Organic Production:

Using NRCS Practice Standards to Support Organic Growers

Practice Fact Sheets

Cover Crop

Introduction

The benefts of cover crops have been recognized and advocated throughout agricultural history. Evidence of the use of legume cover crops to improve soil quality can be traced to early Greek and Roman times when fava beans were grown in vineyards to provide soil cover and nutrients, and more recently to the frst use of lupines in the late 1700's in northern Europe to improve the inherently poor condition of its sandy soils. Cover crops were an integral part of the American farmer's crop rotation through the 1950's. The availability and convenience of synthetic fertilizer has since reduced the use of cover crops and signifcantly altered how cropland is managed.

Today's organic farmer relies on the use of traditional cover crops (e.g., small grains, clovers, vetches) to reduce erosion, control weeds, and provide organic matter and nutrients to improve soil quality. Organic farmers are also fnding new benefts from non-traditional cover crops (e.g., forage radish, phacelia, black oats) to break up compacted soils, eliminate problem pests, and increase habitat for benefcial insects and pollinators. Cover crops can be selected from a wide variety of plants to address the specifc needs of the harvested crop, while ftting into the management system used to produce it.

> "No piece of steel can benefit the soil like roots from a good cover crop."
>
> --Steve Groff, Pennsylvania Farmer

Using cover crops is not a new practice, but recent research supports improved management strategies for planting and terminating them to maximize biomass production and reduce interference with production of the harvested crop. Proper application of these strategies increases the production success that farmers experience with cover crops and the benefts the cover crops provide for the environment.

Comparison of NRCS and National Organic Program Practice Standards for Cover Crop

NRCS Cover Crop (practice code 340) defnes the practice as "crops including grasses, legumes and forbs for seasonal cover and other conservation purposes." The practice can be applied as part of a conservation management system to support one or more of the following purposes:

- Reduce erosion from wind and water
- Increase soil organic matter content
- Capture and recycle or redistribute nutrients in the soil profle
- Promote biological nitrogen fxation
- Increase biodiversity
- Weed suppression
- Provide supplemental forage
- Soil moisture management
- Reduce particulate emissions into the atmosphere
- Minimize and reduce soil compaction

General criteria applying to all purposes are:

- Plant species, seedbed preparation, seeding rates, seeding dates, seeding depths, fertility requirements, and planting methods will be consistent with approved local criteria and site conditions.
- The species selected will be compatible with other components of the cropping system.
- Cover crops will be terminated by harvest,

frost, mowing, tillage, crimping, and/or herbicides in preparation for the following crop.
- Herbicides used with cover crops will be compatible with the following crop.
- Avoid using plants that are on the state's noxious weed or invasive species lists.
- Cover crop residue will not be burned.

Additional criteria for specifc resource concerns are also included. For example, the establishment, management, and termination of a cover crop must minimize the period that soil is left bare and maximize biomass production to control erosion and increase soil organic matter. The use of cover crops to capture and recycle plant nutrients is enhanced by selecting plant species that will take up large quantities of nutrients from the soil profle and timing their termination with the planting date of the following crop to maximize nutrient release. Weeds are controlled by the smothering affect of heavy residues and/or an allelopathic chemical barrier created by some cover crops.

National Organic Program (NOP) Cover Crop rules do not have a separate standard that governs the use of cover crops; however, they are mentioned in two sections. The soil fertility and crop nutrient management practice standard (205.203) lists cover crops as a method to manage crop nutrients and soil fertility. The crop rotation practice standard (205.205) requires producers to use a crop rotation that includes cover crops to address soil organic matter, pest, nutrient, and erosion concerns. Cover crops can be managed as green manure or catch crops, which are also mentioned as possible components of a crop rotation.

The seeds and planting stock practice standard (205.204) requires organically grown seeds, annual seedlings, and planting stock be used, and thus, applies to cover crops. There are several exceptions for using non-organically grown plant materials or those treated with prohibited substances. Organic producers should check with their certifying agent to obtain clearance prior to using any plant materials that are not organically certifed. Use of prohibited materials (plant or chemical) can result in the loss of the certifed organic status for the receiving crop feld if the use of the materials do not meet the exception requirements. Refer to the NOP National List of Allowed and Prohibited Substances for more information.

What are the Differences and Similarities?

Of the ten purposes for applying the NRCS Cover Crop practice, seven directly support the NOP practice objectives of the soil fertility and crop nutrient management (205.203) and crop rotation (205.205) standards (table 1). While the NRCS Cover Crop practice standard does not specifcally mention the use of "certifed" organic seed, as required in NOP 205.204, the standard emphasizes the producer's management system by stating "species selected will be compatible with other components of the cropping system."

Differences between the two standards center around the use of synthetic fertilizer for establishment and herbicides for termination of cover crops, both allowed under the NRCS practice

Table 1. National Organic Program practice objectives met by NRCS cover crop purposes

NRCS Cover Crop Practice Purposes	Meets National Organic Program Practice Objectives
Reduce erosion from wind and water	✓
Increase soil organic matter content	✓
Capture, recycle, redistribute nutrients	✓
Promote biological nitrogen fxation	✓
Increase biodiversity	
Weed suppression	✓
Provide supplemental forage	
Soil moisture management	✓
Reduce particulate emissions	
Minimize and reduce soil compaction	✓

standard. Organic producers must abide by the NOP's National List of Allowed and Prohibited Substances (Subpart G, Section 205.601 – 205.602), making them dependent on mechanical methods to terminate cover crops.

Planning Cover Crops in an Organic System

While most cover crops provide multiple benefts, some are better than others for reducing erosion, providing or trapping nutrients, controlling weeds and pests, etc. For example, with high biomass production, cereal rye performs well to reduce erosion and control weeds. However, as a non-legume, it "consumes" and ties up nitrogen in its biomass decreasing nitrogen availability for the next crop. Selecting a cover crop to provide the benefts the producer desires is critical. Following are things to consider when developing a strategy to include cover crops in the management system.

Cover Crop Considerations

Time of Year - Studying the crop rotation will reveal periods of time when cover crops can be incorporated to address a particular problem. Consider the rotation as a time line and ask the following questions:

- When are crops planted or harvested?
- Is there time to plant a cover crop before a killing frost or planting the next crop?
- How long can I let the cover crop grow?
- How will the cover crop be seeded?

Crimson clover is a cool-season legume that is planted for winter and spring production.

- Is there enough moisture, light, and/or nutrients to get the cover crop up and growing?
- How will harvest affect the cover crop?

Once these questions are answered consideration can be given to using "winter" or "summer" cover crops, or a combination of the two, and the type of cover to be grown (legumes, non-legumes, or a mix). Note that it is not unusual to use more than one cover crop during a growing season in an organic system – that is how important they are!

Winter Cover Crops - One of the most widely advocated uses of cover crops is for erosion control over the winter. For years, cereal grains have been the standard bearer to provide temporary winter cover after low residue summer crops (soybeans, peanuts, cotton) are harvested. Cereal grains were originally used as a green manure crop that was plowed under in the spring; however, now they serve as the medium to no-till plant corn, soybeans, and cotton. Rye, wheat, and oats can be planted by themselves or in a mix with legumes (clovers, vetches or medics) to provide nitrogen for the next crop.

Since organic producers rely on legumes as a primary nitrogen source, it is important that steps are taken to ensure a successful stand. The amount of nitrogen available for next year's crop is related to the amount of legume biomass that will be present in the spring. Legumes must be seeded early enough to allow adequate time for growth before the frst killing frost, six weeks is a good rule of thumb. Winter hardy varieties should be selected where winter freeze or frost heave is a problem.

Attention to seeding in the autumn can pay big dividends in the spring. Autumn over-seeding can be done two to three weeks before fnal crop harvest giving more time for cover crop germination and growth. Getting good seed to soil contact can be a challenge; crops with dense canopies should be avoided. Success can be achieved with crops that have less dense canopies, such as soybeans. Small acreages can be over-seeded using a hand-seeder.

Summer Cover Crops - Use of cover crops during the summer fts in well with vegetable production. The

four to eight week period between spring harvest and fall planting is an excellent times for legumes, such as cowpeas and soybeans, to produce nitrogen for the fall crop. Other plants, such as sorghum-sudangrass, can break up a compacted soil through its extensive root system. Buckwheat grows rapidly making it ideal for smothering weeds, while holding nutrients in its biomass over the summer.

The growth period for summer cover crops can be extended in several ways. Over-seeding in the spring can gain a few weeks, or fall crops can be planted into tilled strips of the summer cover crop, thus leaving the summer cover crop to grow in between the rows of the fall crop. Mowing these strips can be used to reduce competition between the cover crop and the fall cash crop. Typically, the use of live cover crops between rows of growing crops has been most successful under northeastern climates or under situations where irrigation is provided for the cash crop. Research in the southeast has shown signifcant risk of increased drought with live cover crops between rows of cash crops under non-irrigated situations.

Cover Crop Mixtures - The idea of planting a mixture of cover crops is not new. It is recognized that different plants in the mix may respond differently to soil, weather, and pest conditions, so a mixture expands the range of conditions under which good production can be expected. Grasses and legumes are mixed to scavenge or fx nitrogen depending on soil nitrogen levels following harvest of cash crops and to optimize the carbon to nitrogen balance of the cover and residue to promote a slow release of nutrients for the following crops. Multiple cultivars within the same species, but with different maturity dates, are mixed to extend the growing season. Cover crops with different growth forms and germination rates are mixed to increase sunlight interception and ground cover to protect against erosion. Biodiversity reduces risk, but also brings with it potentially higher seed costs, management challenges to get seeding rates and termination dates correct, and potentially more residue than equipment can handle.

Specialty uses for Orchards and Vineyards - Cover crops play the same important roles in orchards and vineyards as they do crop felds, but the availability of vine and tree rows for a yearlong display of fowering plants can also increase the aesthetic value of the land to attract tourists.

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affected by temperature, moisture, the carbon to nitrogen ratio of the residue, how deeply residue is incorporated, and the size of the residue pieces. Producers should minimize the time between cover crop termination and planting the following crop to optimize the amount of nitrogen available for plant growth and to decrease nitrogen losses from the agricultural system.

In organic systems, cover crops are usually terminated using mechanical methods. Equipment commonly used includes mowers, undercutters, roller-crimpers, and plows. Plowing cover crops into the soil kills them, but also disturbs the soil, which can lead to soil quality problems. Rotary mowers leave surface mulch that is cut in relatively long sections and spread out further than the width of the mowing deck. Flail mowers cut plant biomass into smaller, more homogenous pieces resulting in more rapid and uniform decomposition of residue. An undercutter, most often used on deep-rooted winter annuals, cuts the roots of the cover crop just below the soil surface, leaving above-ground foliage uncut for slower decomposition and increased time on the soil surface for weed suppression.

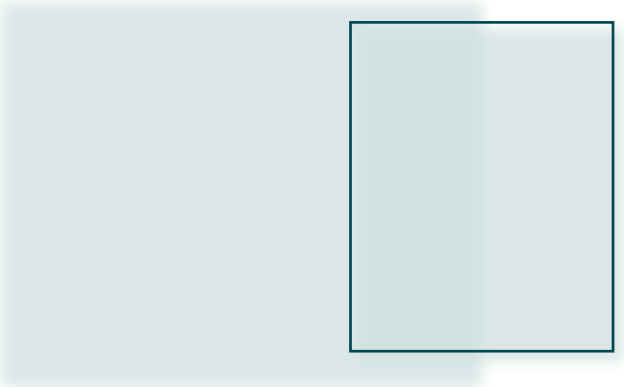
Roller crimpers kill cover crops by crushing stems to prevent the fow of water and nutrients through the plant. Roller crimpers come in a variety of designs. Straight bar rollers have good killing action and are easy to make, but transfer vibrations to the operator and require slower tractor speeds. Curved bar rollers have few vibration problems and can be operated at higher speeds, but also have reduced crimping action.

Estimating Nutrient Contributions - Cover crops accumulate and help recycle nitrogen, phosphorus, potassium, magnesium, calcium, and other nutrients needed for crop growth. Nutrient accumulation can be calculated by multiplying dry matter yield and crop nutrient content; however, the nutrients are not 100% available to the following crop. Availability of nitrogen for subsequent crops is affected by the carbon to nitrogen (C:N) ratio of the cover crop, which is affected by plant type and its stage of development. Legumes are naturally high in nitrogen; and fber (carbon) increases and protein (nitrogen) decreases as plants mature. Most plants contain approximately 40% carbon. To determine the C:N ratio of a cover crop, divide 40 by the crop's nitrogen percentage. For example, if rye plants contain 2% nitrogen, the C:N ratio is 20:1. The optimum C:N ratio for rapid decomposition and nutrient cycling is between 15:1 and 25:1. As plant residues are added to the soil, microbial populations (C:N ratio of 10:1) grow in response to this supply of food (carbon). Decomposition of cover crops with a high C:N ratio, e.g., sorghum-sudan at 50:1, "ties up" nitrogen, including soil nitrogen, since the cover crop does not contain enough nitrogen to meet the demand from microbial growth that is supported by the carbon source. Cover crops with a low C:N ratio, e.g., crimson clover at 15:1, more closely match the C:N ratio of the microbial biomass. These cover crops do a better job of matching nitrogen needs to carbon available for microbial growth and decomposition. There is little or no immobilization of nitrogen from the decomposition of legumes. In fact, nitrogen from legumes can become available before the next crop needs it, sometimes so quickly that it is leached from the soil.

Cover Crops used in Organic Systems - Most NRCS feld employees are familiar with traditional cover crops like rye, wheat, and oats, as well as legumes like crimson clover and hairy vetch. However, there is a much wider variety of plants being used as cover crops in organic systems, some with very specifc benefts that can be incorporated into an over-arching cover crop strategy. A good cover crop strategy does not use the same cover crop every year, but instead incorporates different species to tailor the benefts the cover crop provides to the needs of the following crop. Following is a brief discussion of several cover crops used by the organic community, including the benefts they provide.

Brassica is a diverse genus of plants in the mustard family that includes crops such as radishes, rapeseed, turnips, and mustard. They are known for their rapid growth in cool weather and generating large amounts of biomass. These characteristics make them very competitive with weeds and an excellent catch crop for nitrogen. Several members of this group have demonstrated promise in controlling nematodes in high value

crops like potato. The deep taproot of some Brassica species, e.g., forage radish, has peaked interest in their use to break up compacted soil layers. The large macropores created by their taproot can be one to two inches in diameter and penetrate the soil eight or more inches leading to the term "bio-drilling." Brassica species can be seeded in the spring at about the time corn is planted or in late summer to early fall at least six weeks prior to the first killing frost.



Forage radish has a deep taproot that breaks up compacted soil layers.

Cowpea is a fast growing summer legume with a deep taproot that can produce 3,000 to 4,000 pounds of biomass per acre within a 60 day window. It is ideal for filling a niche between spring and late summer vegetable production since its heavy vegetative cover smothers weeds while providing habitat for beneficial insects. This legume, producing over 100 pounds of nitrogen per acre, can leave a net gain in nitrogen due to the fast breakdown of its residue. Cowpeas are a heat adapted legume that thrives in hot, moist zones like the southeast and eastern corn belt.

Black oat is a highly popular cover crop species in Brazil that is receiving interest as a winter cover crop for the southeastern United States. Like rye, it produces large amounts of biomass, but its C:N ratio is more favorable for cycling nitrogen. Black oat has allelopathic properties to suppress broadleaf weeds, is resistant to root knot nematodes, and it breaks disease cycles typical for wheat and soybeans. 'SOILSAVER' black oat was selected for increased cold tolerance and is adapted to the lower Coastal Plain.

Sunn hemp is a fast growing tropical legume that can produce 5,000 pounds of biomass and 100 pounds of nitrogen per acre in a 60 to 90 day period. This rapid growth makes it an excellent weed suppressant to fill the midsummer niche and a significant source of nitrogen for late summer vegetable production. Sunn Hemp is also a good choice as a late summer cover crop to provide nitrogen for winter small grains. The leaf material of sunn hemp breaks down quickly, potentially releasing a lot of nitrogen over winter under temperate conditions. Thus, if sunn hemp is grown to provide nitrogen for a spring crop, it should be planted in a mixture with a cool-season species, such as small grains or forage radish, or the cool-season species should be planted into the sunn hemp residue. Sunn hemp is not winter hardy and is easily killed by a hard frost. To maximize benefits, a minimum of nine weeks should be allowed for plant growth before the average first frost date.

Sunn hemp is a fast growing, high biomass producing tropical legume.

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