Fitting Cover Crops into Mixed Vegetable Operations

Focus on green manure crop management practices

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COOPERATIVE EXTENSION SYSTEM

College of Agriculture and Natural Resources

NEW ENTRY SUSTAINABLE FARMING PROJECT

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In the dark of the moon, in flying snow, in the dead of winter,

war spreading, families dying, the world in danger,

I walk the rocky hillside, sowing clover.

-- Wendell Berry—

Organic matter and its influence on soil biology

The crops you grow, the roots they have, their yield, the portion of crop harvested, and how you treat crop residues will affect organic matter. Soil fertility itself will influence the amount of organic residues returned, since more fertile soils grow higher yielding crops i.e. they yield more residues.

The more residues your crops leave in your field, the greater the populations of soil organisms. Conventional tillage systems are aggressive and will decrease earthworm populations as well as other soil organisms. When rotations are more complex and include green manure cover crops you will increase soil biological diversity (& activity).

Cover Crop // Catch Crop // Green Manure

- Cover crops are grown for the purpose of protecting the soil during the time of year when soils would otherwise be bare.
- A catch crop is grown to retrieve available nutrients still in the soil following a cash crop & keeps them from being leached during winter.
- A crop grown to maintain or build soil organic matter and to add nitrogen (N) to the soil is called a green manure or a green manure cover crop.

Maintaining a diverse environment

- Where many different types of organisms coexist in the same area, there are fewer disease, insect, weed, and nematode problems. Diversity below the soil surface is as important as above ground.
- Growing cover crops and using crop rotations help maintain the diversity below ground. Adding manures and composts and making sure crop residues are returned to the soil are also important to promoting soil organism diversity.
- Soil organic matter hosts a universe of soil microorganisms including bacteria, fungi, algae, protozoa, nematodes and earthworms.

The special relationship of legumes to atmospheric nitrogen

- Some nitrogen-fixing bacteria form symbiotic or mutually beneficial relationships w/plants. Rhizobia bacteria live on nodules formed on the roots of legumes. These bacteria provide nitrogen in a form that leguminous plants can use while the legumes provide the bacteria w/sugars for energy.
- Rhizobia bacteria can “fix” hundreds of pounds of available nitrogen from the atmosphere/acre/year.
- Available fixed nitrogen varies among legume species. Some vetches and alfalfa can fix as many as a couple of hundred pounds of nitrogen/acre whereas beans and peas will fix about 40-50 pounds of nitrogen a year.

Nodules on the roots of a bell bean

DYNAMICS OF GRAIN/LEGUME COMBINATION

- Most grain crops will scavenge residual N in the soil root zone area & hold it over winter; legumes will fix N (convert atmospheric nitrogen) on legume plant root nodules. As grains shut off easily available N to legumes, the legume plant will work harder to fix additional N.
- If brought to full maturity, there will be a favorable C:N ratio for plant residue mineralization

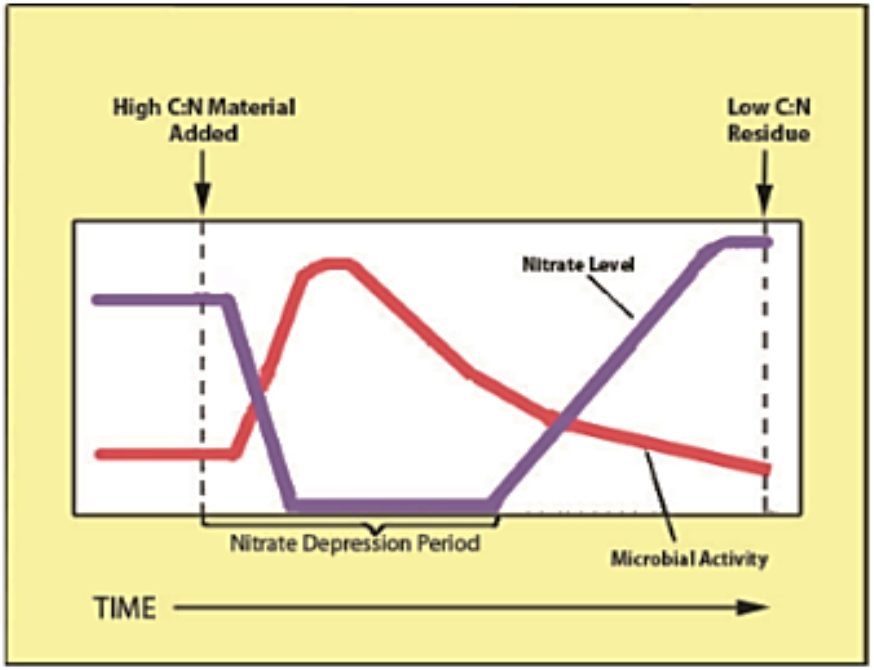


FIGURE 16
When fresh residues are added to the soil there is a rapid increase in microbial activity. If the residues have a high carbon to nitrogen ration (C:N), the microbes will take N from the soil, likely causing a deficiency. After the residues are decomposed, many of the microbes die and N is released from their bodies. This restores N to a level that is somewhat higher than it was originally, but crops could have suffered for a period.

Table 3. Typical carbon-to-nitrogen ratios of common materials.

Material	C:N
Legume hay	15-19:1
Non-legume hay	24-41:1
Corn stalks	42:1
Oat straw	70:1
Rye straw	82:1
Cow manure	8:1
Finished compost	17-20:1
Agricultural soils	10-12:1
Hardwood sawdust	500:1

Note: Straw, hay and corn stalks will have a lower C:N when green than when brown.

POSITIVE BENEFITS FROM GREEN MANURES

- Allelopathic effects on the weed seed bank
- Interuption of pest & disease cycles
- Elevated microbial activity in soils
- Positive effect on soil moisture conservation
- Legume family plants can fix anywhere between 50-300 lbs of N/acre
- Highly attractive to beneficial & pollinating insects

Establishing living mulch strips of medium red clover in harvest aisles of trellised tomatoes

Laying of plastic mulch on 12-foot centers

Tomatoes set into plastic mulch w/Rainflo transplanter

Oats spun into wide aisles between tomatoes

Covering broadcast oats w/cultivating baskets & Lely tines

Medium red clover seed; inoculate w/proper inoculant to insure vigorous growth of root nodules

Cultipacking broadcast clover & oats

Field view of tomato block w/seeded living mulch strips

Established tomato transplants w/living mulch aisles

Well established red clover perma-strips between rows of tomatoes (late August)

Biotello mulch & tomato residue disced; winter rye seeded onto bare soil

Full season fallow
with double green manure cover crop
of field peas (Maxum) & oats

Field pea seed

Individual pea tendril, sometimes called pea shoots in Asian stores

Direct seeded spring greens following field pea/oats fallow previous year

Late August – early September sowing of hairy vetch with winter rye

Overwintered stand of rye/hairy vetch; rye killed by mowing at pollen stage

Late August transplanted broccoli, undersown with winter rye mid-September

Larger plants late-September (rye well established)

Post-harvest December broccoli plants with well-established winter rye from mid-September under-sowing

Quick early spring cover crop of rye (April 1st) prior to winter squash transplants (tillage May 22nd)

Field ready for laying of plastic mulch following minimal tillage (June 7th)

A combine cuts down on cover crop seed purchase costs

Mid-June tillage of rye/vetch supports later season cash crops

Cutting strips in overwintered rye/hairy vetch to reduce field tillage & to provide straw mulch for direct seeded winter squash

Under sowing of medium red clover
into 10-foot center spacing of winter squash

Medium red clover 2nd year, early June

Overwintered medium red clover utilized as living mulch strips in tomatoes

Manage weeds w/mower set at tops of clover but under grass seed heads

Cutting strips into overwintered rye/vetch to inhibit 1st generation of Colorado potato beetles

As potatoes are harvested, red clover migrates into bare soils, providing a good fall cover that will overwinter.

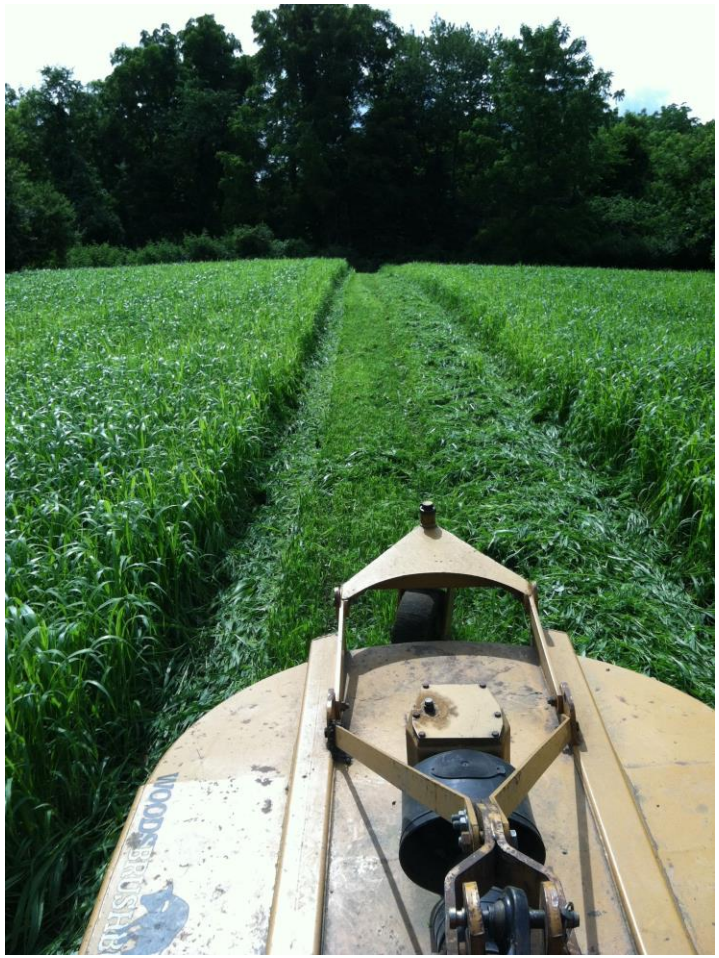
Sudan grass

for building soil organic matter &

for suppressing annual summer weeds

Sudan grass seed

Mowing stimulates root mass & keeps Sudan grass residue more manageable for tillage



Under sowing medium red clover prior to last mowing of Sudan grass

Buckwheat, fast growing
mid-summer smother crop &
attractant to bees & other beneficial insects

Buckwheat insectary strip in Brussels sprouts

Table 3. Top Cover Crop and Legume Species for Bees on CT Vegetable Farms.

Several of these plants are considered weeds in some situations, and crown vetch is listed as an invasive plant in many states.

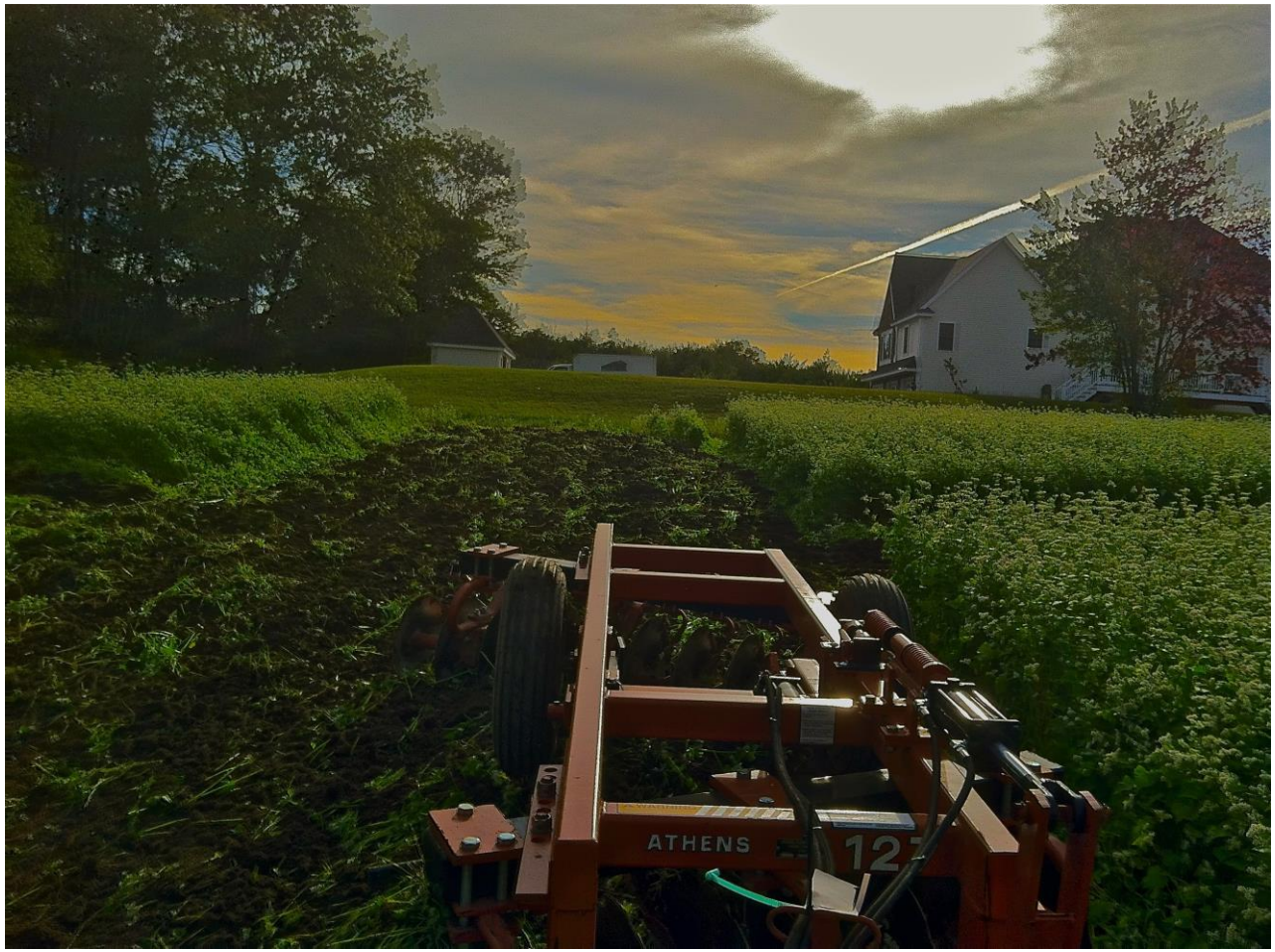
The plant family Fabaceae used to be called Leguminoseae.

Listed in order from highest to lowest number of bees per minute of observation. Plants blooming longer may be visited by more total bees than those with high bees per minute but a short period of bloom.

Common Name	Scientific name	Primary bee category	U.S. Native or Intro-duced	Plant family	Perennial Annual, or Biennial	May	Jun	July	Aug	Sept	Oct
Buckwheat	*Fagopyrum esculentum*	HB	I	Polygonaceae	A		X	X	X	X	
Alfalfa	*Medicago sativa*	BB	I	Fabaceae	P			X			
Crimson Clover	*Trifolium incarnatum*	HB	I	Fabaceae	B	X					
Bird Vetch, Cow Vetch	*Vicia cracca*	BB	I	Fabaceae	B/P		X				
Alsike Clover	*Trifolium hybridum*	BB,HB	I	Fabaceae	P	X	X	X	X		
White Clover	*Trifolium repens*	BB,HB	I	Fabaceae	P	X	X	X	X		
Hairy Vetch	*Vicia villosa*	BB	I	Fabaceae	B/P	X	X				
Crown Vetch	*Securigera varia*	BB	I	Fabaceae	P		X	X			
Red Clover	*Trifolium pratense*	BB	I	Fabaceae	P	X	X	X	X	X	X
Birds Foot Trefoil	*Lotus corniculata*	BB,HB	I	Fabaceae	P	X	X	X	X		

- Others sampled with low bee numbers: cowpea, yellow sweet clover
- HB = honey bee, BB = bumble bee, Other = other species of native bees. "BB,HB" means roughly equal numbers of bumble bees and honey bees.
- A = annual, P = perennial, B = biennial (or winter annual), B/P = perennial but usually grown as biennial (winter annual) cover crop in CT

Smother crop par excellence


ATHENS

Sainfoin (Onobrychis viciifolia) produces copious amounts of nectar & is highly attractive to pollinating insects. It is a premier legume for “monofloral” honey.

Brassica biofumigation
a bioremediation practice
to diminish soil diseases

Fumigant mustard (Caliente 199), April 2

Fumigant mustard, early June

Fumigant mustard June 19th

Important for the plants to be chopped to rupture plant cell walls & release active ingredients, then incorporated immediately to prevent loss to volatilization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JOHN DEERE
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The soil surface should be sealed by rolling a cultipacker, followed by irrigation

Culti-packers are important implements for aiding in the germination of tiny seed such as clover & alfalfa. They press the seed into the soil instead of burying it.


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Medium red clover more resilient to flood waters than winter rye and hairy vetch

Perma-strips in arid regions?

Black medic w/oats

Establishing medium red clover + repeated mowings to weaken areas w/heavy galinsoga weed pressure

The End