



Module 7 Cover Crop Management

Soil Health & Sustainability for Field Employees

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Goals

By the end of the lesson you will be able to:

1. Identify management strategies to integrate cover crops into soil health management systems
2. Discuss the impact that cover crops have on soil functions, e.g. water infiltration & availability, nutrient cycling
3. Identify benefits of cover crops in agricultural systems.
4. Understand key concepts for successful cover crop management, including planting, termination and species selection.
5. Design a cover crop (mono and multi-species) strategy to address identified resource concerns
6. Discuss key concepts to trouble shoot problem cover crop plantings
7. Discuss differences in cover crop planning and management across various geographic regions.

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Cover Crops

“If you’re trying to make your soil healthier, You shouldn’t see it very often”



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Is it a Cover Crop or Biological Primer?

- Cover Crops have been used mainly to provide cover to protect from forms of erosion.
- Many soil health innovators realize that cover crops can be more than providing cover, they are biological primers that jump start the revitalization of the degraded soil ecosystem.



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2nd most important biological process = Nitrogen fixation

What is the most important biological process?



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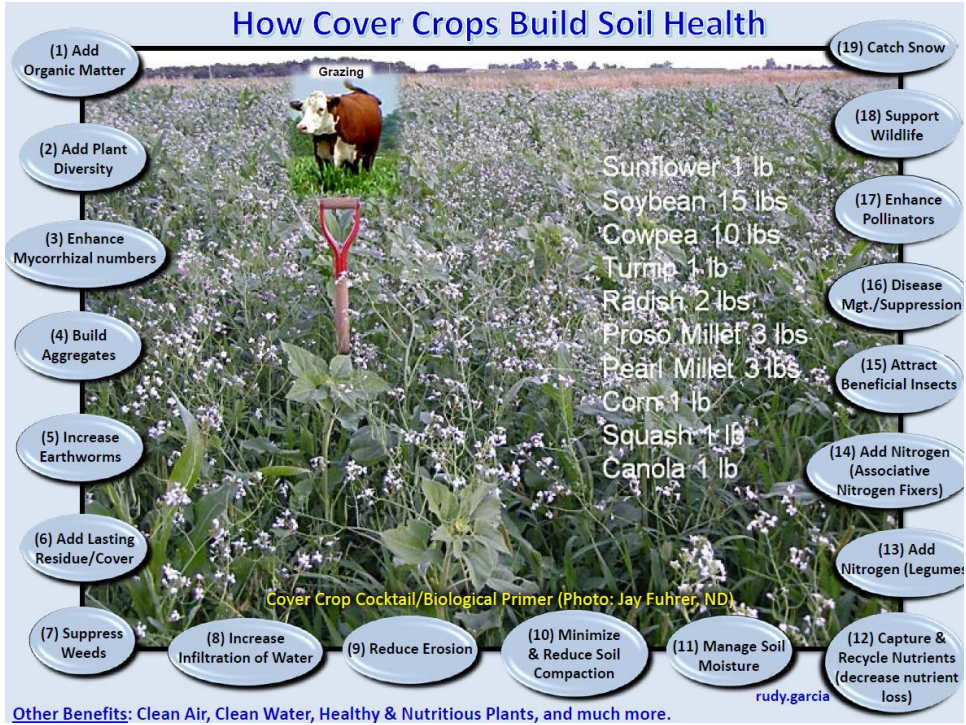


Cover Crops from a Farmer's Perspective:
Gabe Brown talks about Biological Primers (cover crops)

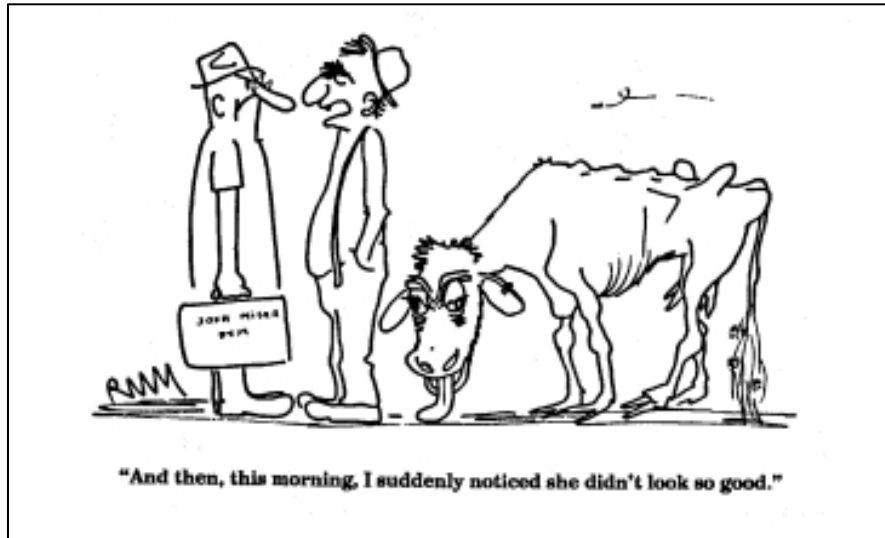


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What is your resource concern?





Nature's Way:



NRCS ID
Cover Crop
Seed Mix
Calculator

Plant Species	Cultivar	Seed Rate PLS Lbs/ac	Seeds per Lbs	Seed per Acre	Total PLS Planned Lbs/field
LEGUMES					
Cllover, Crimson	Elite	2.0	150,000	300,000	80
Pas. spring	WNS	15.0	3,200	48,000	600
Vetch, Chickling		8.0	2,500	20,000	320
GRASSES					
Millet, Proso		5.0	12,000	60,000	200
Teff		0.5	1,300,000	650,000	20
Oats,		5.0	19,600	98,000	200
BRASSICAS					
Turnip, Purple top	Purple top	1.0	192,800	192,800	40
Radish	Graze	1.0	25,000	25,000	40
Collards, Impact Force		1.0	175,000	175,000	40
BROADLEAFS					
Sunflower	black oilseed	1.0	8,000	8,000	40
Total		39.5			1,580

Planned Seeding date: _____
 Planned termination date: _____
 Planned termination method: _____
 Additional specifications and notes: (Specific type of rhizobium for legumes, Planting method, Other information as needed)

The producer has received a copy of the planned practice specifications and understands the contents and requirements.
 Producer: _____ Planner: _____
 Date: 5/6/2014
 for additional info on cover crops see NRCS ID ag technical note #56
 NRCS ID May 14

Why should farmers try cover crops?

Agricultural Benefits

- Supplemental grazing
- Improve organic matter
- Nitrogen capture/cycling
- Additional lasting residue/cover
- Weed suppression/disease cycle
- Beneficial insects,
- Food source for predators/pollinators



Source: <http://www2.mcdaniel.edu/Biology/eco/soil/soils1.htm>

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Why should farmers try cover crops?

Agricultural Benefits

- Soil structure, compaction, porosity (physical properties)
- Erosion and runoff reduction (HELC)
- Nitrogen fixation by legume cover crops
- Soil water management
- Soil health – biological life



Photo: M. Winger, Radish holes

Source: <http://www2.mcdaniel.edu/Biology/eco/soil/soils1.htm>

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Considerations for successful cover crop planning



- Site preparation/Early weed control is essential
- Herbicide carryover and label restrictions
- Timing and species (adequate growing season)
- Crop rotation/diversity
- Seeding method seed-soil contact (broadcast vs. drilling, adequate equipment)
- Seed size/seeding depth
- Site and moisture conditions

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Considerations for successful cover crop planning (cont.)



- Residue management (cash crop) before and after cover crop emergence
- Moisture management (cover benefits, water use)
- Nutrient cycling considerations (C:N ratio, living root)
- Weed, insect and disease management
- Termination method/timing – know before you plant how your are going to terminate
- Establishment of next cash crop
- Economics (yield impacts, cost of establishment, soil improvement,)
 - (“can we afford not to use a cover crop” J. Fuhrer, 2016)

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Why Diverse Cover Crop Mixes?



1. If Soil Health is the goal, Crop Diversity cannot be ignored or overstated
2. Plants were created to grow in diverse ecosystems
3. *Resilience* comes from *Diversity*
4. Balanced “diet” for soil biology
5. Balance: because even good things (legumes, brassicas) when not used in moderated balance can be harmful

Cover Crop impacts on Soil



Worms underneath decomposing cow pie
 165 worms per cubic foot. = 7.2 million
 worms per acre.



Nurture Nature with System Synergies



No Tillage

Minimum carbon loss



Cover Crops

Maximum carbon input

Carbon management

Sustainability



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Questions to ask when planning cover crops with a producer

1. What are the Goals/Concerns?
2. What are the environmental (climate, rainfall, frost, growing season) considerations?
3. What is the timeframe?
4. What is the budget?



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Cover Crops

Designing for what you don't have!



Identify Resource Concerns

- Provide crop diversity
- Provide soil surface armor (erosion)
- Build soil aggregates
- Improve the water cycle
- Integrated Pest Management
- Build soil organic matter
- Nutrient cycling
- Air Quality
- Enhance pollinator /predator habitat
- Adjust carbon/nitrogen ratios
- Wildlife winter food & shelter
- Livestock integration
- Nitrogen fixation

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Main Reason – Soil Erosion



Suppress Weeds

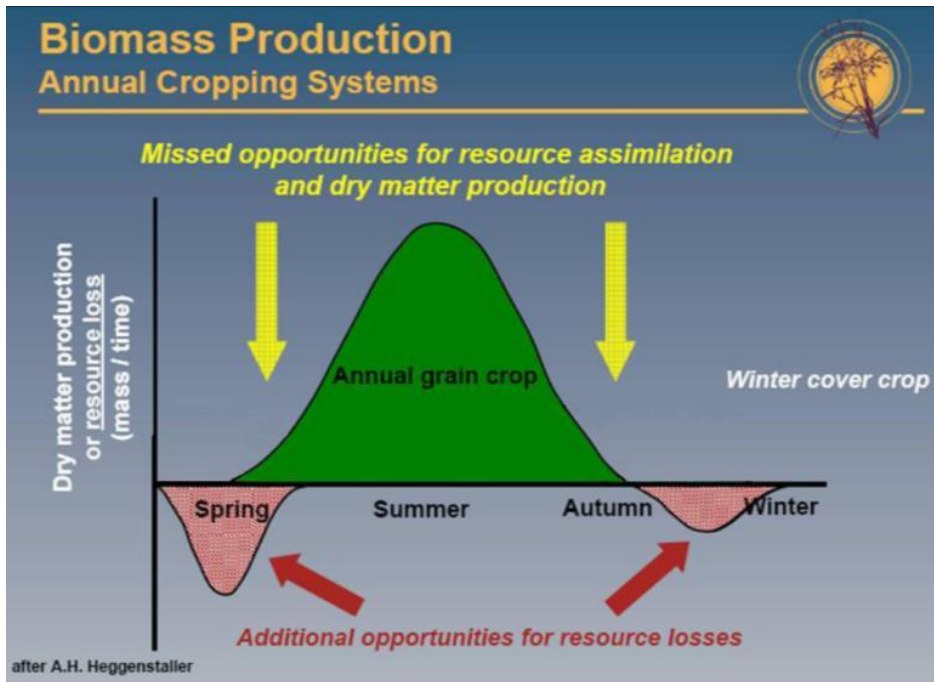


Spring 2008 Weed Suppression (ND)



What are your goals/resource concerns? Generally speaking....

1. The more specific your goals/concerns, the less diverse your mixes will typically be
2. The tighter your planting windows, the fewer species will work and thus the less diverse your mixes will be
3. Minimum of 6 to 8 weeks of growth necessary to achieve most benefits



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What is your timeframe?

1. Spring - fallow ground or prior to a spring crop
(chemical/mechanical termination)
(Check crop insurance implications!)
2. Early Summer - Right after wheat harvest
(frost or chemical/mech. termination)
3. Late Summer - Delay after wheat harvest
(frost termination)
4. Fall - After fall crops
(frost termination or over-wintering)

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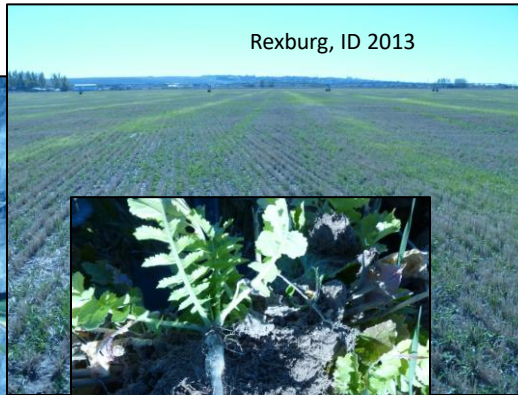
Cover Crop Termination Methods

- Frost termination
- Crimper / Roller (mature enough to kink the stem)
- Herbicide burn down
- Grazing
- Shredding / mowing
- Organic methods (propane flame)
- Combination of methods



Cover Crop Tips

- Use species that are adaptable to your environment
- Adjust species composition to season of use
- Diversity (speeds up biological time)
- Be aware of herbicide residuals
- Check with crop insurance eligibility
- Don't use a species in the mix if you are planning to seed it in that field next year
- If grass finishing, do not allow any grains to set seed
- "It can't grow in the bin, when in doubt seed it"! (G. Brown)



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Diversify!

- Hard to improve Soil Health if there is no diversity of crop types.
- Need To Add Species Diversity.



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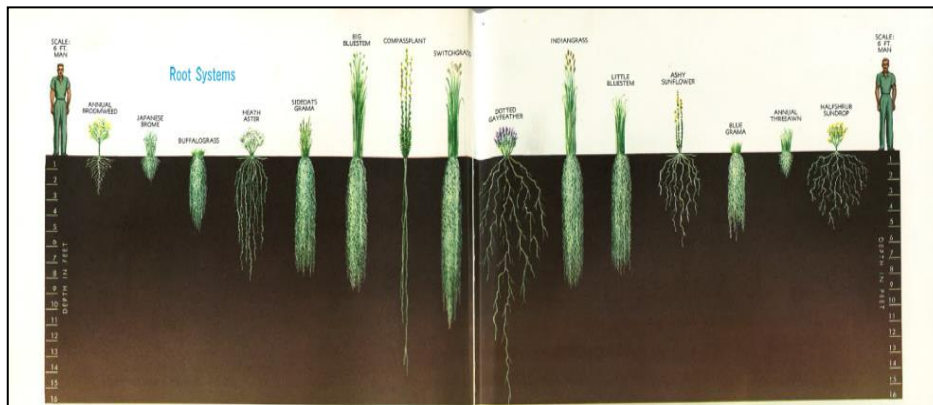
Grace, Id 2014 8 way cover mix



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Diversity in Root Systems

- Diversity in root systems = diversity in soil biota



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Soil Moisture Management

- Increase Infiltration
- Reduce Evaporation
- Remove Excess Moisture
- Terminate while cover crop is vegetative (before peak water use occurs)
- Six weeks of growth to achieve “rotation effect”

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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.

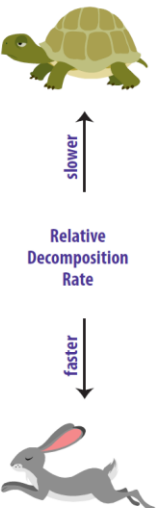


Do you know your cover crops?

- 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 (Nutrient Cycling)

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



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

Get 4 Things Right

1. **The Right Species**
2. **The Right Inoculants**
3. **The Right Seeding Rates**
4. **The Right Seeding Time**



Plant Functional Groups & Species

<p>Legumes</p> <p>Common Vetch</p>  <p>Spring Pea Lentil</p>	<p>Grass</p> <p>Italian Ryegrass</p>  <p>Oats Proso millet</p>
<p>Broadleaf</p>  <p>Safflower Purple Top Turnip</p>	<p>Broadleaf</p>  <p>Daikon radish Winter Canola</p>

Cool Season Grasses

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



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Photos: Michael Kucera



Warm Season Grasses

- Pearl Millet
- Sorghum-Sudan grass
- Forage Sorghum

Brown rib sorghum - sudan grass



Pearl Millet



Cool Season Broadleaf

- Oilseed Radish
- Turnip
- Kale and Collards

Impact Forage Collard



Radish



Warm Season Broadleaves

- Buckwheat (NRCS planning restrictions)
- Safflower
- Sunflower



Cool Season Legumes

- Hairy Vetch
- Crimson Clover
- Winter Pea

Hairy or Woollypod Vetch



Hairy Vetch
Crimson Clover



Balansa Clover

Warm Season Legumes

- Cowpea
- Soybean
- Sunn hemp
- Chickpea
- Mungbean



cowpea



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Cover Crop Herbicide Restrictions

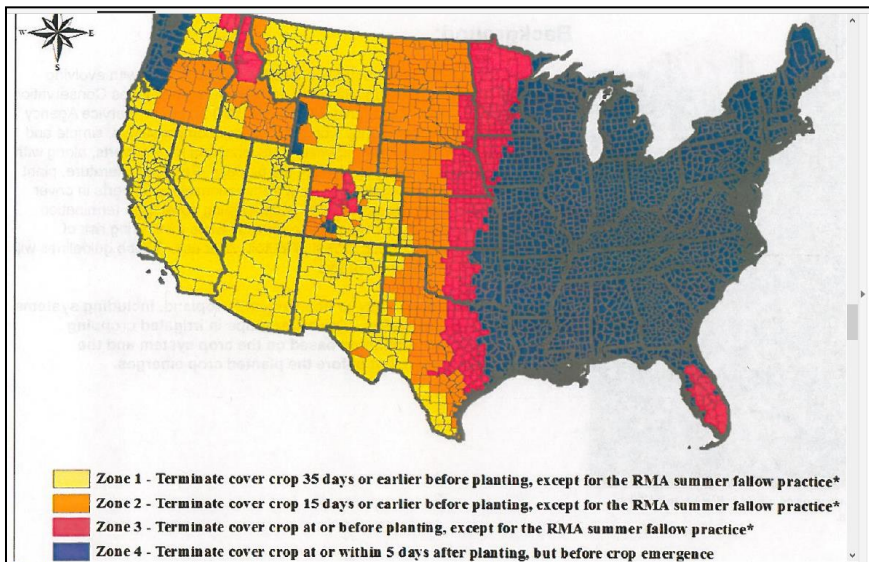
- Forage and grain (food chain)
 - Herbicide must be labeled for all crops
 - Rotation/plant back restrictions
 - Forage restrictions (grazing, haying)
- Cover only (soil building or erosion)
 - At your own risk (some labels lack info)
 - Review labels/experience
 - Climate & soils (biological activity)



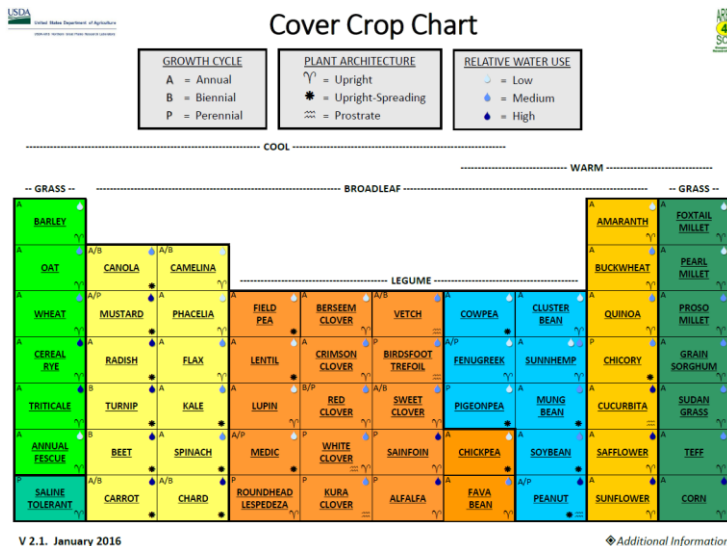
Read Herbicide Labels Thoroughly

- “Cover crops for soil building or erosion control may be planted any time, but do not graze or harvest for food or feed. Stand reductions may occur in some areas”.

Crop Insurance



USDA-ARS Cover Crop Chart





Example cool & warm season Biological Primer mixes

Cool Season Cover crop	PLS/acre
Barely	8
Oat	5
Lentil or Vetch	2
Pea	15
Clover, Crimson	1
Radish	1
Canola or Rape	1
Turnip	1
Total	34 Lbs

Warm Season cover Crop	PLS/acre
Pearl Millet	3
Sudangrass	4
Buckwheat	3
Safflower	2
Radish	1
Turnip	1
Canola	1
Spring Lentil	2
Pea	15
Crimson Clover	1
Total	33 Lbs

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Cover Crop Seeding Rates

- Seeding rates variable depending on location, goals, and objectives
- Consider economics of seeding mixes and consider return on investment
- Examples: Idaho 30-40 PLS for irrigated cropland
- Kansas dryland 750K seeds/ac
- Indiana 12 live plants per/sq. ft.
- Based on your local knowledge and experience
- Legumes \$\$\$\$\$\$

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2014 Cover Crop Mix: (J. Fuhrer 2016) warm season or cool season

• #/acre	Species
5	Super sweetsorg / sudan
5	BMR grazing corn
3	Soybean
1	Cowpea
1	Mung bean
2	Forage collards
1	Hunter turnips
1	Wildlife grain sorghum
1	German millet
1	Berseem Clover, Crimson Clover, Arrowleaf Clover
1	Sunflower
1	Buckwheat, Oats, Safflower

Total 23 lbs

Cost \$27.00/ acre

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Local examples of producers implementing cover crops

- Soil health principles are universal, how you implement them in your operation is unique!
- Each operation is unique and their approach to cover crops may be different.
- Here we will discuss how multiple producers addressed their individual resource concerns by implementing the use of mixed species cover crops on the land.

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Southeast, Rolling multi species over crops and planting the same day



Photosynthesis 365 day

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J. Raybould – St. Anthony ID
Planted 9/7/12
40 DAP = Oct 17





2014 St. Anthony



McIntyre Farms: Caldwell, Id 2013

- Cover crop mix:
- Radish
 - Turnip
 - Sudan grass
 - Millet
 - Buckwheat
 - Oats
 - Soybean
 - Rape
 - Vol. wheat

- Planted: 8/10/2013
- No-Till Drilled into wheat stubble
- Grazed Oct. 17, 2013, End grazed: Dec 17, 2013
- Grazed for 61 days
Biomass: 13,684 lbs DM/ ac
23.1 % DM





- 300 head of wild mother cows
- 3 acres per day
- Stock density: ~106,000 lbs / acre
- Previous crop: Irrigated winter wheat
- Planned crop:
- 2014 Irrigated grain corn -274 bu /ac
 - Idaho no-till record
- 2015 spring peas



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6 way mix: wheat, turnip, radish,
soybean, cowpea, sudan grass
Planted: July 25, 2012



Marsing, ID Deruyter dairv & McIntvre Farms



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Tex Creek, Wildlife mgt area,
Idaho Dept of Fish & Game Idaho Falls, Id
13 way cover crop mix – Great plains no-till drill
Improve forage diversity for wildlife





Terminating cover crops and planting in one pass



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Spreading Rye Cover Crop Mix (Fall 2011)



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Slice and dice with disk drills



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Rye Grows in Spring and corn is planted with no-till planter





Cover Crop Planning Tools

- Cover Crop 340 Practice Standard – *example Idaho 340 job sheet*
- Midwest Cover Crop Council <http://www.mccc.msu.edu/index.htm>
- Resources and Publications
<http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/resource/>
- MO Extension Bulletin: G4161 Cover Crops in Missouri
- 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 at <http://www.sare.org/Learning-Center/Topic-Rooms/Cover-Crops>
- No Till Farmer Pulses and Minuses
- Various industry cover crop calculators



Lets make a mix

- [..\National Standards\340 cover crop\2015 340\Cover crop job sheet 2015.xlsm](#)
- Build your own mix.
- When and how is it planted/ when and how is it terminated?
- Where does it fit in the crop rotation
- What resource concerns does it address