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# Cover Crop Management

# Objectives

1. List benefits of cover crops
2. Identify the different plant functional groups
   - Name 2-3 representative species in each group that are common to most of the US.
   - List key benefits of the representative species
3. Determine how to manage cover crops

# Cover Crop Purposes

## Identify Resource Concerns & Objectives

- Crop diversity (habitat)
- Soil surface armor (erosion)
- Build stable soil aggregates
- Improve water cycle/ availability
- IPM/beneficial insects
- Build or improve soil organic matter
- Nutrient cycling/ efficiency/ acquisition
- Air Quality
- Adjust carbon/nitrogen ratios
- Wildlife winter food & shelter
- Livestock integration
- N fixation

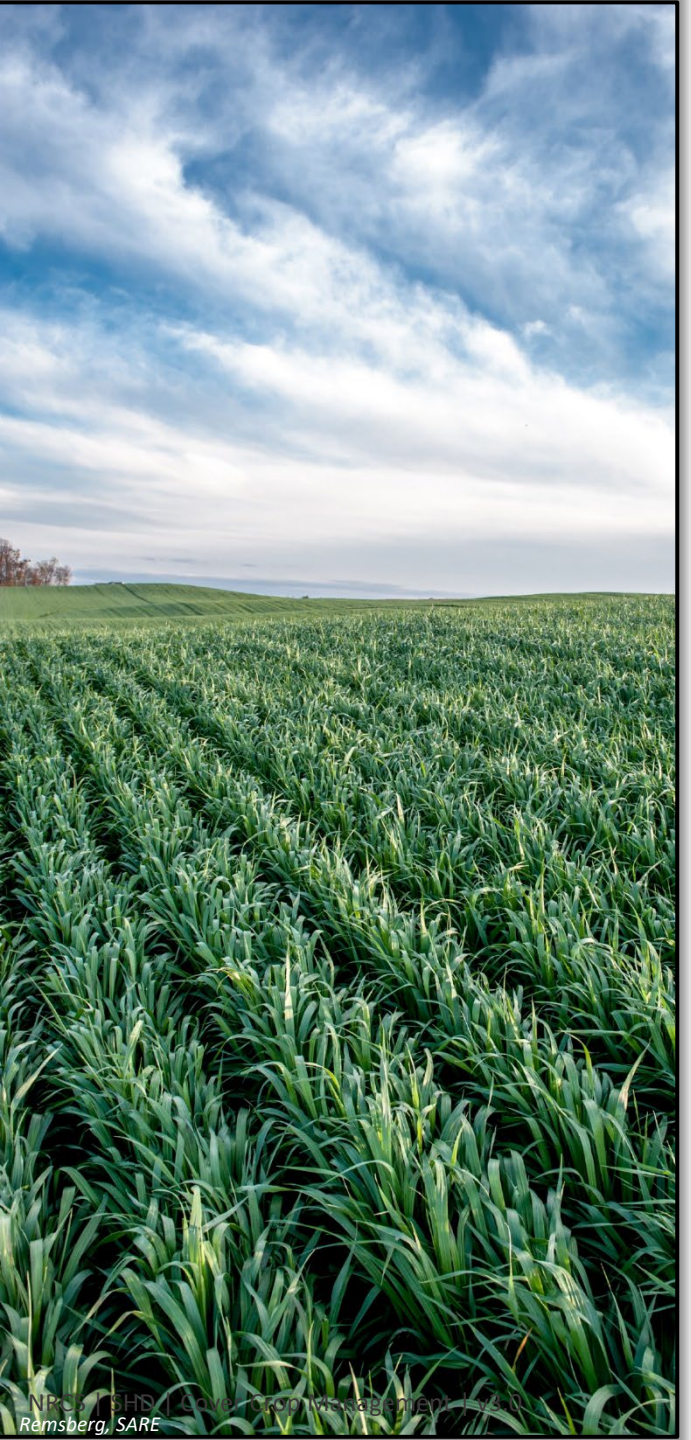
# Cover Crop CPS (340)

**PURPOSE**

This practice is applied to support one or more of the following purposes:

- Reduce sheet, rill, and wind erosion.
- Maintain or increase soil organic matter.
- Improve soil aggregate stability.
- Improve habitat for soil organisms.
- Reduce water quality degradation by utilizing excess soil nutrients.
- Reduce weed and plant pest pressure.
- Improve moisture management.
- Reduce soil compaction.
- Supply nitrogen to the subsequent crop.
- Improve habitat for pollinators, beneficial organisms, or natural enemies of crop pests.

NRCS, NHCP
May 2024



# Cover Crop Considerations

*for Successful Planning*

- Site preparation
- Early weed control
- Timing and species (adequate growing season)
- Crop rotation/diversity
- Seed quality (bin run, PLS, certified)
- Seeding method seed-soil contact (broadcast vs. drilling)
- Seed size/seeding depth
- Legume inoculation
- Moisture management (cover benefits, water use)
- Producer's goals

# Cover Crop Considerations

*for Successful Planning*

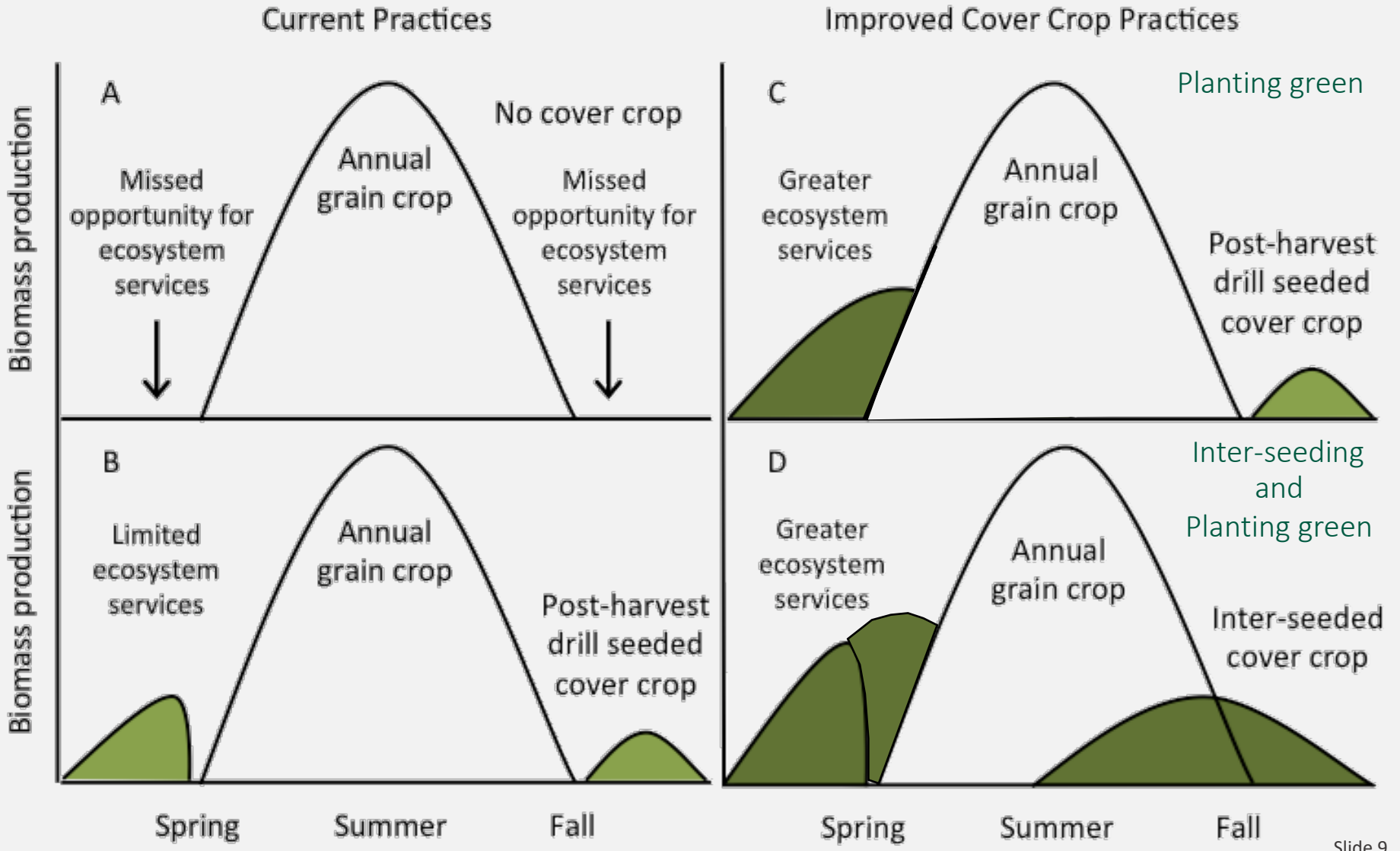
- Residue management (cash crop) before & after cover crop emergence
- Nutrient cycling (C:N ratio, residual $NO_3$)
- Weed, insect & disease management
- Termination method/timing
  - Know how you are going to terminate before you plant
- Economics
  - Yield impacts (+/-), cost of establishment, soil improvement, can we afford not to use them?


Remsberg, SARE


# What is your Seeding Timeframe ?

- Spring - Fallow ground, prevented planting or prior to a summer crop
- Early Summer - After early vegetable harvest, winter grain or small grain forage harvest, after first crop hay
- Late Summer - After grain harvest, Interseeding into corn or soybean, cotton etc.
- Fall - After fall crop harvest

# Cover Crops Niches for Summer Annual Crops






Matt Ryan, Cornell University

# Seeding Considerations

- Earlier seeding results in better seed germination, tillering, growth, survival and more biomass.
- Delaying termination in spring can compensate for delayed planting in the fall (some producers have learned to plant green)
- Be aware of planting dates based on species in the mix (warm / cool season; winter grains /cool season legumes and brassicas)
- Drilling is much more efficient than surface broadcast. Increase seeding rate by 10-30% when broadcasting (some states have specific, higher rates for broadcast vs. drilling).
- Higher seeding rates are not necessarily good – can be detrimental (i.e., increases competition for limited resources)

# What Characteristics Should Be Considered?

- Growth cycle
- Growth habit
- Root architecture
- Growth rate
- Chemical composition
- Stress tolerance
- Time to flowering
- Pest resistance or susceptibility
- Nutrient dynamics

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# What to Seed

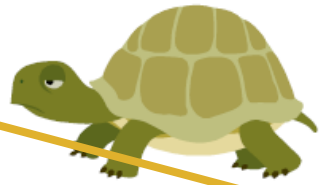
## Choosing the right cover crop for:

- ✓ Nutrient availability
- ✓ Nutrient requirements
- ✓ Stabilizing nutrients
- ✓ Weed suppression
- ✓ Insect and disease suppression
- ✓ Erosion Control
- ✓ Forage: not a purpose of a cover crop but valuable
- ✓ Acceptable planting and termination techniques for the producer

There may be other objectives identified during the planting process to address

# C:N ratio in Cover Crops (Nutrients Availability & Decomposition Rate)

| 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

Best for Legumes

Best for Corn or Cereals

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# Nitrogen Mineralization

## Bacteria

C:N ratio about 5:1

5:1

## Bacteria Feeding Nematode

C:N ratio about 10:1


10:1

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# Nitrogen Mineralization

## Bacteria

C:N ratio about 5:1

**Consume two bacteria to get enough carbon for function and reproduction**

## Bacteria Feeding Nematode

C:N ratio about 10:1

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Only Needs 1 part N

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# Nitrogen Mineralization

## Bacteria

C:N ratio about 5:1

**Consume two bacteria to get enough carbon for function and reproduction**

Only Needs 1 part N

## Bacteria Feeding Nematode

C:N ratio about 10:1


Excrete 1 part N to soil solution as Plant Available N

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# Reduce N Losses

- Nitrate mineralized from crop residues and soil OM Is highly soluble through the winter.
- Nitrogen leaching can be significant even without fall N applications.

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# Residue Management for N Retention and Weed Control

# Nitrogen Immobilization

## Cover Crop

C:N ratio about 40:1

## Bacteria

C:N ratio about 5:1

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# Nitrogen Immobilization

## Cover Crop

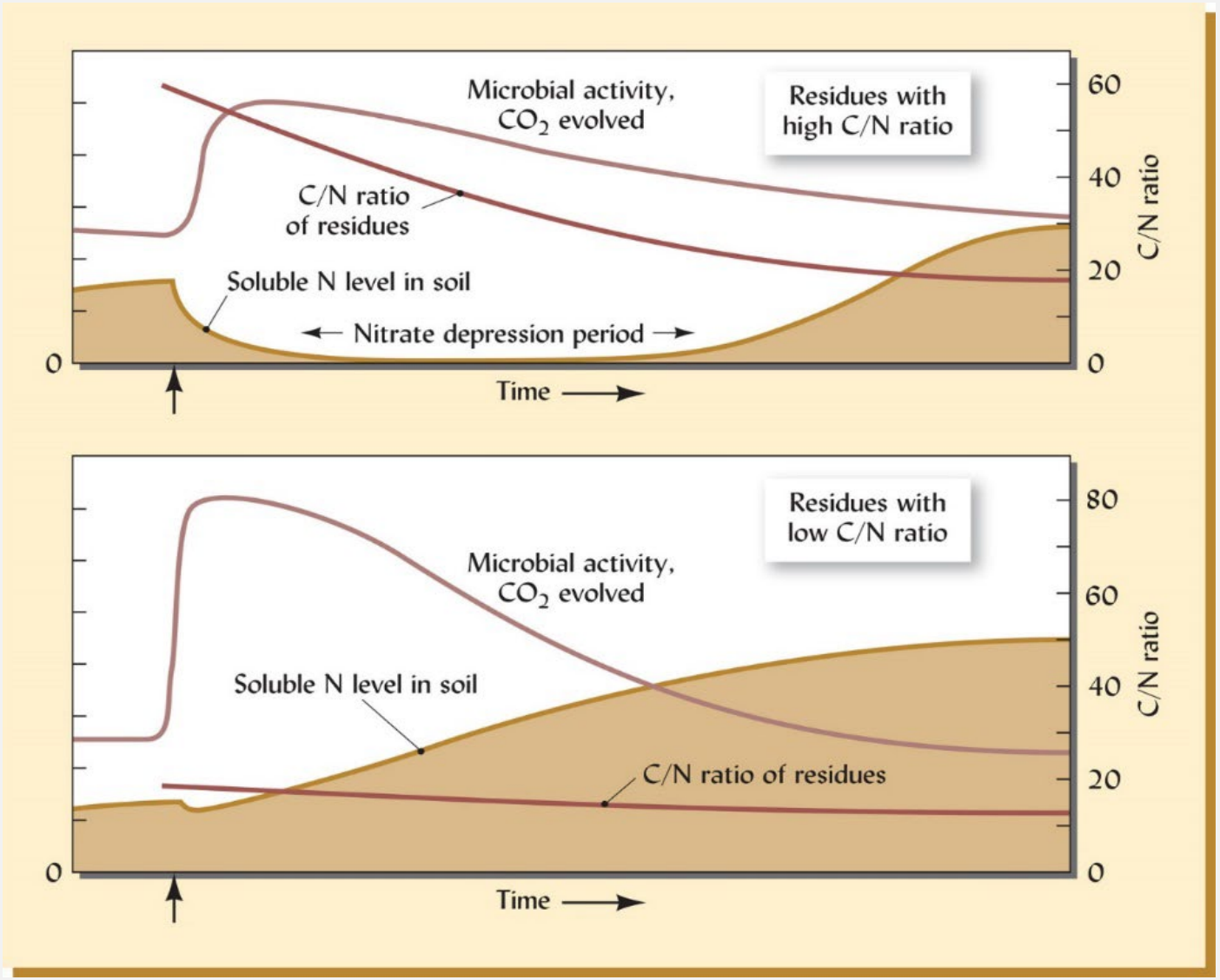
C:N ratio about 40:1

**Consume enough carbon from the rye for respiration & body structure**

## Bacteria

C:N ratio about 5:1

# How C:N is Impacted by Microbes



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Agricultural Research Service

# Cover Crop Chart

AREA 4 SCD Cooperative Research Farm

| GROWTH CYCLE | | | PLANT ARCHITECTURE | | | RELATIVE WATER USE | | |
|---|---|---|---|---|---|---|---|---|
| A | = | Annual | ♈ | = | Upright | 💧 | = | Low |
| B | = | Biennial | ✱ | = | Upright-Spreading | 💧💧 | = | Medium |
| P | = | Perennial | ≈ | = | Prostrate | 💧💧💧 | = | High |

## USDA –ARS Cover Crop Chart

| COOL | | | | | | WARM | | | |
|---|---|---|---|---|---|---|---|---|---|
| --GRASS-- | BROADLEAF | | | | | | | | --GRASS-- |
| A 💧 ANNUAL FESCUE ♈ | | | | | | | | | A 💧 BROWNTOP MILLET ♈ |
| A 💧 BARLEY ♈ | | | | | LEGUME | | | A 💧 AMARANTH ♈ | A 💧 FOXTAIL MILLET ♈ |
| A 💧💧 OAT ♈ | A/B 💧 CAMELINA ♈ | A/P 💧 MUSTARD ✱ | A 💧 BALANSA CLOVER ≈✱ | A 💧 CHICKPEA ✱ | A/P 💧 MEDIC ♈ | A 💧 COWPEA ✱ | A 💧 CLUSTER BEAN ✱ | A 💧💧 BUCKWHEAT ♈ | A 💧 PEARL MILLET ♈ |
| A 💧💧 WHEAT ♈ | A 💧 PHACELIA ♈ | A/B 💧💧 CANOLA ✱ | A 💧💧 BERSEEM CLOVER ♈ | A 💧 PEA ♈ | A 💧 LUPIN ♈ | A/P 💧 LABLAB ≈✱ | A/P 💧 JACK BEAN ✱ | A 💧💧 QUINOA ♈ | A 💧💧 PROSO MILLET ♈ |
| A/B 💧💧💧 ANNUAL RYEGRASS ♈ | A 💧💧 FLAX ♈ | A 💧💧💧 RADISH ✱ | A 💧💧 CRIMSON CLOVER ✱ | A 💧 LENTIL ✱ | A 💧💧 FABA BEAN ♈ | A/P 💧 FENUGREEK ♈ | A 💧 VELVET BEAN ✱ | P 💧💧 CHICORY ✱ | A 💧💧 GRAIN SORGHUM ♈ |
| A 💧💧💧 CEREAL RYE ♈ | A 💧💧 KALE ✱ | B 💧💧💧 TURNIP ✱ | B/P 💧💧 RED CLOVER ♈ | A/P 💧💧 LESPEDEZA ≈✱♈ | A/B 💧💧 SWEET CLOVER ♈ | A/P 💧 PIGEONPEA ✱ | A 💧💧 MUNG BEAN ✱ | A 💧💧💧 CUCURBITA ≈ | A 💧💧 SUDAN GRASS ♈ |
| A 💧💧💧 TRITICALE ♈ | A 💧💧 SPINACH ✱ | B 💧💧💧 BEET ✱ | P 💧💧 WHITE CLOVER ≈✱ | P 💧💧 BIRDSFOOT TREFOIL ≈ | P 💧💧💧 ALFALFA ♈ | A 💧💧 PARTRIDGE PEA ♈ | A 💧💧 SOYBEAN ✱ | A 💧💧💧 SAFFLOWER ♈ | A 💧💧 TEFF ♈ |
| P SALINE TOLERANT ♈ | A/B 💧💧💧 CHARD ✱ | A/B 💧💧💧 CARROT ✱ | P 💧💧 KURA CLOVER ≈ | A/B 💧💧 VETCH ≈ | P 💧💧💧 SAINFOIN ♈ | A 💧💧 SUNNHEMP ♈ | A/P 💧💧💧 PEANUT ≈✱ | A 💧💧💧 SUNFLOWER ♈ | A 💧💧💧 CORN ♈ |

Cover Crop Chart
USDA-ARS NGPRL



Additional Information

# Oat
# (*Avena sativa* L.)

**This is an example of using the ARS Cover Crop Chart**

- Cool Season, grass
- Annual
- Upright plant architecture
- Medium water use
- Fair salinity tolerance
- Seeding depth: 1 – 2 inches
- Crude protein: hay 9-15%, grain 13-18%
- C:N ratio: 33
- Forms arbuscular mycorrhizal associations
- Self pollinator (wind)
- Rated 'very good' at scavenging nitrogen from the soil



◈ *Back to Cover Crop Chart*

Cool Season Grass

# Functional Groups

## Warm Season

- Grasses, Broadleaves and Legumes

## Cool Season

- Grasses, Broadleaves and Legumes

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# Cool Season Grasses

- Annual Ryegrass
- Cereal Rye
- Barley
- Oats
- Wheat
- Triticale

Spring Oats

Cereal Rye



Photos: Michael Kucera & Jodie Reisner

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# Warm Season Grasses

- Pearl Millet
- Japanese Millet
- Sorghum-Sudan grass
- Forage Sorghum
- Teff

Brown rib sorghum - sudan grass

Pearl Millet



Photos: Michael Kucera & Jodie Reisner

# Cool Season Broadleaves

- Radish
- Turnip and Rape
- Kale and Collards
- Mustard
- Phacelia




# Know How & When Cover Crops Produce Seed so They Don't Become a Problem

- Radishes are photoperiod sensitive  Longer days = seed set
  - Avoid spring/early summer
- Mustards mature quickly, blooming in 45-60 days after planting
- Some brassicas (turnips, collards) require vernalization (needs chilling) to make viable seed
- Climate dependent, some brassicas can over winter

# Warm Season Broadleaves

- Buckwheat
- Safflower
- Sunflower

# Cool Season Legumes

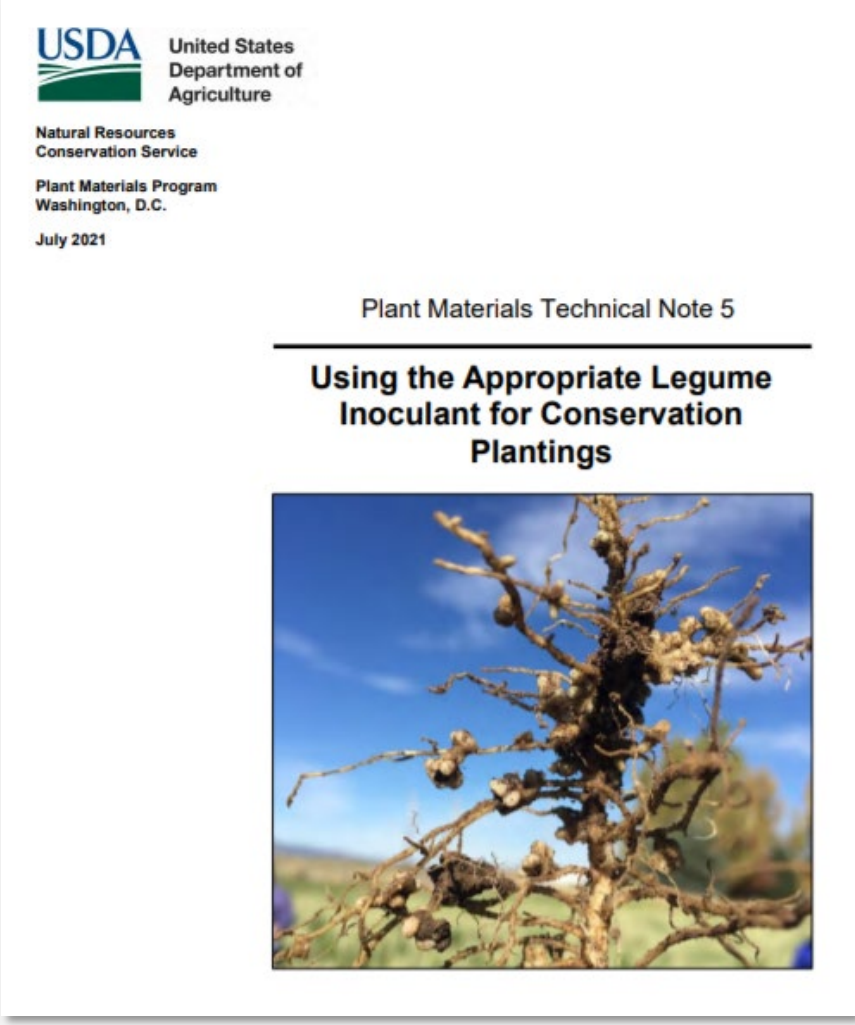
- Vetch
  - Hairy, Purple, Common, Woolypod
- Crimson Clover
- Perennial Clovers
  - Red, White, Alsike
- Winter Pea
  - Austrian, Canadian

# Warm Season Legumes

- Cowpea
- Soybean
- Sunn hemp
- Chickpea
- Mungbean
- Chickling vetch
- Guar

# Need for Legume Inoculation

- Inoculants help guarantee the successful formation of nitrogen-fixing nodules in legumes
- Inoculants are species specific
- Inoculants are alive and have a maximum storage life
- Keep inoculant refrigerated out of direct sunlight and Use prior to expiration date.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Natural Resources Conservation Service

Plant Materials Program
Washington, D.C.

July 2021

Plant Materials Technical Note 5

**Using the Appropriate Legume Inoculant for Conservation Plantings**

USDA United States Department of Agriculture

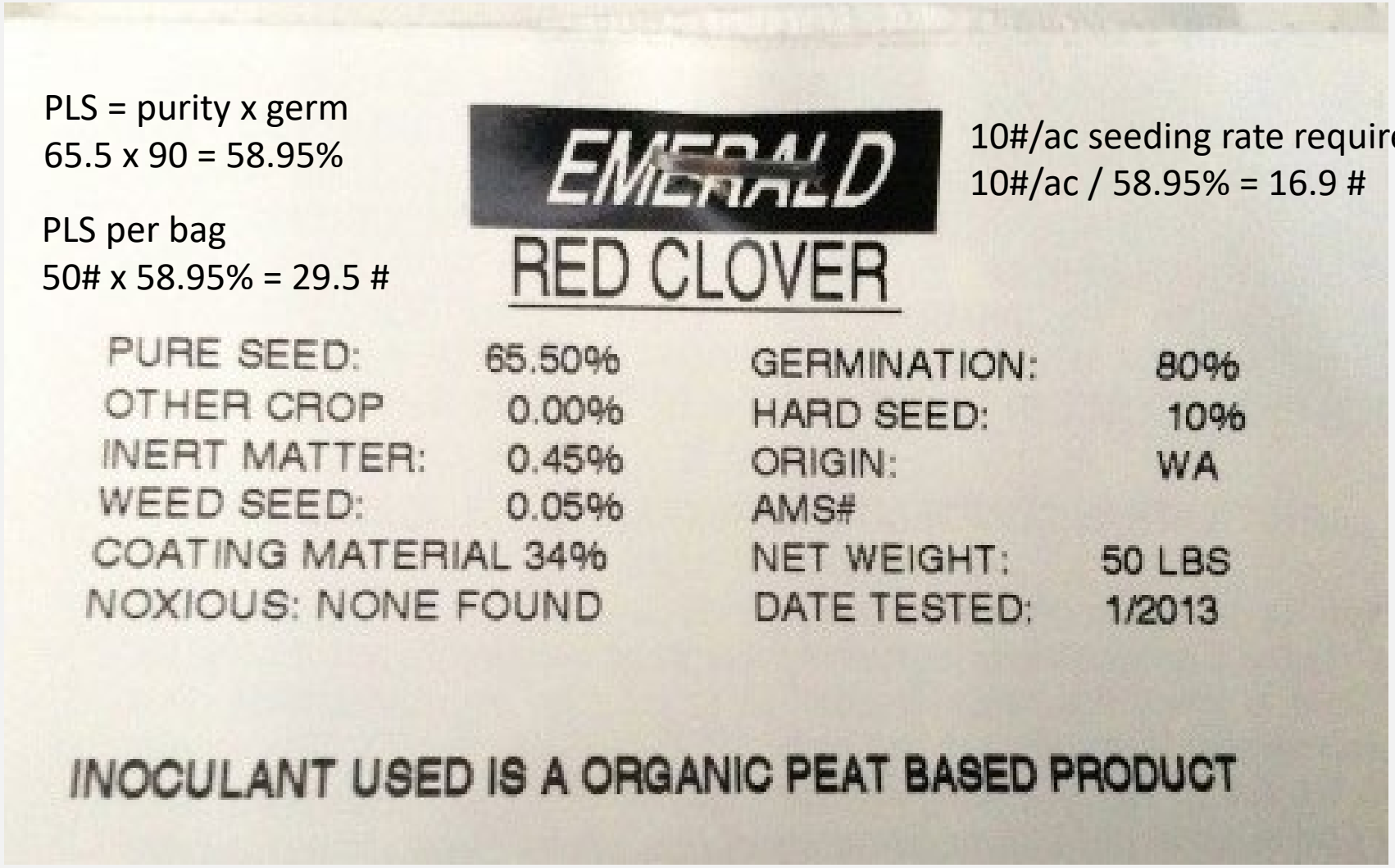
# Bin Run Seed

# Certified or VNS
# What is PLS?

PLS = purity x germ
65.5 x 90 = 58.95%

PLS per bag
50# x 58.95% = 29.5 #

10#/ac seeding rate requires?
10#/ac / 58.95% = 16.9 #



# Completing 340 IR Sheet

| | |
|---|---|
| Planned Seeding date: | 6/1/2023 |
| Planned termination date: | 4/15/2024 |
| Planned termination method: | Herbicide |

Additional specifications and notes: ( Seedbed prep, Planting method, Other information as needed)

**Producer:** _____ **Date:** _____

**Planner:** **Date:**

**Certification**

I have completed a review of the information provided by the client (or checked in the field) and certify this practice has been applied and meets NRCS standards and specifications.

Document or refer to attachment for each item below

| | Year 1 | Year 2 | Year 3 |
|---|---|---|---|
| · Seed tags and receipts for cover crop seed | | | |
| · Record of planting date, and seeding rate | | | |
| · Record of method of termination and date | | | |
| · Photo of cover crop before termination | | | |
| **Acres Certified** | | | |
| **Planner Signature** | | | |
| **Date** | | | |

NRCS UTAH 2023

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# Knowledge Check

What are the four functional groups of cover crops?

Answer:

Warm Season Grasses

Cool Season Grasses

Warm Season Broadleaf

Cool Season Broadleaf

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# PMC Variety Trials

- National Cool Season Cover Crop Adaptation Trials
  - Regional Technical Notes
  - PMC Study Reports
- Spring planted cool season cover crops in the Northern Great Plains
- Other Cool Season Cover Crop Trials
- Warm Season Cover Crop Adaptation Trials

# Cultivars Vary

**black oats (*Avena strigosa*)**

SoilSaver

**black-seeded winter oats (*Avena sativa*)**

Cosaque

**balansa clover (*Trifolium michelianum*)**

Fixation
Frontier

**crimson clover (*Trifolium incarnatum*)**

AU Robin
AU Sunrise
AU Sunup
Contea
Dixie
KY Pride

**field peas (*Pisum sativum*)**

Arvica
Dunn
Frostmaster
Windham
Lynx
Maxum
Survivor-15
Whistler

**red clover (*Trifolium pratense*)**

Cinnamon Plus
Cyclone II
Dynamite
Freedon
Kenland
Mammoth
Starfire
Wildcat

**daikon radish (*Raphanus sativus*)**

Big Dog
Concorde
Control
Defender
Driller
Eco-till
Graza
Groundhog
Lunch
Nitro
Sodbuster
Tilllage

**cereal rye (*Secale cereale*)**

Aroostook
Bates
Brasetto
Elbon
FL 401
Guardian
Hazlet
Maton
Maton II
Merced
Oklon
Rymin
Wheeler
Wintergrazer
Abruzzi

**hairy vetch (*Vicia villosa*)**

CCS-Groff
Lana
Purple Bounty
Purple Prosperity
TNT
Vilana

# How will you seed it?

## Drill

- Most time consuming
- May allow reduced planting rate
- Provides row plant spacing
- Consistent results
- Good soil to seed contact

# How will you seed it?

## Air Seeder on a Harrow or Vertical tillage

- Wide swath at 10 mph
- Fast
- Provides a random plant spacing
- Soil disturbance

# How will you seed it?

## Fly it on

- Most flexible timing
- Fast
- Provides a random plant spacing
- No seed to soil contact/moisture dependent
- Higher seeding rates may become impractical

# How will you seed it?

## Fly it on…When?...What?

- Target the optimum window
- Balance sunlight and moisture
- Growing Degree Days
- Some species are more adapted, seed size
- Lack of soil to seed contact/Moisture dependent

# How will you seed it?

**Highboy for establishing into standing corn**

# How will you seed it?

## Air Seeder on Combine Head

**Ray McCormick, Vincennes, IN**

- Concurrent operation
- Cheap / Fast
- Provides a random plant spacing
- Seed placed beneath the residue

# How will you seed it?

**Precision planting in narrow rows (15” rows)**

- Use existing bean planter
- Less seed per acre
- Provides precision row/ plant spacing
- Consistent results
- Good soil to seed contact

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# Inter-seeding Options

Interseeding into V6 Corn

Crimson clover about 8 weeks after interseeding

ARG, legume mix

Annual ryegrass Oct 30th Central NY

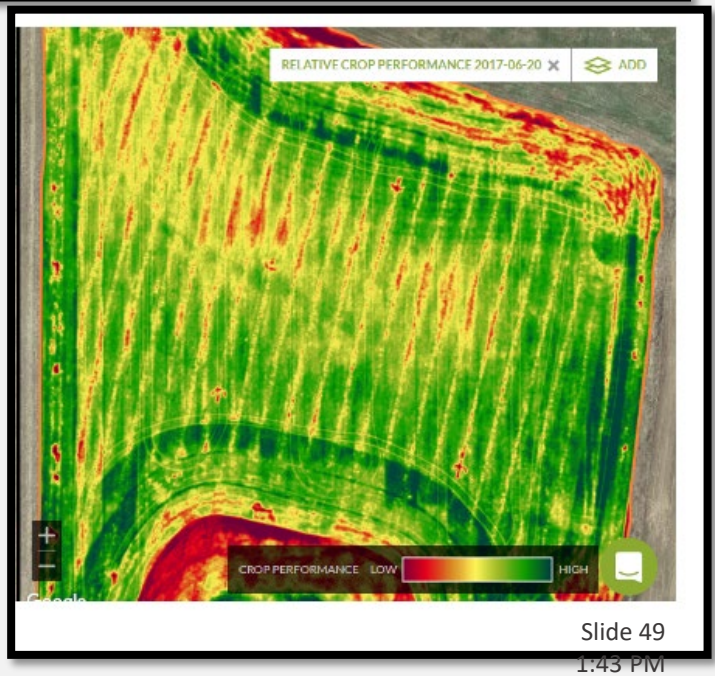
# Planting Green

Advantages:

- increased biomass for weed control
- better planter performance in standing cover vs a thick mat
- more biomass reduces evaporation and erosion

Plan accordingly to reduce potential challenges

- increased pest pressure (green bridge?)
- more risk of wrapping on planter drives and wheels; hair pinning
- pollen shed plugging breathers or air flow devices
- over utilization of moisture.



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# Cover Crop Termination Methods

- Herbicide burn down
- Tillage
- Frost termination
- Crimper / Roller (mature enough to kink the stem)
- Grazing– Not in Termination Guidelines
- Shredding / mowing
- Combination of methods

# COVER CROP -Termination When and How?

- Have a good GAME PLAN…
  - What are your goals?
- Be adaptive to the season
  - Wet springs happen!

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# Cover Crop Herbicide Restrictions

## Forage and grain (food chain)

- Herbicide must be labeled for all crops
- Rotation/plant back restrictions
- Forage restrictions (grazing, haying)

## Cover only (soil building or erosion)

- At your own risk (some labels lack info)
- Review labels/experience
- Climate & soils (biological activity)

# Herbicide Restrictions from a Planning aspect

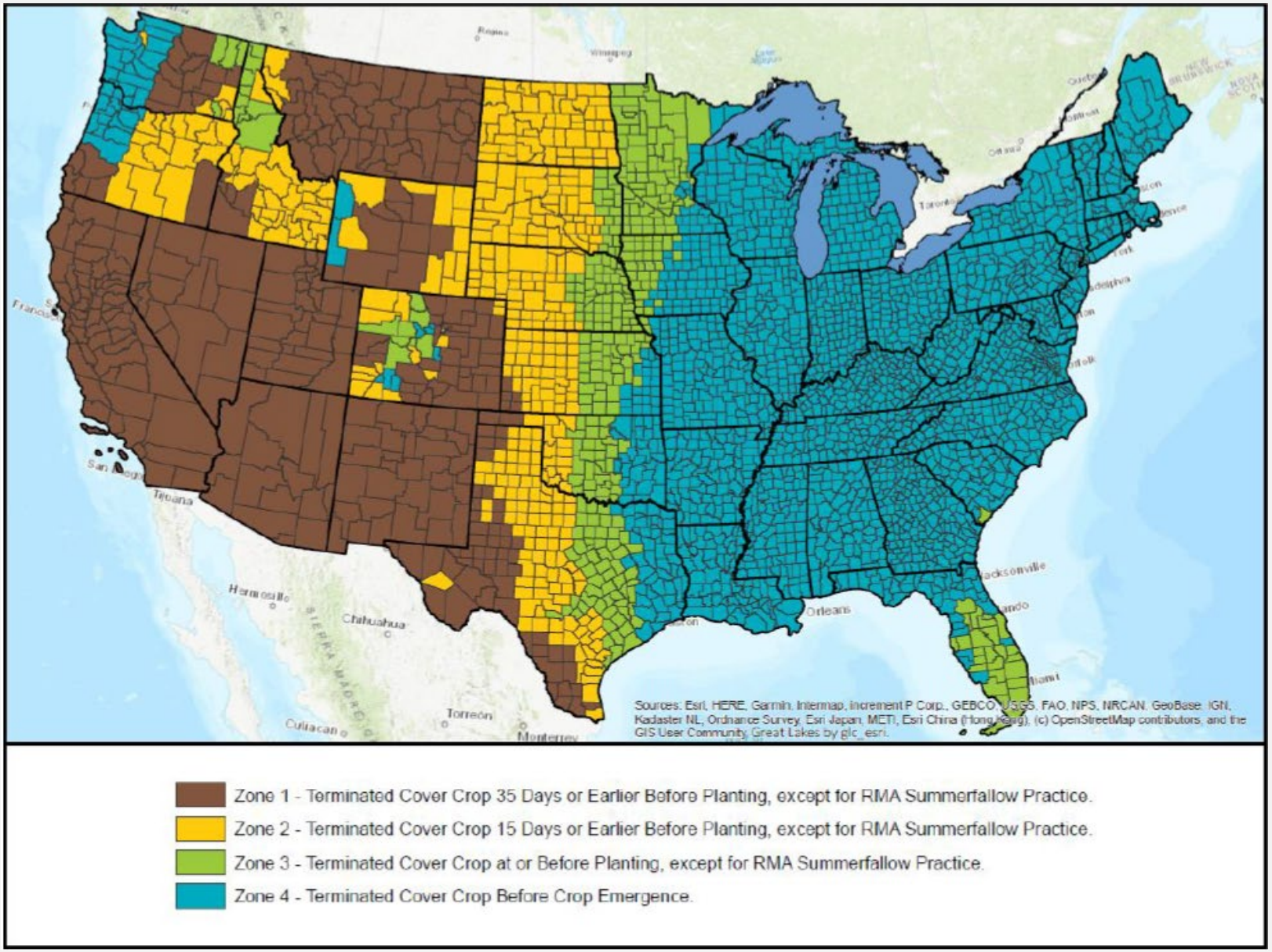
## Planner Needs:

- Determine producers crops in the system
- Need to inventory producer herbicides
- May need to look up labels, Look at plant back timing.
- Decide if your species mix will be an issue

## Producer Needs:

- Follow label
- Do a bioassay to assure no carryover
- Check with the planner if they need to switch a species out of the mix

# NRCS Termination Guidelines



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# Covers and Pest Management

- Reduce sunlight reaching soil surface
- Alter micro-environment during weed seed germination
- Release of chemicals from roots or decaying residue to inhibit weed seed germination (allelopathy)
- Improve overall soil health to enhance crop vigor
- Physical barrier to pathogens

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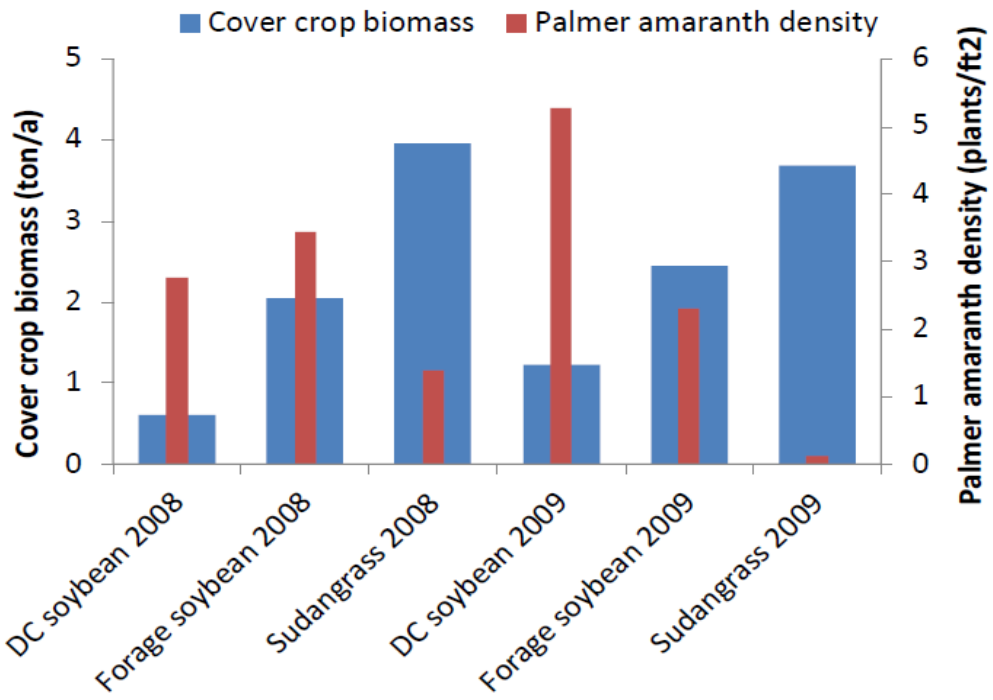
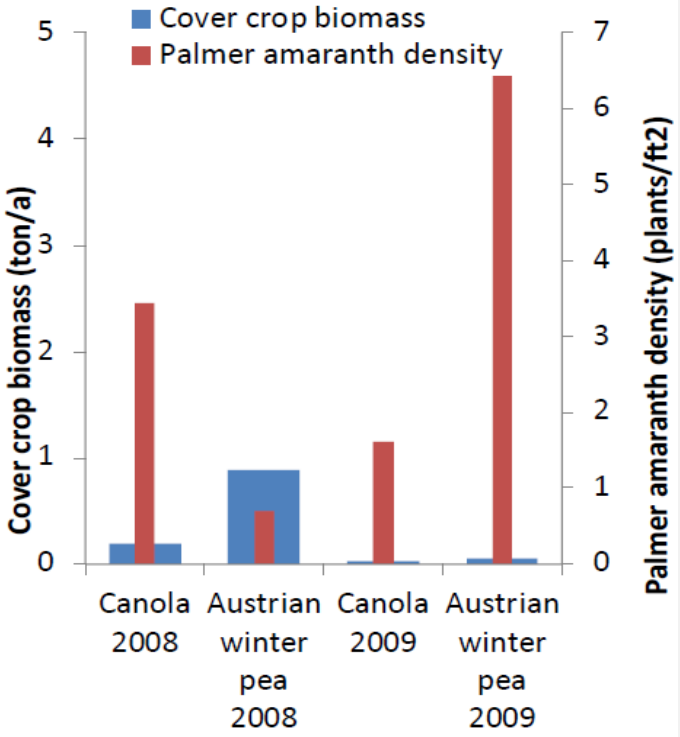
# Residue Effect on Palmer Amaranth

- **Cover crops in wheat stubble, before grain sorghum**
- **Every 900 lb/ac increase in cover crop biomass reduced Palmer amaranth biomass by 4% (Petrosino, 2010)**



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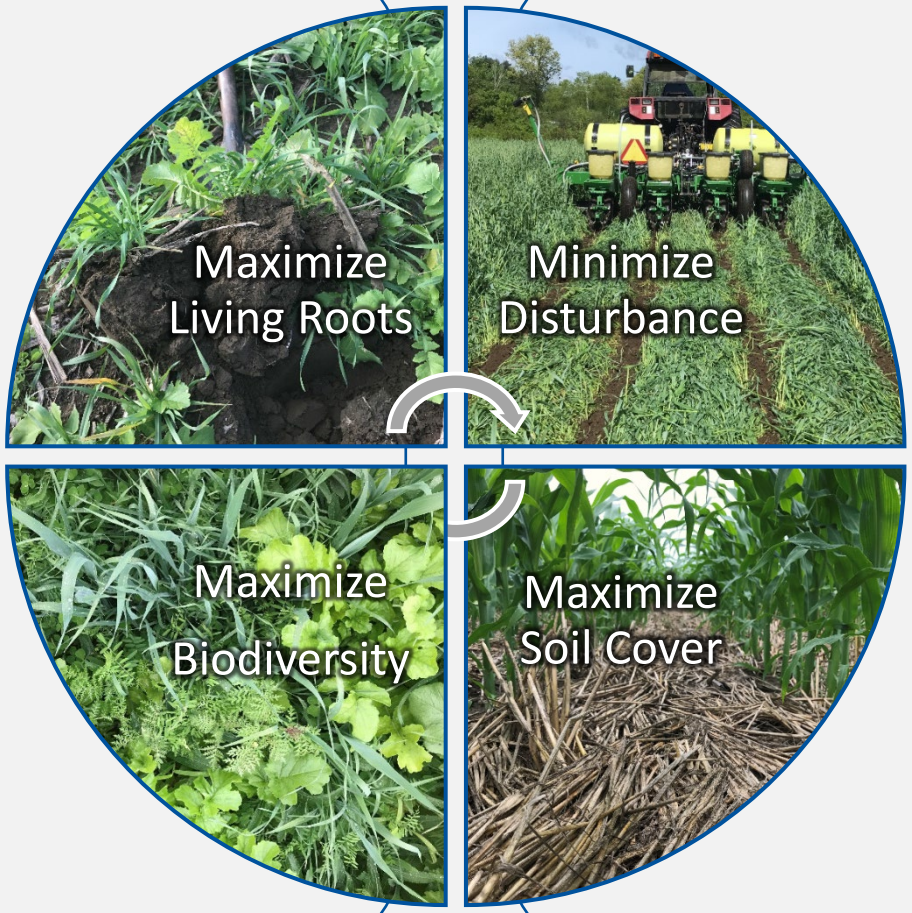
# Cover Crop Planning Tools

- Cover Crop 340 Practice Standard
- Cover Crop Councils
- Resources and Publications—Soil Health Division
- Sustainable Agriculture Research & Education (SARE)
  - Online Book and Topic Room on Cover Crops
- Cover Crops for Sustainable Crop Rotation and Soil Health and the SARE cover crops topic room
- No-Till Farmer: The Pluses And Minuses Of Today's Most Popular Cover Crops
- Various industry cover crop calculators

# Soil Health Principles to Support High Functioning Soils

## Feed

Fuel Soil Biology
Improve Resilience
Improve SOM




## Protect

Soil Aggregates
Organism Habitat
SOM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*While an effort has been made to provide a complete and accurate listing of services, supplies, and equipment, omissions or other errors may occur and, therefore, other available sources of information should be consulted.*
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*Meeh, NRCS*