Organic Vegetable Gardening

*Cover Crops*

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OUTLINE

- Overview of topics of noontime talks on organic vegetable gardening
- Introduction to organic vegetable gardening
- Cover Crops: concepts and applications
Topics of Noontime Talks for Organic Vegetable Gardening

- Introduction (Nov 23, 2011)
- Edible Flowers (Dec 7, 2011)
- Container Gardening (Dec 21, 2011)
- Worm Composting (Jan 4, 2012)
- Frost Protection (Jan 11, 2012)
- Composting – Part 1 (Jan 25, 2012)
- Transplants (Feb 8, 2012)
Topics of Noontime Talks for Organic Vegetable Gardening

• Composting – Part 2 (Feb 22, 2012)
• Irrigation (March 14, 2012)
• Raising Honey Bees (March 28, 2012)
• Companion Planting (April 11, 2012)
• Cover Crops (April 25, 2012)
• Attracting Beneficial Insects (June 13, 2012)
• Fruit Tree Gardening (June 27, 2012)
Goals for Noontime Talks on Organic Vegetable Gardening

– Food for your freshest nutrition
– Food for expanding benefits of backyard vegetable gardening
– Food for thought
– Food for your soul
Approach of Noontime Talks on Organic Vegetable Gardening

• Promote the practice of the guidelines in the reference “Vegetable Gardening in Florida” by James M. Stephens. 1999. Univ. of FL, IFAS

• Provide background information on the science and principles from agroecology for successful organic vegetable gardening.

• Provide additional resources available for successful organic vegetable gardening.
• Available from UF/IFAS bookstore, see http://ifasbooks.ufl.edu/merchant2/
  Also available from your favorite book vender.
Agroecosystem Concept

- An approach that looks at your vegetable garden as a functional whole of interacting living and non living components, i.e. “whole is more than sum of parts”

- A science-based management using models from natural ecosystems

Three processes connect all the parts of the ecosystem:

- Energy Flow is the "power" of the system
- Water Cycling
- Nutrient Cycling are the movements of the elements and compounds that plants and animals need to live and grow.
• Garden agroecosystems have functional properties & subsystems from **biodiversity management**
Cover Crops

• Use dates back over 2,500 years.
• Several ancient Greek and Roman sources suggest growing cover crops to produce green manure for vineyards and other crops.
• Use is critical for many Florida soils, especially for sandy soils which typically have low inherent soil fertility, do not retain much water or nutrients, and are often prone to excessive nutrient leaching losses.
Why Cover Crops?

- Reduces erosion
- Improves soil quality
- Minimizes nutrient loss
- Improves water quality
- Increases water infiltration and storage and reduces risk of short-term drought
- Reduces pests populations
- Supplies nitrogen from legumes
- Produce biomass for compost making
Cover crop as part of a system

- Choose cover crops to best fit desired purpose(s) and niche (window) in system.
- “Green manure” crop—cover crop or forage grown to incorporate into soil while green or flowering, to improve soil
- “Catch or “trap” crop—cover crops planted to reduce nutrient leaching following a main crop
- “Living mulch”—cover crop interplanted with vegetable crops
## Cover Crops Examples

### Table 1. Cover crops for use in Florida.

<table>
<thead>
<tr>
<th>Crop</th>
<th>Yield - Biomass (lbs/acre)</th>
<th>Yield - N (lbs/acre)</th>
<th>Seeding Date</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Annual Summer Cover Crops</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Leguminous Crops</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aeschynomene</td>
<td>2000 - 4000</td>
<td>50-100</td>
<td>Mar. 1 - June 30</td>
</tr>
<tr>
<td>Alyce clover</td>
<td>1500-3500</td>
<td>20-65</td>
<td>Mid April to late June</td>
</tr>
<tr>
<td>Cowpeas</td>
<td>4000 - 6000</td>
<td>50-90</td>
<td>April to August</td>
</tr>
<tr>
<td>Hairy Indigo</td>
<td>7 to 10 tons of greenchop/acre</td>
<td>80-150</td>
<td>Middle of March to May/June</td>
</tr>
<tr>
<td>Sesbania</td>
<td>2000-8000</td>
<td>35-80</td>
<td>Mar. 1 - July 15</td>
</tr>
<tr>
<td>Sunhemp</td>
<td>4500-10,000</td>
<td>90-180</td>
<td>Mar. 1 - June 30</td>
</tr>
<tr>
<td>Velvetbeans</td>
<td>2200 - 4000</td>
<td>50-85</td>
<td>Mar. 1 - June 30</td>
</tr>
<tr>
<td><strong>Grain Crops</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pearlmillet</td>
<td>6000-8000</td>
<td>55-70</td>
<td>Mid March to June in North Florida, earliest planting is April 1st.</td>
</tr>
<tr>
<td>Sorghum-sudan</td>
<td>6500-9500</td>
<td>55-80</td>
<td>Mar. 1 - June 30</td>
</tr>
</tbody>
</table>
# Cover Crops Examples

## Annual Winter Cover Crops

<table>
<thead>
<tr>
<th>Leguminous Crops</th>
<th>Annual Winter Cover Crops</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crimson Clover</td>
<td>1500-5000</td>
</tr>
<tr>
<td>Hairy Vetch</td>
<td>2000-4000</td>
</tr>
<tr>
<td>Lupine</td>
<td>2000-4500</td>
</tr>
</tbody>
</table>

| Grain crops            |                           |       |
|------------------------|---------------------------|
| Black oats             | 1500-3500                 | 20-40  | Oct. 1 - Nov. 15 |
| Winter rye             | 3000-6000                 | 30-50  | Oct. 15 - Nov. 15 |

## Perennial Cover Crops

| Leguminous Crops       |                           |       |
|------------------------|---------------------------|
| Rhizoma Peanut (living mulch) | 2000-10000 (12-months)     | 50-130 | Dec. to March |

| Perennial Grasses      |                           |       |
|------------------------|---------------------------|
| Bahiagrass             | 3000-8000                 | 55-140 | Jun to August (if rainfed) |
| Pangola digitgrass     | 4000-9000                 | 60-135 | Mar. 1 - Aug. 15 |
Cover Crops Examples

Hairy Vetch
Rye Winter Cover Crop
Crimson Clover
Perennial Peanut
Possible Groundcover or Living Mulch
Lupine
Sudax = hybrid of sorghum and sudangrass = looks like and used like Forage Sorghum
Sunn Hemp (*Crotalaria juncea*) as Summer Cover Crop

Excellent N source
Good biomass production
Reduces root-knot and other nematodes
Bush Velvetbean
Cowpea Cover Crop
Cowpea and Sunn Hemp Cover Crops
Green Manures

- Can add N from symbiotic nitrogen fixation for succeeding crops
- Plowed in while still green, at optimum C:N ratio
- Example sequence
  - Summer green manure
  - Cut and tilled in
  - Rye cover crop in winter
  - Cut and tilled in
Symbiotic Nitrogen Fixation

Nodules on legume roots

- N-fixing bacteria (e.g., *Rhizobium* species) infect roots of legumes & induce formation of specialized nodules.

- Benefit of this process is the transformation of atmospheric N to plant N, e.g., protein.

- Correlates with ‘high protein’ content of legumes.

Nodules with good N fixation activity have an internal red color due to leghaemoglobin.
Table 1. Average biomass yields and nitrogen yields of several legumes.

<table>
<thead>
<tr>
<th>Cover Crop</th>
<th>Biomass</th>
<th>Nitrogen</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Tons/acre</td>
<td>lbs./acre</td>
</tr>
<tr>
<td>Sweet clover</td>
<td>1.75</td>
<td>120</td>
</tr>
<tr>
<td>Berseem clover</td>
<td>1.1</td>
<td>70</td>
</tr>
<tr>
<td>Crimson clover</td>
<td>1.4</td>
<td>100</td>
</tr>
<tr>
<td>Hairy vetch</td>
<td>1.75</td>
<td>110</td>
</tr>
</tbody>
</table>

ATTRRA, 2003
Table 2. Distribution of plant nitrogen in legume tops and roots.

<table>
<thead>
<tr>
<th>Crop</th>
<th>Tops</th>
<th>Roots</th>
</tr>
</thead>
<tbody>
<tr>
<td>%N</td>
<td>%N</td>
<td></td>
</tr>
<tr>
<td>Soybeans</td>
<td>93</td>
<td>7</td>
</tr>
<tr>
<td>Vetch</td>
<td>89</td>
<td>11</td>
</tr>
<tr>
<td>Cowpeas</td>
<td>84</td>
<td>16</td>
</tr>
<tr>
<td>Red clover</td>
<td>68</td>
<td>32</td>
</tr>
<tr>
<td>Alfalfa</td>
<td>58</td>
<td>42</td>
</tr>
</tbody>
</table>

ATTRA, 2003
How to Estimate N from Cover Crops

1. **Yield (lb/acre) =** Total weight of dry sample (lb) \( \times \) 43,560 sq ft

\[
\frac{\text{Area sampled (sq ft)}}{1 \text{ acre}} = \text{Yield (lb/acre) \times 43,560 sq ft}
\]

2. **Estimate Nitrogen**

Total N (lb/acre) = Yield (from above) \( \times \) amount of N as a decimal (\( \frac{\%N}{100} \))

3. **Nitrogen Content of Cover Crops – Use the table values to estimate N.**

<table>
<thead>
<tr>
<th>Cover Crop Group</th>
<th>Percent (%) N at Cover Crop Growth Stage</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Before Flowering</td>
</tr>
<tr>
<td>Non – Woody Legumes</td>
<td>3.5 – 4.0</td>
</tr>
<tr>
<td>Woody Legumes</td>
<td>2.5 – 3.0</td>
</tr>
<tr>
<td>Cereal Grains and Others</td>
<td>2.0 – 3.0</td>
</tr>
</tbody>
</table>
Trap crops

• Amount of biomass produced is key to nutrient uptake—good stand, rapid growth

• Age/stage of plant when killed, determines N%, C:N, plant composition, and therefore decomposition rate (along with weather!)

Huge challenge!

• Non-legume examples: cereal rye, annual ryegrass, wheat, oats, barley
Cover crops, living mulches, and perennials can capture N left in the soil before it is lost.

Plants growing in the fall, winter, & spring

N remaining in the soil in the fall

N losses to tiles or groundwater
Cover Crops Retain N in the Soil

Figure 3. Effect of a cereal rye cover crop on soil nitrate concentrations (ppm) in broccoli plots fertilized the previous spring with 250 pounds N/acre. Samples were taken April 15, 1992. (Data from Hemphill and Hart, 1993.)

Using winter cover crops to reduce nitrate contamination of ground water requires the establishment of the crop early enough in the fall to have adequate growth during the fall and winter rains. Relay interplanting of the cover crop into the standing cash crop during the summer has shown promise in getting a crop well established by winter. Selection of fast-growing cultivars is also important.
Living Mulches

Benefits

- Suppress weeds in row middles
- Supply nitrogen to crop
- Reduce insect pests vs. plastic mulch
- Prevent sandblasting of transplants

Cabbage with Clover Living Mulch
For a long time, the visible part of the plant (shoot) was studied much more frequently than its hidden part (root).

Roots of cover crops also have system level benefits to crops.
Root-Based Benefits: Soil Tilth

Intensive tillage

Long term no-till (w/ healthy soil biology)

Plow pan

Network of biopores

Ontario Ministry of Ag and Food
Examples of Root Penetration of Compacted Soils Horizons

Canola root

17 July, Soybean root
Pest Control With Cover Crops

✓ Weed Control Examples

- A growing cover crop can suppress weeds in several ways:
  - Direct competition
  - Allelopathy—the release of plant growth-inhibiting substances
  - Blocking stimuli for weed seed germination
  - Altering soil microbial communities to put certain weeds at a disadvantage

- Terminated cover crops can prolonged weed suppression by:
  - Physically hindering seedling emergence
  - Releasing allelopathic substances during decomposition
  - Promoting fungi that are pathogenic to weed seedlings
  - Tying up nitrogen (N) (when low-N residues are incorporated into soil)

http://www.extension.org/pages/18524/how-cover-crops-suppress-weeds
Pest Control With Cover Crops

✓ Weed Control Examples

This buckwheat (left), planted immediately after a vegetable harvest, has nearly covered the ground within 15 days after planting (DAP). Pearl millet (right) has formed substantial biomass by 42 DAP and effectively crowded out most weeds.

http://www.extension.org/pages/18524/how-cover-crops-suppress-weeds
A cover crop biculture of grass–legume can compete more effectively against weeds than either component alone. In this mature winter cover crop, the cereal rye has permeated the topsoil with a dense fibrous root system and provided support for the hairy vetch, allowing the latter to grow more vigorously and cast dense shade on the soil surface.

http://www.extension.org/pages/18524/how-cover-crops-suppress-weeds
## Pest Control With Cover Crops

*✓ Nematode Pests of Vegetable Crops*

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### Table 1. List of plant parasitic nematode genera known to be of economic importance to vegetable crops in Florida.

<table>
<thead>
<tr>
<th>Nematode</th>
<th>Bean and Pea</th>
<th>Carrot</th>
<th>Celery</th>
<th>Crucifers</th>
<th>Cucurbits</th>
<th>Eggplant</th>
<th>Leaf Crops</th>
<th>Okra</th>
<th>Onion</th>
<th>Pepper</th>
<th>Potato</th>
<th>Sweet Corn</th>
<th>Sweet Potato</th>
<th>Tomato</th>
</tr>
</thead>
<tbody>
<tr>
<td>Root Knot</td>
<td>X</td>
<td></td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sting</td>
<td>X</td>
<td></td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
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<tr>
<td>Stubby Root</td>
<td>X</td>
<td></td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Root Lesion</td>
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<td></td>
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<tr>
<td>Cyst</td>
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<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Awi</td>
<td>X</td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Stunt</td>
<td></td>
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<td></td>
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<tr>
<td>Lance</td>
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<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Reniform</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

[http://edis.ifas.ufl.edu/ng005](http://edis.ifas.ufl.edu/ng005)
### Table 2. Effects of some cover crops on nematodes important as plant pests in Florida.

<table>
<thead>
<tr>
<th>Plant Species</th>
<th>Nematodes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Root-knot*</td>
</tr>
<tr>
<td>Bermudagrass, <em>Cynodon dactylon</em></td>
<td>G</td>
</tr>
<tr>
<td>French marigold, <em>Tagetes patula</em></td>
<td>G**</td>
</tr>
<tr>
<td>Hairy Indigo, <em>Indigofera hirsuta</em></td>
<td>G</td>
</tr>
<tr>
<td>Pangola digitgrass, <em>Digitaria decumbens</em></td>
<td>G</td>
</tr>
<tr>
<td>Transvala digitgrass, <em>Digitaria decumbens</em></td>
<td>F</td>
</tr>
<tr>
<td>Showy crotalaria, <em>Crotalaria spectabilis</em></td>
<td>G</td>
</tr>
<tr>
<td>Sunn hemp, <em>Crotalaria juncea</em></td>
<td>G</td>
</tr>
<tr>
<td>Velvetbean, <em>Mucuna pruriens</em></td>
<td>G</td>
</tr>
</tbody>
</table>

* G = good control of the most common species of this nematode; P = poor or no control of this nematode; F = fair control

** Effectiveness differs among varieties of marigolds; one report stated yellow or gold "Petite French" types to be most effective against the greatest number of root-knot nematode species.
Pest Control With Cover Crops

✓ Nematode Control Examples

Table 1. Cover crops that may be useful in managing common plant parasitic nematodes in Florida gardens. Yes = should reduce nematode populations. No = might increase nematode populations. Depends = some varieties are resistant, others are susceptible, see "more detailed information" for variety-specific information.

<table>
<thead>
<tr>
<th>Cover Crop</th>
<th>Root-knot (Meloidogyne spp.)</th>
<th>Sting (Belonolaimus longicaudaus)</th>
<th>For more detailed information see:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cowpea (Vigna unguiculata)</td>
<td>Depends</td>
<td>No</td>
<td>IN516</td>
</tr>
<tr>
<td>Sunn Hemp (Crotalaria juncea)</td>
<td>Yes</td>
<td>Yes</td>
<td>NG043</td>
</tr>
<tr>
<td>Sorghum (Sorghum spp.)</td>
<td>Yes</td>
<td>No</td>
<td>IN531</td>
</tr>
<tr>
<td>Marigold (Tagetes spp.)</td>
<td>Depends</td>
<td>No</td>
<td>NG045</td>
</tr>
<tr>
<td>Velvetbean (Muconia deeringiana)</td>
<td>Depends</td>
<td>Yes</td>
<td>IN483</td>
</tr>
<tr>
<td>Rye (Secale cereale)</td>
<td>Yes</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Bahiagrass (Paspalum notatum)</td>
<td>Yes</td>
<td>No</td>
<td></td>
</tr>
</tbody>
</table>

✓ Nematode spp identification is required for success!
Pest Control With Cover Crops

Nematode Suppression by Cowpea Cultivar

- California Blackeye#5
- Tennessee Brown
- Mississippi Silver
- Purple Knuckle
- Texas Purplehull
- Pinkeye Purplehull
- Whippoorwill

- Cover crop cultivar selection is required for success!
Pest Control With Cover Crops

✓ Insect & Disease Control Examples

- A growing cover crop can provide suppression in several ways:
  - break insect and disease cycles
  - provide constant habitat, pollen, and nectar for beneficials to maximize natural predator-pest interactions
  - altering soil microbial communities to put certain pathogens at a disadvantage
### Insects attracted to common cover crop species

<table>
<thead>
<tr>
<th>Cover crop</th>
<th>Beneficial insects</th>
<th>Pest insects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Buckwheat</td>
<td>Parasitic wasps, ladybugs, tachinid and hover flies, lacewings</td>
<td>Tarnished plant bugs and aphids (note: aphids can act as a food source for beneficials)</td>
</tr>
<tr>
<td>Clovers</td>
<td>Parasitic wasps, big eyed bugs, minute pirate bugs, ladybugs, tachinid flies, and aphid midges</td>
<td>Spider mites &amp; flower thrips (note: flower thrips can prey on spider mites and provide food for several predatory insects)</td>
</tr>
<tr>
<td>Hairy vetch</td>
<td>Minute pirate bugs, ladybugs predatory and parasitic wasps</td>
<td>Tarnished plant bugs</td>
</tr>
<tr>
<td>Cereals/grains</td>
<td>Ladybugs</td>
<td>Aphids</td>
</tr>
</tbody>
</table>
Cover Cropping Advantages for Organic Vegetable Gardens

- Short season vegetables lend themselves perfectly to cover cropping.
- Small garden plots are ideal for experimentation with different cover crops.
- Cover crops keep a garden looking lush & dynamic throughout the full length of the growing season.
- Cover crops help keep gardener’s busy lives in balance by keeping a focus on long-term soil building in addition to different growing management demands.

What to Look For in A Cover Crop

- Fast germination and emergence
- Competitiveness
- Tolerance to adverse climatic & soil conditions
- Ease of suppression/residue management
- Fertility/soil quality benefits
- Low-cost
Planting Cover Crops

- Planting Date
  - Fall planting
    - Cool season small grains and legumes
  - Spring and Summer
    - Warm season grasses and legumes

### Chart 3A CULTURAL TRAITS

<table>
<thead>
<tr>
<th>Species</th>
<th>Aliases</th>
<th>Type¹</th>
<th>Hardy through Zone²</th>
<th>Tolerances</th>
<th>Habit³</th>
<th>pH (Prot.)</th>
<th>Best Established⁴</th>
<th>Min. Garmin. Temp.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annual ryegrass p. 74</td>
<td>Italian ryegrass</td>
<td>WA</td>
<td>6</td>
<td></td>
<td>U</td>
<td>6.0–7.0</td>
<td>Esp, LSu, EF</td>
<td>40F</td>
</tr>
<tr>
<td>Barley p. 77</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>6.0–8.5</td>
<td>FW, Sp</td>
<td>38F</td>
</tr>
<tr>
<td>Oats p. 93</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4.5–7.5</td>
<td>LSu, Esp W in 8+</td>
<td>38F</td>
</tr>
<tr>
<td>Rye p. 98</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>5.0–7.0</td>
<td>LSu, F</td>
<td>34F</td>
</tr>
<tr>
<td>Wheat p. 111</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>6.0–7.5</td>
<td>LSu, F</td>
<td>38F</td>
</tr>
<tr>
<td>Buckwheat p. 90</td>
<td></td>
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<td>5.0–7.0</td>
<td>Sp to LSu</td>
<td>50F</td>
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<td>Sorghum–sudan. p. 106</td>
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<td>6.0–7.0</td>
<td>LSp, ES</td>
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<td>Mustards p. 81</td>
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<td>5.5–7.5</td>
<td>Sp, LSu</td>
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<td>Radish p. 81</td>
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<td>6.0–7.5</td>
<td>Sp, LSu, EF</td>
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<td>Rapeseed p. 81</td>
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<td>5.5–8</td>
<td>E, Sp</td>
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<td>Berseem clover p. 118</td>
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<td>ESP, EF</td>
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<td>Cowpeas p. 125</td>
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<td>5.5–6.5</td>
<td>LSu</td>
<td>58F</td>
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<td>Crimson clover p. 130</td>
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<td>LSu/ESu</td>
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<td>Field peas p. 135</td>
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<td>6.0–7.0</td>
<td>E</td>
<td>41F</td>
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<td>Hairy vetch p. 142</td>
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<td>5.5–7.5</td>
<td>EF, ESP</td>
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<td>Medics p. 152</td>
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<td>6.0–7.0</td>
<td>EF, ESP, ES</td>
<td>45F</td>
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<td>Red clover p. 159</td>
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<td>LSu, ESP</td>
<td>41F</td>
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<td>Subterranean cl. p. 164</td>
<td>Subclover</td>
<td>CSA</td>
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<td>5.5–7.0</td>
<td>LSu, EF</td>
<td>38F</td>
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</tbody>
</table>
Challenges

Planting Legume Cover Crops

• Seed treatments for legumes
  – Inoculants

Note nodules on roots
Challenges

• Long enough growth period to produce enough biomass to fix sufficient N
  – Good results in south (longer winter growth)

• Usually need manure, composts, or other organic materials in addition to legume covers, to provide sufficient N to main crop
Challenges

✓ Difficulty Predicting Nitrogen Mineralization

Timing of N mineralization from cover crop residue compared to soil organic matter & organic fertilizer relative to crop demand.

Gaskel et al., 2006
Terminating Cover Crops

- Timing

Low biomass, quick decomposition

High biomass, slow decomposition
Cover Crop Decomposition

- C:N ratio > 25-30 results in nitrogen immobilization
- Cover crops and C:N ratio
  - Small grains have high C:N ratio
  - Mature, older crops have high C:N ratio
  - Legumes have low C:N ratio
  - Succulent, young crops have low C:N ratio

Winter Rye Cover Crop
Residue Addition and N Availability

High carbon residues added

Avail. Soil N

Time

Immobilization (tie-up)  Mineralization (release of N)
Residue Addition and N Availability

Low carbon residues added

Avail. Soil N

Time

No Immobilization (tie-up)

Mineralization (release of N)
Challenges

✓ Avoiding Negative Impacts on Crops

• Depletion of soil moisture
• Temporary decrease in nutrient availability
• Increased weed occurrence
• Allelopathic effects
Summary

• Cover crops help develop a functional garden ecosystem

• Practices are designed to enhance ecosystem health benefits

• Cover crops “feed the soil so that the soil can feed the plant”

• Careful management is needed to provide desired benefits
Online Resources

- Cover Crops and Green Manures for Hawaii http://www2.ctahr.hawaii.edu/sustainag/Database.asp
- Newman, Y., et.al., Cover Crops, EDIS, UF/IFAS http://edis.ifas.ufl.edu/aa217
• Relf, D., et.al., Mulches for the Home Vegetable Garden. VA Cooperative Extension
  http://pubs.ext.vt.edu/426/426-326/426-326.html

• Sustainable Practices for Vegetable Production in the South
  http://www.cals.ncsu.edu/sustainable/peet/index.html
