

COVER CROPS IN A WHOLE FARM SYSTEM

by Lynda Prim

The Benefits of Cover Crops

Cover crops are plants grown specifically for their soil-enhancing qualities. Many farm crops such as clover, vetch, field peas, oats, buckwheat, winter wheat, and winter rye can be soil rejuvenators. They also function to protect areas of the soil between plantings and build soil fertility as living mulches or turned in as green manure. Legume cover crops, such as peas, clovers, cowpeas, fava beans, and vetch, store nitrogen for future use by other plants.

The presence of cover crops on the landscape can increase nutrient capture and lower soil erosion, both of which can improve water quality. In annual row-cropping systems where biomass is being removed by annual harvest cover crops have been found to have a positive impact on soil quality by helping to offset the carbon and nutrient losses. A self-seeded cover crop system is a technique that can minimize competition with row crops, save the farmer time and money, while taking advantage of the effectiveness of self-seeding for plant vigor.

A crop rotation system with grass that includes other suitable plant associations improves the soil by mobilizing and, at the same time, continuously renewing its biotic potential. Cover cropping and crop rotations together are organic management practices that can help to restore biological diversity in the landscape by providing plant diversity and habitat for beneficial insects in the field and garden while protecting the soil and building its fertility. Cover cropping in a crop rotation system allows for growing annual vegetable crops while replacing the nutrients removed by the cultivars without the use of off-farm inputs. Cover crops can also supply rotational grazing for small-scale livestock. For this reason, an organic farm or garden can become a habitat for all the species living in the system — from cultivated and wild crops, to livestock, to beneficial and predator insects, to microbial life in the soil. In this context, the farmer/gardener maintains and manages biological diversity. The crop rotation contributes to the management of diversity by moving the cover crops in the field or garden through time and space as needed.

Managing for Biodiversity

In a whole farm system, biological diversity provides the most favorable conditions for a balance to become established in an ecosystem. For farmers/gardeners this means that the natural control of weeds, pests, and plant diseases are more likely to be effective in such a diverse system and that the occurrence of specific population explosions of a pest or disease is less likely. Diversity in an ecosystem or on the farm is more than just the number of species present — just as important are the links between the species that are present. In a whole farm system, one of the keys to creating more diverse, balanced habitats is finding species that can provide links to lots of other species. When planting cover crops, remember that the plants provide habitat for both beneficial insects and soil organisms. To enhance the attraction of beneficial insects specialized wildflowers and other insectary plants can be added to the mix.

Managing the land to grow a cultivated annual crop or permanent crop inevitably involves a simplification of the ecosystem, and therefore, the inter-relationships which usually keep potential pest or disease outbreaks under control can be adversely affected. Cover cropping and crop rotations improve insect and disease control by managing the system to benefit

the soil and the crop. Monoculture, on the other hand, encourages many pest problems because the pests specific to a crop can multiply out of proportion when that crop is grown in the same place year after year. Pests are most easily kept in control when the soil grows different crops over a number of years. Mixed plantings or intercropping of one or more plant species (polycultures) also provides diversity. For example:

- low growing clover planted in permanent pathways between planting beds or as an understory for vegetable crops provides diversity and acts as a “living mulch”;
- perennial cover crops on the orchard floor provide beneficial insect habitat and can be managed by mowing for mulch and to maintain beneficial insect sanctuary

Plant mixtures tend to have greater efficiency (or total yield) than monocultures. This is because mixed plant systems utilize resources like light, water, and nutrients more efficiently and, when legumes are grown, there is also the benefit of nitrogen fixation. Mixed plantings also result in a reduction in the spread of pests and diseases and increased opportunities for natural predators or improved weed control because there is more competition. Combinations of cover crop plants are useful for cycling nitrogen, building organic matter and microbial biomass for example: legumes such as peas, fava beans and vetch legume in combination with a grass such as winter rye. A favorite of traditional farmers throughout millennia are oats combined with field peas which also makes an excellent livestock hay. In permanent systems, like orchards, clover, alfalfa or sainfoin, with grass provides a long term cover with the same benefits as annual cover crop systems.

Growing Cover Crops

A cover crop can be annual or perennial.

Annual cover crop species include, but are not limited to: winter wheat, spring barley, winter rye, oats, field peas, bell beans (favas), cowpeas, buckwheat, and vetch. A cover crop scheme can be spring or fall planted depending on the crop that is preceding or following. They can also be planted as a reseeding annual cover crop on land that is going to be rested for several seasons. Cover crops that are planted in early spring can be turned into the soil before planting summer annual crops. For instance:

- spring barley or oats and field peas can be planted as soon as the soil can be worked and turned into the soil as green manure in time to plant tomatoes and squash;
- oats and peas can also be left to grow all season and to winter kill with the hard frost leaving a protective mulch on the soil over the winter;
- spring-planted vetch can be left to grow until summer when it can be mowed and interplanted with tomatoes. The vetch enhances the growing environment for the tomatoes. If you don't mow it, vetch will reseed itself and re-grow in the spring.

An oat/fieldpea/vetch cover crop scheme is a classic in organic systems because it is well balanced in terms of cycling nitrogen and providing short term soil mineralization while boosting microbial biomass. Vetch in this annual cover crop mix serves the purpose of attracting beneficial insects. Several varieties of vetch (Purple, Common, Hairy) can be mixed together to optimize beneficial habitat. Annual cover crops can be used within perennial crop-

ping systems such as orchards and vineyards when the goal is to build soil, manage weeds, or provide seasonal protection for the soil and beneficial habitat.

Perennial cover crop species can include: clovers, medics, alfalfa, sainfoin, and grasses. A low-growing clover like New Zealand White or White Dutch (6" to 8" tall at maturity) is a good choice for permanent garden bed systems, field cropping systems where an understory crop is desired, and in orchards or vineyards. Salina Strawberry clover (also low-growing, 6" to 8" tall at maturity) can be added for diversity and to enhance the attraction of beneficial insects. The low-growing clovers will take foot and equipment traffic once established. Mowing is an essential technique to manage the growth and vigor of perennial cover crops. High mowing of perennial cover crops, timing of mowing, and leaving unmown strips of perennial cover crop as sanctuary for beneficials are all strategies to maximize the effectiveness of perennial cover crop systems.

To sow a cover crop it is necessary to prepare the surface of the soil by shallow tillage and raking. The seed can be broadcast or drilled depending on the scale, design, and equipment. It's important that the soil surface be opened up to make a seed bed and that the seed is covered at the proper planting depth. If broadcasting the seed distribute it as evenly over the soil surface as possible whether using a mechanical broadcast seeder or if broadcasting by hand. After broadcasting, the seeds can be covered by hand using a rake or mechanically using a harrow so that the seeds are covered with soil but not buried too deeply. When raking by hand, it helps to tamp the soil lightly with the back of the rake to make sure that the seeds are in contact with moist soil. In drier climates, it is often necessary to pre-irrigate unless the soil already has good moisture.

A cover crop can be planted anywhere you need it as the next crop in a rotation with vegetable and grain crops. An early spring cover crop is desirable before planting summer crops, but it isn't worth the trouble if the cover crop will be growing less than 6 to 8 weeks because there won't be enough biomass developed to provide the "green manure" benefit. Allow at least 2 weeks after turning in a cover crop to allow for decomposition of the plant material and assimilation of soil nutrients. The early stages of the decomposition process, right after the residues are incorporated into the soil, can inhibit seed germination and root growth. It's especially important to incorporate winter rye well and allow time for decomposition because excessive amounts of spring residue produced by winter rye can delay crop planting and actually decrease the availability of nitrogen to subsequent crops because the nitrogen is tied up or 'immobilized' by the decomposing residues.

If the cover crop is intended as a "green manure" it has to be cut, chopped up and incorporated into the soil. This is most easily accomplished when the crop is 10 to 12 inches tall and still tender and green. A rototiller or walking tractor is a good tool for this because it chops and incorporates the cover crop in one operation in a thorough manner. A green manure crop can be incorporated by hand by turning the soil shallowly with a spade if the crop is still young and tender. For larger scale mechanical management of green manure crops, a rotary mower followed by disking or a rototiller can be used. Whatever method is used, it's best to turn the soil shallowly, only 4 to 6 inches, so that the living part of the soil structure doesn't become buried too deep.

Applying a thin layer of compost into a cover crop before it's incorporated into the soil will help the decomposition process and humus formation. In heavy soils, inoculating with earthworms helps speed up the decomposition of the cover crops.

An alternative method of managing a cover crop by hand is to mow the crop off as close to the ground as possible with the tools mentioned above and gather the plants material up for adding to a compost pile. After removing the valuable green manure crop, chop the surface clean with a hoe to prevent regrowth. To prepare the planting bed, rake the growing area smooth and spread a light layer of compost on the surface. A planting bed prepared this way is fine for transplants or planting large seeded crops such as corn, squash or beans, but is too rough for smaller seeds (like lettuce and carrots) that need a finer seed bed. This system will still protect the soil through fall and winter but will save work the following spring.

Mowing Cover Crops

- When mowing annual or perennial cover crops, leave some areas unmowed to preserve established beneficial insect habitat.
- Mowing can help to maximize the availability of nitrogen accumulated by legume cover crop species by causing them to release the accumulated nitrogen load for other crops. If the soil has a lack of nitrogen, it helps to apply a light layer of compost before mowing.
- It's better to mow during cool, moist periods as nitrogen can be lost in appreciable amounts to the atmosphere as ammonia, nitrogen oxides, and molecular nitrogen. Dry conditions (low soil moisture, low humidity, wind, heat) increases the amount of ammonia produced to cause volatilization of nitrogen.
- Staggered, progressive mowing produces smaller amounts of organic material that decompose progressively, so less ammonia is produced to cause volatilization.
- If sprinkler irrigation is available it can be used to keep mowed cover crops moist as they decompose and reduce the volatilization of nitrogen.

Legumes and Nitrogen Fixation

Specific soil bacteria live in association with the roots of legumes. Through this mutually beneficial association, the bacteria provide the legumes with access to nitrogen in the air, while the legume roots provide nutrition to the bacteria. The captured nitrogen is stored in nodules on the roots. Whether the legumes are incorporated into the soil, killed by winter temperatures, or mowed and composted the nodules remain in the soil for other plants to use. Since nitrogen is an important food, this natural process adds plant food to the soil.

If you have not grown a specific legume in your soil before, it's beneficial to purchase specific legume inoculant bacteria when you purchase the legume seeds. The inoculant comes in the form of a dry powder that looks like fine compost and contains the symbiotic bacteria specific to that legume. You mix the powder with the seeds before sowing. Inoculants can be purchased where you buy legume cover crop seed and are a time dated product, so be sure to check the date on the package.

“Which cover crop should I grow?”

Cover crops serve many purposes, including protecting soil from erosion, preventing leaching of nutrients, fixing nitrogen and adding it to the soil, competing with weeds in a crop rotation, and habitat for beneficials. However, no single cover crop will serve all situations.

To begin answering the question of which cover crop to grow, first identify the most important objective you have for cover cropping. All of the benefits of cover crops are appealing, but you must set priorities. For example, a cover crop that fixes a great deal of nitrogen may fail to prevent leaching of nutrients already present in the soil. Farmers and gardeners who use a lot of composted manure may have plenty of nitrogen already, so the concern would be not to lose it. In this case, the best choice would be a grass like winter rye that can take up the nitrogen and turn it into increased biomass. An important consideration in choosing a cover crop is whether the particular cover crop is one that will do well in your locale.

Example Rotations Using Cover Crops

onions → potatoes → carrots → brassicas → fava beans and vetch → winter rye

This is a simple rotation, but probably pretty effective. The crops are in a good sequence in terms of weed control, because each vegetable crop requires a different cultivation timing. This rotation is dependent on composted manure or compost added to the soil. The legume mix, when cut and left to decompose on the soil as a mulch, or turned into the soil, helps increase nitrogen and provides some benefit in terms of replacing organic matter used up in growing the vegetable crops. The cover crop also gives some weed control. The winter rye cover crop protects the soil and retains nutrients over the winter months.

oats and peas → beans → winter wheat → summer squash → winter rye, Austrian Winter peas, and vetch

This rotation provides an early spring cover crop that can be turned as in green manure before planting a summer crop. There is plenty of time to plant beans after turning in the cover crop and the beans are cultivated during the growing season for weed control. The winter wheat can be planted after bean harvest in the fall and turned in for organic matter in early spring. The wheat residue will have time to decompose in the soil before planting summer squash which will provide some weed control through cultivation and vining. Summer squash can be harvested in time for an early fall cover crop planting of winter rye, Austrian Winter peas, and vetch.

On a mixed crop and livestock operation where you want forage production in the rotation you could have:

oats and peas → beans → winter wheat → summer squash → oats and alfalfa

This rotation provides a cutting of hay in the early spring before ploughdown for green manure. Beans are grown as a cash crop and provide cultivation for weed control in the se-

quence. The winter wheat can be planted after bean harvest in the late fall and grazed once in the early spring before ploughing in for organic matter. The wheat residue will have time to decompose in the soil before planting a cash crop of summer squash which will provide some weed control through cultivation and vining. Summer squash can be harvested in time for an early fall permanent pasture planting of alfalfa with a nurse crop of oats. The oats can be harvested before winter for hay or feed, depending on the season. This rotation could also be used in the preparation of land for an orchard or vineyard, ending with the permanent cover crop which could be a combination of grass and alfalfa or clover or just clover.

These examples are just a few examples in a wide range of possibilities. The limiting factors are climate, soil, equipment, labor, and the imagination of the farmer or gardener.

SOME EXAMPLES OF COVER CROPS for GARDEN, FARM, & ORCHARD

LEGUMES

New Zealand White clover or White Dutch Clover (*Trifolium fragiferum*) perennial

- New Zealand variety is more heat and alkaline soil tolerant. Both white clovers make an excellent low-growing cover for use as a "living mulch" with vegetable row crops, in orchards and vineyards. For this purpose, New Zealand White clover can be intersown with Strawberry clover to make a more diverse bee forage and beneficial insect habitat.
- Shade tolerant species
- Low-growing 8"-10"
- Sow in spring, 1-2 lbs. per 1,000 sq. ft.

Salina Strawberry clover (*Trifolium fragiferum*) perennial

- Drought and alkaline tolerant. Can also tolerate standing water.
- Low growing, so it's useful as an understory or living mulch crop.
- Makes a sod-like cover which has resistance to foot traffic making it a good choice for paths between growing beds.
- Sow in spring, 1-2 lbs. per 1,000 sq. ft.

Purple Prairie Clover (*Petalostemum purpureum*) perennial

- A very drought tolerant, nitrogen-fixing native plant. Good for long-term or permanent cover crop.
- Provides nectar and habitat for beneficial insects like Trichogramma wasps.
- Sow anytime except for 2 months before first frost. 2 lbs. per 1,000 sq. ft.

Sainfoin (*Onobrychis viciaefolia*) perennial

- Widely used in France and England, and in part of the U.S. as a hay and "no bloat" grazing plant. It is the source of a very light, delicate honey. The name literally means "healthy hay."
- A long-lived, deep rooted perennial native of western Asia and the Balkans. Grows to a height of about 3' to 4'.
- Renumex is a variety that is specifically selected for New Mexico.

- Sow in fall, 20 lbs. per acre with a companion crop (grass), 40 lbs per acre without a companion crop

Alfalfa (*Medicago sativa*) perennial

- A long-lived, deep-rooted hay crop. Grows to a height of about 3' to 4'.
- Sow in spring, 5-10 lbs per acre with a companion crop (oats) or 8-10 lbs per acre without a companion crop

Red Kenland Clover (*Trifolium pratense*) reseeding annual

- Very good bee forage and beneficial insect habitat
- The blossoms are medicinal and edible
- Cold tolerant to 0°F and grows to 18". Widely adaptable to many soil types, especially those high in calcium. Not tolerant of poorly drained soils.
- Sow in fall or spring, 1 lb. per 1,000 sq. ft.

Hykon Rose Clover (*Trifolium hirtum*) reseeding annual

- The rose colored blossoms are very attractive to bees and beneficial insects.
- Can thrive on poor, rocky soils and with moderate irrigation or rainfall.
- Grows to 18"
- Sow in early fall, 1 lb. per 1,000 sq. ft.

George Black Medic (*Medicago lupulino*) reseeding annual or perennial

- Native to Europe, temperate Asia, and East Africa
- 'George' black medic, distributed by Timeless Seeds and released by Montana State University, is the predominant cultivar in the Western U.S.
- Shade intolerant, cold tolerant. Grows to 24".
- Does best on fertile, calcareous soils.
- Sow at 6-10 lbs per acre in late summer or early fall.

Vetch (*Vicia spp.*) annual

- Many varieties, including Hairy (*Vicia villosa*), Common (*Vicia sativa*), and Purple (*Vicia atropurpurea*)
- Excellent nectar source for beneficial insects and pollinators.
- Short-term legume green manure for nitrogen fixation, so it's good in a garden rotation.
- Sow in spring or late summer.
- A good mixture to sow in spring-summer is with rye or oats.
- When sown in late summer, regrowth in spring is vigorous and the plants produce a lot of nitrogen, for tilling in before planting spring garden crops.
- 1 lb. per 1,000 sq. ft.

Field Peas (*Pisum sativum*) annual

- Austrian Winter peas, Trapper, and Maple peas are good varietal choices.
- Legume green manure for nitrogen fixation with vigorous early spring growth.
- Sow in early spring. 1-4 lbs. per 1,000 sq. ft.

Cowpeas (*Vigna unguiculata* and *Vigna* spp.) annual

- Many varieties, some are native.
- Good in combination with buckwheat for a summer cover crop.
- Sow after danger of frost and soil is warm, 2-4 lbs. per acre.

Fava Beans (*Vicia faba*) annual

- There are numerous varieties that can be used. Bell Beans are a small fava used specifically for cover cropping.
- Fixes nitrogen. Grows 3 to 6' tall.
- Plant in spring, 2-4 lbs. per 1,000 sq. ft.

GRASSES

Winter Wheat (*Triticum* spp.) annual

- Good cover crop and winter soil stabilizer. Germinates in the fall and lies dormant in the winter.
- Sow in early fall, 2 lbs. per 1,000 sq. ft.

Winter Rye (*Secale cereale*) annual

- A very productive plant tolerant of poor soils. Stays green in winter.
- Provides very good weed competition.
- Till in before the stems grow stiff and difficult to till.
- Sow in fall, 2 lbs. per 1,000 sq. ft.

Oats (*Avena sativa*) annual

- Red and white varieties work equally well.
- Suppresses weeds by an excretion from its roots.
- Vigorous and fast growing cover crop.
- In an organic system, oats are managed as a light feeder and can be used as a nurse crop to establish a clover or legume crop.
- For soil protection that will winter kill.
- Sow in spring or summer, 2 1/2 lbs. per 1,000 sq. ft.

Barley (*Hordeum vulgare*) annual

- Does well in dry, cool, or poor soils.
- For soil protection that will winter kill.
- In an organic system, spring barley is managed as a light feeder and can be used as a nurse crop to establish a clover or legume crop.
- Sow in fall or early spring, 2 1/2 lbs. per 1,000 sq. ft.

OTHER

Buckwheat (*Fagopyrum esculentum*) annual

- Warm-season cover crop.
- An aggressive plant that assists in weed control, builds and loosens soil.

- Tolerates poor soil. Buckwheat's ability to use phosphate unavailable to other crops, thereby increasing the amount of phosphorus available to following crops, is one of the reasons it is useful as a green manure.
- May be planted and turned under at least two times per season or mowed each time it flowers and turned under in September.
- Good bee forage.
- This plant needs warm soil to germinate, so sow in late spring or during summer
- 1-2 lbs. per 1,000 sq. ft.

Phacelia tanacetifolia ("bees friend")

- Bees very attracted to the blue flowers.
- Not winter hardy (winter kills at 20°).
- Broadleaf, cool-weather, fast-growing 2 - 3" annual.
- Excellent ability to accumulate and recycle excess nitrates and calcium.
- When planted at high seeding rates, it provides very good weed suppression and the succulent plant tissue is easy to incorporate into the soil.
- Plant in early fall, at 1/2 lb. per 1,000 sq. ft.

Lynda Prim
The Farm Connection
P.O. Box 477
Dixon, NM 87527
tel: 505-579-4386
email: lunalsfc@la-tierra.com