



CMG GardenNotes #244

Cover Crops and Green Manure Crops

Outline: Terms: Green Manure and Cover Crop, page 1
Why Is a Cover Crop Beneficial? page 1
Why Is a Green Manure Crop Beneficial? page 2
Basic Recipes for Cover Crops and Green Manure Crops in the Garden, page 2
Spring-Planted, page 3
Fall-Planted for Spring Till, page 3
Landscape Uses, page 3
Establishment and Care, page 4
Choosing a Cover Crop for Colorado, page 4

Terms: Green Manure and Cover Crop

A **cover crop** is a vegetative cover used to improve soil health, erosion or degradation in quality that is seeded annually in a garden or field. Cover crops can include grasses, legumes, or herbaceous plants. When the cover crop is tilled into the soil it is referred to as a **green manure** crop. These two terms are often used interchangeably.

Why Is a Cover Crop Beneficial?

Cover crops can protect the soil from wind and water erosion, suppress weeds, fix atmospheric nitrogen, build soil structure, and reduce insect pests.

Erosion Protection – The primary erosive force for Colorado is wind. Winter winds are especially destructive, carrying away small particles of topsoil from the soil surface. Another source of erosion can be from water movement, especially on sloped surfaces without much vegetative cover to hold the soil in place. A thick stand of a cover crop protects the soil surface from wind erosion and the cover crop's roots hold soil in place against water erosion during heavy downpours.

Weed Suppression – Cover crops left in place for all, or part, of a growing season can suppress most annual and some perennial weeds. Among the grasses, annual rye has allelopathic properties that prevent weed seeds from germinating and suppresses weed seedlings around the root zone of the rye.

Nitrogen Fixation – Legumes, inoculated with their specific Rhizobium bacteria, will take nitrogen out of the air (present in the soil), and store it in their plant tissues via nodules on the roots of the legume. This is a symbiotic relationship, as the bacteria uses the plant's sugar in return for nitrogen. Some of this nitrogen is available as roots die, but the majority becomes available when the legume is tilled under as green manure.

Soil Structure Creation – Plant roots exude a sticky substance that glues soil particles together, creating structure. Grasses are exceptional in their ability to do this.

Insect Pest Reduction – Cover crops encourage beneficial insect populations, often minimizing or eliminating the need for other insect control measures when cover crops are in place.

Why Is a Green Manure Crop Beneficial?

The use of green manure enhances soil fertility and soil structure by feeding soil organisms and gluing together soil particles into aggregates.

Soil Fertility – When fresh plant material decomposes in the soil, its carbon-to-nitrogen ratio becomes low, allowing the nitrogen to be easily released into the soil chemistry by bacteria. **Table 1** shows how nitrogen accumulation is greater with legumes, which have nitrogen-fixing Rhizobium bacteria growing in nodules on the legume roots. Notice the lower figure for rye.

Table 1. Nitrogen Accrue ment of Selected Cover Crops	
Cover Crop	Nitrogen Accrue ment *
Hairy Vetch	3.2 lbs./1000 ft ²
Crimson Clover	2.6 lbs./1000 ft ²
Austrian Winter Pea	3.3 lbs./1000 ft ²
Winter (Annual) Rye	2.0 lbs./1000 ft ²
* Nitrogen accumulated in growing crop prior to tilling under. Source: ATTRA: Overview of Cover Crops and Green Manures.	

Table 2 shows values of nitrogen fixation for legumes. Rates vary due to differences in the activity level of the Rhizobium bacteria.

Table 2. Potential Nitrogen Fixation Rates of Selected Legumes for Colorado	
Legume Crop	Pounds N per 100 ft ²
Crimson Clover	1.6-3.0
Field Peas	2.0-3.4
Hairy Vetch	2.0-4.6
Medics	1.1-2.8
Red Clover	1.6-3.4
Sweet Clover	2.0-3.9
White Clover	1.8-4.6
Source: <i>Managing Cover Crops Profitability</i> , Sustainable Agriculture Network	

Soil Structure – Microorganisms decomposing plant material and the plant material itself produce substances that glue soil particles together. These substances include slime, mucus, and fungal mycelia, which contain gums, waxes, and resins. These are aggregate soil particles, thereby enhancing the tilth, porosity, and water holding capacity.

Basic Recipes for Cover Crops and Green Manure Crops in the Garden

Spring-Planted

Most gardeners do not have enough area to surrender the space to a cover crop for an entire growing season. However, if you do, a spring seeded clover would give your soil a great boost. Some seed companies will “rhizo-coat” seed with the specific Rhizobium bacteria or apply

Rhizobium as specified on the bag. Rhizobium comes in a black powder specific to the species of clover and has a definite shelf life, so check the expiration date. To apply, you would broadcast the seed-Rhizobium mix at a specified rate after the last frost has passed using either a handheld broadcaster or other broadcasting method. The mixture should be applied to a loose seedbed and shallowly incorporated and watered consistently, until germination and seedling growth have occurred. Monitor water as you would in a lawn.

Till the cover crop under at least two weeks prior to planting. Decomposing plant material consumes soil oxygen and can create plant health problems if not tilled in ahead of time. More than one tilling may be necessary to get an acceptable kill of the clover.

Fall-Planted for Spring Till

Most will opt for a fall cover crop that is then tilled under as a spring green manure. Seeding dates for fall planted cover crops should be done by mid-October. Mid-September is ideal for the Colorado Front Range and the western valleys. In mountain elevations, plant in August or earlier. A rye-Austrian winter pea or rye-hairy vetch mixture will overwinter in Colorado. Hairy vetch is hardier than winter pea. Rye is extremely winter hardy.

Newer winter cover crops include Daikon radish, tillage radish, and turnips. There are many cover crop mixes available as well, usually referred to by the number or species per mix (for example, a 3-way mix). Prepare as above and broadcast at the rates in **Table 3**.

Table 3. Seeding Rates for Selected Winter Cover Crops		
Cover Crop	Ounces per 100 Square Feet	Pounds per 1000 Square Feet
Winter Rye	4-6	2.5-3.75
Austrian Winter Pea	4-6	2-4
Hairy Vetch	2-3	1-2
Radish, Daikon	-	8-12 lbs./acre
Source: <i>Managing Cover Crops Profitability</i> , Sustainable Agriculture Network		

Over-wintered cover crops become readily available salad-bar to geese and deer when other food resources are scarce. A cover crop that is well established prior to winter temperature extremes should rebound from wildlife grazing in late winter/early spring.

Till the cover crop in mechanically or turn it under with a spade one month before you plan to plant to seed into that area. Decomposing plant material consumes soil oxygen and can create plant health problems if not tilled in ahead of time.

Landscape Uses

Bare soil presents erosion and aesthetic issues. During droughty periods, watering restrictions and the lack of natural precipitation may make plants or turf establishment difficult or impossible. A temporary cover crop or long-term xeric grass may be the answer. In this scenario, the homeowner must understand that a cover crop will not look or feel like a healthy Kentucky bluegrass lawn but should satisfy the need to cover the soil.

Establishment and Care

Before Seeding – Prepare a seedbed for fine grass seed, ideally amending the soil with compost and tilling as deeply as possible. If possible, fence off the area from traffic.

Seeding – Water the area prior to seeding, if possible, to establish ample soil moisture levels. Broadcast the correct number of seed per area onto a loosely tilled, fine (no soil pieces bigger than 1/4 inch) seedbed. Shallowly incorporate seed with garden rake (not a leaf rake) to a depth of 1/4 to 3/4 inch deep.

For larger areas consider hydromulching the seed. This will save time and increase germination of seeds. When seed is applied with the mulch (hydroseeding) typically consists of applying a mixture of wood fiber, seed, fertilizer, and stabilizing emulsion with hydromulching equipment.

After Seeding – Consider laying a thin layer (<1” deep) of seed-free straw to hold in moisture and increase germination and survival of grass seedlings. Bird netting over the straw fastened to the ground with landscape fabric staples will keep the straw from blowing away.

Check moisture levels in the upper inch of soil at least every other day (soil should feel as moist as a wrung-out sponge) and water if necessary (and if possible).

Mowing – If necessary, mow as high as possible or use a weed eater to reduce the height or remove seed heads.

Removing Cover Crops – For most cover crops, either till under, mow and mulch heavily, or spray herbicide before it goes to seed.

Choosing a Cover Crop for Colorado

There are several options of cover crops for use in Colorado, however, they differ in their attributes and life cycles.

Cereal rye, winter wheat, and oats can all be grown as a thick mat to help prevent erosion and weed suppression. Oats will not survive the winter, whereas winter and cereal rye can be planted in the fall, overwinter as dormant plants and begin growth again in the spring. This ability for cover crops like winter wheat or cereal rye to remain in place over many months makes them a good fit to use in conjunction with warm-season crops such as tomatoes. This is done by removing the cover crop just prior to planting and seeding it again in the fall once the warm season crops are finished for the summer season.

Clovers can be used for cover-crops as they are readily available, easy to grow and add nitrogen to the soil through nitrogen fixation. Many species are cold-tolerant and will survive a mild winter, however red and crimson clover have low survivability with Colorado winters. Avoid white clover as a perennial crop as it is difficult to remove.

Buckwheat and rapeseed are both broadleaf cover crops that grow well in warmer temperatures and are effective at weed suppression. However, it is very important not to allow flowering or seed set of these crops, as they are very prolific with hundreds of seedlings emerging from dropped seed. Rapeseed is moderately cold hardy and may survive a mild winter, whereas buckwheat has no frost tolerance.

Alfalfa and hairy vetch also fix nitrogen and will survive our Colorado winters and regrow with warmer spring temperatures. However, alfalfa is a high-water crop with complex management needs

and is also difficult to remove due to being a deep-rooted perennial. Hairy vetch should be terminated prior to setting flowers to prevent it from becoming weedy.

Peas and beans are another type of legume that fixes nitrogen and can be used as cover crops. In addition, they can be grown as green manures or edible crops by harvesting the pods and turning under the plants. Most will not survive Colorado winters.

Authors: Adrian Card, CSU Extension; David Whiting, CSU Extension, retired; Carl Wilson, CSU Extension, retired; and Jean Reeder, Ph.D., USDA-ARS retired. Revised October 2015 by Susan Carter, CSU Extension. Reviewed August 2023 by Amy Lentz, CSU Extension.

- Colorado Master Gardener GardenNotes are available online at <https://cmg.extension.colostate.edu/>.
- No endorsement is intended of products mentioned, nor is criticism implied of products not mentioned.
- Copyright Colorado State University Extension. All Rights Reserved. CMG GardenNotes may be reproduced, without change or additions, for nonprofit educational use with attribution.
- Colorado State University, U.S. Department of Agriculture, and cooperating Colorado counties.

Colorado State University Extension is an equal opportunity provider.

Colorado State University does not discriminate on the basis of disability and is committed to providing reasonable accommodations.

CSU's Office of Engagement and Extension ensures meaningful access and equal opportunities to participate to individuals whose first language is not English.

<https://col.st/OWMJA>

Colorado State University Extension es un proveedor que ofrece igualdad de oportunidades.

Colorado State University no discrimina por motivos de discapacidad y se compromete a proporcionar adaptaciones razonables.

Office of Engagement and Extension de CSU garantiza acceso significativo e igualdad de oportunidades para participar a las personas quienes su primer idioma no es el inglés.

Reviewed August 2023