Functional Groups/Characteristics

- Cool Season Grasses
- Warm Season Grasses
- Cool Season Broadleaf's (legumes, brassicas)
- Warm Season Broadleaf (legumes, non-legumes)
- Perennial, Biannual, Annual
- Tap root?
- Fibrous root?
- C:N Ratios
- Growing season for each group/species (frost sensitivity)?
- Diversity
- Moisture Use
- Other Considerations
## C:N Ratio for Various Crops

<table>
<thead>
<tr>
<th>Material</th>
<th>C:N Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>rye straw</td>
<td>82:1</td>
</tr>
<tr>
<td>wheat straw</td>
<td>80:1</td>
</tr>
<tr>
<td>oat straw</td>
<td>70:1</td>
</tr>
<tr>
<td>corn stover</td>
<td>57:1</td>
</tr>
<tr>
<td>rye cover crop (anthesis)</td>
<td>37:1</td>
</tr>
<tr>
<td>pea straw</td>
<td>29:1</td>
</tr>
<tr>
<td>rye cover crop (vegetative)</td>
<td>26:1</td>
</tr>
<tr>
<td>mature alfalfa hay</td>
<td>25:1</td>
</tr>
<tr>
<td><strong>Ideal Microbial Diet</strong></td>
<td><strong>24:1</strong></td>
</tr>
<tr>
<td>rotted barnyard manure</td>
<td>20:1</td>
</tr>
<tr>
<td>legume hay</td>
<td>17:1</td>
</tr>
<tr>
<td>beef manure</td>
<td>17:1</td>
</tr>
<tr>
<td>young alfalfa hay</td>
<td>13:1</td>
</tr>
<tr>
<td>hairy vetch cover crop</td>
<td>11:1</td>
</tr>
<tr>
<td>soil microbes (average)</td>
<td>8:1</td>
</tr>
</tbody>
</table>

### Rye
- High C:N
- Ties up N
- Compounds problem following another high C:N crop

### Hairy Vetch
- Low C:N
- Release lots of N
- Decomposes Fast

### Rye & Hairy Vetch Mix
- Balance C:N ratio
- Control decomposition
- Ideal cover crop mix
Biomass Production
Annual Cropping Systems

Missed opportunities for resource assimilation and dry matter production

Dry matter production or resource loss (mass/time)

Spring  Summer  Autumn  Winter

Annual grain crop

Winter cover crop

Additional opportunities for resource losses

after A.H. Heggenstaller

A. H. Heggenstaller, University of Alberta
Midwest Cover Crops Field Guide

Midwest Cover Crops Field Guide is now available from the Purdue Extension Education Store.

Copies cost $5 each.

25 copies are $112.50—a 10 percent discount.

Order copies of this 136-page guide now by clicking on the links above or by calling the Education store toll free: (888) 398-4636, extension 46794.

A full list of the guide’s contents is available here.

Growing the Guide

People who want to prevent soil erosion, improve nutrient cycling, sustain their soils, and protect the environment have been using a very old practice: planting cover crops.

Farmers have been using cover crops for centuries, today’s producers are part of a generation that has little experience As they rediscover the role that cover crops can play in sustainable farming systems, many growers find they lack the knowledge and information necessary to take advantage of all the potential benefits cover crops can offer. That inexperience can lead to costly mistakes.

This guide will help you effectively select, grow, and use cover crops in your farming systems. While this guide isn’t the final word on cover crops, it is meant to be a comprehensive guide. It includes information on specific cover crops as well as general principles of cover crop management.
Pure Stands vs. Mixtures

Before you select a particular cover crop species, consider whether you can meet your objectives better with one species or if you require a mixture of different (yet compatible) species.

Advantages of pure stands include:
- If you have only one objective, a pure stand of a single species is generally easier to manage (as long as the species is adapted to the soil type and growing conditions).
- The following cash crop will respond more uniformly across the field. One species will generally affect the cash crop in just one way, multiple species may affect it in several ways.
- Managing pests is usually easier in pure stands.

Advantages of mixed stands include:
- Mixed stands often provide multiple benefits that a single cover crop cannot.
- If one part of the stand doesn’t perform, other parts of a mixed stand may be able to compensate for it.

Seeding Methods

There are a number of methods for seeding cover crops. Like selecting a cover crop species, choose a seeding method best suited to your operation and crop. The six most common methods are described in more detail on the next few pages. The Cover Crops Species section (pages 32-121) provides seeding rates for the first three methods (drilled, broadcast with shallow incorporation, and aerial/surface).

Drilled Seeding

This method uses a seed drill to plant the cover crop after the cash crop is harvested.

When using this method:
- Consider planting earlier maturing corn hybrids or soybean varieties if the grain crop harvest is usually too late to establish a cover crop. This will allow more time for cover crops to be planted and grow.
- Be aware that drilling cover crop seed improves seed-to-soil contact, but hard soils, soil compaction, soil crust, or inadequate soil moisture and rain may still reduce seed germination and establishment.
- Take time to adequately set up the drill for good seed depth placement and spacing.
Barley (winter and spring)
_Hordeum vulgare_

**Plant Characteristics:** Upright winter annual that grows 1½-3 feet tall. Has hollow, jointed stems with narrow, tapered leaves. Leaves are broader than those of most other grasses. Flower spikes appear bearded due to their long awns. Winter barley requires vernalization to produce grain.

**Seed Characteristics:**
Average seeds per pound: 13,600. Emergence time: 6-8 days. Minimum germination soil temperature: 38°F.

**Seeding:** Use the lower end of the drilled seed rate with narrow row planters. May be inter-seeded into cash crop at physiological maturity. Very rapid growth, good for short windows.

<table>
<thead>
<tr>
<th>Method</th>
<th>Lbs./A Pure Live Seed (PLS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drilled*</td>
<td>50-75</td>
</tr>
<tr>
<td>Broadcast with Shallow Incorporation</td>
<td>55-83</td>
</tr>
<tr>
<td>Aerial/Surface Seeding</td>
<td>60-90</td>
</tr>
</tbody>
</table>

*Depth: ½-1½ inches

**Soil Tolerances:** Somewhat poorly drained to excessively drained soil with a pH of 6.0-8.5. Very good tolerance of low soil fertility.

**Environmental Tolerances:** Good drought tolerance. Low heat tolerance. Does not tolerate shade. Tolerates brief flooding or ponding.

**Termination:** Till (multiple passes often required), apply herbicides, mow (milk or dough stages), use roller crimper (milk or dough stages).

**Crop Selection Benefits:**

<table>
<thead>
<tr>
<th></th>
<th>N Source</th>
<th>N Scavenger</th>
<th>Soil Builder</th>
<th>Subsoiler</th>
<th>Topsoil Loosener</th>
<th>Erosion Preventer</th>
<th>Lasting Residue</th>
<th>Weed Fighter</th>
<th>Grazing Value</th>
<th>Forage Value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Continued on next page.
**Oilseed Radish**

*Raphanus sativus*

**Plant Characteristics:** Upright cool-season annual that grows 12-18 inches tall. Has a rosette of leaves; purple, light purple, light pink, or white flowers; and a deep, thick white taproot.

**Seed Characteristics:** Average seeds per pound: 34,000. Emergence time: 3-5 days. Minimum germination soil temperature: 45°F.

**Seeding:** If precision planted, seeding rate may be reduced to as low as 1 pound per acre in combination with a legume cover crop. May be interseeded into cash crop at physiological maturity. Very rapid growth, good for short windows.

---

**Method** | **Lbs./A Pure Live Seed (PLS)**
---|---
Drilled* | 5-10
Broadcast with Shallow Incorporation | 5.5-11
Aerial/Surface Seeding | 6-12

*Depth: 1/4 - 3/4 inch

**Soil Tolerances:** Somewhat poorly drained to well-drained soils with a pH of 6.0-7.5. Low tolerance of low soil fertility. Highly responsive to N.

**Environmental Tolerances:** Good heat and drought tolerance. Low shade tolerance. Might not winterkill completely if there is adequate snow cover on young plants. Does not tolerate flooding or ponding.

**Termination:** Freeze (might not freeze-kill completely, especially young plants), till, apply herbicides.

**Crop Selection Benefits:**

- **N Source**
- **N Scavenger**
- **Soil Builder**
- **Subsoiler**
- **Topsoil Loosener**
- **Erosion Preventer**
- **Lasting Residue**
- **Weed Fighter**
- **Grazing Value**
- **Forage Value**

*Continued on next page.*
Cover Crop Plants

About Cover Crops

The following is a list of several cover crops used in the PLANTS floristic area (PFA). By clicking on the appropriate column heading, this list can be sorted by PLANTS symbol, scientific name, common name, or plant family. Click on a scientific name to view its Plant Profile with more information. Synonyms are indented beneath accepted counterparts.

74 cover crops returned

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Scientific Name</th>
<th>Common Name</th>
<th>Plant Family</th>
</tr>
</thead>
<tbody>
<tr>
<td>ARGL18</td>
<td>Arachis glabrata</td>
<td>rhizoma peanut</td>
<td>Fabaceae - Pea family</td>
</tr>
<tr>
<td>ARHY</td>
<td>Arachis hypogaea</td>
<td>peanut</td>
<td>Fabaceae - Pea family</td>
</tr>
<tr>
<td>AVSA</td>
<td>Avena sativa</td>
<td>common oat</td>
<td>Poaceae - Grass family</td>
</tr>
<tr>
<td>AVST2</td>
<td>Avena strigosa</td>
<td>black oats</td>
<td>Poaceae - Grass family</td>
</tr>
<tr>
<td>BRJU</td>
<td>Brassica juncea</td>
<td>brown mustard</td>
<td>Brassicaceae - Mustard family</td>
</tr>
<tr>
<td>BRNA</td>
<td>Brassica napus</td>
<td>rape</td>
<td>Brassicaceae - Mustard family</td>
</tr>
<tr>
<td>BRNI</td>
<td>Brassica nigra</td>
<td>black mustard</td>
<td>Brassicaceae - Mustard family</td>
</tr>
<tr>
<td>BRRA</td>
<td>Brassica rapa var. rapa</td>
<td>field mustard</td>
<td>Brassicaceae - Mustard family</td>
</tr>
<tr>
<td>BRCA2</td>
<td>Brassica campestris</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BRHO2</td>
<td>Bromus hordeaceus</td>
<td>soft brome</td>
<td>Poaceae - Grass family</td>
</tr>
<tr>
<td>CACA27</td>
<td>Cajanus cajan</td>
<td>pigeonpea</td>
<td>Fabaceae - Pea family</td>
</tr>
<tr>
<td>CAEN4</td>
<td>Canavalia ensiformis</td>
<td>jack bean</td>
<td>Fabaceae - Pea family</td>
</tr>
</tbody>
</table>
Lolium perenne L. ssp. multiflorum (Lam.) Husnot
Italian ryegrass

Symbol: LOPEM2
Group: Monocot
Family: Poaceae
Duration: Annual Perennial
Growth Habit: Graminoid
Native Status: L48 I, AK I, HI I, CAN I, GL I, SPM I

Other common names:
anual ryegrass

© Robert Soreng, Courtesy of Smithsonian Institution, Department of Systematic Biology
Trifolium pratense L.  
red clover

Click on the image below to enlarge it and download a high-resolution JPEG file.

Symbol: TRPR2  
Group: Dicot  
Family: Fabaceae  
Duration: Biennial/Perennial  
Growth Habit: Forb/herb  
Native Status: L48 I  
AK I  
HI I  
PR I  
CAN I  
GL I  
SPM I

More Information:
- Characteristics
- Classification
- Fact Sheet (pdf) (doc)
- Plant Guide (pdf) (doc)
- Data Source and Document

Symbol: VIUN
Group: Dicot
Family: Fabaceae
Duration: Annual
Growth Habit: Vine
Forb/herb
Native Status: L48 I
PR I
VI I

Other common names:
blackeyed pea
field pea

Images:
Vigna unguiculata (L.) Walp.

Click on a thumbnail to view an image, or see all the Vigna thumbnails at the PLANTS Gallery
Symbol: MEIN2
Group: Dicot
Family: Fabaceae
Duration: Annual
Growth Habit: Forb/herb
Native Status: L48 I
HI I
CAN I
GL I

Other common names:
sourclover

Mellilotus indica

@Larry Allain. USGS NWRC. Usage Requirements. Any use of copyrighted images requires notification of the copyright holder.
Selecting Cover Crops

- Identify purpose(s)/use (340 standard)
  - Erosion Reduction
  - Increase soil organic matter C:N Ratio
  - Capture, recycle, redistribute nutrients in the soil profile
  - Nitrogen fixation
  - Weed suppression
  - Forage uses
  - Minimize Plant Water Use
  - Reduce soil compaction
  - Attract Beneficial Insects
  - Seedbed for grass seeding
Selecting Cover Crop Continued

- Identify the best place and time in crop sequence
- Conditions (climate, growth, seeding conditions, moisture, bare ground, herbicides, planting method, canopy, termination method, weeds/disease i.e. mosaic, escapes, other management considerations i.e. rye contamination in wheat rotations)
- Match Cover Crop to meet the purpose and site conditions/rotation/niche
- Termination Method
- Seeding method
Cover Crop Practice Standard (340)

Purposes:

• Reduce erosion from wind and water.
• Increase soil organic matter content.
• Capture & recycle or redistribute nutrients in the soil profile.
• Promote biological nitrogen fixation and reduce energy use.
• Increase biodiversity.
• Suppress weeds.
• Manage soil moisture.
• Minimize and reduce soil compaction.
Reduce Soil Erosion (increase infiltration)

- Cover crop with high C:N ratio with a fibrous root such as rye or sudan grass is best to protect the soil surface from erosion
- Cover crops following low residue crops are most important (cotton, soybeans)
- Prevents soil particle detachment by wind and water
- Reduces raindrop impact
- Prevents crusting
Reduce Soil Erosion

Raindrop impact destroys soil aggregates and disperses soil particles ...

Creating soil crusts ...
Rainfall Simulator Demonstration

Runoff and Erosion Results
Rainfall Simulator Demonstration

Infiltration Results
Control Ephemeral Erosion
Increase Soil Organic Matter

• Use high C:N ratio cover crops 30 or greater

• Contributes directly to nutrient cycling, nutrient availability, nutrient holding capacity, and water holding capacity.

• Plays a significant role in the formation of water stable aggregates which affects infiltration, aeration, drainage and bulk density.

• Provides carbon and energy for soil organisms that are essential for maintaining a healthy soil.
Capture & Recycle Nutrients

• Cover crops such as wheat, rye, oats and sorghum-sudangrass which establish quickly and have fibrous roots systems are ideal for scavenging excess nitrates from the soil profile.

• Brassicas such as oilseed radish and turnips are also good scavengers although they establish more slowly and will winter kill.

• Growing deep rooted cover crops may help redistribute micro-nutrients in the soil profile and make them more available for the subsequent crop.
Promote Biological N-fixation

- Legumes can fix atmospheric N through a symbiotic relationship between the plant and Rhizobium.

- Growing legume cover crops can supply additional N for the subsequent crop providing that a majority of the above ground biomass is returned to the soil.

- Considerations:
  - Works best when N is limiting
  - Legumes need to be properly inoculated
Increase Biodiversity

• Addition of different functional groups into an existing rotation (i.e. warm season grass, cool season grass, warm season broadleaf, cool season broadleaf)

• Adding diversity of plant species helps feed the biological life in the soil, improving soil health.
Corn-Soybean-Wheat Example
Cocktails
Cocktails can provide diversity similar to a Native Prairie Ecosystem
Suppress Weeds

• A healthy stand of cover crops can out-compete weeds for light and nutrients.
• The mulching effect of some types of cover crops can reduce weed pressure.
• Some types of cover crops produce chemical exudates that can inhibit weed growth.
• In addition to controlling weeds cover crops can help break pest cycles
• Terminate cover crop before weeds produce viable seed
• Cover crops can become weeds if not properly managed
Suppress Weeds
Soil Moisture Management

• Increase infiltration
• Reduce Evaporation
• Remove Excess Moisture
• Utilize cocktails instead of mono cultures
• Terminate while cover crop is vegetative (before peak water use occurs)
Reduce Evaporation

• Crop residue improves infiltration and reduces soil evaporation. Maintaining adequate residue cover takes the “E” out of ET.

• A study in Kansas found that leaving crop residue in place resulted in a savings of 3.5” of soil water. That is equivalent to an extra 40 bu/ac dryland corn or an irrigation savings of $25 to $35 per acre.
Minimize and reduce soil compaction
One Turnip the cows
didn’t get . . .

Above, 5 year old, Krayton Kucera, son of
Seed Corn-Soybeans Example
Herbicide Skip
Planning Principle/Purposes Achieved??
High Clearance Seeders
# Cover Crop Design Worksheet

## Note:
Yellow areas indicate required data. Blue areas indicate optional data.

<table>
<thead>
<tr>
<th>Name:</th>
<th>Program:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Address:</td>
<td>Contract #:</td>
</tr>
<tr>
<td>Field Number:</td>
<td>Contract Item Number:</td>
</tr>
<tr>
<td>Section:</td>
<td>Township:</td>
</tr>
</tbody>
</table>

### Indicate the decision-maker’s objective(s) for applying cover crop, in priority order (1, 2, 3, etc.)

- Reduce Erosion / Particulates
- or Crop Abrasion / Blow-out
- Biological Nitrogen fixation
- Pest Suppression
- Increase Soil Organic Matter
- Seedbed for grass seeding

If crop abrasion is an objective, note:  
- Crop:  
- Crop Soil Loss Tolerance: ____ tons/ac/year

### Design soil map unit:

<table>
<thead>
<tr>
<th>Existing Condition Without Cover Crop</th>
<th>Planned Condition With Cover Crop</th>
</tr>
</thead>
</table>

- Erosion rates (water, wind):
- Soil Condition Index:

### Seeding Window:

- Termination Method:
- Fertilization:

### Management Considerations:

Weeds will be controlled by clipping or with proper herbicides as needed in accordance with product label directions and current UNL Guide to Herbicide Use recommendations.
Cover Crop Info on CPA-7

- Allelopathic
- Seeds per lb (pls calculation)
- Full Rate lbs/ac by Rainfall Zone
- Seed size
- C:N Ratio (Early to Mid Vegetative)
- C:N Ratio (late Vegetative)
- C:N Ratio value Late Vegetative to reproductive
- N Fixation, Erosion Reduction, Forage and other purposes
- Crop Type  (CS, WS, Brassica, Legume, grass, broadleaf)
- SEEDING DEPTH
- Winter Hardiness (Temp)
- Ideal Planting Date by Zone
Class Example

• Growing Season Window (how much growth is needed and how much growing season is available)
• Which crop in rotation provides the best option for cover crop/highest need?
• Cost of cover crop and practical?
• Moisture conservation?
• Purposes achieved?
• Seeding Method (drill, broadcast spreader, highboy, plane)?
• Termination method and timing (freeze, herbicide)