OHIO STATE UNIVERSITY EXTENSION

Economics of Cover Crops

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Cost of Tillage Operations/Acre

- Chisel Plow $14/A
- Disk Tandem $13/A
- Field Cultivate $11/A
- Plow $17/A
- Soil Finishing Tools $11/A

- Subsoil $18/A

Ohio Farm Custom Rates 2010
Barry Ward, OSU Economist

Legume Cover Crop Seed Cost

Cover Crop	Seed Price/lb	Pound	Planting	Kill	Total Cost/A.
Cowpeas	$.80	40-50	$14	$0	$46-54
Winter peas	$1.00	30-40	$14	$0-15	$34-$69
Red Clover	$2.00	10-12	$6	$15	$41-$45
Chickling vetch	$1.00	30-70	$14	$15	$59-$99
Sweet Clover	$1.50	10-20	$6	$10	$31-$46
Hairy Vetch	$1.25	15-20	$14	$15	$49-$54

Grass Cover Crop Seed Cost

Cover Crop	Seed Price/lb	Pound	Planting	Kill	Total Cost/A.
Cereal Rye	$.20 $12/bu	60 1 bu	$14	$15	$41
Annual rye	$.80	15-25	$14	$15	$41-$49
Wheat	$.10 $6/bu	60 1 bu	$14	$15	$35
Oats	$.15 $6/Bu	42-63 1-1.5 bu	$14	$0	$20-$23
Brassicas					
Oilseed Radish	$3.00	1-10	$14	$0	$17-$44

Value of Soil Organic Matter

Assumptions: 2,000,000 pounds soil in top 6 inches
1% organic matter = 20,000#

Nutrients:

Nitrogen:	1000# * $0.50/#N	=	$500
Phosphorous:	100# * $0.70/#P	=	$ 70
Potassium:	100# * $0.50/#K	=	$ 50
Sulfur:	100# * $0.50/#S	=	$ 50
Carbon: 10,000# or 5 ton	* $?/Ton	=	$ 0

Value of 1% SOM Nutrients/Acre = $670

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Original Jim Kinsella/Terry Taylor(2006)/revised Jim Hoorman (2011)

Soil Organic Matter Accumulation

- Takes 10 tons of Decomposed Organic Matter to equal 1% SOM
- If start with 40 tons Organic Matter and lose 75% to get 10 tons decomposed SOM
- Accumulate 4-6 tons and lose 75% equals 1-1.5 tons Decomposed SOM or

  .1-.15% SOM * $670/Acre or $67 to $100/Acre

You are Building Your Soil Fertility with SOM!

Crop Residue along Ditch from Bare Cropland, Chiseled Wheat Stubble

Value of Ton of Topsoil

- Most Biological activity occurs in top 3 inches.
- One million pounds or 500 ton of topsoil in top 3 inches.
- Average Value of Cropland = $10,000/Acre
- Soil Lost at T value = 4-5 ton/acre
- Soil Productivity Value: $5,000/500 = $10/Ton
- Lost value per acre = $10/ton soil loss * 4-5 tons

Losing $40 to $50 per acre.

Productivity of SOM

- Michigan study: Every 1% SOM =12% increase in crop yields.
- Baseline Yields: 170 bu corn, 50 bu soybeans

Starting SOM = 2.5% and add 1% SOM

Soybeans 50 bu * 12% = 6 bu * $10 = $60/A.
.1 to.15% SOM increase/year = $6-$9/yr.

Corn 170 bu * 12% = 20.4 bu * $4 = $81/A
.1 to.15% SOM increase/year = $8.10-$12.30/yr.

Lime Costs/acre

- 1 to 2 tons of lime per acre * $15/Ton
- Plus spreading cost $6/Acre
- Total lime cost: $36/Acre over 3-5 years
- Cost /Acre/Year: $7-$12
- No-till and Cover Crops need less lime because they keep Ca^{2+} circulating

Legume Cover Crop N Economics

Cover Crop	Total Cost/A.	Pound Of N	Value of N	Total N $	Net Gain
Cowpeas	$46-54	120-150	$.50	$60-75	$6-$29
Winter peas	$34-$69	120-150	$.50	$60-75	($9) - $41
Red Clover	$41-$45	100-120	$.50	$50-60	$5-$19
Chickling Vetch	$59-$99	50-120	$.50	$25-$60	($74)-$1
Crimson Clover	$18-25	100-150	$.50	$50-$75	$25-$50
Hairy Vetch	$49-$54	100-200	$.50	$50-$100	($4)-$51

Drainage

- $800 to $1000/acre for subsurface drainage.
- Farmers say you pay for drainage every 20 years whether you pay for it or not. Poor drainage costs you in reduced yields.

  Keep $1000 in Bank, Collect 2-3% interest

  Spend Interest on Cover Crops: $20-30/A.

  Still have principal at end of 20 years.

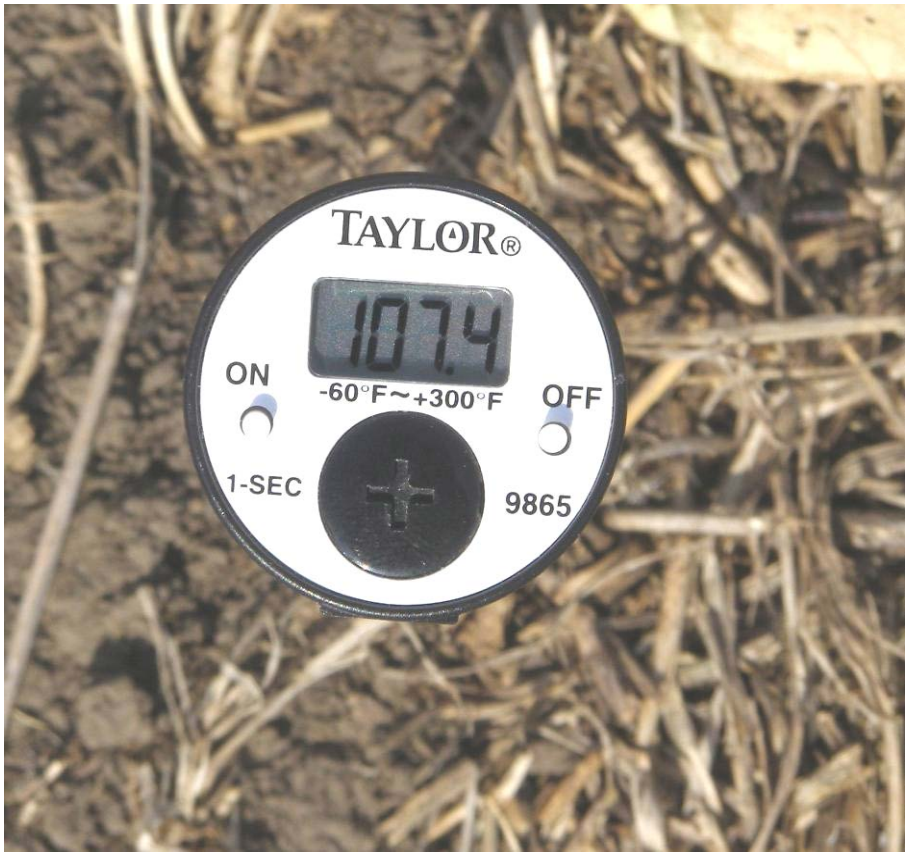
Annual Ryegrass Cover Crop

No-till Cropland No cover

Annual Ryegrass Cover Crop

Soil Temperature Differences

Conventional /No-till??



No-till + Cover Crops & Live Plants

SOM and Available Water Capacity Inches of Water/Per one foot of Soil

Berman Hudson Journal of Soil & Water Conservation 49(2) 189-194 March-April 1994

Percent SOM	Sand	Silt Loam	Silt Clay Loam
1	1.0	1.9	1.4
2	1.4	2.4	1.8
3	1.7	2.9	2.2
4	2.1	3.5	2.6
5	2.5	4.0	3.0

For Hot Dry Summers

For Corn Production:

75 degrees Fahrenheit – 1 Inch water/week

85 degrees Fahrenheit – 2 inch water/week

95 degrees Fahrenheit – 4 inch water/week

2X Water requirements for every 10F increase

1” Rain = 8 bu. corn, 22” needed for 200 bu. Corn

Rain = 19-23 inch/year in growing season

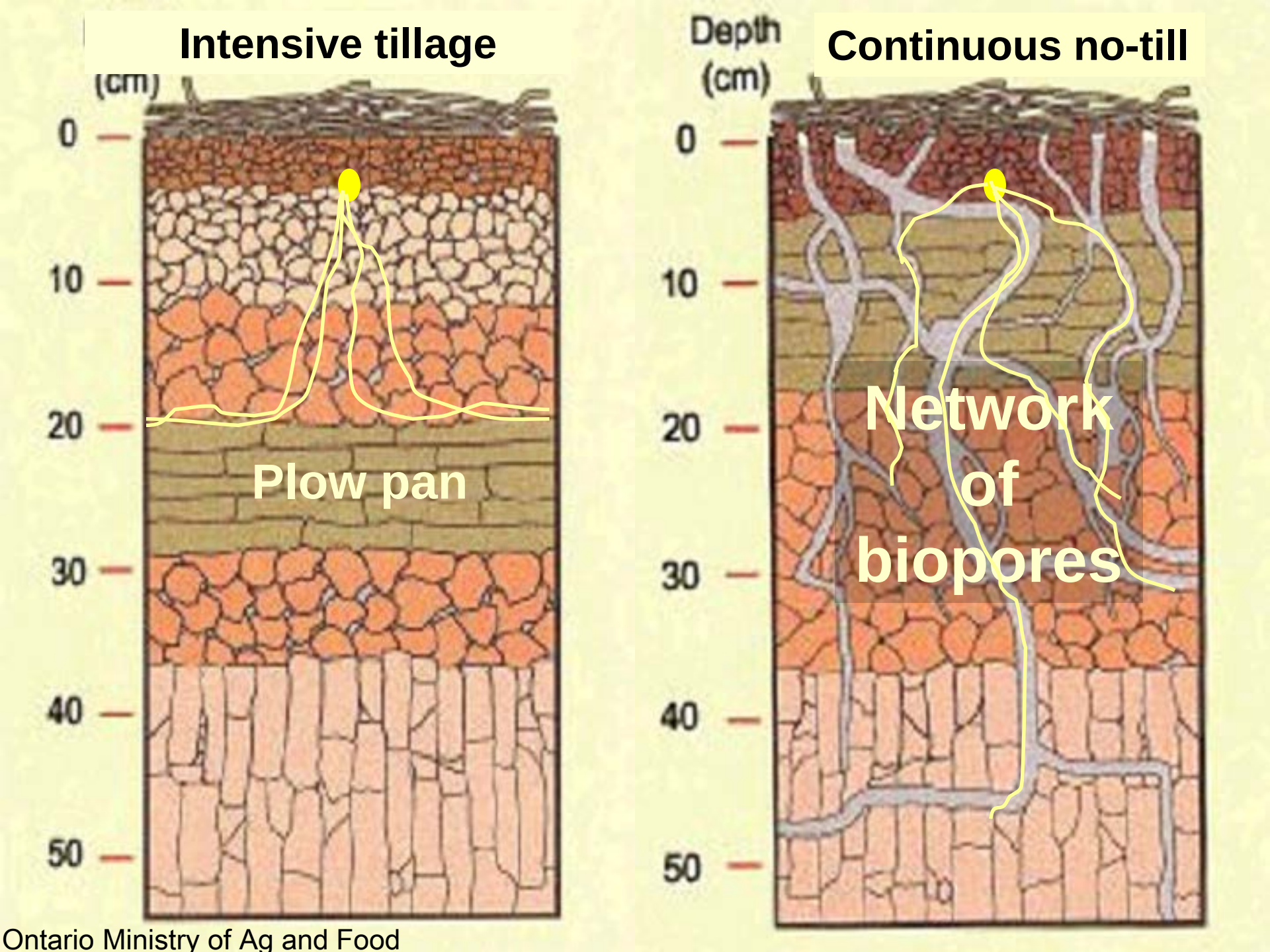
1” Rain fully used = 8 bu/A * $4 = $32/A

Heat and drought quickly increase yield losses!

By Elwynn Taylor, Iowa Ag. Climatologist

SOM Buffers Soil Temperatures

- Early frost 1/20 years
- Value to replant soybeans $120/acre
- Value of frost protection over 20 years = $6/acre/year



Ontario Ministry of Ag and Food

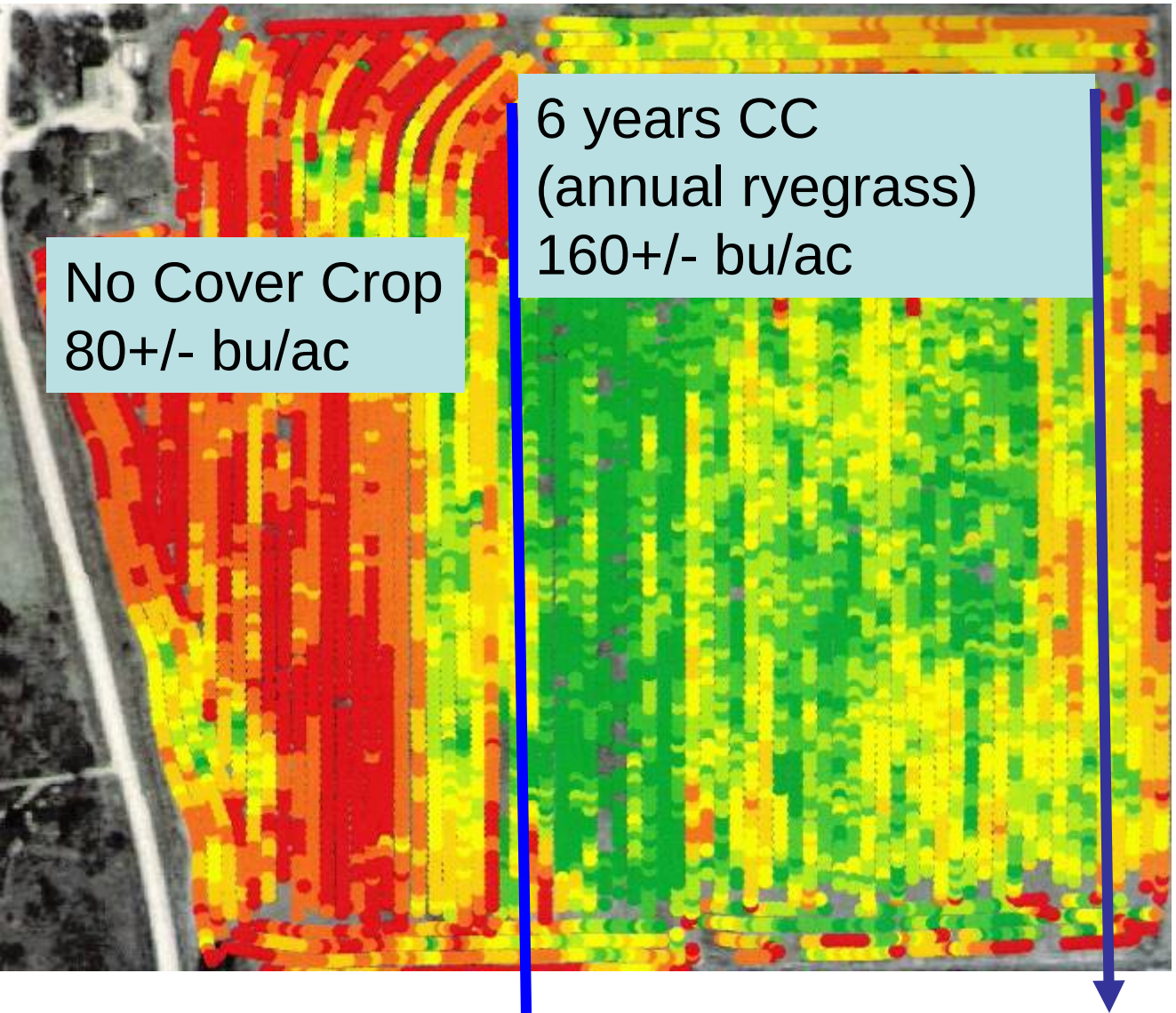
Soil Compaction costs

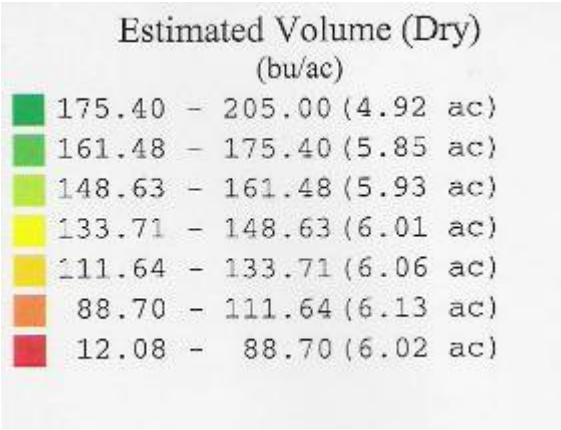
Conventional tillage vs No-till and Cover Crops
Corn 3% yield gain
170 bushel corn * 3% = 5.1 bu * $4 = $20.40/A

Soybeans 10% yield gain
50 bushels soybeans * 10% = 5 bu * $10 =$50/A

Cover crops improve soil structure, water infiltration, and decrease runoff.

Cover Crop Effects





Mike Plumer's long-term no till with ryegrass cover crops on heavy clay soil.

2005 Illinois Demonstration Results

Tillage/cover crop	Yield bu./A.
Conventional tillage	82
No cover crop no-till	124
Ryegrass 1 year no-till	137
Ryegrass 6 years –claypan	165
Ryegrass 6 years no claypan	215

Rain fall …. May- Sept. 2.3”

Cover Crop Benefits in Drought

2005 Illinois Corn Data (2.3 inches rain)

Conventional tillage	82bu.
No-till 124-82=42 bushels * $4.00/Bu =	$168
No-till + Annual Rye 137-82=55*$4.00 =	$220

$220/20 years = $11/Acre/Year

Negative Effects:

Cover crops may excessively dry the soil through respiration in a dry spring. Solution is to kill the cover crop early if the soil is getting too dry.

CTIC Survey: Cover Crops & Yield

In 2012 (Drought)

Corn plus cover crops yielded 11 bushels more than conventional @ $7/bu. Or $**77**/Acre.

Soybean plus cover crops yielded 5 bushels more than conventional @ 15/bu. Or $**75**/Acre.

In 2013 (Good Moisture)

Corn plus cover crops yielded 5 bushels more than conventional @ $4/bu. Or $**20**/Acre.

Soybean plus cover crops yielded 2 bushels more than conventional @ 10/bu. Or $**20**/Acre.

Robison Farms Corn Yields w/wo Cover Crops - 2012

Plot	Corn Yield
check (no cover crop on No-till, replicated 3 times)	**105.24**
Annual Ryegrass + Crimson Clover + Radish	**120.31**
Winter Cereal Rye	**126.86**
Oats + Radish	**138.79**
Annual Ryegrass Blend	**134.27**
Annual Ryegrass + Crimson Clover	**136.41**
Crimson Clover + Radish	**153.99**
Oats + Rye + Appin Turnips	**164.37**
Austrian Winter Peas + Radish	**164.82**

The NET PROFIT from Cover Crops 2012

Robison Farms Cover Crop Research Plot	Revenue	(Revenue less Seed and application cost)	Net Advantage (extra profit)
check (no cover crop)	$ 605.13	$605.13	**$0.00**
Annual Ryegrass + Crimson Clover + Radish	$ 691.78	$646.91	**$41.78**
Winter Cereal Rye	$ 729.45	$696.97	**$91.84**
Oats + Radish	$ 798.04	$733.29	**$128.16**
Annual Ryegrass Blend	$ 772.05	$743.05	**$137.92**
Annual Ryegrass + Crimson Clover	$ 784.36	$750.76	**$145.63**
Crimson Clover + Radish	$ 885.44	$829.44	**$224.31**
Oats + Rye + Appin Turnips	$ 945.13	$870.23	**$265.10**
Austrian Winter Peas + Radish	$ 947.72	$892.07	**$286.94**

Dave Brandt Farm 2012

30 Years No-Till and 15 years Cover Crops

Corn: 149.9 Bu/A Soybeans: 49.5 Bu/A

Neighbors: Conventional Tillage

Corn: 80-95 Bu/A Soybeans: 32-35 Bu/A

Corn = $7.50/Bu. Soybeans = $15/Bu.

$7.50 * 55-70 = $412-$525/A $15 * 15-18 = $225-$270/A.

Rain makes Grain! Increased moisture equals higher yields.

2012 Putnam County Soybeans Replicated 4 times

Conventional Soybeans:	55 Bu/A	---
Cereal Rye/Soybeans:	60 Bu/A	$75
Daikon Radish/Soybeans:	68 Bu/A	$195

Soybeans = $15/Bu

Weeds

Conventional: Highest Level = Moderate

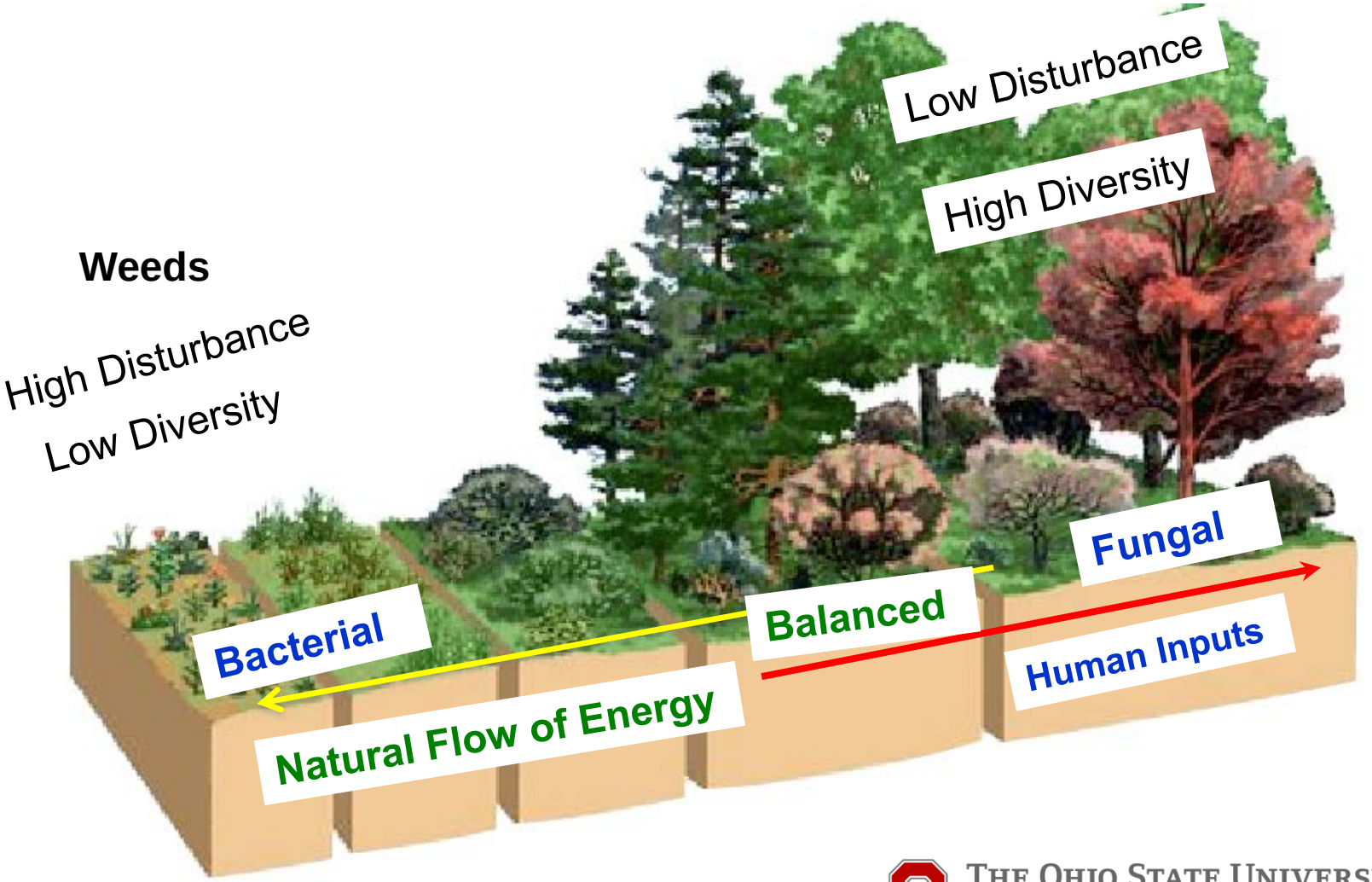
Cereal Rye: Medium Level = Few

Oilseed Radish: Lowest Level = Scattered

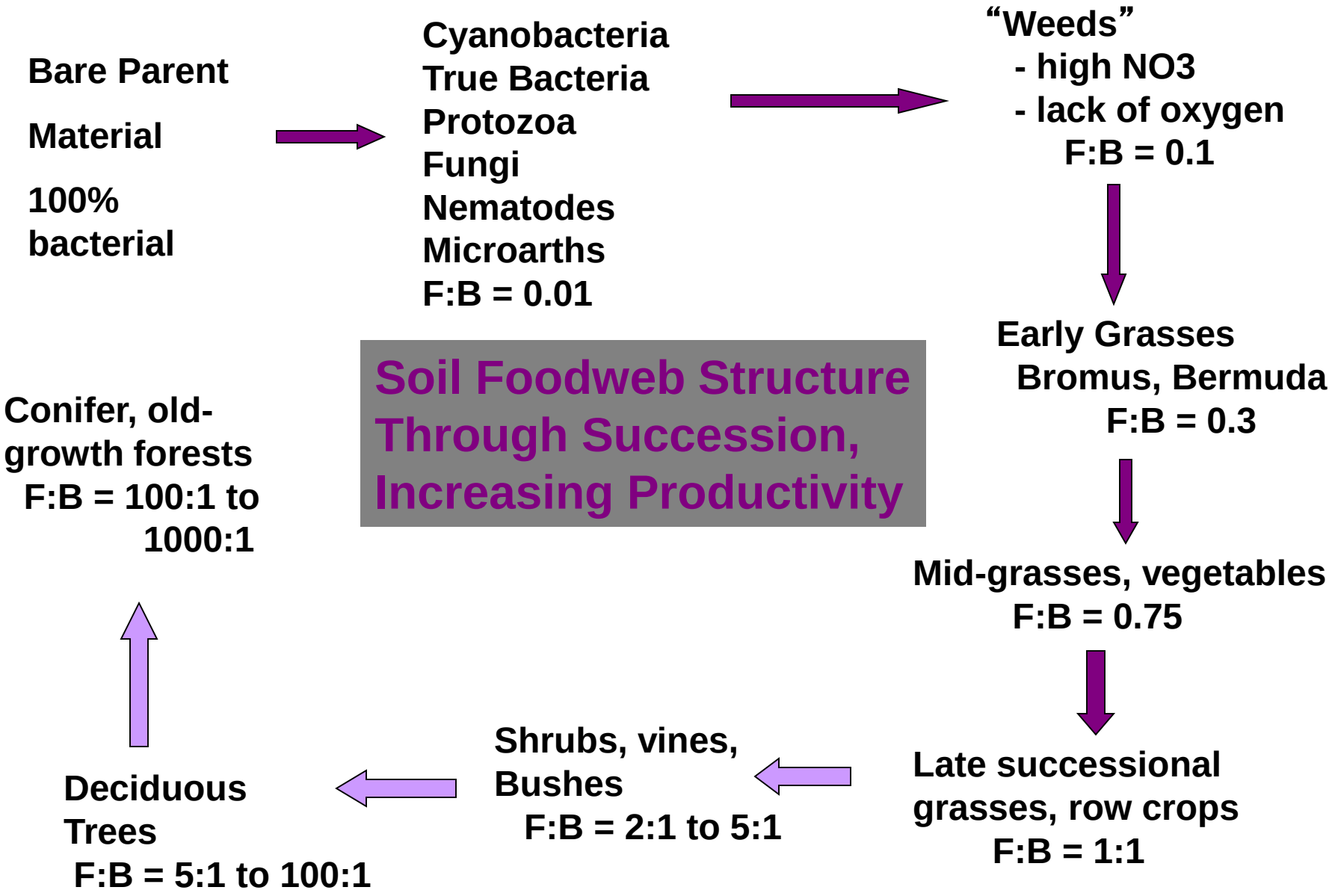
Ecological Concepts

- Weeds, Insects and Diseases Cost Farmers 30% of their Crop every year since 1940's.
- Native undisturbed soils have diverse species (predators, prey, parasites). Keep pests in check.
- 100% Pest Control not Achievable!
- New ECO Goal: Keep pests at acceptable levels using all Ecological strategies: Safe, durable, $$$
- Keep Insecticides, Fungicides, Herbicides around for major outbreaks.

Natural Succession of Plants & Soil



What does your plant need?



Weeds

- Farmers promote weed seed by tilling the soil.
- Ways to fight weeds

  1) Hoe or pull them out

  2) Kill with herbicides

  3) Compete for sunlight and nutrients by growing cover crops and reduce weed seed production.
- Farmers with No-till and Cover Crops reduce herbicide cost by 1/3 = $7-$12/A.
- Early weeds reduce crop yields 10% * 50 bu soybeans * $10/Acre = $50
- Reduced weeds: cereal rye, oilseed radish, etc.

Insects

Positive: Soybean Cysts Nematodes (SCN)

1) 80-90% Reduction using cereal rye/annual rye
   50 bu * 30% =15 bu * $10 =$150/A

Natural Pollinators:$5 Billion/350 million =$14/A

Negative: Slugs, Cutworm, Armyworm

1) *Carabidae* beetles/ground beetles and lightning bugs are natural predators of soft body insects.

2) Cover crops may be an alternative food source for slugs and may protect corn from damage.

Five Steps to Fighting Insect Pests

- Small Fields surrounded by natural vegetation. These areas offer refuge and extra food.
- Diverse crops with diverse flowers. Small flowers with open flowers promote predators.
- Minimize use of insecticides and fungicides.
- Keep soils high in SOM (mulch) and biological activity. Winter refuge and food for predators.
- Use multiple natural tactics. Plant cover crops and mow every other row or raise mowing height.

Promote Predator Friendly Plants

- Promote nectar early spring, mid-summer, and late fall.
- Early spring: Dandelions, Henbit
- Mid summer: Buckwheat, Sunflower, Flowering Legumes: crimson clover, sweet clover, hairy vetch, red clover
- Late Fall: Wild carrot (Queen Ann's Lace), Goldenrod
- Ecosystems with more diversity are more stable and *Resistant* to change and are more *Resilient!*

Diseases

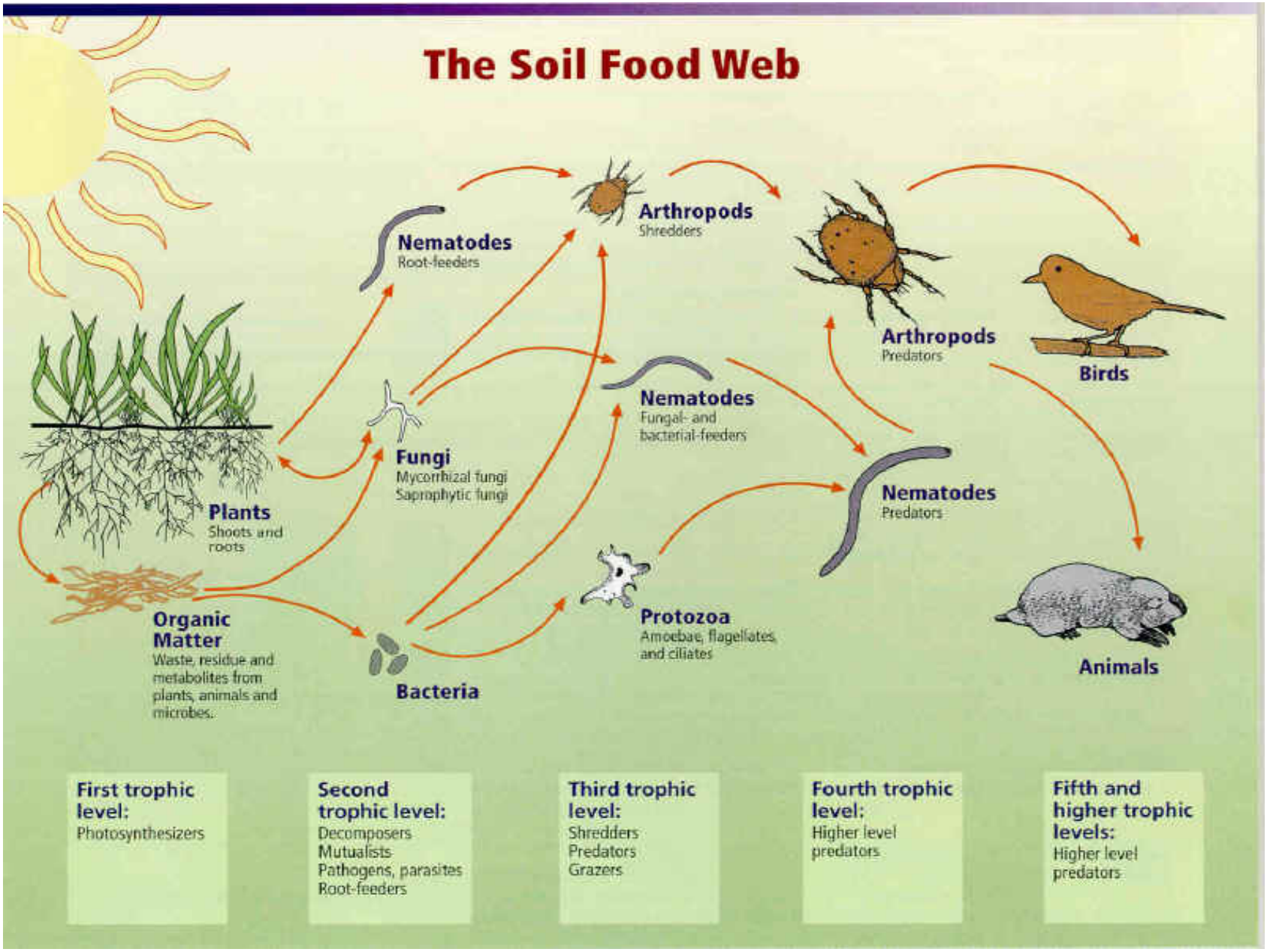
Diseases that thrive under excess water

- Phytophthora: 20% loss*50 bu=10 bu * $10= $100/A
- Phythium: 5-10% *50 bu=2.5-5 bu*$10= $25-$50/A
- Fusarium: 10% * 50 bu= 5 bu. * $10 = $50
- Rhizoctonia 2-5%*50 bu=1-2.5bu*$10= $10-$25/A

Thrive with less biological activity (tillage)

- Sclertina/White Mold (Bury seed with tillage)

2 to 4 bushel per acre * $10 = $20-40/A


The Soil Food Web
Nematodes
Root-feeders
Arthropods
Shredders
Arthropods
Predators
Birds
Nematodes
Fungal- and bacterial-feeders
Fungi
Mycorrhizal fungi
Saprophytic fungi
Nematodes
Predators
Plants
Shoots and roots
Organic Matter
Waste, residue and metabolites from plants, animals and microbes.
Protozoa
Amoebae, flagellates, and ciliates
Bacteria
Animals
First trophic level:
Photosynthesizers
Second trophic level:
Decomposers
Mutualists
Pathogens, parasites
Root-feeders
Third trophic level:
Shredders
Predators
Grazers
Fourth trophic level:
Higher level predators
Fifth and higher trophic levels:
Higher level predators

Seed Production

Cereal rye:

30-60 bushels * $12 =

$360-$720/A minus $49 seed, plant, kill it plus $30 for harvesting = $280 - $640

Cowpeas: 30-35 bushels per acre or 1500 to 1750 pounds times $.80/lb = $1200 -$1400/A

minus seed, planting, harvesting costs

Forage Value of Cover Crops

- Oats, cereal rye, annual ryegrass
- 4 tons cereal rye at $100/ton =$400 Income
- Costs $60 (2 bu/Acre for seed) per acre for seed, plant, kill it.
- Harvest Costs: $40
- Net Income: $300

Mimic Mother Nature

60 Million Bison
in USA
in early 1800's

Did they stop eating or pooping in winter?

Water Quality?

Holding Nitrogen from Manure... Effects from Annual Ryegrass

Manure w/o cover crop

Manure w/ cover crop

Holding Nutrients from Manure

3 kernels = 1 bushel corn on 30,000 corn pop.
18 rows * 4-5 kernels =75-90 kernels more per ear
25-30 bushel yield difference * $7 = $175-$210/A.

Manure w/o cover crop
Ave. 5 ½ -6”

Manure w/ cover crop
Ave. 7 ½”

Manure Value of Cover Crops

Swine Manure: 95% Water 5% solids
Manure Nutrient Analysis:18-16-14/1000 gallons
Uptake: At 5,000 gallons/A =90-80-70 $80
At 10,000 gallons/A =180-160-140 $147

Dairy Manure: 98% water 2% solids
Manure Nutrient Analysis: 20-15-15
Uptake: At 5,000 gallons/A =100-75-75 $87
At 10,000 gallons/A =200-150-150 $122

*Absorb 70% N, maximum 20# P
Crops absorb about 0.5% N Maximum and 0.2% P

Cost Effectiveness of BMP'S

JEQ 2002 Forster & Rausch

BMP	$/Ton of Sediment	BMP	$/Ton of Sediment
Cover Crops	$1.99	Diversions	$18.10
No-till	$2.99	Sediment Retention	$50.21
Permanent Cover	$6.95	Average Cost	$8.71
Wind break	$12.10	CRP Program	$22.95
Sod water way	$13.50		

Water Quality Benefits from Winter Cover Crops

- Reduces nutrient and pesticide runoff by 50% or more.
- Decreases Soil Erosion by 90%
- Reduces Sediment Loading by 75%
- Reduces Pathogen Loading by 60%
- May decrease flooding potential by increasing water infiltration

GLCCI Cover Crop Resources – MCCC Decision Tool

The MCCC Decision Tool is available on the MCCC website

www.mccc.msu.edu

Cover Crop Resources - Websites

Midwest Cover Crops Council

Illinois Indiana Iowa Michigan

Home

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Cover Crop Resources
- Cover crop species
- Cover crops selector
- Innovator profiles
- Extension material
- Publications
- Multimedia
- Links
- Slurry seeding
- Survey...coming soon

Calendar of Events
- Upcoming events
- Past events

Contact

Activities and research

The Cover Crops Program University focuses on inte make information from rese cover crops on their farms.

State representative

Mutch has more than 28 ye crops and sustainable agric Technical Committee and P Sustainable Agriculture Sta input and organic farming s

Leave a comment
Press materials

Other important contacts i

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Click here to visit Dr. Snapp'

Since Dr. Snapp joined MSU biological principles to improv cover crops and perennial gra best for different soil types an that promote phosphorus and nitrogen and phosphorus in su coordinates a website at MSU http://www.safs.msu.edu/so involving farmers, educators a management.

MCCC Report

- 2008 Michigan Repo

Selection of cover crops us

Cereal Rye:

- Cereal Rye: Manure

Clovers and Medic:

- Red Clover Overview
- Crimson Clover Over integrated into crop rot
- Annual medics (Medi flowering, setting seed more than 35 known sp Mediterranean region.

Oilseed Radish:

- Oilseed Radish Over
- Oilseed Radish: A N oilseed radish cover cr

Rich Leep, Dept. of Crop and Soil Sciences, MSU.

Links

Michigan State University cover crops website:

- http://www.covercrops.msu.edu

NRCS

- Michigan electronic Field Office Technical Guide (eFOTG): Cover Crops

MICHIGAN STATE UNIVERSITY

Michigan State University Extension (bulletins)

- Cover Crop Choices for Michigan by Dale R. Mutch
- Cover Crop Choices for Michigan - Vegetables by Sieglinde S. Snapp
- No-till drilling cover crops after wheat harvest and their influence on next season's corn by Dale R. Mutch1 and Kurt D.Thelen
- Oilseed radish: A new cover crop for Michigan by Mathieu Ngouajio
- Mustards - A Brassica cover crop for Michigan by Sieg Snapp, K. Date, K. Cichy and K. O'Neil
- Cover Crops Always a Good Idea by Laura Probyn (MSU Extension 8/22/05)
- Manure Slurry-Enriched Seeding of Cover Crops (Resource, February 2007) by Tim Harrigan, Sieglinde Snapp, Rich Leep, Dale Mutch, and Natalie Rector

Presentations

- From Soil Problems to Progress: Advanced Cover Crops Systems Planning presentation by Vicki Morrone and Sieglinde Snapp (MSU)
- Cover Crops - Their Challenges and Benefits presentation by Vicki Morrone (MSU)
- Mixtures of legume and grass summer cover crops for integrated weed and soil management presentation by Daniel Brainard (MSU), and Virender Kumar, Robin Bellinder, Laurie Drinkwater (Cornell University)
- Identifying the factors affecting cover crop performance in row crops under organic

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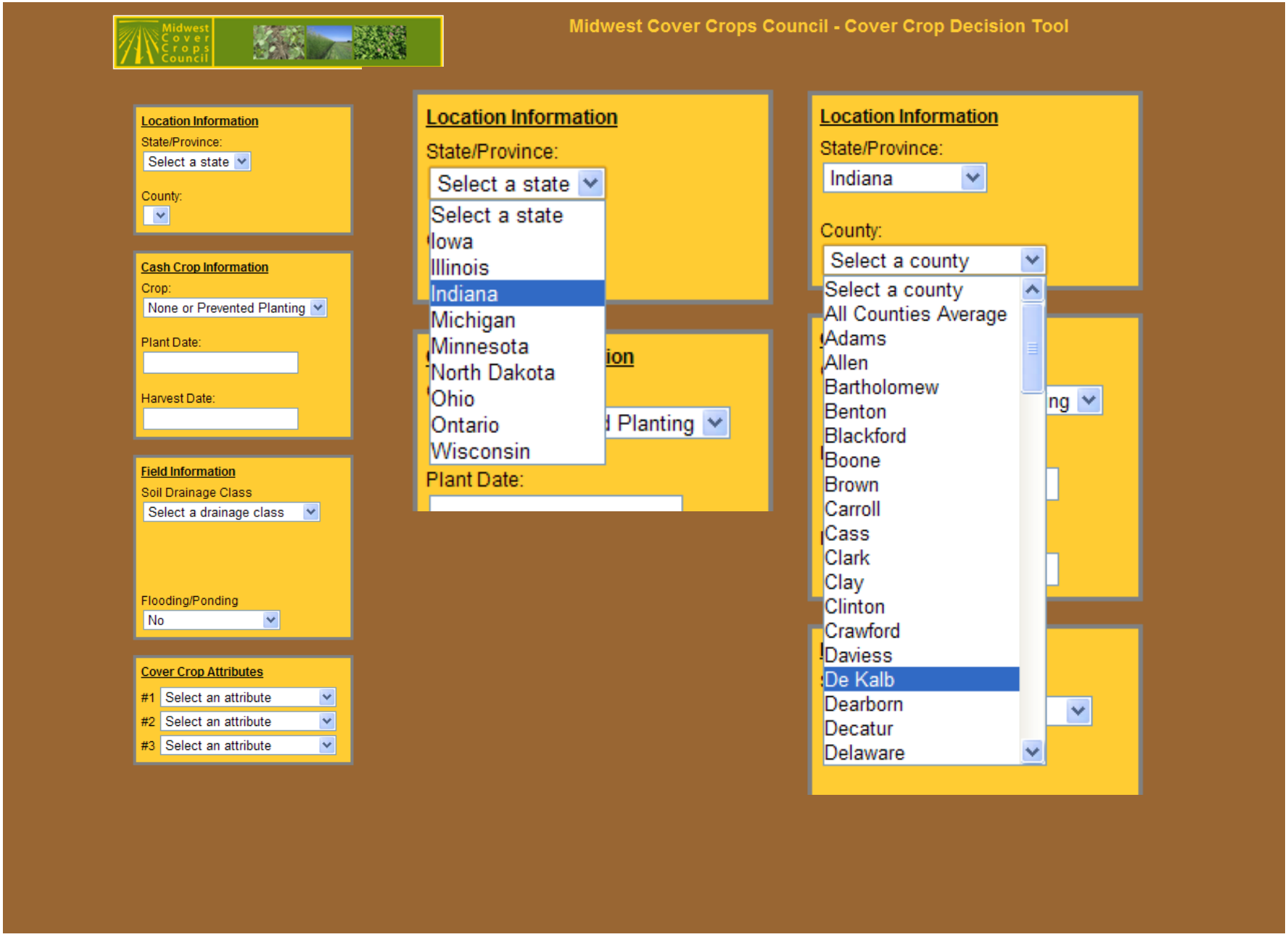

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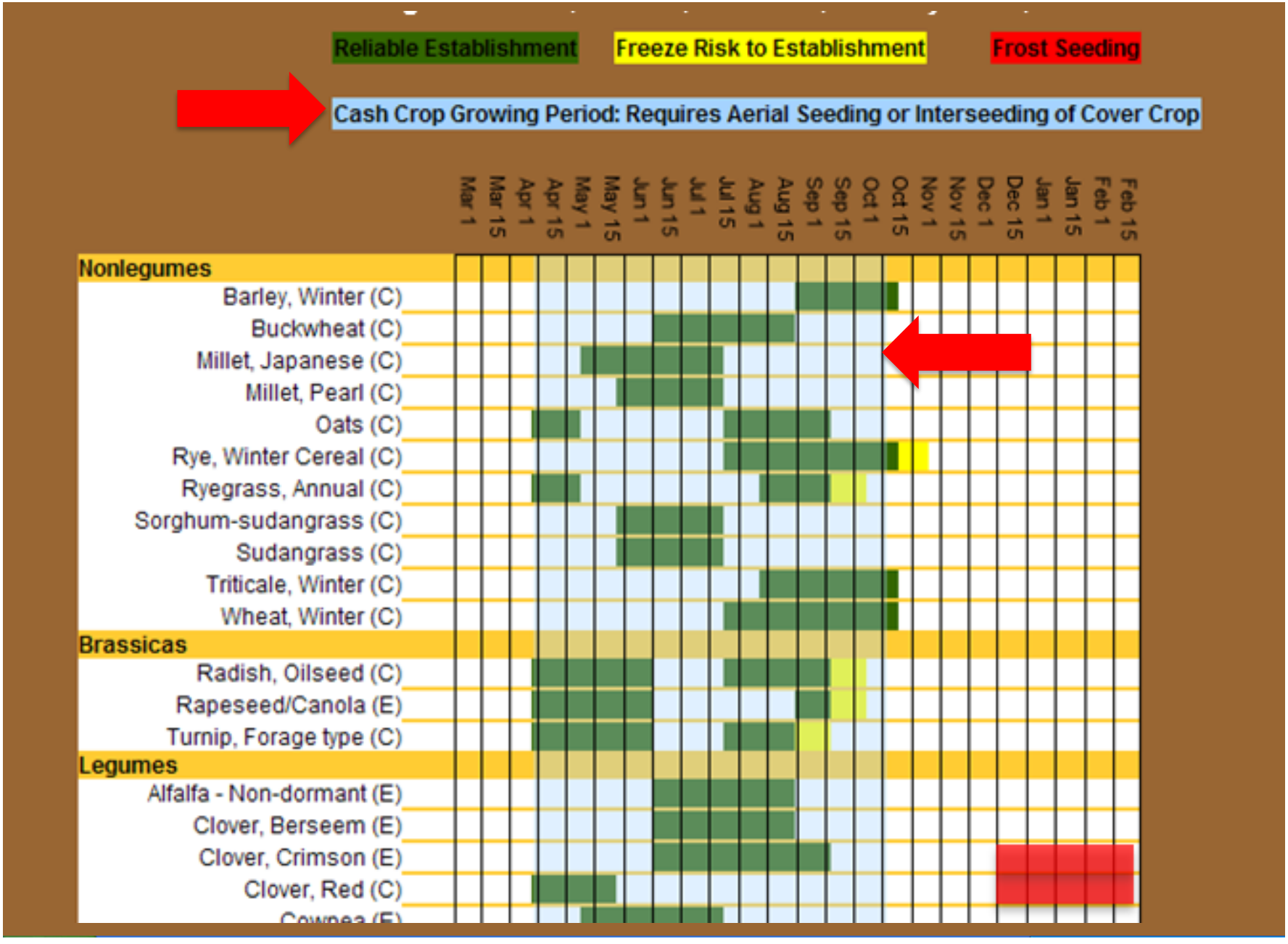

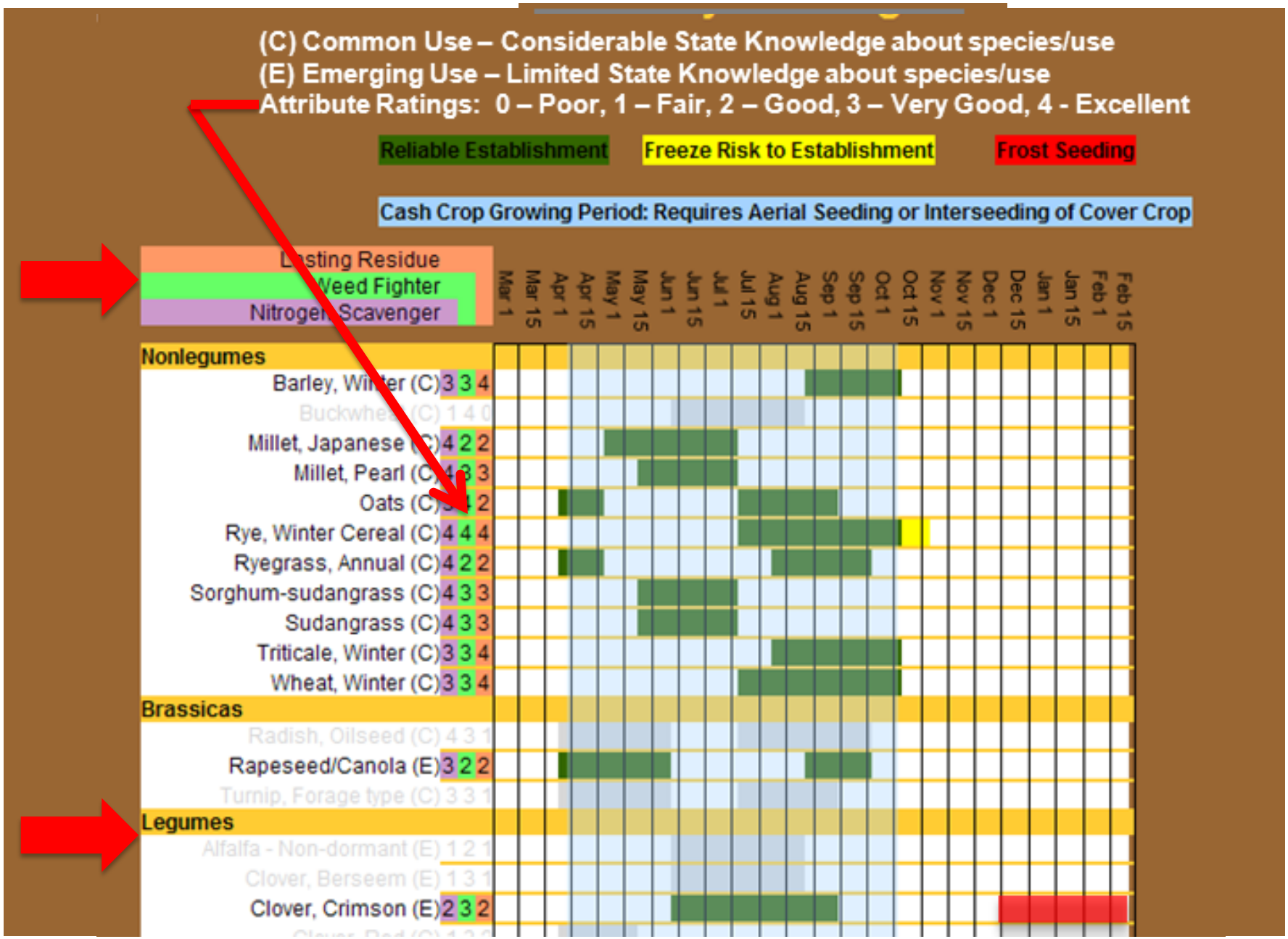
(C) Common Use – Considerable State Knowledge about species/use
(E) Emerging Use – Limited State Knowledge about species/use
Attribute Ratings: 0 – Poor, 1 – Fair, 2 – Good, 3 – Very Good, 4 - Excellent
Reliable Establishment
Freeze Risk to Establishment
Frost Seeding
Cash Crop Growing Period: Requires Aerial Seeding or Interseeding of Cover Crop
Lasting Residue
Weed Fighter
Nitrogen Scavenger
Mar 1
Mar 15
Apr 1
Apr 15
May 1
May 15
Jun 1
Jun 15
Jul 1
Jul 15
Aug 1
Aug 15
Sep 1
Sep 15
Oct 1
Oct 15
Nov 1
Nov 15
Dec 1
Dec 15
Jan 1
Jan 15
Feb 1
Feb 15
Nonlegumes
Barley, Winter (C) 3 3 4
Buckwheat (C) 1 4 0
Millet, Japanese (C) 4 2 2
Millet, Pearl (C) 4 3 3
Oats (C) 3 4 2
Rye, Winter Cereal (C) 4 4 4
Ryegrass, Annual (C) 4 2 2
Sorghum-sudangrass (C) 4 3 3
Sudangrass (C) 4 3 3
Triticale, Winter (C) 3 3 4
Wheat, Winter (C) 3 3 4
Brassicas
Radish, Oilseed (C) 4 3 1
Rapeseed/Canola (E) 3 2 2
Turnip, Forage type (C) 3 3 1
Legumes
Alfalfa - Non-dormant (E) 1 2 1
Clover, Berseem (E) 1 3 1
Clover, Crimson (E) 2 3 2

Cover Crop Information Sheet

Considerations for using Rye, Winter Cereal in Indiana

There are no special considerations

Web links to information on using Cover Crops in Indiana can be found at: http://mccc.msu.edu/states/Indiana.html

Location Information	
Location:	Indiana - De Kalb County
Cash Crop:	Corn - Grain
Plant Date:	April 14
Harvest Date:	October 19
Soil Drainage Class:	Poorly Drained
Artificial Drainage:	Yes
Flooding:	No

Cover Crop Selection Information	
Cover Crop Selected:	Rye, Winter Cereal
Cover Crop Attribute #1:	Nitrogen Scavenger
Cover Crop Attribute #2:	Weed Fighter
Cover Crop Attribute #3:	Lasting Residue
Use within the State:	Common

Planting Information	
Drilled Seeding Depth:	¾-1½ Inches
Drilled Seeding Rate:	50-90 lb./A PLS
Broadcast Seeding Rate:	55-99 lb./A PLS
Aerial Seeding Rate:	60-108 lb./A PLS
	0
Seed Count:	18,160 Seeds/lb.
Frost Seed:	No
Fly-Free Date:	No
Inoculation Type:	
Comments:	

Cultural Traits	
Scientific Name:	Secale cereale
Life Cycle:	Cool Season Annual
Growth Habit:	Upright
Preferred Soil pH:	5.0-7.0
Min. Germination Temp.:	34F
Heat Tolerance:	Fair
Drought Tolerance:	Very Good
Shade Tolerance:	Fair
Flood Tolerance:	Good
Low Fertility Tolerance:	Excellent
Winter Survival:	Expected
Comments:	

Potential Advantages	
Soil Impact - Subsoiler:	Very Good
Soil Impact - Frees P and K:	Very Good
Soil Impact - Loosens Topsoil:	Excellent
Soil Ecology - Nematodes:	Good
Soil Ecology - Disease:	Good
Soil Ecology - Allelopathic:	Excellent
Soil Ecology - Choke Weeds:	Excellent
Other - Attract Beneficials:	Fair
Other - Bears Traffic:	Very Good
Other - Short Windows:	Excellent
Comments:	

Out of Region: Rye as a Cover Crop

Summary

- No-till is an important first step in keeping soils healthy. Cover crops or live plants is the second step.
- Farmers can reduce their input costs by planting cover crops.
- How we manage the soil impacts soil temperature, water storage, & crop yields.
- Soil health also impacts weeds, insects, diseases, weather and climate.

OHIO STATE UNIVERSITY EXTENSION

Economics of Cover Crops

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