Bulletin #1170, Cover Cropping for Success

extension.umaine.edu/publications/1170e

Cover Cropping for Success

By Jason Lilley, Sustainable Agriculture Professional, University of Maine Cooperative Extension

Reviewed by Associate Extension Professor, Agriculture Caragh B. Fitzgerald and Richard Kersbergen, Extension Professor, Sustainable Dairy and Forage Systems, University of Maine Cooperative Extension

For information about UMaine Extension programs and resources, visit extension.umaine.edu.
Find more of our publications and books at extensionpubs.umext.maine.edu.

Cover cropping is an increasingly popular and important practice for improving economic and environmental sustainability on many Maine farms. Cover crops are plants used to improve soil health and fertility, provide beneficial insect habitat, reduce weed pressure, and/or provide other agronomic or

environmental benefits. Cover crops are generally not harvested for profit, but to improve water quality, reduce fertilizer needs, decrease insect pest and weed pressure, protect against soil erosion, and increase cash crop yields.

As with most aspects of farming, there are several considerations to look at before planting a cover crop, as planting at the wrong time of year, not having the correct equipment to handle high biomass cover crop species, tying up nutrients due to improper management, and other factors that can negatively affect future yields. This fact sheet, as well as your neighboring farmers, Extension professionals, and other service providers, will help you to develop a cover cropping strategy that works for your farm.

Species Selection

Setting Goals

Before selecting what species of cover crops you will use, first determine what goals you hope to achieve in planting a cover crop. Possible goals include

- improve soil organic matter
- increase soil microbial activity
- improve soil structure
- decrease erosion
- improve soil moisture management (drainage and moisture retention)
- decrease weed populations
- capture nutrients
- fix nitrogen
- provide habitat and food sources for beneficial insects.

Different species of cover crops will offer varying degrees of benefit in these categories. Some species will yield only one type of benefit, while others may provide several benefits. Mixes of multiple cover crop species may provide more benefits than a single species. Many of these benefits are interrelated, so planting a cover crop for one benefit may result in several others. For example, increasing soil organic matter levels will generally increase soil microbial activity, improve soil structure, and improve soil moisture management. See Table 1 for attributes of commonly used cover crop species in the Northeast.

Table 1. Attributes of commonly used cover crop species in the Northeast.

Species	Organic Matter Contribution / Weed Suppression[a]	Nitrogen Fixation[a]	Nutrient Capture[a, b]	Soil Pathogen Management[a, b]	Resource for Pollinators / Beneficial Insects[a]	Winter Kill in Maine

Winter cereals e.g., rye, wheat, triticale, or spelt	X		X			
Sorghum × sudangrass or millet	X		X	X		X
Annual or Italian ryegrass	X		X			X
Oats	X		X			X
Buckwheat	X				X	X
Hairy vetch		X			X	
Medium red clover		X			X	
Alfalfa	X	X			X	
Field peas		X				X
Tillage (forage) radish	X		X	X		X
Mustard				X		X
Rapeseed				X		X

[a] Benefits seen from allowing the cover crop to grow to the appropriate stage of maturity.

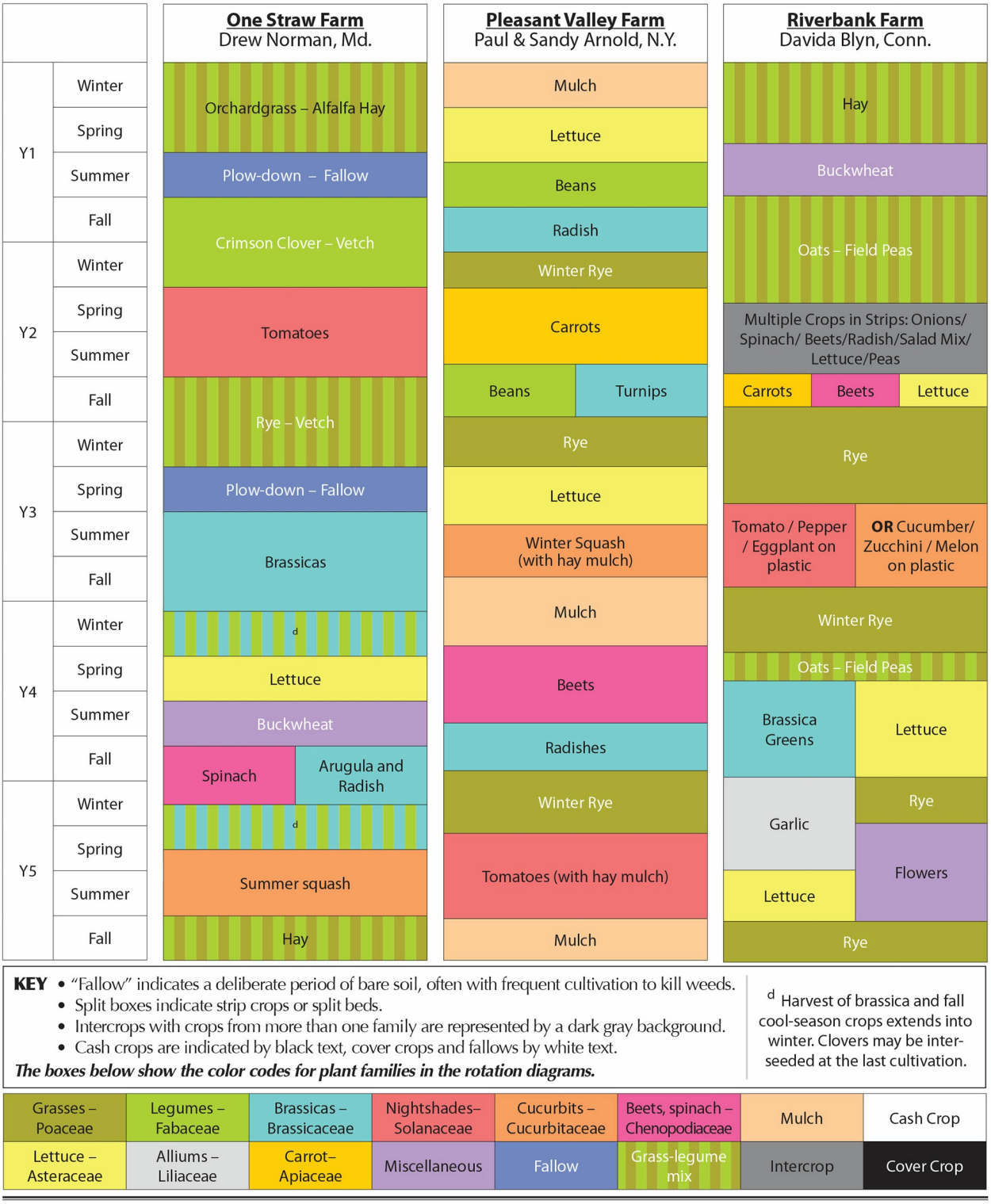
[b] *Managing Cover Crops Profitably*, SARE, 2007.

Timing

Next, determine what time of year you can plant the cover crop and how long you can leave it in the field.

Crop Rotations: Fitting In Cover Crops — The practice of cover cropping is a trade-off between obtaining the agronomic and ecological benefits listed above and having a cash crop in the ground. Developing multiseason crop rotation maps, as in Figure 1, will help to identify times of year when your cash crops will be out of the field, and are suitable for cover cropping. This is particularly helpful on diversified vegetable farms, where crops are planted at various times throughout the season.

Figure 1: Sample four- and five-year vegetable crop rotations. *Excerpted with permission from Crop Rotation on Organic Farms, published by Sustainable Agriculture Research and Education (SARE) Outreach, USDA – National Institute of Food and Agriculture (NIFA). Citation of SARE materials does not constitute SARE's or USDA's endorsement of any product, organization, view, or opinion. For more information about SARE and sustainable agriculture, see www.sare.org.*



Developing multiseason crop rotation maps for each of your fields allows you to visualize when you will be able to plant cover crops, as well as to identify possible ways in which a cover crop would interfere with your crop rotation plan. For example, you would not want to plant a field of spring rapeseed (a brassica) in a field that will have fall broccoli, as there are several possible carry-over insect and disease pests. You also might want to avoid direct seeding a small-seeded crop, such as carrots, after a high biomass cover crop, like winter rye, because preparing a fine seedbed would be difficult.

Cover Crop Species Planting Requirements — Just as spinach prefers cool temperatures,

each cover crop species has specific planting and growing requirements. Planting a cover crop that prefers cool temperatures in midsummer can lead to poor competition against weeds as well as bolting and seed set before desired biomass is achieved. When cover crops set seed, they can become future weed problems themselves. Planting a warm season cover crop in late fall can lead to poor germination and slow growth. Planting in soils that are too cool or that have inadequate moisture can result in poor germination, which can allow weeds to flourish. For these reasons, planting cover crop species that are appropriate for the time of year and field conditions is crucial for success. Planting quality seed that has been tested for germination is important for a successful established cover crop. See Table 2 for recommended planting times for commonly used cover crop species in the Northeast.

Planting Cover Crops

Fertility, Soil Preparation, and Weed Management

Planting cover crops is usually done in a similar fashion as is planting grain. The goal is to plant into a weed-free soil, with adequate moisture and fertility, good seed-to-soil contact, and good distribution of the seed to ensure quick germination and soil coverage.

Just like any other crop, optimum soil fertility is required to maximize cover crop benefits. Cereal and grass cover crops will benefit from 50–60 pounds/acre of nitrogen (N) supplied either as applied fertilizer or as residual soil N from the previous crop. This nitrogen will significantly increase root development and overall biomass. Legume cover crops can fix their own N by converting atmospheric N into a form the plants can use. This process is suppressed when soil N levels are adequate, so legume cover crops should not receive fertilizer N. However, they do need adequate pH and levels of phosphorus and potassium.[1] When planting a legume cover crop in fields that have not historically had that species of legume, it is critical to inoculate the seed with the appropriate inoculum to maximize N fixation.

Cover crop seed should be planted as soon as possible after crop harvest or the last cultivation pass to minimize weed growth before the cover crop can get established. One way to accomplish this is to use a light cultivation to incorporate broadcasted seeds. This effectively prevents weed emergence while simultaneously covering your seed. In weed-free fields, drilling a cover crop directly into crop stubble is also an option.

After planting, make sure to scout your cover crop fields. A cover crop may look good from the road, but walking into the field will allow you to identify potential weed or pest problems. If weeds become a problem, it may be best to terminate the cover crop early, rather than develop a weed problem for future seasons.

Seeding Rates

Planting at the correct seeding rate is important to optimize the benefits of your cover crop. When planting for weed control, utilize the high end of the recommended seeding rate for the species that you are planting, or slightly higher. This ensures adequate cover crop biomass to

smother out weeds. Excessively high seeding rates may cause competition within the cover crop and result in high seed costs with little additional benefit. When planting multiple species in a mix, reduce the seeding rate for all species to reduce interspecies competition. See Table 2 for recommended seeding rate ranges.

Calibrate your planting equipment for the seed size that you are planting. Always check your seed drill or broadcaster for obstructions before use. Methods and calculations for calibrating your seeding equipment can be found at the University of Arkansas publication Calibrating Drills and Broadcast Planters for SmallSeeded Forages (PDF).

Planting Equipment

The equipment used to plant a cover crop can influence germination rates and overall success. Broadcasting can be done by hand, with a chest-mounted broadcaster, a tractor-mounted broadcaster, or a drop spreader. It is critical to incorporate broadcasted seed into the soil. Incorporate larger seed with implements as heavy as a disk harrow, but preferably with a light pass with an s-tine harrow or other secondary tillage implement. Small seeds can be sufficiently incorporated using a cultipacker. The cultipacker has the added advantage of pressing the soil down to create a firm seedbed for good seed-to-soil contact.

Frost seeding is another technique used to plant cover crops in the late spring. This involves broadcasting seed over the ground when soil is freezing and thawing. In Maine, this is done in late March or early April. The process of the soil freezing and cracking, and thawing and closing back up, allows the seed to work its way into the soil. This is a low-labor method of planting, and usually results in lower germinations rates. University of Maine Cooperative Extension's video "How to Frost Seed" explains the details of frost seeding.

Grain drills are often the preferred method for planting cover crops. Drills are easier to calibrate and ensure more accurate planting densities than the above methods. Drills usually have planting depth adjustments and result in good seed-to-soil contact. Many drills also have separate hoppers for large and small seeds, simplifying planting mixes. However, drills are more costly than most broadcast implements and typically plant rows at 7-inch spacing. This space can allow weeds to establish between the rows before the cover crop is able to fully cover the soil. Some growers have used a two-pass system to reduce the plant spacing and increase the competitiveness of the cover crop. This involves making two passes with the drill in different directions across the field, at a half seeding rate for each pass. Recommended seeding rates when using a drill are significantly lower than with broadcasting due to higher germination rates with the drill (see Table 2 or *Managing Cover Crops Profitably* for seeding rates by planting method).

Table 2. Planting considerations of commonly used cover crops in the Northeast

Species	Preferred Planting Time	Seeding Rate Range (lb/A)[a]	Inoculation Needed	Termination[b]	Biomass / Incorporation Requirements if Grown to Maturity
Winter (cereal) rye	Mid Aug.–mid Oct.	100–160		Spray; mow/inc.; roll	Heavy
Sorghum × sudangrass	Mid June–mid Aug.	35–50		Spray; mow/inc.; frost	Heavy
Annual ryegrass	May–June or mid Aug.–late Sept. or FS	15–30		Spray; mow/inc.	Heavy
Oats	Early May–early Sept.	80–140		Spray; mow/inc.; frost	Heavy (low in spring; frost killed)
Buckwheat	Mid May–late Aug.	50–90		Spray; mow/inc.; frost	Mid
Hairy vetch	Early Aug.–early Sept.	15–40	X	Spray; mow/inc.	Mid
Medium red clover (biennial/ perennial)	Early June or early Aug–early Sept. or FS	8–12	X	Spray; mow/inc.	Low
Alfalfa (perennial)	Early May–June 1 or mid July–mid Aug.	12–15	X	Spray; mow/inc.	Mid
Field peas	Mid April–early June or early Aug.–early Sept.	60–100	X	Spray; mow/inc.; frost	Low
Tillage (forage) radish	Mid April–early June or late July–late Aug.	10–20		Mow/inc.; frost	Low
Mustard	Mid April–early June or late July–late Aug.	8–15		Mow/inc.; frost	Low
Rapeseed	Mid April–early June or late July–late Aug.	8–14		Mow/inc.; frost	Low

[a] *Managing Cover Crops Profitably*

[b] Frost–frost killed; inc.–incorporate

Termination and Incorporation

Planning and Timing — Before planting a cover crop, make sure that you have a plan for terminating the planting. Cover crops that are allowed to set seed can become a weed problem for years to come. A cover crop that is allowed to produce more biomass than the equipment you have available can be problematic. Developing a good plan to ensure that you have the time to manage the cover crop at the appropriate time of year, and that you have the equipment to handle the residue, will serve you well toward avoiding future problems and maximizing your benefits.

Cereal and grass cover crops should be terminated at stem elongation (joint stage) to minimize N immobilization or "tie-up." Cereal crops at later growth stages contain higher levels of carbon and will tie up N, making it unavailable to the following crop until late in the season. On the other hand, cereal rye terminated early (at 8–10 inches tall) can add 30–50 pounds N/acre.[2]

Terminate legumes planted for N fixation at peak budding stage to receive the maximum N credit. Incorporate the crop residue soon after termination to maximize the N contribution.

Methods for Termination — Winter-killed cover crops are the easiest to manage. After planting these crops at the appropriate time in the fall, let them develop until a hard frost kills them. The crop residue will provide soil coverage, yet be relatively easy to incorporate in the spring. A mix of oats and field peas or tillage radish is a highly beneficial, winter-killed option.

Spring plantings of cover crops, or plantings of winter annuals in the fall, will grow until the crop sets seed. Cereal and grass cover crops will produce biomasses as high as 10,000 pounds of dry matter/acre. It can be easier to incorporate the residue if it is first finely chopped with a flail mower.

Herbicides can be used to terminate cover crops, and are particularly useful in no-till systems. Choose the herbicide based on the cover crop species and apply at an appropriate growth stage and under the proper environmental conditions.

When selecting an herbicide, consider the efficacy of the material to kill the specific cover crop species (Controlling Cover Crops (PDF)), but also the potential residual activity and likelihood of the product to injure your succeeding crop (Common corn and soybean herbicides, estimated half-lives, cash crop restrictions and their potential to injure fall cover crops (PDF)).

To kill the cover crop mechanically, use either a mower or a roller crimper. A flail mower will chop the plant material, allowing it to be more easily incorporated. A roller crimper is a heavy rolling implement with dull blades to crimp the cover crop stems. This results in decreased nutrient flow and cover crop death if done near crop maturity. Using a roller crimper leaves the residue intact and provides a mulch layer that can be left on the soil surface in no-till systems.

Incorporation — After spraying, mowing, or rolling the crop to terminate it, use a disk harrow or possibly moldboard plow to incorporate the crop residue. Minimizing the number of tillage passes and the intensity of tillage will help maintain soil health.

Considerations and Conclusions

Cover cropping improves the environmental and economic sustainability on farms. Success with cover cropping depends on good planning around

- determining goals to achieve
- identifying the time of year that a cover crop will fit into your system and that you will have time to manage it
- selecting species that work for your farm.

When your plan is in place and you are ready to plant be sure to

- add any necessary fertilizer
- prepare weed-free planting zones
- plant at the appropriate seeding rate and time of year
- ensure that seeds are planted at the appropriate depth with good seed-to-soil contact.

When planning to terminate cover crops do so

- *before* the crop sets seed
- at the appropriate stage to meet your goals
- at a stage that your mowing and cultivation equipment can handle the residue
- at stem elongation for cereals, to avoid N immobilization
- at full bloom of legumes for optimal N fixation.

As with any component of your farm operation, consider the time and money spent in managing your cover crops. After reviewing your cover crop management plan, you may identify alternatives that would reduce time, or inputs needed for your cover crop while maintaining the benefits that you are receiving. Quantifying the benefits achieved from a cover crop in monetary terms can be difficult; however, resources such as the cover crop economics calculator by the U.S. Department of Agriculture-Natural Resources Conservation Service will guide you through developing a comprehensive analysis of your cover crop management.

Bibliography and Additional Resources

1. Cover Crops for Home Gardens. Oregon State University. https://catalog.extension.oregonstate.edu/sites/catalog/files/project/pdf/fs304.pdf.

2. Estimating Plant Available Nitrogen Release from Cover Crops. Oregon State University. https://www.uvm.edu/vtvegandberry/NMP/PANFromCoverCrops.pdf.

Crop Rotation on Organic Farms: A Planning Manual, Sustainable Agriculture Research and Education (SARE) Outreach, USDA-National Institute of Food and Agriculture. http://www.sare.org/Learning-Center/Books/Crop-Rotation-on-Organic-Farms.

Managing Cover Crops Profitably. SARE Publication. http://www.sare.org/Learning-Center/Books/Managing-Cover-Crops-Profitably-3rd-Edition.

Sustainable Farming Methods: Cover Crops, Strip-Till, Row Covers, and Pest Scouting. http://cucurbit.plantpath.iastate.edu/sustainable-farming-methods-cover-crops-strip-till-row-covers-and-pest-scouting/

Vegetable Cover Crop Decision Tool. Midwest Cover Crop Council. http://mccc.msu.edu/covercroptool/vegtool.php

Access to Equipment

Shared Use Equipment. Maine Farmland Trust. http://www.mainefarmlandtrust.org/shared-use-equipment/

Information in this publication is provided purely for educational purposes. No responsibility is assumed for any problems associated with the use of products or services mentioned. No endorsement of products or companies is intended, nor is criticism of unnamed products or companies implied.

© 2017

Call 800.287.0274 (in Maine), or 207.581.3188, for information on publications and program offerings from University of Maine Cooperative Extension, or visit extension.umaine.edu.

The University of Maine does not discriminate on the grounds of race, color, religion, sex, sexual orientation, including transgender status and gender expression, national origin, citizenship status, age, disability, genetic information or veteran status in employment, education, and all other programs and activities. The following person has been designated to handle inquiries regarding non-discrimination policies: Director, Office of Equal Opportunity, 101 North Stevens Hall, Orono, ME 04469, 207.581.1226, eoinfo@umit.maine.edu.