

# Cover Crops and Crop Rotation

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## Cover Crops

### How Cover Crops Improve the Soil

- o Increase soil organic matter through additions of plant biomass.
- o Form soil aggregates, which stabilize soil and reduce runoff and erosion.
- o Increase soil porosity and decrease soil bulk density to promote root growth.
- o Improve soil tilth, which reduces crusting and increases the rate of water infiltration.
- o Encourage populations of soil microbes, micro- and macro-arthropods and earthworms, all of which contribute to efficient nutrient cycling and improvements in soil structure.

### Legumes and Nitrogen (N) Fixation

Rhizobium bacteria

Inoculate or not? Need to inoculate with:

- o Fresh inoculant
- o Correct rhizobia species for the crop
- o Good source:

Becker Underwood

801 Dayton Avenue

Ames, Iowa 50010

515.232.5907

[www.beckerunderwood.com](http://www.beckerunderwood.com)

Check your nodules to see if they are fixing nitrogen: slice the root nodule in half with your thumbnail; the inside should be purple

Maximum N at about 1/2 bloom

o Types of Cover Crops

- Annuals: Winter and Summer
- Biennials
- Perennials: Long and Short Term

- Legumes
- Grasses
- Brassicas

**Combinations are best:**

o Winter Annual Cover Crops

- Legumes: Crimson Clover, Hairy Vetch, Winter Peas, Red Clover
- Brassicas: Rapeseed, Mustards, Radishes (oil seed and forage)
- Grasses: Rye (grain), Oats, Wheat, Triticale, Barley

o Summer Annual Cover Crops

- Legumes: Soybeans, Cowpeas, Velvet bean, Sun hemp
- Grasses: Sorghum-Sudan grass, Millets,
- Buckwheat

o Biennial and Perennial Cover Crops

- Legumes: Sweet Clover, White Clover, Lespedezas
- Grasses: Fescues, Perennial Rye grass, Orchard grass, Bermuda grass

**Additional Notes:**

- Long term perennial cover crops can be used with small fruits or in an orchard
- Common mixes: grain rye and hairy vetch, crimson clover and oats, soybeans and Sudan grass, cowpeas and millet
- If a fall cash crop follows the summer cover, millet doesn't get woody like Sudan grass does
- Hairy vetch and crimson clover are the easiest
- Grain rye is number one winter biomass producer, oats is second
- Mustards have nematicidal properties
- Black oats or a late planting of millet are good candidates for intentional cover crop winterkill
- Buckwheat is good for honeybees and other beneficials
- When sudangrass reaches 18-36", mow it to encourage deeper rooting
- Rotate your cover crops too
- Rotate turkeys in: they love soybeans and cowpeas, supply 1000 pounds of manure per acre per year
- Lespedeza germinates in late winter and early spring; Alex is working with it in asparagus

Incorporates cover crops with a flail mower and disc

## Crop Rotations

- o the most important pest management tool
- o hand in hand with Soil Fertility
- o diversity is the key ingredient
- o include cover crops, animals (pastures), perennial crops and rest periods in planning

“From his experience as a researcher at Rutgers, Firmin Bear stated that well-thought-out crop rotation is worth 75 percent of everything else that might be done, including fertilization, tillage, and pest control. Rarely are all principles of crop rotation applied as thoroughly as they might be in order to garner all of their potential benefits.

To my mind, crop rotation is the most important practice in a multiple-cropping program.”

--Eliot Coleman

### **What is crop rotation?**

A planned system of growing different kinds of crops in recurrent succession on the same piece of land. Generally the aim is to plant crops that are not related botanically, do not share the same nutrient requirements, and do not share the same pest problems. Rotation is both spatial (crops move over an area) and temporal (crops change over time)

### **Why is crop rotation important?**

Crop rotation is planned diversity, which provides stability to biological systems.

Rotation breaks up disease, weed, and insect life cycles by spacing susceptible crops at intervals sufficient to hinder the buildup of their specific pest organisms. Rotation encourages better use of soil nutrients and amendments.

### **Possible benefits (per Eliot Coleman)**

- o Increase in soil nitrogen
- o Improvement in the physical condition of the soil
- o Increased bacterial activity
- o Increased release of carbon dioxide
- o Excretion of beneficial substances
- o Control of weeds, insects, disease

### **Possible deleterious effects of preceding crops:**

- o Depletion of soil nutrients
- o Excretion of toxic substances
- o Increase in soil acidity
- o Production of injurious substances resulting from decomposition of plant residue
- o Unfavorable physical condition of the soil due to a shallow-rooting crop
- o Lack of proper soil aeration
- o Removal of moisture
- o Diseases passed to subsequent crops
- o Influences of crops upon the soil flora and fauna

### Three types of rotations:

- o Cash crop based
- o Cover crop based
- o Nutrient based--roots-shoots-leaves have different nutrient needs

### Guidelines for Rotation

- o Separate similar crops or families of crops as much as possible

*Apiaceae* (Carrot Family): carrot, parsnip, parsley, celery

*Asteraceae* (Sunflower Family): lettuce, endive, radicchio

*Brassicaceae* (Mustard Family): cabbage, broccoli, cauliflower, Brussels sprouts, kohlrabi, turnip, radish, Chinese cabbage, kale, collards, rutabaga

*Chenopodiaceae* (Goosefoot Family): beet, Swiss chard, spinach

*Convolvulaceae* (Bindweed Family): sweet potato

*Cucurbitaceae* (Gourd Family): cucumber, muskmelon, watermelon, squash, pumpkin, gourd

*Fabaceae* (Pea Family): garden pea, snap bean, lima bean, soybean

*Liliaceae* (Onion Family): onion, garlic, leek, shallot, chive

*Malvaceae* (Mallow Family): okra

*Poaceae* (Grass Family): sweet corn, popcorn, ornamental corn

*Solanaceae* (Nightshade Family): tomato, pepper, eggplant, potato, husk tomato

- o Alternate cover crops

- legumes/grasses
- cool-season/warm-season

- o Alternate heavy feeders with light feeders

- Heavy feeders: broccoli, Brussels sprouts, cabbage, cauliflower, celery, collards, corn, cucumbers, eggplant, endive, escarole, kale, kohlrabi, lettuce, okra, onions, parsley, pumpkins, rhubarb, spinach, squash, tomatoes
- Light feeders: beets, carrots, garlic, leeks, mustard, parsnips, potatoes, radishes, rutabagas, shallots, sweet potatoes, Swiss chard, turnips
- Soil builders: alfalfa, broad beans, clover, lima beans, peanuts, peas, snap beans, soybeans, vetch

- o Alternate flowering crops with vegetative crops

- o Place crops with different canopy heights next to each other

- o Alternate cool season crops with warm season crops

- o Be mindful of the allelopathic effects of certain crops

- o Alternate deep-rooted crops with shallow-rooted crops

- Shallow-rooted crops are those whose main root system is in the top 1-2 feet of soil. Examples are cabbage, cauliflower, lettuce, celery, sweet corn, onion, white potato, and radish.
- Moderately deep-rooted crops are those that have the main root system in the top 1-4 feet of soil. Examples are snap bean, carrot, cucumber, eggplant, peas, pepper, and summer squash.

- Deep-rooted crops are those whose main root system is in the top 1-6 feet of soil. Examples are cantaloupe, pumpkin, tomato, and watermelon.

### **Suggestions, Hints and Refinements**

Observe and record the good and bad effects from your rotation strategies. Coleman noted certain patterns from his readings and experience:

- Legumes are generally beneficial preceding crops;
- The onions, lettuces, and squashes are generally beneficial preceding crops;
- Potato yields best after corn;
- For potatoes, some preceding crops (peas, oats, and barley) increase the incidence of scab, whereas others (soybeans) decrease it significantly;
- Corn and beans are not greatly influenced in any detrimental way by the preceding crop;
- Liming and manuring ameliorate, but do not totally overcome, the negative effects of a preceding crop;
- Members of the chicory family (endive, radicchio, etc.) are beneficial to following crops;
- Onions are often not helped when they follow a leguminous green manure;
- Carrots, beets, and cabbages are generally detrimental to subsequent crops;

“...the rotation guidelines...qualify under the category of standard crop rotation ‘rules,’ the patterns above belong more in the category of ‘suggestions, hints, and refinements.’ The effect of any of them on improved yield, growth, and vigor may only be 1 percent, an amount that may not seem worth considering to some. What must be understood is that a biological system can be constantly adjusted by a lot of small improvements. I call them one percenters.’ *The importance of these one percenters is that they are cumulative.* If the grower pays attention to enough of them, the result will be substantial *overall* improvement.”

--Eliot Coleman

### **Tips to make it easier to live with a rotation:**

“A rotation that really suits your farm will create a structure that actually allows for a lot of options and flexibility. What’s really remarkable is how many aspects of a market garden can be rotated and integrated in an organized fashion.”

--Anne and Eric Nordell, Beech Grove Farm, Pennsylvania

- o Make rotational units (blocks/sections/fields) the same size if possible, with the size large enough to hold either the crop with the most space/production requirements or half of it
- o If the rotational unit is not filled with cash crops then grow a cover crop
- o Allow for expansion
- o You can have more than one rotation scheme on a farm (hoophouses, field crops)
- o Try and have rotational units with crops going in at the same time and coming out at the same time to better accommodate planting and turning under of cover crops
- o Try and group crops with similar cultural requirements (weeding, irrigation, etc.)
- o Maintain good records of your crop rotation plans!

“Although vegetable crop rotations are unlikely to be fulfilled *exactly* as planned, it is still advisable to develop a written plan and to follow it up by writing down what was actually planted where. Such recordkeeping is key to improving rotations over time, since it helps track what worked and what didn’t)--information that should be the basis of future plans.”

--Vernon Grubinger

- o Rotate with livestock and perennials, moving animals annually through cropping fields.
- o Alternate annual production with several years in soil building perennials.

**Steps to Planning a Rotation:**

- o Identify all crops to be grown and expected acreage requirements
- o Using the guidelines from above group crops based on botanical family, production practices, pest complex, or other features
- o Define the size of the rotational unit
- o Determine the land area (number of rotational units) needed for each grouping of crops
- o Use 3x5 note cards with different crops on each card to visualize the rotation

“Time spent planning a rotation is never wasted. Not only will you learn a great deal about important biological balances on the farm, but the results will be so effective in halting problems before they occur that you may sometimes have to remind yourself that a lot is happening. Very often farmers fail to take full advantage of a well-planned rotation, because rotations don’t have any computable costs and because they work so well at preventing problems that farmers are not aware of all the benefits. Those benefits are, in a sense, invisible.”

--Eliot Coleman