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PREPARING A NEW GENERATION OF ILLINOIS FRUIT AND VEGETABLE FARMERS

COVER CROPS FOR VEGETABLE AND FRUIT PRODUCTION IN ILLINOIS

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with contributions from Mike Plumer, Jeff Kindhart, Rick Weinzierl, and Sam Wortman

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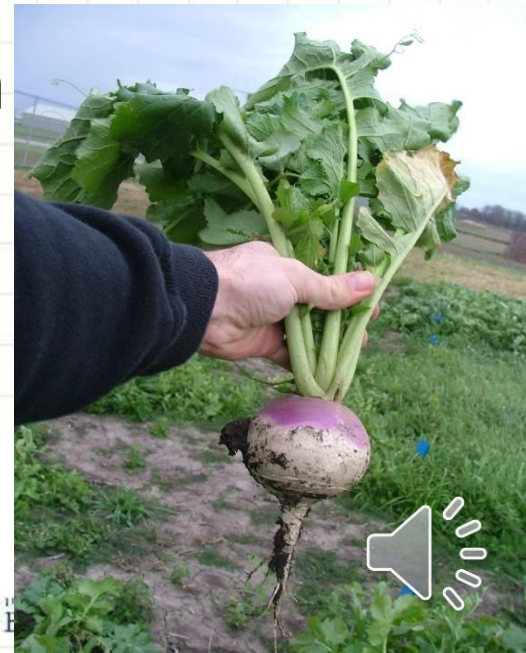
Cover Crops Defined

- Crops planted for the purpose of conserving natural resources, improving soil health, and/or preserving, adding or cycling nutrients, and managing weeds
- Often planted during times when no other cash crop is present
  - Over winter or between summer crops



Why Use Cover Crops?

- Prevents erosion
- Reduces soil compaction
- Improves soil drainage
- Breaks up plow pans
- Increases water infiltration
- Increase soil organic matter
- Suppresses weeds
- Scavenges and holds nutrients
- Produce nitrogen
- Improves soil tilth
- Protects water quality
- Habitat for beneficial insects, pollinators, earthworms, and soil microbes
- Suppress nematodes
- **Improves overall soil health = Increased crop health!!**

Different cover crops provide different benefits!!

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Plant Nutrient Production and Recycling

- Nitrogen
  - Nitrogen scavenging (catch crops)
  - Biological nitrogen fixation
  - What is a realistic goal for adding N to the system?

Will you be able to replace synthetic N on your farm?

http://smallfarms.oregonstate.edu/calculator

ENTER YOUR COVER CROP INFORMATION FROM THE FIELD AND THE LAB									
Enter your information in yellow cells. Results are in green cells.									
	Area sampled (ft^2)	Fraction of acre sampled	Fresh weight of field sample (x.x lb)	% N from lab (x.x%)	% dry matter from lab (xx.x%)	fresh weight (lbs/A)	Total dry weight (lb/A)	Total N (lb/A)	PAN (lb/A)
COVER CROPS									
Hairy Vetch	5	0.000115	5.0	3.0	15.0	43560	6534	196	78
Field Pea	10	0.000230	8.0	3.5	18.0	34848	6273	220	103
		0.000000				0	0	0	0
Comments to:	nick.andrews@oregonstate.edu								

Soil Organic Matter (SOM) has economic value

- Cover crops are key to building SOM!
- Every 1% point increase in SOM adds about 1 inch of water holding capacity/acre, each inch is 1 week in a drought
- Water infiltration and soil aggregation increases, while erosion and bulk density decreases
- Nutrient efficiency improves
  - Value of N from SOM: $9-$15/acre
- Increased SOM and cover cropping have shown yield stability in years with low rainfall, compared to rotations without cover crops

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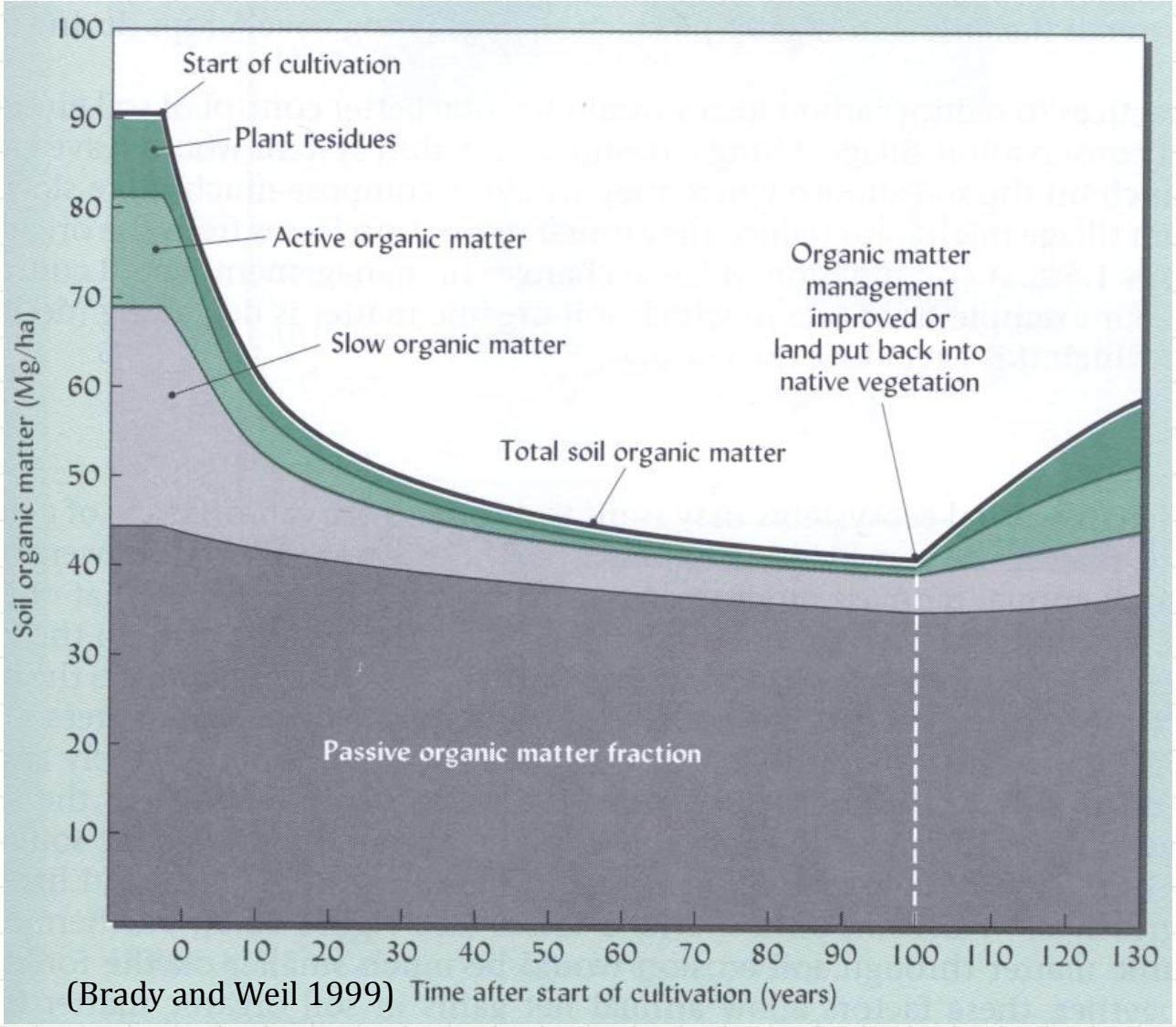
Tillage Can Reduce Soil Organic Matter



(Brady and Weil 1999)

Profitable Production Practices Can Actually Increase Organic Matter!

- Photo courtesy of S. Snapp

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Cover Crops are an Important Soil Conservation Tool

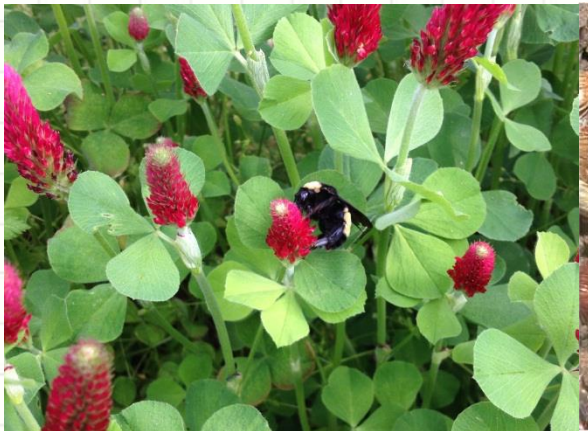
- Soil coverage (most species living or dead) reduces erosion especially on highly erodible soils

Fuel Soil Microbial Communities

- Including cover crops in rotation results in changes to the structure of microbial communities – so what?
  - Increased microbial diversity and resilience
  - Depending on management, cover crops can increase fungal populations
- Fungi – specifically AMF (arbuscular mycorrhizal fungi) – are essential for nutrient cycling and adsorption of immobile elements
  - Hosts = tomato and pepper
  - Non-hosts = Brassica crops

Habitat for Beneficial Insects

- Cover crops increase weed seed predators
- Cover crops increase pollinator populations
  - *Researchers in Georgia were able to eliminate one pesticide application in cotton by attracting beneficial pest predators*



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Weed Suppression

- Light interception
- Lower soil temperature
- Physical interference
- Delayed soil N release
- Allelopathic phytotoxins

Biofumigation

Mustards produce isothiocyanates. Flail/mow and incorporate for biofumigation. Results (disease and weed suppression as well as crop establishment) can vary.

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Mike Plumer, retired U of I Extension Educator and cover crops / no-till authority. Currently an agricultural consultant in southern IL.

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Impact of cover crop 2012

Cover crop	Harvest population	Yield bu/a
Ryegrass/crimson clover **late killed**- moisture deficit, no rain	31,00	25.6
Windham winter pea	30,200	35
Ryegrass /crimson	29,500	79.7
Ryegrass/crimson/radish	30,500	139.0
hairyvetch,/ryegrass/radish	31,00	147.1
Hairyvetch/ryegrass/radish early killed	29,200	180.4

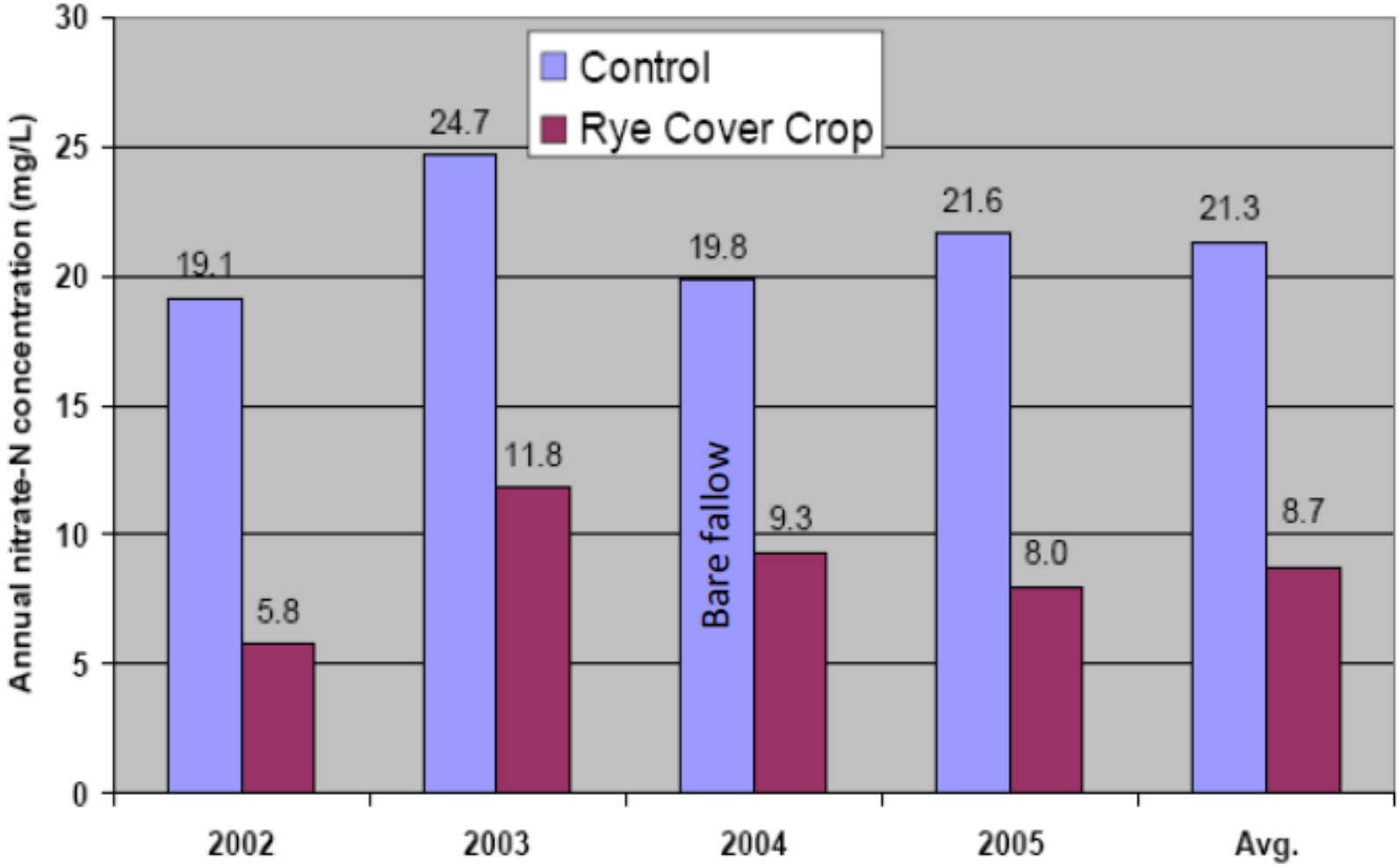
Nitrogen: 50#/a at planting, 70#/a side dressed as 28% lsd .05 16 bu/a

Continuous no-till with spring vertical tillage … note compaction layers.


Soil tilth after multiple years of cover crops and no-till


Corn root depth after years of cover crops

Average annual flow-weighted nitrate-N concentration of drainage water for 2002-2005



U of Ill.

Cover Crops for Vegetable Cropping Systems in Illinois

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How to Use Cover Crops in Vegetable Crop Systems

- Fall/Winter crop to be left in place to protect soils and hold nutrients
- Summer fill between crops
- Main crop during the primary growing season
  - Good to incorporate into a crop rotation
  - Helps break disease and insect cycles from continuous vegetable production
  - Excludes production of cash crop

How to Use Cover Crops in Vegetable Crop Systems

- Companion crop planted between rows of the vegetable crop (between rows of black plastic!)
- Pollinator Habitat
  - Strips of Buckwheat planted around cucurbits
- Residue cover for no-till production

No-till/Cover Crop Benefits in Fruit and Vegetable Production

- Cleaner fruit/fruit not lying directly on the soil
- Weed Control
- Easier field access/harvesting under adverse weather conditions
  - Especially less muddy after rains
- Preserve soil moisture
- Nitrogen production (legumes)




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

Buckwheat

- Great at improving soil tilth
- Quick to establish
- Very good at mineralizing phosphorus in the soil
- Very competitive with weeds
- Caution can re-seed!
  - Plan to kill about a 7-10 days after flowering (~40 days after planting)
- Great quick, summer cover between crops
  - Seeding rate: 30-50 lbs/A

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Oats (Spring Oats)

- Establishes fast, good erosion control
- Will pick up nitrogen
- Winter kills at around 20 degrees
  - Winter oats grow all winter in southern Illinois
- Reduces winter annuals
  - Seeding rate: 30-50#/a
- Easy to plant into in spring

Crimson Clover

- Annual Clover
- Great soil builder
- Excellent nitrogen producer (Legume)
- Rapid vigorous growth
- Establish late summer/early fall
  - Seeding rate: 10-20 lbs/A
- Small seed is easy to over-seed and establish into existing crops

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Red Clover

- Excellent nitrogen producer
- Slower to establish than crimson clover
  - Often seeded with a companion crop of oats
- Establish late summer/early fall or early spring
  - Seeding rate: 8-12 lbs/A
- Good for year-long cover
  - Can be mowed and will regrow

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Hairy Vetch

- Good weed suppression while growing
- Very good as a nitrogen producer
- Can produce a lot of biomass and can be difficult to manage at planting
- Establish in late summer/early fall
  - Seeding Rate: 12-20 lbs/A

Oilseed Radish

- Aerate the soil
- Easy to establish
- Great nutrient scavenger
  - The root holds a lot of nitrogen
- Winter-kill and must be fall planted early
  - Ideal = Mid-August to Mid-September
  - Seeding Rate: 1-5 lbs/A

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Cereal Rye

- Allelopathy (weed supression)
- Great soil builder
- Produces more biomass than other small grains
- Deeper rooting than most other small grains
- Good nitrogen scavenger
  - less need for supplemental N for cover crop growth
- Very cold hardy and can be planted late (Nov.)
  - Seeding rate 40-90 lbs/A

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60#/a cereal rye, mowed at pollination
- 2 weeks later – no marestail

Annual Ryegrass

- Great soil builder
- Rapid vigorous growth
- Excellent nitrogen scavenger
- VERY deep rooted (+3 ft)
  - Good at penetrating hard-pans and tolerates poorly drained soils
  - Lots of fibrous root mass which builds soil organic matter
- Establish late summer/early fall
  - Seeding rate 12-20 lbs/A
- Always plant a known variety; not VNS

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Proper Cover Crop Selection and Management is Important

- Understand the biology and cost of the cover crop
- Consider the management goals
- Consider possibility of mixtures

Cover Crop Chart

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

http://www.ars.usda.gov/SP2UserFiles/Place/54450000/CCC/CCC_v13_5_2012.pdf

Cool Season							Warm Season	
Grass	Broadleaf						Broadleaf	Grass
A Barley								A Pearl millet
A Oat	A Phacelia						A Amaranth	A Foxtail millet
A/P Ryegrass	A Flax			Legumes			A Buckwheat	A Proso millet
A Wheat	A Spinach	B Turnip	A Field pea	A Berseem clover	A/P Medic	A Chickpea	A Sunflower	A Sudan grass
A Cereal rye	A Kale	A Radish	A Lentil	B/P Red clover	P Birdsfoot trefoil	A Cowpea	A Safflower	A Teff
A Triticale	A/B Canola	B Beet	A Lupin	P White clover	P Sainfoin	A Soybean	A Squash	A Grain sorghum
A Annual fescue	A/P Mustard	A/B Carrot	A/B Vetch	A/B Sweetclover	P Alfalfa	A Mung bean	P Chicory	A Corn

Midwest Cover Crops Council - Cover Crop Decision Tool

Illinois: Jackson County Seeding Dates

Location Information | Cash Crop Information | Soil Information | Attribute Information

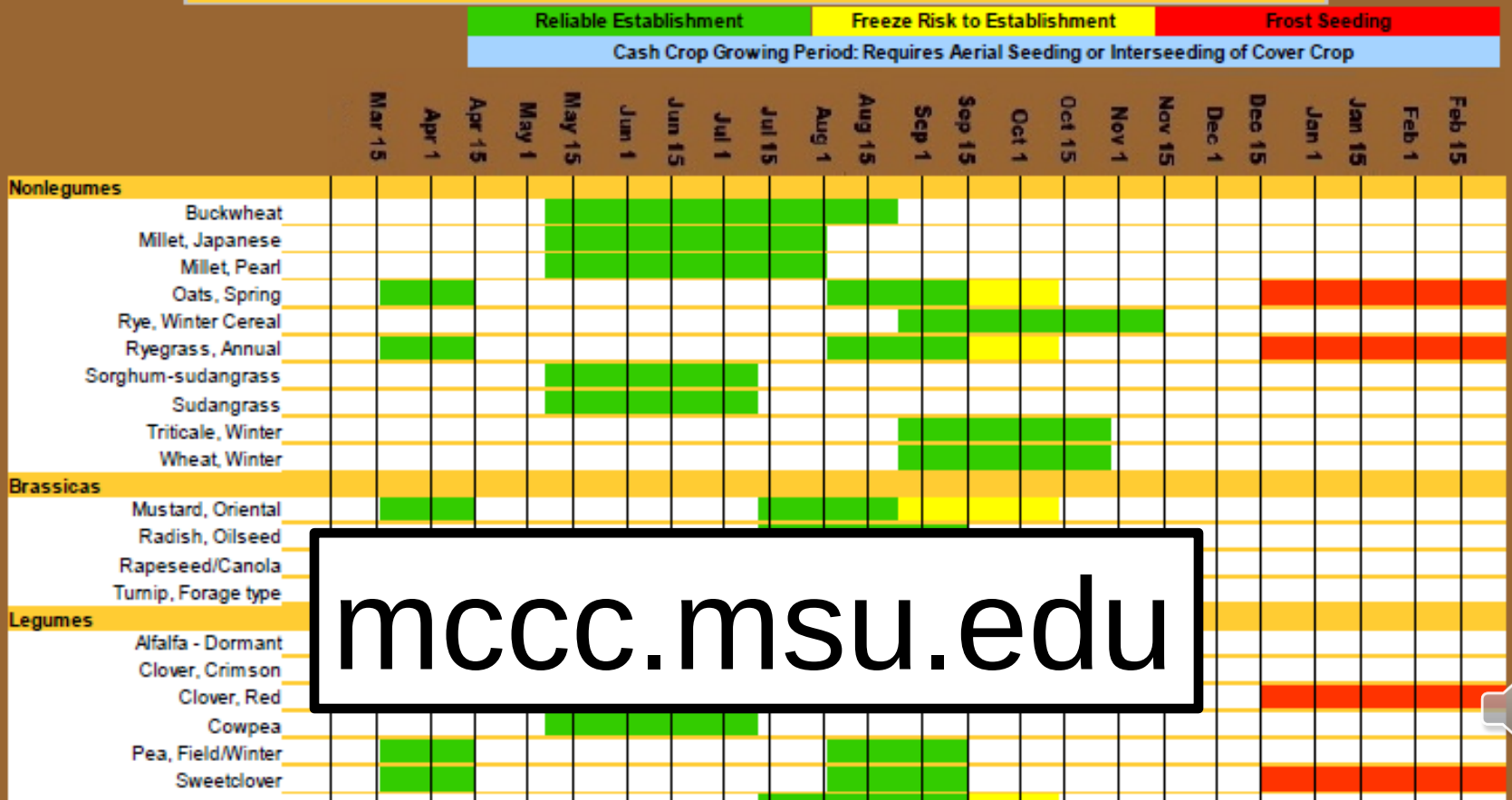
Location Information: Illinois | Jackson

Cash Crop: None or Prevented Planting | Plant Date: | Harvest Date:

Drainage Information: Select a Drainage Class | Flooding: No

Goal #1: Select an attribute | Goal #2: Select an attribute | Goal #3: Select an attribute

Select cover crop to create information sheet: 50% HV/50% Oats | Submit



mccc.msu.edu

Planting

- Planting date is **critical** to performance and winter hardiness
- Each cover crop needs specific management
- If using a mix of species decrease seeding rates compared to seeding crops alone
- Method of planting
  - Broadcast
    - Fast but variable success, may need some minor soil movement or rainfall
  - Drilling
    - Best and most reliable, most efficient use of seed, takes more time, added expense
  - Aerial seeding
    - takes luck (timely rain), good timing


Seeding date is critical to developing radish—
It likes warm weather and nitrogen
Date of planting study
Near I-70
Oct 1
Sept. 15
Aug. 15
as of November 12
Mike Plumer

Planting Date Performance

- Hairy Vetch
- Planted July 23rd
  - 209 #/A Nitrogen as of Dec. 23
- Planted 10 days later
  - 168 #/A Nitrogen as of Dec. 23

Drilling cover crops produces the best stand that establishes the quickest


Broadcast/harrow vs Drilled


Gandy
Orbit-Air

Aerial Seeding Turnips, Oats and Rye

Cultipackers and corrugated rollers can be used to improve seed-soil contact before/after broadcast seeding

Cover Crop Mixes

- Can be companion crop to enhance growth
  - ie. oats
- Mixing species can allow you to capture the benefits of multiple crop species
  - ie. cereal grain + legume
- Some blends competitive/allelopathic
- Can be difficult to control in spring
  - Due to differences in growth patterns/maturity/species

Green Cover Seed SmartMix Calculator

Use the yellow area to select your seed and your seeding rate per acre. Use the drop down boxes to select the species you want to include.

			C:N Ratio (mature growth estimate) 10			N Fixing Potential (scale of 1-10) 5.0		Diversity Rating (scale of 1-10) 5.0			Frost Tolerance (scale of 1-10) 6.5	
		* Full Rate	lbs per acre	Season	% by weight	% by # seed	% by cost	Seeds/lb	Seeds per acre	Cost per pound	Cost 1K seed	Cost per acre
TOTALS			**34**						**862,000**			**$30.53**
Legumes					**69%**	**48%**	**57%**					**$17.50**
Winter Pea	Info	50-90	10	CS-B	30%	5%	16%	4,000	40,000	$0.50	$0.125	$5.00
Hairy Vetch	Info	20-30	3	CS-B	9%	4%	15%	12,000	36,000	$1.50	$0.125	$4.50
Crimson Clover	Info	8-12	1.25	CS-B	4%	36%	4%	250,000	312,500	$1.00	$0.004	$1.25
Chickling Vetch	Info	50-75	9	CS-B	27%	3%	22%	2,500	22,500	$0.75	$0.300	$6.75
Grasses					**0%**	**0%**	**0%**					**$0.00**
	Info											
	Info											
	Info											
Brassicas					**10%**	**38%**	**24%**					**$8.13**
Tillage Radish	Info	8-12	1.5	CS-B	4%	4%	13%	25,000	37,500	$3.00	$0.120	$4.50
Rape/Canola	Info	5-8	1	CS-B	3%	20%	3%	175,000	175,000	$1.00	$0.006	$1.00
Hunter Hybrid	Info	4-6	0.75	CS-B	2%	13%	8%	150,000	112,500	$3.50	$0.023	$2.63
Other Broadleaves					**21%**	**15%**	**15%**					**$4.90**
Buckwheat	Info	35-60	7	WS-B	21%	15%	15%	18,000	126,000	$0.70	$0.039	$4.90
	Info											

Add your own seed and seed cost in the section below. Totals will be reflected in grand totals at top but not in the Green Cover Seed cost total.

Green Cover SmartMix total: $30.53

Inoculant and mixing: $0.00

http://www.greencoverseed.com/smartmix_web/smartmix_web.htm

Termination

- Herbicides, Roller Crimper, Mowing, Tillage…
- Many cover crops such as cereal rye are easiest to terminate around flowering or pollination
- Best control roller/crimping cereal rye at pollination (ave. 95% control)

A Cover Crop Rotation for Your Farm

- How can I build a crop and cover crop rotation that will help meet most of my cash crop N demands and build soil organic matter?
  - Example:

2014											2015											2016						
J	F	M	A	J	J	A	S	O	N	D	J	F	M	A	J	J	A	S	O	N	D	J	F	M	A	J	J	A
	Onions/ Lettuce					Oats/Radish/ Crimson Clover					Tomatoes								Hairy vetch + Cereal Rye				Cucumber						

Tips to Success with Cover Crops

- Manage the cover crop as another crop
- Have a "Plan B"
  - Know that weather and crop growth might require a modification to your management plan
- Consider planting date when choosing a cover crop
- Don't give up if at first you don't succeed
  - **Learn** from your experiences and explore ways to overcome any challenges
  - Different soils and field conditions can change the performance of these cover crops
  - Keep records on what you have done so you can determine what works best for you!

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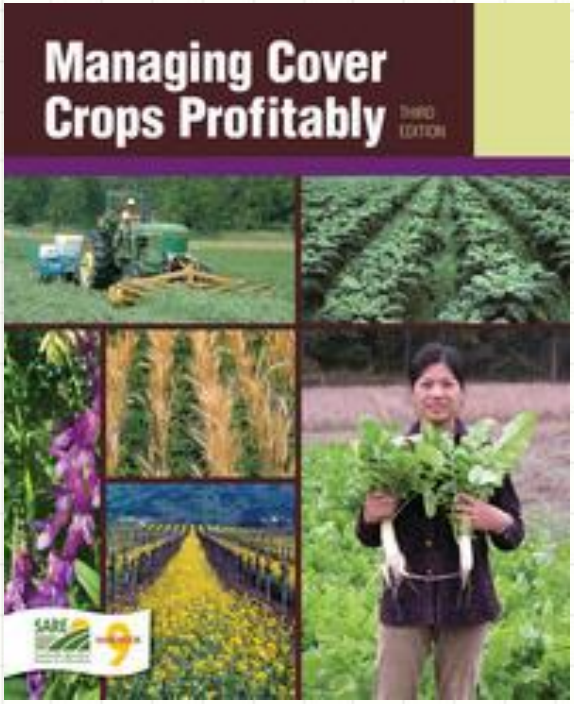
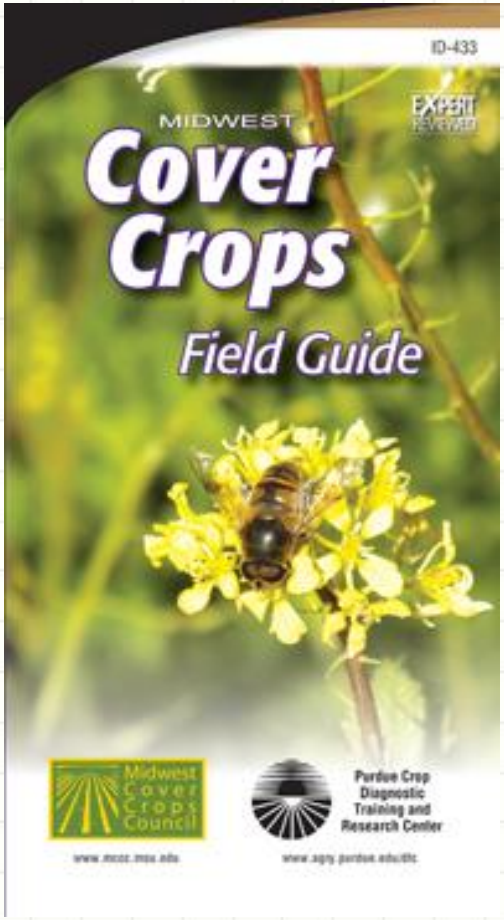
Information on Cover Crops





-University Extension

- Field Days

-Seed Dealers

-Conferences

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Great Success

To reach us

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