

Figure 1. Lush growth of radish and annual ryegrass.

Cover crops can help:

- Reduce wind and water erosion.
- Mitigate soil compaction.
- Improve water infiltration.
- Keep residual fertilizer in the field.
- Add organic matter and nutrients to soil.
- Absorb excess moisture.
- Provide a food source for livestock and wildlife.
- Provide sustenance for pollinators.
- Control weeds.

Cover crop challenges:

- If seeding within a standing crop, cover crop seeds may not become established because the soil surface is too wet, too dry, or highly shaded.
- In no-till seedings, good seed-to-soil contact can be difficult because harvest residue may be pinched into the seed slot.
- Termination timing can be challenging for non-winterkilled species because of termination (should occur at least two weeks prior to field crop planting) and potential for re-growth if not killed.
- Cover crop seed selection may be limited by a previous herbicide application.
- Seeding window for cover crops after harvest of primary crop may be too short to allow successful establishment prior to freezing temperatures.

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Desired Use: The desired use for a cover crop should be determined prior to choosing which cover crop to use, because different cover crops can be beneficial for different reasons (Table 1). Grass species are more likely to hold soil in place from wind and water erosion; fast growing grasses or Brassica species are a good choice for nutrient retention; and nitrogen (N)-fixing legume cover crops can potentially help reduce the amount of fertilizer N needed. Feed for animals through grazing or harvesting may best be accomplished with fall or winter grasses and legumes. Soil compaction is best addressed with cover crops with penetrating root systems, like radish and deep-rooted annual ryegrass.

Most cover crop species can be classified as warm-season or cool-season plants (Table 2). Warm-season plants perform best in warm weather and usually require warm soil temperatures for germination and plant establishment. Cool-season plants perform best in spring or fall, and some can overwinter.

Table 1. Common cover crop characteristics and recommendations.[2]

Crop	Characteristic	Nitrogen Fixing	Overwinters	Drilling Rate (lb/acre)	Broadcast Rate (lb/acre)	Comments
Crimson clover (legume)	Winter annual	Yes	Yes	12 to 15	20	Fast growing; spring blooms are good for pollinators
Hairy vetch (legume)	Winter annual	Yes	Yes	15	20	Slow fall growth; fast spring growth; avoid planting before wheat
Cereal rye	Annual cereal	No	Yes	70 to 80	100 to 120	Cold hardy; excellent erosion control; fast spring growth; spring decay after termination may slow corn growth; can plant later in fall; very good at absorbing unused N but decomposwition can tie N up
Triticale	Annual cereal	No	Yes	60 to 70	80 to 100	Cross between wheat and cereal rye; good for erosion control and grazing
Oats	Annual cereal	No	No	80 to 100	120 to 140	Good for early fall cover but winterkills; offers fall grazing
Oilseed and forage radishes (Brassica species)	Annual	No	No	5 to 6	8 to 10	Rapid fall growth; deep taproot for compaction relief; establishes easily; good at absorbing N
Forage turnips (Brassica)	Annual	No	No	5 to 6	8 to 10	Very good for grazing; compaction relief
Annual ryegrass	Annual	No	Can regrow after turning brown	12 to 15	20 to 25	Good forage; good erosion control; requires spring termination; fast growing; conducive to interseeding

Soil Enhancement: Cover crops can help fields rebound from intensive farming and tillage practices that have led to compaction, erosion, and soil structure damage. Root growth of cash crops in soils with subsoil compaction can be improved by increasing the presence of active living roots. For example, soybean roots can grow into root channels created by deep-rooted annual ryegrass.[3] Reducing erosion is one of the main goals of growing cover crops and is dependent on how much the cover crop reduces the forces of soil detachment and transport. Soils are susceptible to erosion when they lack cover from a crop canopy and residues. Above-ground biomass from cash crops may only last four months but cover crops can be used to supplement additional soil surface cover. Cover crop growth extends the period of biomass production and can build soil organic matter (SOM). Climate and vegetation are two of the most important factors influencing the amount of SOM near the soil surface. Increasing SOM creates larger, more stable soil aggregates near the soil surface, which helps decrease the potential for soil detachment and erosion.

Table 2. Warm- and cool-season cover crops[2]

Warm-season	Cool-season	
Buckwheat	Annual ryegrass	Crimson clover
Cowpea	Austrian winter pea	Forage turnips
Foxtail millet	Balansa clover	Hairy vetch
Pearl millet	Black oats	Oats
Sorghum-Sudangrass	Brassicas, other	Oilseed radish
Sunflower	Canola and Rapeseed	Triticale
Sunn hemp	Cereal rye	Wheat

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Soil structure, soil fertility, and soil health are associated with SOM as are many physical and chemical characteristics of soils. No-till practices help preserve the SOM gained from cover crop growth. Conversely, tillage quickly breaks down SOM. An approximate 9% SOM increase in the top foot of soil was produced from rye and hairy vetch cover crops on a no-till corn and soybean field in Illinois.[4] Agricultural top soils have SOM levels ranging from 1 to greater than 5% with the potential to release 10 lb of N/acre/year for each 1% of SOM.[5]

Additional soil fertility benefits related to cover crop use include increased rates of infiltration, nutrient cycling, and residue decomposition. Cover crops can reduce nutrient loss by improving soil water infiltration. By keeping precipitation in fields, sediment detachment and transport can be reduced, which is important for the retention of phosphorus (P). Phosphorus is attached to soil sediment, and P losses in runoff were reduced by 54 to 94% with various cover crops and different site years.[4]

Figure 2. Radish taproot down 8 inches along with annual ryegrass roots.

Grazing or Harvesting: Establishing cover crops for livestock feed provides a dual advantage – conservation and economic return through meat, milk, and manure. **Residual herbicide labels should be read and followed as restrictions for livestock consumption may apply.** Depending on the crop, grazing may occur in the fall, during the winter, or in the spring. For fall or early winter grazing, a fast-growing species should be used such as oats, rye, or Brassica species. However, rye should not be overgrazed in the fall because of lower overwinter plant survival and if in-spring grazing is desired. Brassica species should not be grazed alone because of their ability to take up excess N that may result in bloating of ruminants.

If spring grazing is desired, winter-hardy species such as winter rye, triticale, barley, or wheat are considerations. If the cover crop is to be harvested for feed it should be cut by boot stage for best forage quality and water preservation (water uptake increases during reproductive stages). Grazing helps keep some of the nutrients in the field while harvesting can remove nutrients but still provides soil health benefits. Crop insurance programs should be reviewed to determine any potential effect on insurance payments.

Weed Suppression: Cover crops are being used to help control weeds after harvest and into early spring prior to planting. A thick, robust, and healthy cover crop can help suppress weed growth by 1) changing the soil dynamics, 2) becoming established and growing quicker than weeds, and by smothering weed seedlings. A lush cover crop can keep soils too cool for some weed seeds to germinate or for winter annuals to aggressively grow. Cover crops that winter-kill or are terminated with herbicides in the spring can provide a mat that helps keep weeds from germinating. Additionally, some cover crops produce chemicals that are toxic to certain germinating seeds (allelopathy).

Cover Crop Termination: Controlling cover crops prior to spring planting can be a challenge under some circumstances. Planning and scouting is critical for a successful control program. Removal of cover crops is influenced by the species used (grasses, Brassica species, cereals, broadleaves) their growth stage, temperature, and the crop to be planted. Methods to control cover crops include winterkill, tilling, mowing, and herbicides. The geographical location can limit or be advantageous for cover crop winterkill.

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To minimize the potential for corn or soybean yield loss, cover crops should be terminated at least two weeks prior to planting the field crop. Termination four to eight weeks prior to spring planting may allow for faster soil warming, residue drying, and decompostion.[5] However, delaying termination until two weeks prior helps maximize the benefits that cover crops provide. Should spring-time moisture be limited, consideration should be given to terminating the cover crop at six to eight inches tall.

While termination via tillage may accomplish the goal, it can reduce some of the benefits provided by the cover crop.[6] Roller-crimpers can be used to kill tall-growing cover crops by breaking or crimping the stem of flowering stage or later plants. Mowing can be an effective killing method for some species.

When selecting herbicides to control cover crops, consideration should be given to the cover crop species, the weed species present, the growth stage and plant height of each, weather conditions at application, the nature of herbicide activity (systemic or contact), and the crop to be planted. Non-selective herbicides include contact herbicides (paraquat, glufosinate) and systemic herbicides (glyphosate). Systemic herbicides translocate (move within the plant) to the plant's site of action, but the rate of translocation is influenced by plant metabolism. Actively growing crops under warm temperatures have higher metabolism rates that move systemic herbicides to their site of action more quickly. Therefore, applications should be made after three to four days of daytime temperatures in the high 50° to low 60° F range and nighttime temperatures greater than 40° F.[7]
When using herbicides, the product label must be read for application guidelines and re-cropping restrictions concerning the following crop.

To maintain farm program eligibility for federal crop insurance on spring planted crops and other programs, check with your local Farm Service Agency (FSA) concerning specific cover crop termination dates for your area.[8]

Seeding Rates: Seeding rates vary depending on the seeding method and if a cover crop species is planted by itself or in a combination of two or more species. Aerial, drilled, and broadcast rates should be higher than if a row crop planter is used because seed-to-soil contact is much less. Smaller seeded species such as radish, turnip, flax, rapeseed, cereal rye, and barley are best suited for broadcast or aerial seeding. Larger seeded species such as peas and sunflowers should be drilled, or row cropped.9 The mix ratio may vary based on the cover crop objective. A proportional rate for a two-way mix may be 55 to 60% of the normal rate of a species by itself. A three-way mix may be 35 to 40% of an individual species.[2]

Sources:

[1]Census finds cover crop acreage increases 50% nationwide. 2019. FarmProgress. https://www.farmprogress.com/.

[2]Myers, R., Ellis, C., Hoormann, R., Reinbott, T., Kitchen, N., and Reisner, J. 2015. Cover crops in Missouri: Putting them to work on your farm. G4161. University of Missouri. https://extension2.missouri.edu/.

[3]Bennett, D. 2013. Cover crop use growing as corn/soybeans acreage on upswing. Delta Farm Press. https://www.farmprogress.com/.

[4]Kaspar, T.C. and Singer, J.W. 2011. The use of cover crops to manage soil. Soil Management Practices. American Society of Agronomy and Soil Science Society of America. Chapter 21

[5]Mitchell, C.C. and Everest, J.W. 1995. Interpreting soil organic matter tests. Soil Testing & Plant Analysis. SERA-IEG-6*1. Auburn University. http://aesl.ces.uga.edu/.

[6]Johnson, J. Termination time for cover crops. USDA. Natural Resources Conservation Service. Iowa. https://www.nrcs.usda.gov/.

[7]Loux, M. 2007. Burndown herbicide activity—can we kill anything when it's this cold? C.O.R.N. Newsletter 2007-08. The Ohio State University. http://corn.osu.edu/.

[8]NRCS cover crop termination guidelines. 2019. USDA.

[9]DeJong-Hughes, J. 2018. Guide to planting cover crops in Minnesota. https://extension.umn.edu/.

Other sources:

Benefits of cover crops. Managing Cover Crops Profitably. 3rd Edition. SARE. https://www.sare.org/.

Cover crops. MSU Extension. Michigan State University. https://www.canr.msu.edu/.

Filbert, M. Livestock & cover crops. Practical Farmers of Iowa. https://practicalfarmers.org/.

Hartzler, B. and Anderson, M. Effect of residual herbicides on cover crop establishment. Integrated Crop Management. Iowa State University. https://crops.extension.iastate.edu/.

Williams, S.M. and Weil, R.R. 2004. Crop cover root channels may alleviate soil compaction effects on soybean crop. Division S-6-Notes. Soil Science Society of America Journal 68:1403-1409. https://www.enst.umd.edu/.

Web sites verified 9/19/19