

Mike Kucera

Cover Crop Use and Planning



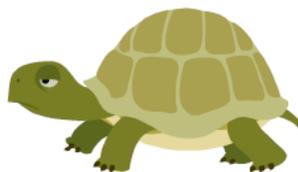


Functional Groups/Characteristics

- 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

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



↑
slower

Relative
Decomposition
Rate

↓
faster



Rye

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

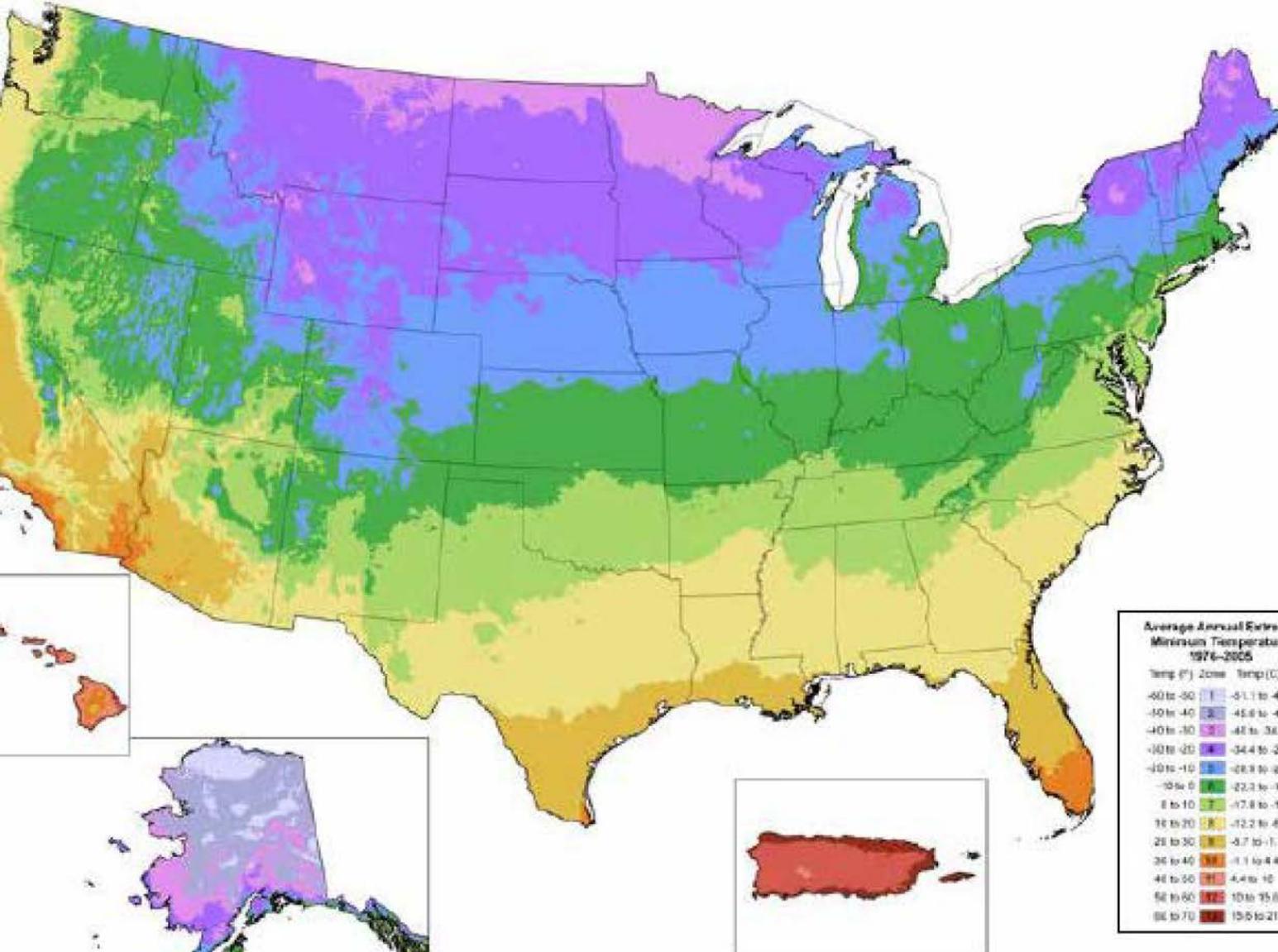
Hairy Vetch

- Low C:N
- Release lots of N
- Decomposes Fast

Rye & Hairy Vetch Mix

- Balance C:N ratio
- Control decomposition
- Ideal cover crop mix

USDA Plant Hardiness Zone Map

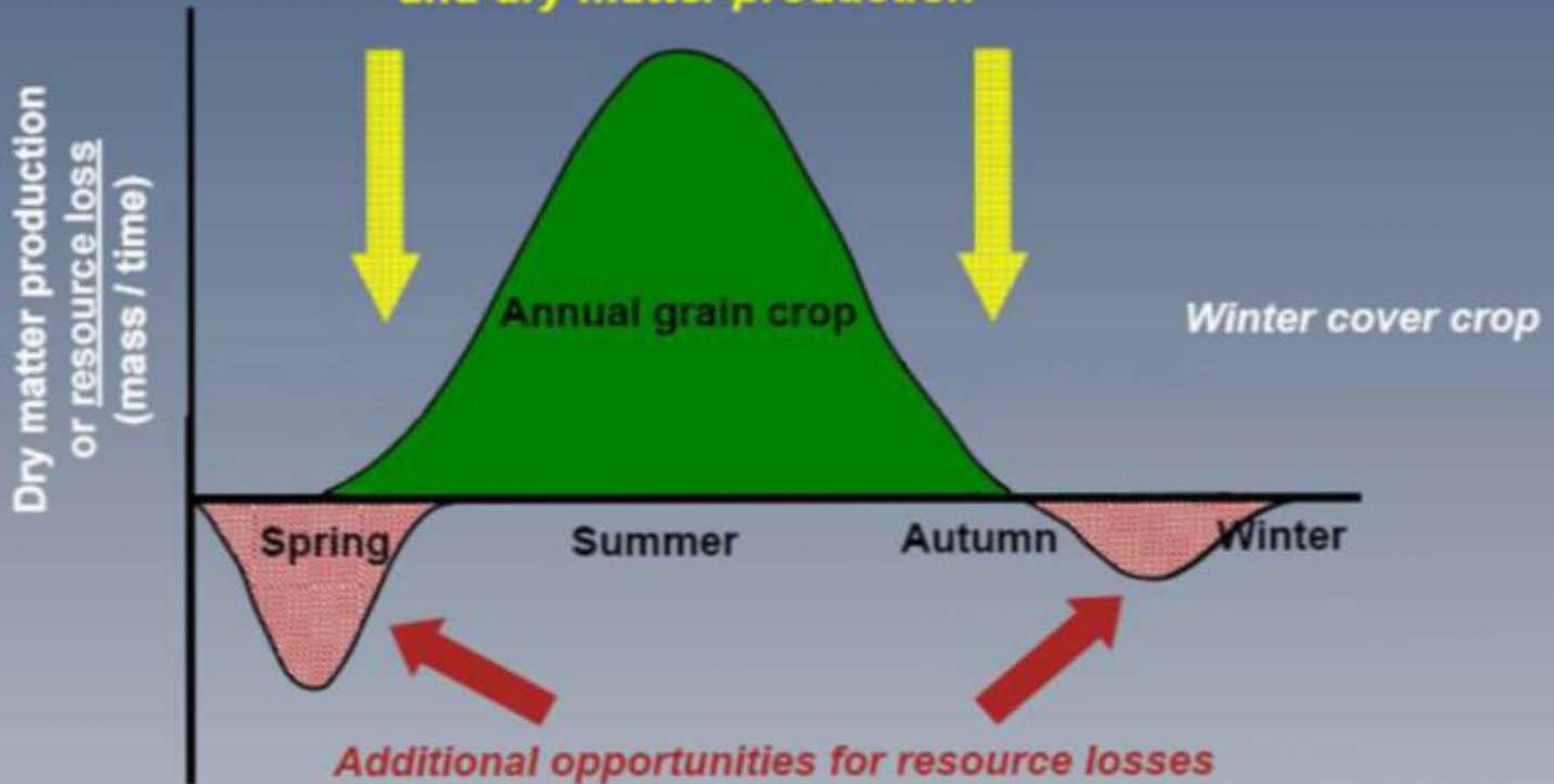


Biomass Production

Annual Cropping Systems



*Missed opportunities for resource assimilation
and dry matter production*



after A.H. Heggenstaller

Midwest Cover Crops Field Guide

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

Individual 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.

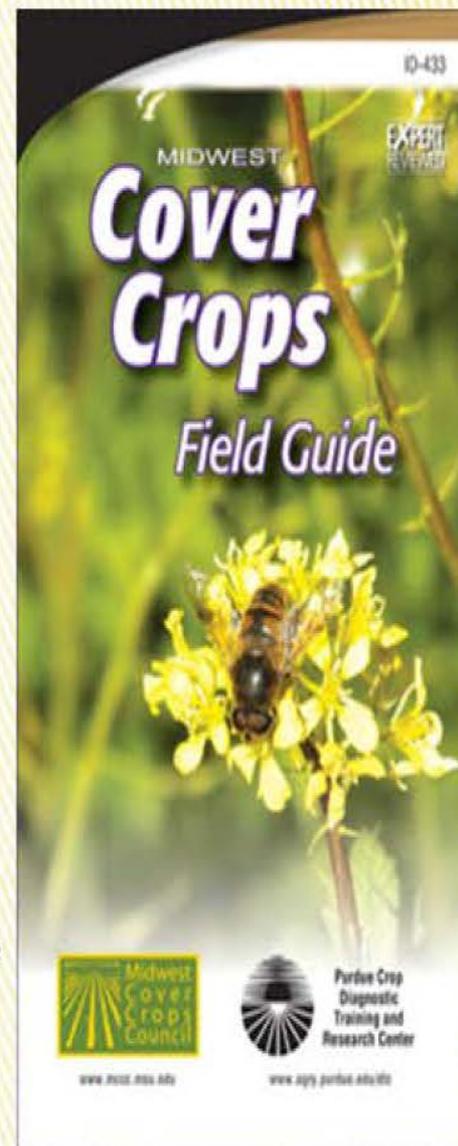
More of the guide's contents is available [here](#).

Why the Guide

Farmers who want to prevent soil erosion, improve nutrient cycling, sustain their soils, and protect the environment have been practicing an age-old practice: planting cover crops.

While farmers have been using cover crops for centuries, today's producers are part of a generation that has little experience with them. 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



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).



Drilling ryegrass

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 crusting, 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.



Seed

Method	Lbs./A Pure Live Seed (PLS)
Drilled*	50-75
Broadcast with Shallow Incorporation	55-83
Aerial/Surface Seeding	60-90

*Depth: ¾-1½ 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:

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

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 inter-seeded into cash crop at physiological maturity. Very rapid growth, good for short windows.



Seed

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.

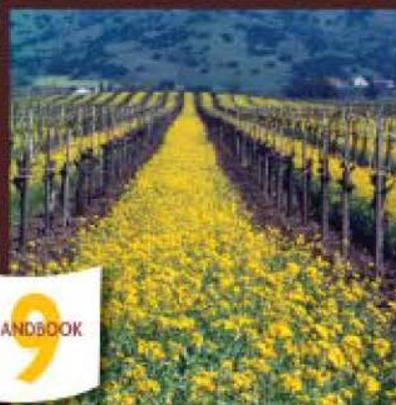
Crop Selection Benefits:

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<i>N Scavenger</i>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>
<i>Soil Builder</i>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
<i>Subsoiler</i>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>
<i>Topsoil Loosener</i>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
<i>Erosion Preventer</i>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<i>Lasting Residue</i>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<i>Weed Fighter</i>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
<i>Grazing Value</i>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
<i>Forage Value</i>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>

Continued on next page.

Managing Cover Crops Profitably

THIRD EDITION



You are here: [Home](#) / [Cover Crops](#)

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

Symbol	Scientific Name	Common Name	Plant Family
ARGL18	<i>Arachis glabrata</i>	rhizoma peanut	Fabaceae - Pea family
ARHY	<i>Arachis hypogaea</i>	peanut	Fabaceae - Pea family
AVSA	<i>Avena sativa</i>	common oat	Poaceae - Grass family
AVST2	<i>Avena strigosa</i>	black oats	Poaceae - Grass family
BRJU	<i>Brassica juncea</i>	brown mustard	Brassicaceae - Mustard family
BRNA	<i>Brassica napus</i>	rape	Brassicaceae - Mustard family
BRNI	<i>Brassica nigra</i>	black mustard	Brassicaceae - Mustard family
BRRAR	<i>Brassica rapa var. rapa</i>	field mustard	Brassicaceae - Mustard family
BRCA2	<i>Brassica campestris</i>		
BRHO2	<i>Bromus hordeaceus</i>	soft brome	Poaceae - Grass family
CACA27	<i>Cajanus cajan</i>	pigeonpea	Fabaceae - Pea family
CAEN4	<i>Canavalia ensiformis</i>	jack bean	Fabaceae - Pea family

Search

Name Search

safflower

Common Name

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Lolium perenne L. ssp. *multiflorum* (Lam.) Husnot Italian ryegrass

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

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:
annual ryegrass



© Robert Soreng
Lolium multiflorum

More Information:

- Characteristics
- Classification
- Fact Sheet (pdf) (doc)
- Data Source and Document

safflower

Common Name

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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](#)

Robert H. Mohlenbrock. USDA NRCS. 1992. *Western wetland flora: Field office guide to plant species*. West Region, Sacramento. Courtesy of USDA NRCS Wetland Science Institute. Usage

PLANTS Topics

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- Complete PLANTS Checklist
- State PLANTS Checklist
- Advanced Search Download

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



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

Tracey Slotta. Provided by ARS Systematic Botany and Mycology Laboratory, Costa Rica. [Usage Requirements.](#)

More Information:

- Characteristics
- Classification
- Plant Guide (pdf) (doc)
- Data Source and Documentation

Images:

Vigna unguiculata (L.) Walp.

Click on a thumbnail to view an image, or see all the *Vigna* thumbnails at the PLANTS Gallery



PLANTS Topics

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- Complete PLANTS Checklist

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

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](#)



© Larry Allain

Melilotus indica

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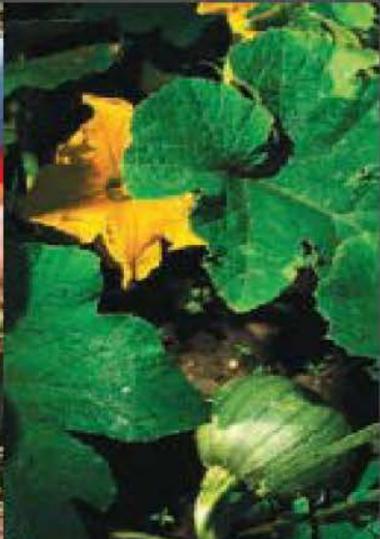
More Information:

- [Classification](#)
- [Data Source and Documentation](#)

Synonym Information:

- [MEIN14: Characteristics](#)

THIRD EDITION



BUILDING SOILS FOR BETTER CROPS

SUSTAINABLE SOIL MANAGEMENT

BY FRED MAGDOFF AND HAROLD VAN ES



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)



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.

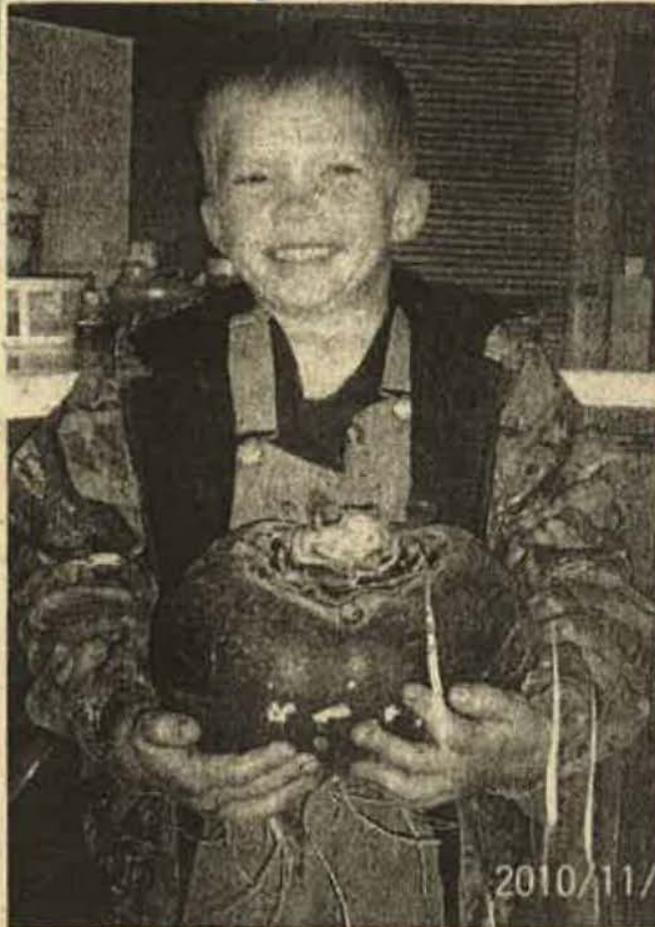
Minimize and reduce soil compaction



Forage



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

Clear Worksheet

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

Name: Program:
 Address: Contract #:
 Field Number: Contract Item Number:
 Section: Township: Range: Acres:

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

<input type="text"/>	Reduce Erosion / Particulates or Crop Abrasion / Blow-out	<input type="text"/>	Provide Supplemental Hay
<input type="text"/>	Biological Nitrogen fixation	<input type="text"/>	Provide Supplemental Grazing
<input type="text"/>	Pest Suppression	<input type="text"/>	Utilize excess soil moisture
<input type="text"/>	Increase Soil Organic Matter	<input type="text"/>	Attract Beneficial Insects
<input type="text"/>	Seedbed for grass seeding	<input type="text"/>	Minimize and Reduce Soil Compaction
		<input type="text"/>	Capture, Recycle, Redistribute Nutrients

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

Design soil mapunit:

	Existing Condition Without Cover Crop	Planned Condition With Cover Crop
Erosion rates (water, wind):	<input type="text"/>	<input type="text"/>
Soil Condition Index:	<input type="text"/>	<input type="text"/>

Seeding Window: Termination Method:
 Seeding 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)