BE LOYAL TO THE SOIL

SOIL HEALTH PRESENTATION WITH A SPRINKLING OF ECONOMICS

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FOR TODAY

- What is soil health?
- How do we test the health of our soil?
- What practices improve our soil health?
- Is their an economic benefit with improved soil health?

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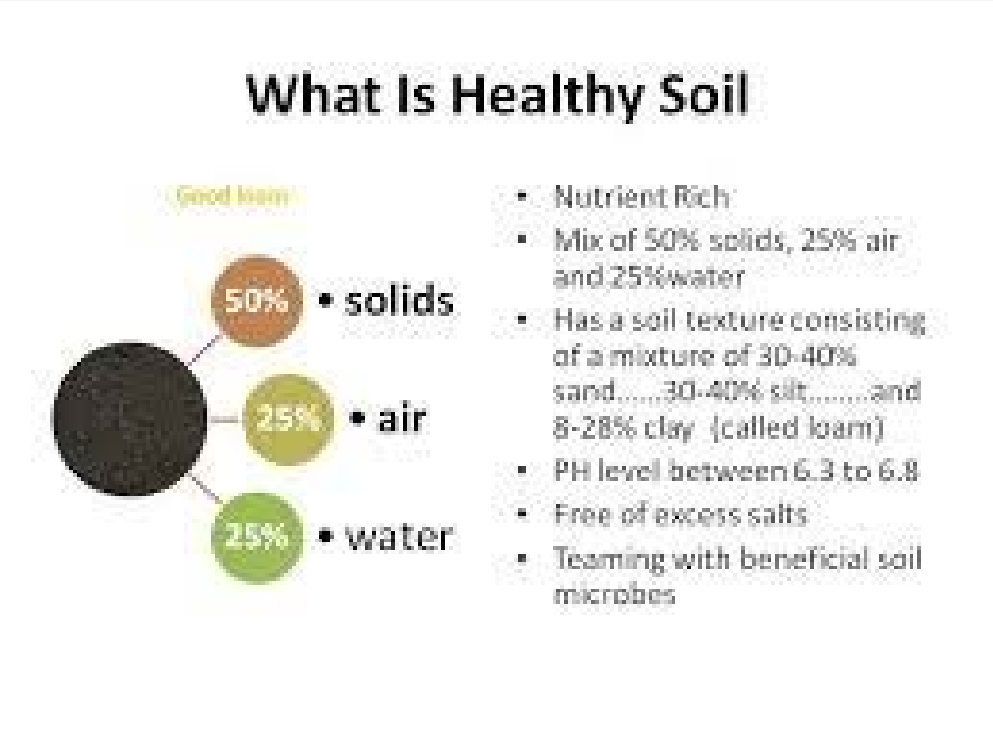
DIG A LITTLE-LEARN A LOT



- https://www.youtube.com/watch?v=2JZJB4zM3Y4 1 min

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DEFINITION

- **Soil health** can be defined as "the continued capacity of the **soil** to function as a vital living ecosystem that sustains plants, animals, and humans."
- **To put it simply, it is how well the soil does what it is supposed to do.** For a soil to be healthy, all the processes—physical, chemical, and biological—are working as they should. A healthy soil has good soil structure, high infiltration rates, and high water-holding capacity. It resists erosion, cycles nutrients, and supports healthy plants and animals. Most people know a healthy soil when they see it—by its color, its structure, and even its smell.

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OVERVIEW OF SCIENCE OF HEALTHY SOILS

https://www.youtube.com/watch?v=wD7cX-2yvas 6 min

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HEALTHY SOIL

HEALTHY PRACTICES

- NO-TILL
- COVER CROPS
- NUTRIENT MANAGEMENT
- INTEGRATED PEST MANAGEMENT
- CROP DIVERSITY

HEALTHY IMPACTS

- RESPIRATION
- BULK DENSITY
- INCREASE SOIL ORGANIC MATTER
- INCREASE C:N
- SOIL ORGANISMS
- INFILTRATION-CONSERVE WATER
- AROMA
- LESS FUEL, LABOR & COMMERCIAL FERTILIZER
- LESS EROSION

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WHAT NEEDS CONSIDERED TO IMPROVE SOIL HEALTH?

- SOIL STRUCTURE
- SOIL ORGANIC MATTER
- MICROORGANISMS
- BULK DENSITY/COMPACTION
- INFILTRATION
- WATER HOLDING CAPACITY
- SOIL TEMPERATURE
- REDUCE EROSION

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SOIL HEALTH TESTS

- Soil Quality Test Kit Guide
  - Bulk Density
  - Respiration
  - Infiltration
  - Stability
  - Earthworm
  - Slake

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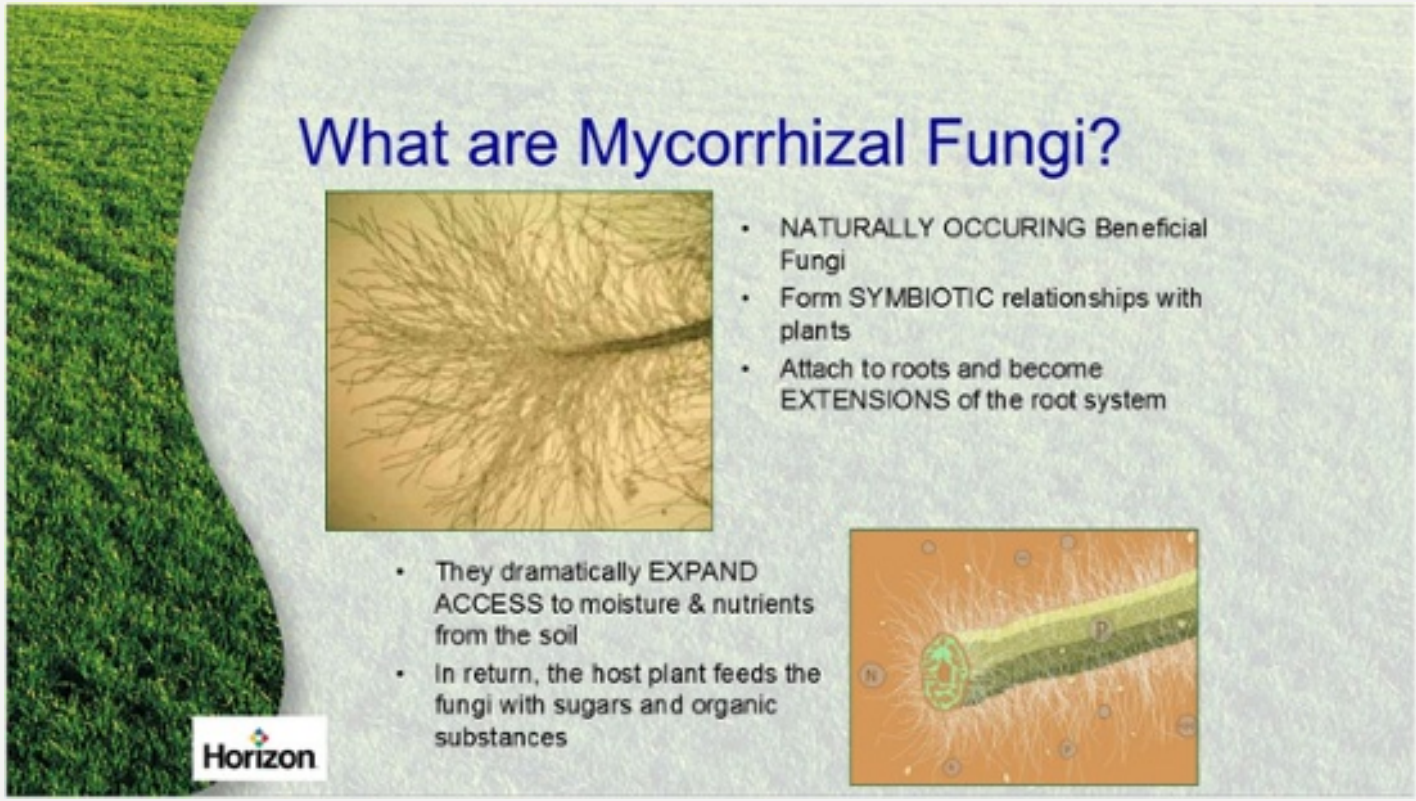
SOIL RESPIRATION A SIMPLE TEST WITH LOTS OF IMPACT



By Beth Hiatt

SC in the Kearney NRCS office

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SOLVITA TEST

Respiration

SOLVITA BASAL RESPIRATION – using a bulb planter helps to take a sample

Solvita CO2-Burst Method Soil Test

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SOIL HEALTH ASSESSMENT

SOLVITA TEST OF 6— ORGANIC N 245#

Nebraska Natural Resources Conservation Service | USDA | SOIL HEALTH | Soil Health Assessment Worksheet

County Dawson | Tract_Field S2 HOME | Field Review Date 11/10/2016

Operator Jill Blow | Completed_By THE

Soil_MU | Soil_Texture Silt Loam (c<20) | Soil_Temp 45

Management and Background Information

Rotation C-B-W | Current Crop COCKTAIL MIX CC

Tillage NT | Irrigation Irr | Years Of Cover Crop Use 7

Background Notes 2016 WHEAT, 2017 TRITICALE FOR SILAGE FOLLOWED BY GRAN SORGHUMCOCKTAIL MIX INCLUDES: TURNIP, RADISH, OATS, CORN, SUDANS, RAPE, SOYBEANS, BUCKWHEAT, VETCH AND MORE-PLANS TO GRAZE

Physical and Biological Measurements

A) First Run Infiltration (in/hr): 30.00 | A)Second Run Infiltration (in/hr) Steady State): 8.60

Avg. steady state infiltration for soil texture = 0.50 in/hr

If second run completed; infiltation compared to average steady state infiltration= 1720 % of average

Bulk Density Procedure			30 - 50 gram sub-sample - soil water content						
(h) ring H cm	(E) bag soil gm	(F) empty bag gm	(G) cup empty	(I) soil + cup	(K) dry + cup	(L) dry soil gm	(M) Soil	B) BULK DENSITY g/cm3	Avg. gm/cm3 for soil texture
4.400	479.6	4.2	7.3	51.4	41.0	33.7	0.309	1.03	1.30

B) Bulk Density Effect on Root Growth - Rating *: Very Good BD

Total Pore Space (Porosity) 61.1% | Pore space filled with H20 51.99% | Inches of H20 per ft 3.8 | Water Holding Capacity if all pores filled (inch H20/ft) 7.3

C) Solvita At 24hrs 6.0 | Estimated Solvita Microbial Activity Rating: Very High

Basic Solvita Calculator v1.0+ Solvita.com | Grow Season Days for County: 158 | Adjusted CO2-C @ 68 deg F - lbs/ac: 165

+ Likely Organic N mineralized over growing season lbs/ac: 246

In Field Assessments - 3.0 Max Score For Each Indicator

D1_Compaction	2.9
D2_Structure	3.0
D3_OM	3.0
D4_Management	3.0
D5_Roots	3.0
D6_Worms	3.0
D7_Biology	3.0
D8_Smell	2.0
D_Total	22.9

Actual Number of Assessments Scored (D1 through D8) Max of 8: 8

This Field Average Soil Health Indicator Score: 2.86 Out of 3.0 Possible

Indicator Notes: NO PENETRATION RESISTANCE, TILLAGE LAYER AT 4", FA STIC SOIL

Latitude 40.832966 | Longitude -99.504463

Monday, December 12, 2016 | Database v 1.3

* Bulk Density Rating on Root Growth is determined by Bulk Density and Soil Texture.

\+ https://solvita.com/soil/basal-co2-guide. Mineralization will occur throughout the growing season with proper moisture/conditions. If there is not a growing crop to utilize this N, it can easily leach away.

SOLVITA TEST OF 3.5— ORGANIC N 59#

Soil Health Assessment Worksheet - Data Entry | Operator Joe Blow | Tract/Field

County Clay | Completed By R. Boettcher | Date 6/9/2016

Soil MU 3889 | Soil Texture Silty Clay Loam | Texture Clay modifiers (cl - Texture By Feel Method)

Soil Temp 76 | Rotation c-Bcc | (Rotation - select from list OR enter a new rotation)

Current Crop Soybeans | Irr/Dry: Irr | Tillage: No Till | Years in Cover Crops: 1

Background Notes Has been N/T for 15 years. C/B rotation with cover crop drilled after beans.

A) 1st Run Infiltration In/Hr (ie .75): 1.70 | A)2nd Run Infil. In/Hr (steady state): | Avg. steady state = 0.50

B) Page 1 and 2 Bulk Density Procedures	(h) ring height cm	(E) bag soil gm	(F) empty bag gm	30 - 50 gram sub-sample - soil water content (G) cup empty gm	(I) soil + cup gm	(K) dry soil + cup gm	(L) dry soil calc gm	(M) Soil H20 g/g	*** Bulk Density gm/cm3	Avg. BD for Soil Texture
	5.080	407.6	10.0	0.7	48.9	39.3	38.6	0.249	0.98	1.3

Root Growth Bulk Density Chart | Bulk Density Effect on Root Growth | Very Good BD

Total pore space (Porosity) 62.9% | Pore space filled with H20 38.88% | Inches of H20 per ft soil 2.9 | Water Holding Capacity if all pores filled with H20 (inches/ft) 7.5

C) Solvita 24hr: 3.5

Estimated Solvita Microbial Activity Rating - 24 hrs: Medium High | Grow Season Days for County: 160

Basic Solvita Calcs v 1.0 | Adj. CO2-C @ 68 deg F - lbs/ac: 13 | Likely Organic N mineralized over growing season lbs/ac: 59

D1) Compaction	2.0
D2) Structure	2.0
D3) Organic M	2.0
D4) Management	2.0
D5) Roots	2.0
D6) Worms	1.5
D7) Biology	1.5
D8) Smell	2.0
Total:	15.0

How many of the 8 indicators were actually scored? 8

This Field Average Soil Health Indicator Score: 1.9

Indicator Notes: HEL hillside. 3" dark top that motteled light subsoil. Calcarous deposits. Heavier smell than silt loam on flats.

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Use Google Maps or Web Soil Survey (WSS) link button to zoom into the field. Google Maps will give Lat - Lon very quickly. WSS use [i] button for Lat Lon. Create AOI and soil map to get Soil MU. (Click HELP for

Google Maps | Web Soil Survey

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INFILTRATION AND SOIL STABILITY (SLAKE TEST)

A one inch layer of water is added to a six inch diameter ring to measure infiltration rate.

Table 1. Steady infiltration rates for general soil texture groups in very deeply wetted soil. (Hillel, D. 1982. Introduction to soil physics. Academic Press, San Diego, CA)

Soil Type	Steady Infiltration Rate (in/hr)
Sands	> 0.8
Loams	0.2 - 0.4
Clays	0.04 - 0.2

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SOIL STABILITY

https://www.youtube.com/watch?v=9_ItEhCrLoQ 1 min

Did You Know?

Soil stability serves as a qualitative indicator of soil biological activity, energy flow, and nutrient cycling. Binding of soil particles must constantly be renewed by biological processes.

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BULK DENSITY

Measures compaction level of soil

http://www.bing.com/videos/search?q=youtube+video+measuring+bulk 3min+density&view=detail&mid=04BDA9C9D3A7F8C4B78C04BDA9C 9D3A7F8C4B78C&FORM=VIRE1 2.5 MIN

Table 1.—General relationship of soil bulk density to root growth based on soil texture*

Soil texture	Ideal bulk density for plant growth (grams/cm^3)	Bulk density that affects root growth (grams/cm^3)	Bulk density that restricts root growth (grams/cm^3)
Sand, loamy sand	<1.60	1.69	>1.80
Sandy loam, loam	<1.40	1.63	>1.80
Sandy clay loam, clay loam	<1.40	1.60	>1.75
Silt, silt loam	<1.40	1.60	>1.75
Silt loam, silty clay loam	<1.40	1.55	>1.65
Sandy clay, silty clay, clay loam	<1.10	1.49	>1.58
Clay (>45 percent clay)	<1.10	1.39	>1.47

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EARTHWORM COUNT

dig a hole 12” X 12” X 12”

count the worms

https://www.youtube.com/watch?v=OcpXeSRGdXA 3 min

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WHAT IS THE DIFFERENCE BETWEEN EARTHWORMS & NIGHTCRAWLERS?

NIGHTCRAWLERS (DEW WORMS)

- Much larger-14”
- Grayer
- Thicker
- Burrow during the day up to 6.5’ deep
- Earthmoving
- Used for bait

EARTHWORMS (RED WIGGLERS)

- Smaller- 4”
- Reddish
- Used in composting-eat up to ½ their weight a day
- Can buy from garden supply catalogues
- Toxic to snakes

SOIL HEALTH ASSESSMENT

FIELD ASSESSMENT SCORE = 2.86

ORGANIC N 245#

Nebraska Natural Resources Conservation Service — USDA — SOIL HEALTH — Soil Health Assessment Worksheet

County Dawson | Tract_Field S2 HOME | Field Review Date 11/10/2016

Operator Jill Blow | Completed_By THE

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Google Maps | Web Soil Survey

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NO-TILL

BENEFITS INCLUDE: INCREASED ORGANIC MATTER, FUEL SAVINGS, IMPROVED SOIL STRUCTURE, INCREASED EARTHWORMS AND MYCORHYZAE, INCREASED INFILTRATION, REDUCED RELIANCE ON CHEMICALS

NO TILL

A system for planting crops without plowing, using herbicides to control weeds and resulting in reduced soil erosion and the preservation of soil nutrients.

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ECONOMICS OF NO-TILL-TIME & FUEL

	Time Period	Spring Grain Conventional	Spring Grain No-Till	Winter Wheat No-Till
		minutes		
Labor	Fall[a]	31	9	21
	Spring[b]	25	19	4
	Summer[c]	4	4	0
	Total	60	32	25
		gallons		
Fuel	Total	5.77	2.02	1.67

[a] Machinery labor from August 21 to December 31.
[b] Machinery labor from January 1 to May 20.
[c] Machinery labor from May 21 to August 20.

NO-TILL RESIDUE

CORN INTO CORN

SOYBEANS INTO CORN

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ORGANIC MATTER & SOIL ORGANISMS

ORGANIC MATTER IS THE HOUSE

CARBON IS THE FOOD

SOIL ORGANISMS LIVE IN THE HOUSE & MAKE THE FOOD INTO FERTILIZER

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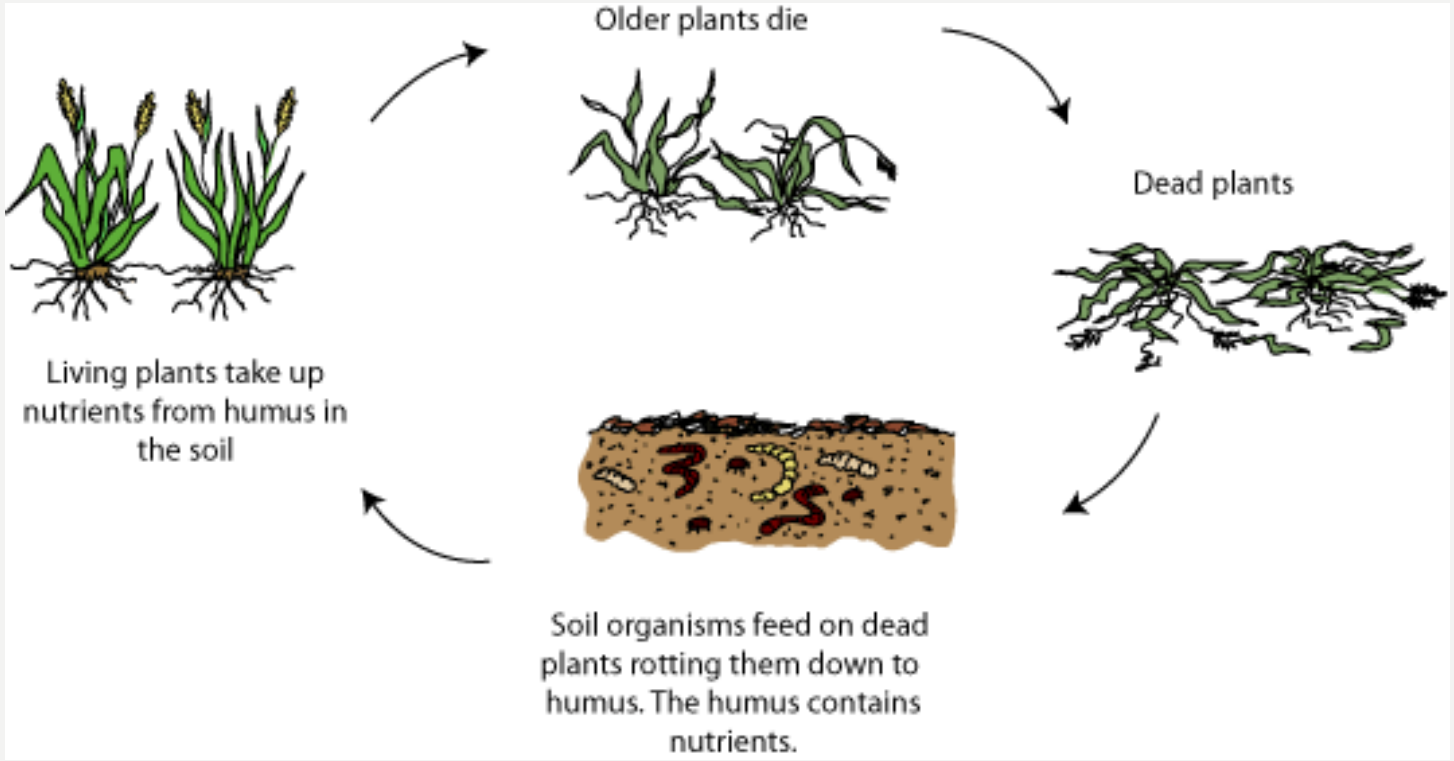

THE CYCLE CONTINUES

SOIL MOISTURE

TEMPERATURE

OXYGEN LEVELS

As C:N ratio goes down ⇩ 8:1-15:1 N & P available
below 8 C limited
above 15 N limited

Organic N & P go up ⇧

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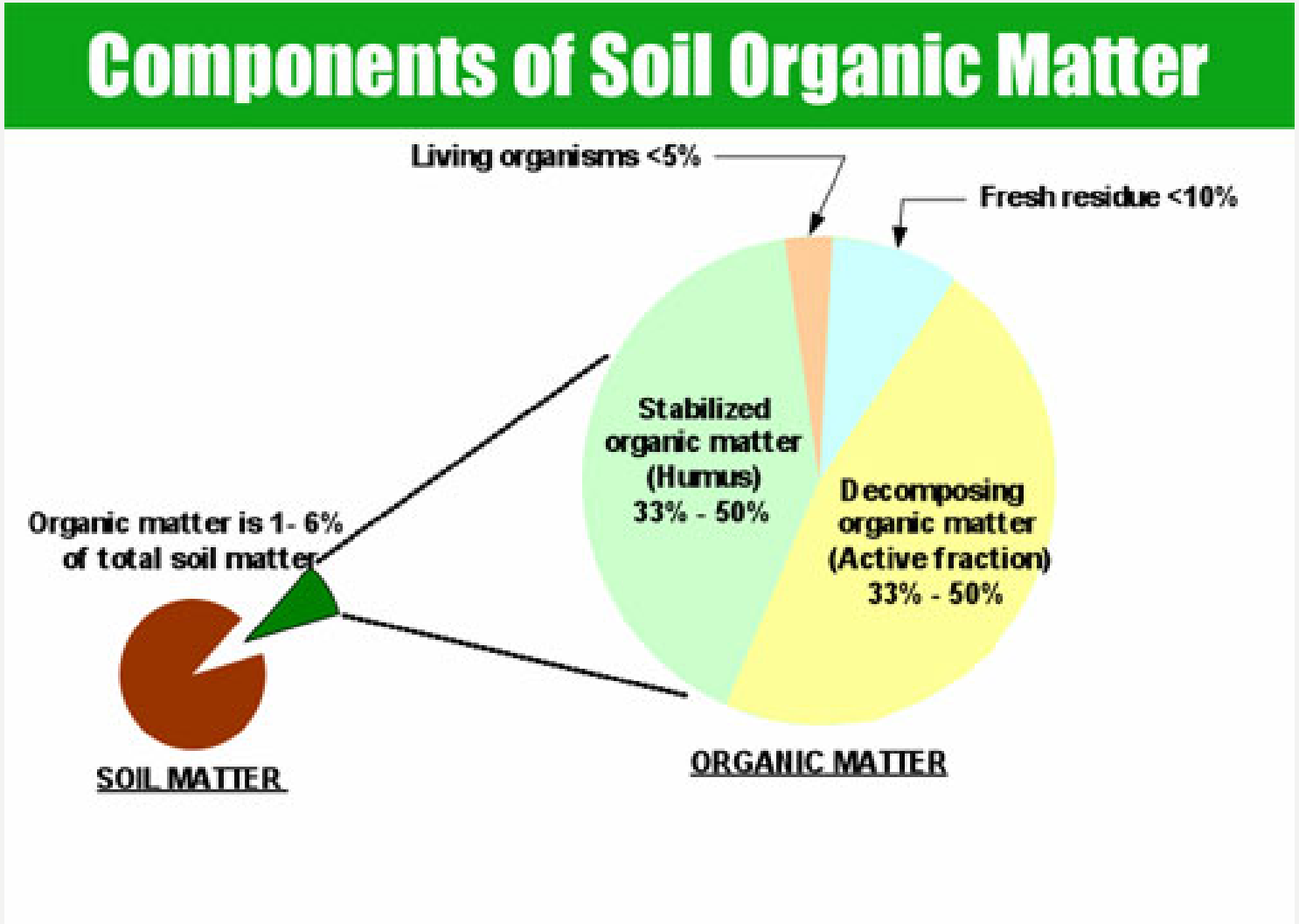

SOIL ORGANIC MATTER

ANYTHING THAT WAS ALIVE AND IS NOW IN OR ON THE SOIL AND DECOMPOSED INTO HUMUS. HUMIUS IS THE MATERIAL THAT WAS DECOMPOSED BY MICROORGANISMS

IT TAKES ABOUT 10# OF ORGANIC MATERIAL TO DECOMPOSE INTO 1# ORGANIC MATTER

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WHY IS ORGANIC MATTER IMPORTANT?

- RESERVOIR OF NUTRIENTS
  - 1%=23-30# N/ac
  - Anhy Ammonia $391.75/T= .20/#
    - $0.20/lb X 30 # N/ac = $6/ac!!
  - Urea $309.28/T
    - $0.15/lb X 30 = $4.50/ac
  - 32-0-0 $294.00/T
    - $0.15 X 30 = $4.50/ac

- WATER HOLDING CAPACITY
  - 1%=16,500 gal/Ac water holding capacity
  - Water allocations
  - Drought resistance

  - BETTER SOIL STRUCTURE
    - improved permeability

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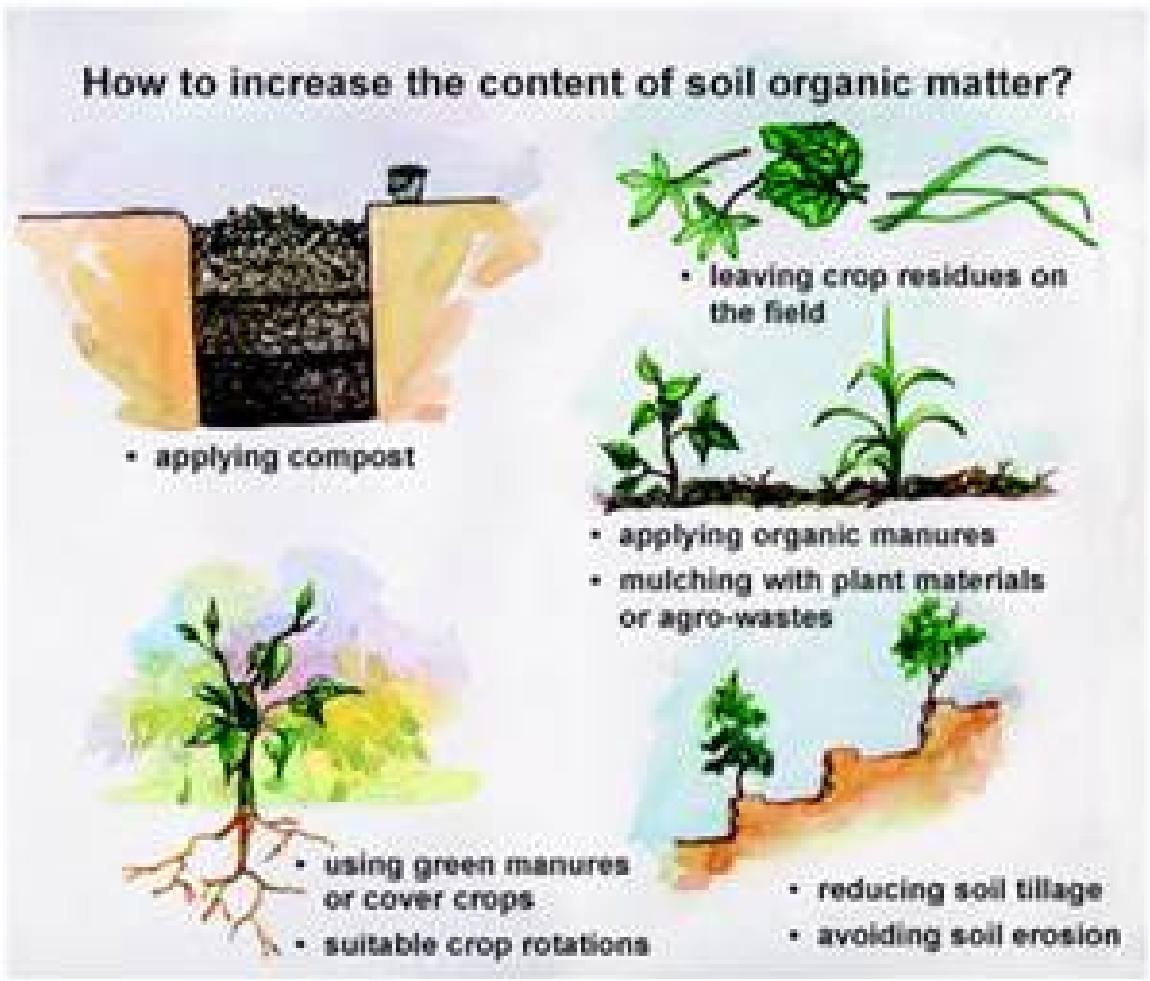
HOW TO BUILD ORGANIC MATTER-BUILD CARBON



- ADD COMPOST OR MANURE
- NO TILLAGE
- AVOID SOIL EROSION
- CROP ROTATION
- COVER CROPS

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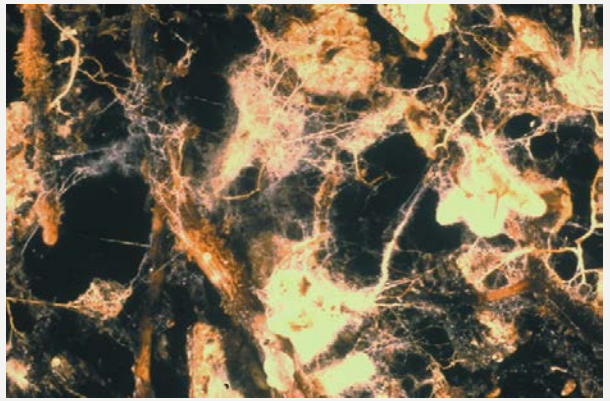
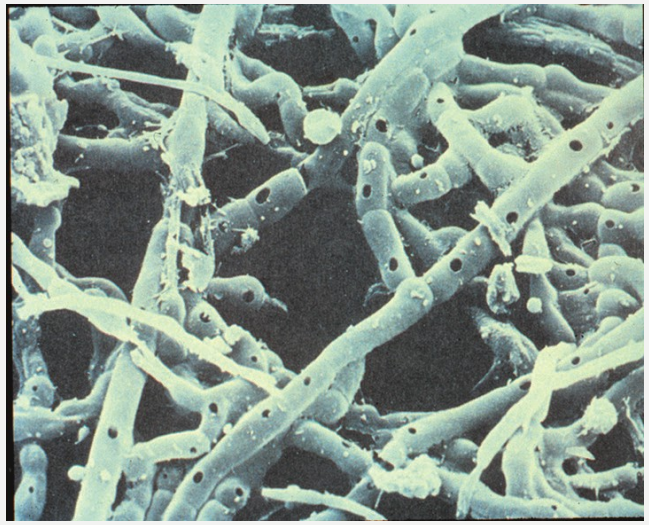
SOIL CRITTERS



Mycorrhizae fungi

Earthworms



Protozoa

COVER CROPS

BENEFITS: WARMER SOIL IN WINTER, COOLER IN SUMMER, CONSERVE SOIL WATER, NITROGEN FIXATION AND NITROGEN SCAVENGING, BREAK UP HARD PAN/PLOW LAYER, REDUCE EROSION

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COVER CROP ECONOMICS

SPECIFIC INFORMATION FOR YOUR OPERATION

Cover Crop Economics (Long Term Analysis)

The long term analysis assumes the continued utilization of cover crops modeled in the short term analysis, and also captures additional benefits that may be realized over time with the continued use of cover crops in rotation. Refer to the "Instructions" worksheet and "References and Citations" worksheet for more information and guidance on entering the long

General Information

The lifespan refers to the length of time being analyzed and assumes a continued use of cover crop in the farming rotation, based on the information entered into the Short Term Analysis.

Analysis Lifespan (years) - *up to 50 years*	25
Discount Rate	3%
Current Soil Organic Matter (SOM) (%)	2
Estimate of years of mgmt change to increase SOM 1%	10
Estimate of maximum potential SOM (%)	4

The Analysis Lifespan (years) must be greater than the Estimate of years of mgt change to increase SOM 1% in order for the long term analysis results to begin capturing the long term benefits.

Costs

The costs shown below are based on the information entered into the short term analysis and amortized over the long term analysis lifespan.

Cover Crop Establishment & Mgt ($/ac/yr)	**$55.25**
Other Costs ($/ac/yr)	**$7.81**
Total Cost ($/ac/yr)	**$63.06**

Benefits

Short Term Benefits: *The benefits below are based on the information entered into the short term analysis and amortized over the long term analysis lifespan.*

Direct nutrient credit ($/ac/yr)	$7.91
Herbicide/insecticide/fungicide input reduction ($/ac/yr)	$3.01
Yield Increase ($/ac/yr)	$8.70
Erosion Reduction ($/ac/yr)	$21.13
Grazing ($/ac/yr)	$47.35

Economic Analysis of Cover Crops Summary

12/12/2016

Scenario Description

A soybean/corn rotation where producer is establishing fall cover crops. The cover crop established after corn harvest is grazed in fall and/or spring depending on weather and cover crop establishment timing. The forage provided by the cover crop offsets some of the typical winter feeding expenses.

Short Term Analysis:

Rotation Information

	Soybeans	Corn
Baseline Yield (bu/ac)	90	225
Crop Value ($/bu)	$9.25	$3.02

Cost Summary

Cover Crop Establishment and Management ($/ac)	$51.60	$59.04
Other Cost ($/ac)	$0.00	$16.30
Total Costs ($/ac)	$51.60	$75.34

Benefits Summary

Direct Nutrient Input Reduction ($/ac)	$0.00	$16.50
Herbicide, fungicide, insecticide Input Reduction ($/ac)	$3.00	$3.00
Yield Increase ($/ac)	$16.65	$0.00
Erosion Reduction ($/ac)	$21.09	$21.09
Grazing Benefit ($/ac)	$37.70	$57.70
Total Benefit ($/ac)	$78.44	$98.29

Short Term Analysis Results	Soybeans	Corn
Total Cost ($/ac)	$51.60	$75.34
Total Benefit ($/ac)	$78.44	$98.29
Net Benefit ($/ac)	$26.84	$22.95

Long Term Analysis

Long Term Analysis Details

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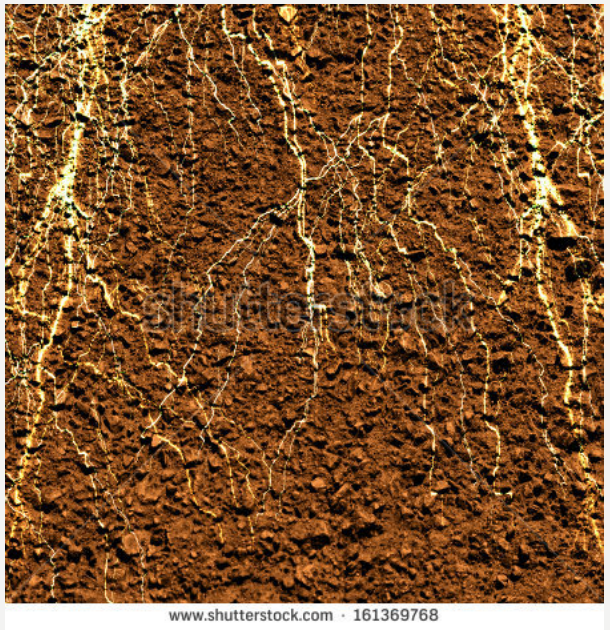

"plants fix dirt"
Rick Haney

SOIL HEALTH ASSESSMENT

7 YEARS OF COVER CROPS

Nebraska Natural Resources Conservation Service | USDA | SOIL HEALTH | Soil Health Assessment Worksheet

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Background Notes: 2016 WHEAT, 2017 TRITICALE FOR SILAGE FOLLOWED BY GRAN SORGHUMCOCKTAIL MIX INCLUDES: TURNIP, RADISH, OATS, CORN, SUDANS, RAPE, SOYBEANS, BUCKWHEAT, VETCH AND MORE-PLANS TO GRAZE

Physical and Biological Measurements

A) First Run Infiltration (in/hr): 30.00 | A)Second Run Infiltration (in/hr) Steady State): 8.60

Avg. steady state infiltration for soil texture = 0.50 in/hr

If second run completed; infiltation compared to average steady state infiltration= 1720 % of average

Bulk Density Procedure — 30 - 50 gram sub-sample - soil water content

(h) ring H cm	(E) bag soil gm	(F) empty bag gm	(G) cup empty	(I) soil + cup	(K) dry + cup	(L) dry soil gm	(M) Soil	B) BULK DENSITY g/cm3	Avg. gm/cm3 for soil texture
4.400	479.6	4.2	7.3	51.4	41.0	33.7	0.309	1.03	1.30

B) Bulk Density Effect on Root Growth - Rating *: Very Good BD

Total Pore Space (Porosity) 61.1% | Pore space filled with H20 51.99% | Inches of H20 per ft 3.8 | Water Holding Capacity if all pores filled (inch H20/ft) 7.3

C) Solvita At 24hrs 6.0 | Estimated Solvita Microbial Activity Rating: Very High

Basic Solvita Calculator v1.0+ Solvita.com | Grow Season Days for County: 158 | Adjusted CO2-C @ 68 deg F - lbs/ac: 165

+ Likely Organic N mineralized over growing season lbs/ac: 246

In Field Assessments - 3.0 Max Score For Each Indicator

D1_Compaction	2.9
D2_Structure	3.0
D3_OM	3.0
D4_Management	3.0
D5_Roots	3.0
D6_Worms	3.0
D7_Biology	3.0
D8_Smell	2.0
D_Total	22.9

Actual Number of Assessments Scored (D1 through D8) Max of 8: 8

This Field Average Soil Health Indicator Score: 2.86 Out of 3.0 Possible

Indicator Notes: NO PENETRATION RESISTANCE, TILLAGE LAYER AT 4", FA[illegible]STIC SOIL

Latitude 40.832966 | Longitude -99.504463

1 YEAR OF COVER CROP

Soil Health Assessment Worksheet - Data Entry | Operator Joe Blow | Tract/Field

County Clay | Completed By R. Boettcher | Date 6/9/2016

Soil MU 3889 | Soil Texture Silty Clay Loam | Texture Clay modifiers (c) - Texture By Feel Method

Soil Temp 76 | Rotation c-Bcc | (Rotation - select from list OR enter a new rotation)

Current Crop Soybeans | Irr/Dry: Irr | Tillage: No Till | Years in Cover Crops: 1

Background Notes: Has been N/T for 15 years. C/B rotation with cover crop drilled after beans.

A) 1st Run Infiltration In/Hr (ie .75): 1.70 | A)2nd Run Infil. In/Hr (steady state): | Avg. steady state = 0.50

B) Page 1 and 2 Bulk Density Procedures — 30 - 50 gram sub-sample - soil water content

(h) ring height cm	(E) bag soil gm	(F) empty bag gm	(G) cup empty gm	(I) soil + cup gm	(K) dry soil + cup gm	(L) dry soil calc gm	(M) Soil H20 g/g	*** Bulk Density gm/cm3	Avg. BD for Soil Texture
5.080	407.6	10.0	0.7	48.9	39.3	38.6	0.249	0.98	1.3

Root Growth Bulk Density Chart | Bulk Density Effect on Root Growth: Very Good BD

Total pore space (Porosity) 62.9% | Pore space filled with H20 38.88% | Inches of H20 per ft soil 2.9 | Water Holding Capacity if all pores filled with H20 (inches/ft) 7.5

C) Solvita 24hr: 3.5

Estimated Solvita Microbial Activity Rating - 24 hrs: Medium High | Grow Season Days for County: 160

Basic Solvita Calcs v 1.0 | Adj. CO2-C @ 68 deg F - lbs/ac: 13 | Likely Organic N mineralized over growing season lbs/ac: 59

D1) Compaction	2.0
D2) Structure	2.0
D3) Organic M	2.0
D4) Management	2.0
D5) Roots	2.0
D6) Worms	1.5
D7) Biology	1.5
D8) Smell	2.0
Total:	15.0

How many of the 8 indicators were actually scored? 8

This Field Average Soil Health Indicator Score: 1.9

Indicator Notes: HEL hillside. 3" dark top that motteled light subsoil. Calcarous [illegible]posits. Heavier smell than silt loam on flats.

Latitude (ie 41.79990) 40.62235 | Longitude (ie -98.2298)(neg) -98.268653

Use Google Maps or Web Soil Survey (WSS) link button to zoom into the field. Google Maps will give Lat - Lon very quickly. WSS use [i] button for Lat Lon. Create AOI and soil map to get Soil MU. (Click HELP for

Google Maps | Web Soil Survey

DISCOVER THE COVER-COVER CROPS

USING COVER CROPS TO MANAGE YOUR HEARD OF SOIL MICROORGANISMS

- https://www.youtube.com/watch?v=VHMCJSxQAgo 1min

Photo on the left shows cover crop rows shaded by a canopy of corn. At right, cover crop in full growth after corn harvest and withering of stalks.

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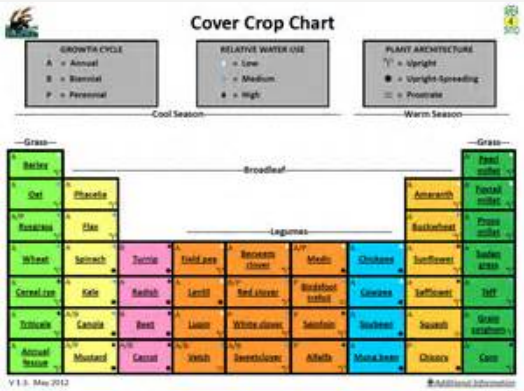
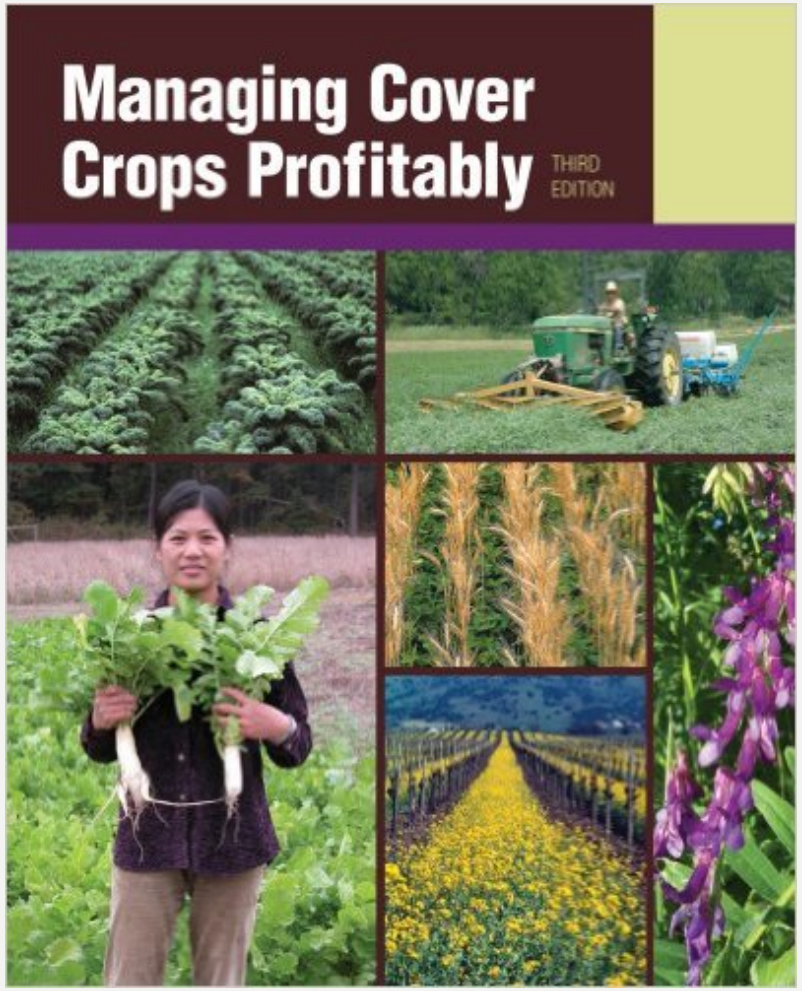
WHAT TO PLANT?
WHAT ARE YOUR OBJECTIVES?

COVER CROP TURNIP

COVER CROP ROOTS





MULTIPLE USES AND BENEFITS

DIVERSITY

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HOW TO PLANT

BROADCAST RATE X 1.5

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WHEN TO PLANT

Cover Crop Spp.	Planting Date Zone I, II
barley, spring	3/15-5/15 or 8/1-9/1
buckwheat	5/1-9/1
canola /rapeseed	3/15-4/15 or 7/1-9/15
chickling vetch	3/15-4/15 or 8/1-9/15
chickpea (desi-type)	4/15-5/15
clover, arrowleaf	3/15-5/15 or 8/15-9/15
clover, Berseem/Persian	3/15-5/15 or 7/15-9/15
clover, Crimson	3/15-5/15 or 7/15-9/15
clover, red	NA
clover, sweet	8/1-9/15 or 11/1-5/15
corn (BMR)	NA
cowpea	NA
Ethiopian Cabbage	7/15-9/15
faba bean	3/15-4/15 or 7/15-9/1
flax	3/15-5/10 or 7/1-9/1
Hybrid Brassica	3/15-4/15 or 7/1-9/15
lentil, spring	3/15-4/15 or 7/1-9/15
millet, foxtail (German)	5/15-8/1
millet, pearl	5/15-8/15
millet, proso*	5/15-8/1
mustard, brown, oriental or yellow	3/15-4/1 or 7/15-9/1
oats	3/15-5/1 or 8/1-9/1
pea, spring field	3/15-4/15 or 7/15-9/1
pea, spring forage	3/15-4/15 or 7/15-9/1

pea, winter	7/15-10/15 or dormant
Phacelia	3/15-5/15 or 7/15-9/1
radish	7/15-8/20
rye (cereal)	8/1-10/15
ryegrass (annual)	3/15-5/15 or 8/1-9/15
ryegrass (Italian)**	3/15-5/15 or 8/1-9/15
safflower	3/15-5/1 or 8/1-9/15
sorghum, grain or forage	5/15-8/15
soybean	NA
sudangrass	5/15-8/15
sudan-sorghum hybrid	5/15-8/15
sunflower	5/15-8/16
Sunn Hemp	6/1-8/1
triticale	8/1-9/15
triticale,spring	3/15-5/1 or 8/1-9/1
turnip	7/15-8/20
vetch, common	3/15-4/15 or 7/1-9/15
vetch, hairy or crown	8/1-9/15 or 11/1-5/15
vetch, woolypod (Lana)	3/15-4/15 or 7/1-9/15
wheat (winter)	8/15-9/20

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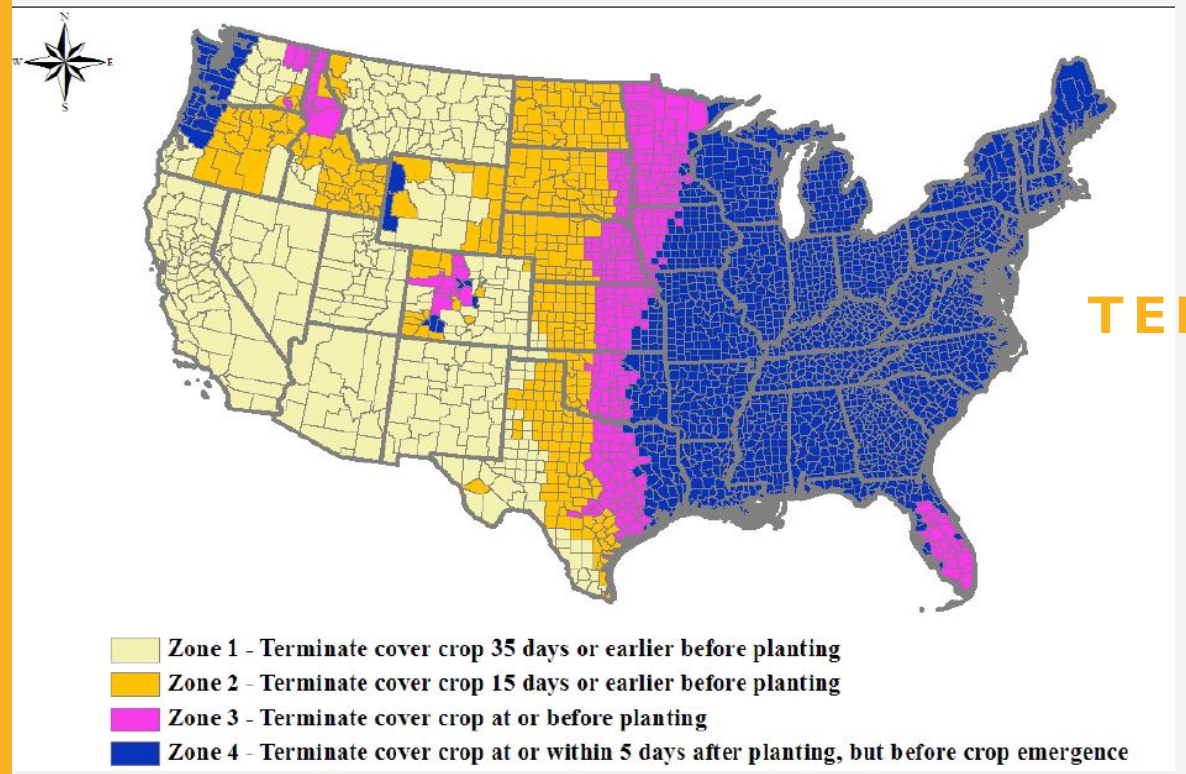

TERMINATION METHODS & GUIDELINES

ROLLER

MECHANICAL

CHEMICAL

OVER WINTER

HARVESTED

TIMING

Zone 1 - See Map	Zone 2 - See Map	Zone 3 - See Map	Zone 4 - See Map
NRCS Cover Crop Termination Period Guidance - Non-Irrigated Cropland:			
For Late Spring to Fall Seeded Crops - Terminate cover crops 35 days or earlier prior to planting the crop. **For Early Spring Seeded Crops** - Terminate cover crops as soon as practical prior to planting the crop. (Additional Cover Crop Termination Considerations 4 and 8)	**For Late Spring to Fall Seeded Crops** - Terminate cover crops 15 days or earlier prior to planting the crop. **For Early Spring Seeded Crops** Terminate cover crops as soon as practical prior to planting the crop. (Additional Cover Crop Termination Considerations 4 and 8)	Terminate cover crop at or before planting the crop.	Terminate cover crop at or within 5 days after planting, but before crop emergence.
RMA Designated Summer Fallow Practice * For summer seeded or fall seeded crops terminate the cover crop at least 90 days prior to planting. * For early spring seeded crops terminate the cover crop either in late fall or as early as possible in the spring prior to planting.	**RMA Designated Summer Fallow Practice** * For summer seeded or fall seeded crops terminate the cover crop at least 90 days prior to planting. * For early spring seeded crops terminate the cover crop either in late fall or as early as possible in the spring prior to planting.	**RMA Designated Summer Fallow Practice** * For summer seeded or fall seeded crops terminate the cover crop at least 90 days prior to planting. * For early spring seeded crops terminate the cover crop either in late fall or as early as possible in the spring prior to planting.	

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GRAZING COVER CROPS

Incorporating grazing of cover crops into a cash crop operation is a reliable way to capture short term benefits from cover crops and increase the overall profitability of the operation. To maximize the long term soil health benefits of the cover crops, grazing must be managed to balance the forage needs of the livestock with the needs of the living organisms in the soil. Over grazing cover crops can have a negative effect on long-term soil health benefits.

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GRAZING ECONOMICS- COST ANALYSIS

Analysis

Costs

Cover Crop Before Corn		Grazing Infrastructure	
Cover Crop Seed ($/acre) - Winter Triticale, 20 lbs/acre, $0.31/lb Purple Top Turnip, 4 lbs/acre, $1.70/lb Spring Oats, 20 lbs/acre, $0.30/lb	$19.00	Fence ($/acre) [1/]	$49.17
Cover Crop Planting ($/acre)	$20.00	Watering Facilities ($/acre)[2/]	$71.52
Cover Crop Termination ($/acre)	$10.00		
Total Cost ($/acre)	$49.00	Total Cost	$120.69

Benefits

Cover Crop Before Corn	
Grazing Value ($/acre) – 2.7 AU/ac, 35 lb/AU/day forage demand, 42 days grazing, $80.00/ton forage value	$158.76

GRAZING ECONOMICS--RESULTS

Results

Short Term

Grazing Infrastructure One Time Investment Cost __ -$120.69/ac
Cover Crop mix for grazing before Corn net benefit _ $109.76/ac
Year 1 Net Cost _____ -$10.93/ac

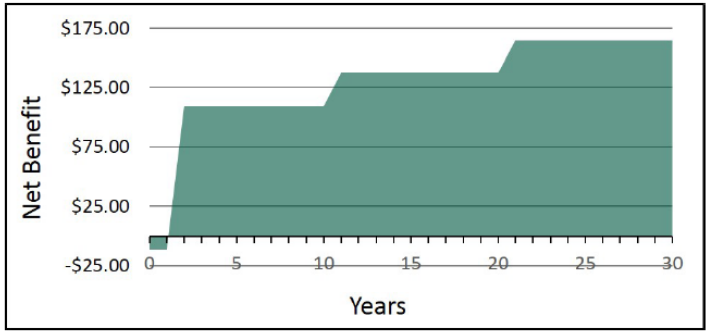
Long Term

If the farmer continues to utilize cover crops in his rotation he will experience improvements in the physical and biological properties of the soil. One way to measure this improvement is through soil organic matter. For each 1 percent increase in soil organic matter (based on increasing the active carbon content in the soil) approximately 20 lb/acre of plant-available nitrogen becomes available. Additionally, the water-holding capacity of the soil increases, reducing the risk of drought-induced yield reductions in dryland farming systems. Assuming it takes this farmer 10 years to increase soil organic matter 1 percent, the additional benefits after year 10 are $27.50/acre/year.

Long Term Benefits	
Soil Fertility ($/acre/year) - 20 lbs/acre plant available N at $0.55/lb	$11.00
Water Storage ($/acre/year) - avoided yield reduction due to drought [3/]	$16.50
Total Long Term Benefits ($/acre/year)	$27.50

Combining the Short Term and Long Term Results

Year 1	Net Cost	-$10.93/acre
Years 2-10	Net Benefit	$109.76/acre
Years 11-20	Net Benefit	$137.26/acre
Years 21-30	Net Benefit	$164.76/acre



NUTRIENT & PEST MANAGEMENT

BENEFITS: CLEANER DRINKING WATER, LESS POLLUTION OF STREAMS & RIVERS, FEWER CHEMICALS, OPTIMIZE ON FARM NUTRIENTS, REDUCE FERTILIZER COSTS, PREVENT EXCESSIVE NUTRIENT BUILD-UP

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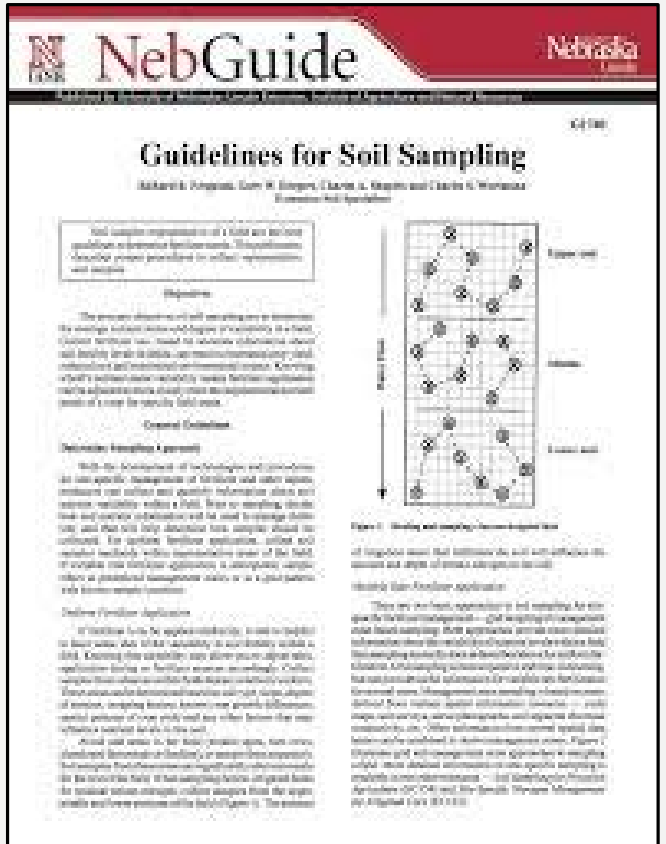
SOIL TEST PROCEDURE

PROPER SAMPLING


NebGuide

Nebraska Extension

Guidelines for Soil Sampling

GARBAGE IN-GARBAGE OUT

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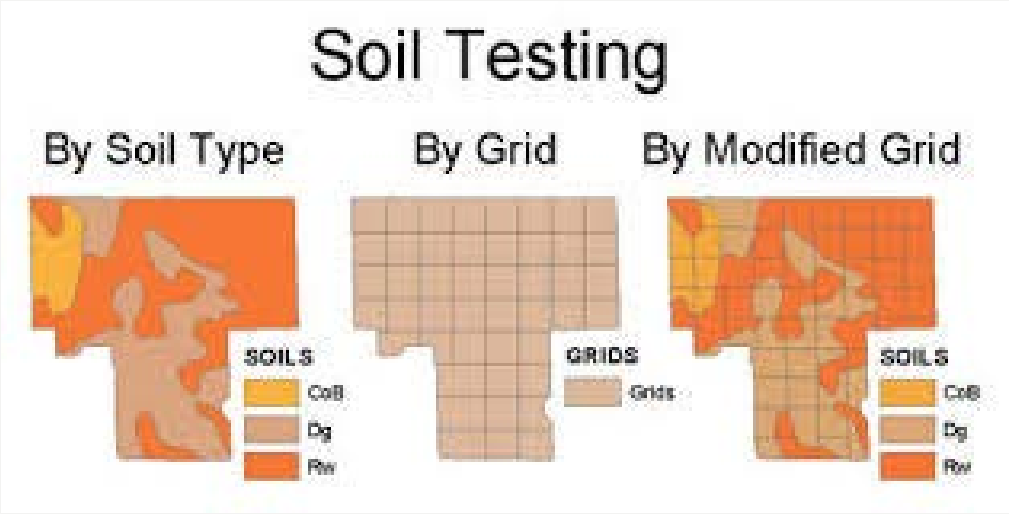
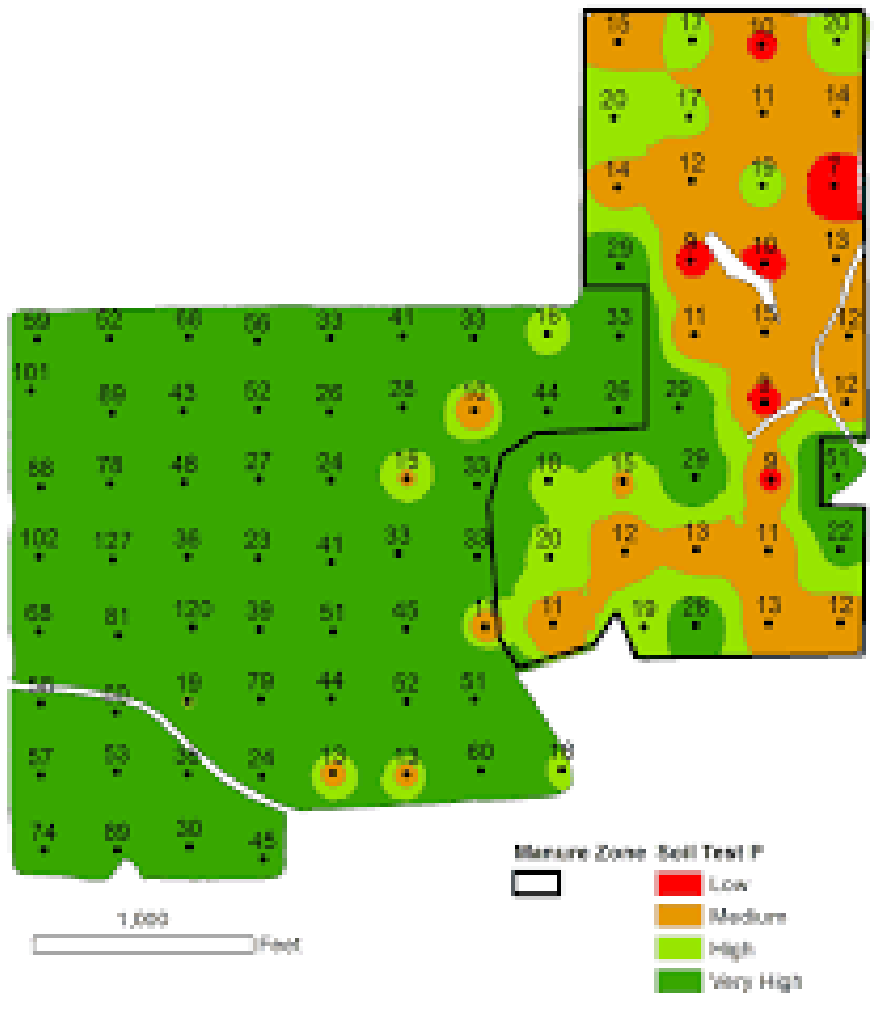
GRID SAMPLING FOR PRECISION AG





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Natural Resources Conservation Service

UNDERSTAND WHAT YOUR REPORT TELLS YOU

WARD Laboratories, Inc.

Ag Testing - Consulting

Account No. : 25105

Soil Analysis Report

Results For : RAY WARD
Location :

Invoice No. : 1193677
Date Received : 10/19/2015
Date Reported : 10/22/2015

Sample ID / Lab No.	Soil pH 1:1	Modified WDRF BpH	Soluble Salts 1:1 mmho/cm	Excess Lime Rating	Organic Matter LOI-%	FIA Nitrate ppm N	Depth Nitrate Lbs N/A	Method Phosphorus ppm P	Ammonium Acetate K ppm	Ca ppm	Mg ppm	Na ppm	Ca-P Sulfate ppm S	DTPA Zn ppm	Fe ppm	Mn ppm	Cu ppm	Hot Water Boron ppm B	CaNO3 Chloride ppm Cl	Sum of Cations me/100g	% Base Saturation H	K	Ca	Mg	Na
N OF BARN							0 - 8 in	M-P3																	
707115	5.1	6.4	0.22	NONE	2.8	6.3	15	45	259	1746	235	19	8	2.18	79.0	23.6	1.18	0.43		17.2	34	4	51	11	0
N OF LANE							0 - 8 in	M-P3																	
707116	4.9	6.2	0.19	NONE	3.0	8.5	20	53	179	1625	240	16	8	2.28	92.3	33.3	1.53	0.52		18.6	43	2	44	11	0

Fertilizer Recommendations In Actual Pounds of Plant Nutrients per Acre

Crop	Yield Goal	Nitrogen N	Phosphorus P_2O_5	Potassium K_2O	Sulfur S	Zinc Zn	Magnesium Mg	Iron Fe	Manganese Mn	Copper Cu	Boron B	Chloride Cl	Lime, ECC Tons/Acre
Sample ID : N OF BARN	Sub-Soil ID(s) | Depth(s) :							Past Crop : Soybeans				N Credit : 40	
(Ward) Wheat BU/A	80	115	15	0	18	0	0	0	0	0.0	0.0		2.4
Sample ID : N OF LANE	Sub-Soil ID(s) | Depth(s) :							Past Crop : Soybeans				N Credit : 40	
(Ward) Corn, BU	150	80	0	20	11	0	0	0	0	0.0	0.0		3.2

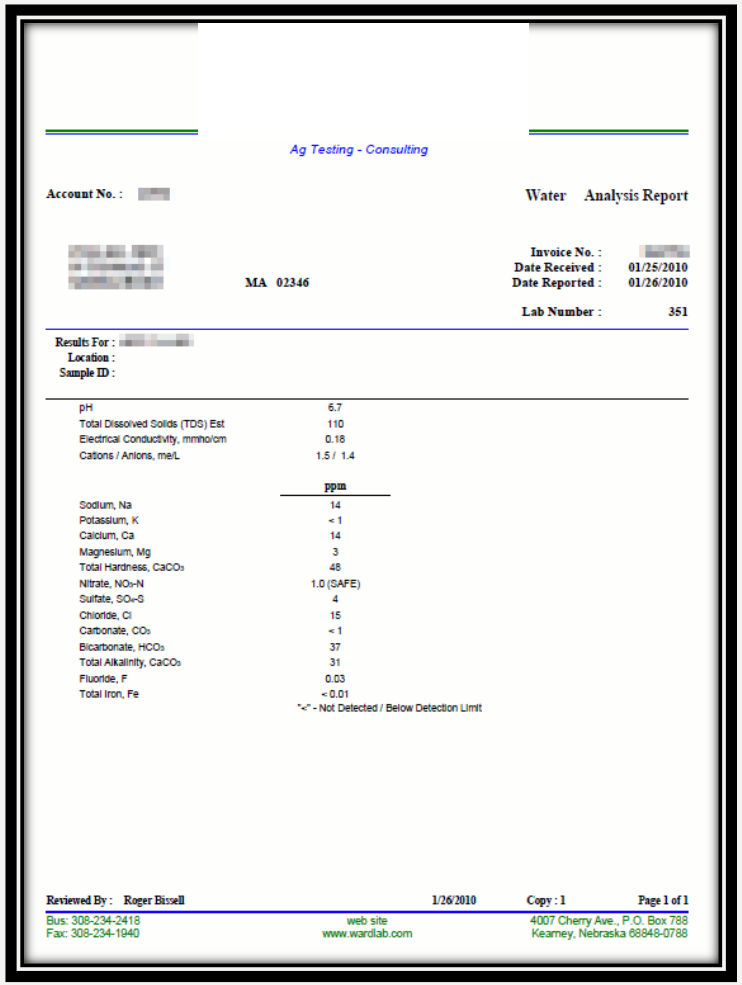
Reviewed By: Raymond Ward Copy : 1 10/28/2015 Page 1 of 1

Bus: 308-234-2418 Fax: 308-234-1940 Web site www.wardlab.com 4007 Cherry Ave., P.O. Box 788 Kearney, Nebraska 68848-0788

NRCS Natural Resources Conservation Service

- Depth of sample
- Organic Matter
- Nitrogen—parts per million and/or pounds
- Phosphorus
- Potassium
- pH above 7—alkaline, below 7—acid, 7—just right!

WATER TEST--ONCE EVERY 5 YEARS



Ag Testing - Consulting

Account No. :

Water Analysis Report

MA 02346

Invoice No. :
Date Received : 01/25/2010
Date Reported : 01/26/2010

Lab Number : 351

Results For :
Location :
Sample ID :

pH	6.7
Total Dissolved Solids (TDS) Est	110
Electrical Conductivity, mmho/cm	0.18
Cations / Anions, me/L	1.5 / 1.4

	ppm
Sodium, Na	14
Potassium, K	< 1
Calcium, Ca	14
Magnesium, Mg	3
Total Hardness, $CaCO_3$	48
Nitrate, NO_3-N	1.0 (SAFE)
Sulfate, SO_4-S	4
Chloride, Cl	15
Carbonate, CO_3	< 1
Bicarbonate, HCO_3	37
Total Alkalinity, $CaCO_3$	31
Fluoride, F	0.03
Total Iron, Fe	< 0.01

"<" - Not Detected / Below Detection Limit

Reviewed By : Roger Bissell 1/26/2010 Copy : 1 Page 1 of 1

Bus: 308-234-2418
Fax: 308-234-1940
web site
www.wardlab.com
4007 Cherry Ave., P.O. Box 788
Kearney, Nebraska 68848-0788

N pounds/ac applied =
[(average inches pumped for current crop x ppm nitrate) x 2.7] divide by 12 inches

Example 10" pumped X 14 ppm X 2.7/12 = 31.5 #/ac N
31.5 # N X $0.15/# = $4.72/ac

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NITRATE LEVELS IN WATER

- **Good levels!**
- Typical levels for surface waters is 0.1 ppm or below.
- **Bad levels!**
- 2-9 ppm this level increases algal and plant growth.
- This can lead to winter kills
  - Run off from sewage or fertilizer runoff causes an increased in algal growth.
  - Algae dies and decomposes which results in poor water clarity.
  - There is low dissolved oxygen.
  - Aquatic plant growth is inhabited.
  - This is stressful on fish and organisms especially when the water body freezes during the winter.
- Levels from 10-12 can lead to premature eutrophication of an aquatic system.
- Levels above 10 ppm can call infants to have methemoglobinemia. Which is a condition of having oxygen poor blood.

NITRATES IN THE WATER HAVE ALREADY BEEN PAID FOR!
USE THEM TO FERTILIZE YOUR CROPS!!

NRCS Natural Resources Conservation Service

MORE SHORT TERM ECONOMIC BENEFITS OF COVER CROPS

- Increase OM
  - (OM% X RYG) X 0.14 = #N/AC
  - RYG = 5 yr average + 5%
  - 200 bu/ac ave = 210 RYG
  - 2% OM X 210 RYG = 420
  - 420 X 0.14 = **58.8#/A AVAILABLE N**
- "Trap Crop" to scavenge Nitrogen, Phosphorus and Potassium
  - 5 year study in Ohio found 250# N, 23# P and 239# K were recycled by oilseed radish and present just ahead of spring planting
  - 10-40# trapped above ground portion
  - But don't forget the roots
  - 80-100# is combined with manure application
  - Substantial N in the roots
  - Availability based on the C:N ratio
- Natural means of suppressing soil diseases and pest. Serves as mulch to reduce weeds.
  - Could rye be an answer to some of our "resistance" problems?

C:N ratios of common organic residues

Organic material	C:N ratio
Newspaper	120:1
Wheat straw	80:1
Corn stover	57:1
Rye cover crop, anthesis	37:1
Rye cover crop, vegetative	26:1
Hairy vetch cover crop	11:1
Soil microbes (average)	8:1

Source: Adapted from Carbon to Nitrogen Ratios in Cropping Systems (2011), USDA-NRCS

C:N ratios wider than 25:1 cause N immobilization for some time period. If utilizing covers with wide C:N ratios, then should either:

- allow time for decomposition before high N-using crop (corn)
- apply extra starter N
- don't choose high C:N covers before corn

PURDUE UNIVERSITY

MANURE APPLIED

KNOW WHAT TO APPLY

TO AVOID THIS

MANURE TESTS

MANURE IS BENEFICIAL TO INCREASED SOM. IF MANURE IS NOT INCORPORATED WITH TILLAGE IT CAN BE BENEFICIAL TO OVERALL SOIL HEALTH AND GOOD SOURCES OF N & P

PENNSTATE

(814) 863-0841 Fax (814) 863-4540

Agricultural Analytical Services Laboratory
The Pennsylvania State University
University Park PA 16802

Analysis Report For:	Copy To:

LAB ID:	SAMPLE ID:	REPORT DATE:	DATE SAMPLED:	COUNTY:	MATERIAL:	TYPE:	STORAGE SYSTEM:
M00001		11/12/1998	10/29/98		Manure	Poultry (Broilers)	Bedded Pack or Litter

ANALYSIS REPORT

Results on as sampled (wet weight) basis

Analyte	lb/ton	lb/1000 gal
Solids: 71.7 %		
Total Nitrogen (N)	60.9	253.9
Ammonium N (NH_4-N)	6.64	27.68
Calculated Organic N	54.3	226.2
Total Phosphate (P_2O_5)	68.8	287.1
Total Potash (K_2O)	54.3	226.4

Optional Test Results:	pH	Org. Carbon (C) (%)	C:N Ratio	Ash (%)	Volatiles (%)	Nitrate Nitrogen (lb/ton)	Nitrate Nitrogen (lb/1000 gal)

Comments:

- The enclosed fact sheet "Using Your Manure Analysis Report" provides information to help you interpret this report and calculate appropriate manure application rates for your crops.
- Analytical results are presented as both "lb/ton" and "lb/1000gal". Choose results with the units that are most convenient for you.
- Manure nutrients are not all equivalent to fertilizer nutrients. Phosphorus and potassium can be substituted directly for fertilizer to meet your soil test recommendation. Nitrogen (N) availability varies with handling. This must be accounted for in utilizing manure to meet soil test N recommendations. See the enclosed fact sheet "Using Your Manure Analysis Report".

NRCS Natural Resources Conservation Service

NRCS NUTRIENT BUDGET FOR CORN

NE-CPA 38b NUTRIENT BUDGET JOBSHEET FOR GRAIN CORN

KNOWING WHAT YOU HAVE AND WHAT Y OU NEED!

USDA - Natural Resource Conservation Service — *Revised 03/2014*

Annual Nutrient Budget Jobsheet (NE-CPA-38b) for grain corn

Section 1 - Producer/Field/Crop Information

Attach Map with Field Boundaries

Producer Name				Crop Year	
Site #	Tract #	Field #	Acres	Tillage Practices:	
Current Crop			Prior Crop / Yield		
[1]5-Year Average Yield (units)	bu/ac		Irrigated? No or Yes, If yes, list method:		
[2]Realistic Yield Goal (RYG)	0.0	(105% of 5-Yr. Ave. Yield)	If cover crop used, list type		
Legal Description					

County

Section 2 - Risk Assessments

[3]Nitrogen (N) Leaching Assessment

Complete Annually for each field

►Complete the following information:

Predominant Soil	
Soil Texture	
Nitrogen Fertilizer(s)	
Application Timing(s)	
► Circle N-Risk Assessment (in Table to the Right)	

TABLE 1. Inorganic N Leaching Risk Assessment

Circle N Risk in Gray Area	Soil Texture		
Application Timing	*Coarse*	*Medium*	*Fine*
Fall	(High)	(Med-Low)	(Low)
Spring, Preplant	(High-Med)	(Med-Low)	(Low)
Sidedress or Split	(High-Med)	(Low)	(Low)

[4]Nebraska Phosphorus (P) Index: ► Attach Summary Report

Complete once every 5 years unless rating is ≥ 5.0.

Provide: 1) Risk Numerical Score and 2) Circle the corresponding Risk Level: Low - Medium - High - Very High

Section 3 -Soil Test Information

►Attach copy of soil test

Nutrients from Soil Test

For Bray Test Results, use Weak Bray over Strong

		N (Surface)	N (Deep)	N (Deep)	*P	K	Non-Nutrients from Soil Test	
	Soil Test Values (ppm)	0	0				% O.M.	
Soil Test Depths	Top Layer (in.)	0	8				If O.M. is > 3.0, Use 3.0	
	Bottom Layer (in.)	8	24				Soil pH	

►Do soil tests depths, etc. meet UNL procedures? Yes____ or No____ If "No" explain: _____

Section 4 -Nutrient Budget

Nutrients:		N	P_2O_5	K_2O	Notes
[5]NEEDS (UNL Nutrient Recommendations) (lb./acre)		0.0			(RYG x 1.2) + 35 = N Needs
[6]CREDITS (lb./acre) - Organic -N					
[7]Soil Nitrate-N Residual	Weighted Soil Value 0.0	0.0			See Guidance #7 for calculations
[8]Soil Organic Matter (O.M.) Nitrogen		0.0			(O.M. % x RYG) x 0.14
[9]Legume (Type:					See Table 2. in guidance for values
[10a, 10b]Irrigation Well Water	Test Report (ppm)	0.0			Test once / five yrs — Inches Applied:
[11]Organic-N Credits for Prior Applied Manure					Source & Rate:
[12]TOTAL CREDITS (sum of items 7-11)		0.0			
[13]NUTRIENTS REQUIRED (= Needs - Credits)		0.0	0	0	

Not for manure applied for current crop

Section 5 -Planned Nutrient Application - To be completed by the producer/consultant

PLANNED NUTRIENT APPLICATIONS

Mo/Yr	Formulation/Form	Rate	lb. / acre N	P_2O_5	K_2O

Check box ☐ if planned rates are listed on Soil Sample Report

Section 6 -Actual Nutrients Applied

►If application was not uniform include map with field information. ►Provide info relating to unusual weather conditions affecting actual yields.

[14]ACTUAL NUTRIENT APPLIED

Mo/Yr	Formulation/Form	Rate (units)	Liquid, dry, slurry	lb. / acre N	P_2O_5	K_2O
		Total		0	0	0

[15]Actual Yield

[16]N-inhibitor Used? Yes or No

“T” CHART

QUICK ECONOMIC EVALUATION

EVALUATE THE CONSERVATION TREATMENT

IS IT AFFORDABLE?

IS IT PROFITABLE?

HOW LONG TO GET MY MONEY BACK

WHAT IS THE RETURN ON THE INVESTMENT?

WHAT IS THE NET GAIN TO COVER EXPENSES?

CONSERVATION TREATMENT EFFECTS INFORMATION

NAME – H. Gordon LOCATION – Aloha, Oregon DATE – July 4, 2004
SETTING – Wheat, Columbia Plateau, Oregon

CONSERVATION TREATMENT: Residue Management, Direct Seeding	RESOURCE PROBLEMS: Productivity, Erosion, Water Quality
POSITIVE EFFECTS (Benefits)	**NEGATIVE EFFECTS (Costs)**
Crop Yield Increase 8 Bushels/Year X $4/Bu = $32/Year	No-Till Drill $15,000/2,000 Acres = $7.50/Acre Annual Cost (7%, 10 Years) $7.50 X .142 = $1.07/Acre/Year
Crop Quality Improvement	
Pheasant/Quail Habitat Improvement	Increased Herbicide Cost = $25.00/Acre/Year
Reduced Erosion = 2 Tons	
Water Quality Improvement	Increased Risk of New System
Total Benefits = $32/Acre/Year	Total Costs = $26.07/Acre/Year

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NRCS "T" CHART EXAMPLE

CONSERVATION TREATMENT EFFECTS INFORMATION	
NAME – H. Gordon, Rocking Raindrop LOCATION – Aloha, Oregon DATE – 7/12/2004 CONSERVATION MANAGEMENT UNIT – Pasture, Willamette Valley, Oregon	
CONSERVATION TREATMENT: Pasture Seeding, Brush & Weed Control	RESOURCE PROBLEMS: Plant Productivity, Erosion, Profitability
"+" POSITIVE EFFECTS (Benefits)	"-" NEGATIVE EFFECTS (Costs)
Forage Quality Improvement Reduced Erosion, 2 Tons/Acre Water Quality Improvement Goose Habitat Improves Bird Watching Forage Increase 3 AUMs Year X $12/AUM = $36/Ac/Year Total Benefits = $36/Ac/Year	Goose Habitat Increases Trespassing Brush Control $50/Acre Reseed Pasture $65/Acre $115/Acre 7% Interest, 10 Years = .142 X $115 = $16.33 Annual Installation Cost = $16.33/Acre/Year Weed Control $15.00/Acre/Year Total Costs = $31.33/Acre/Year

LEVEL I GREEN:

Qualitative Statements

LEVEL II BLUE:

Units of Measurements, Dollars

LEVEN III RED:

Economic & Financial Analysis

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T CHART TEMPLATE

CONSERVATION TREATMENT EFFECTS INFORMATION

CONSERVATION MANAGEMENT UNIT -

CONSERVATION TREATMENT: RMS #	RESOURCE PROBLEMS:
POSITIVE +	NEGATIVE -

SOIL HEALTH SUMMARY

A COMPLEX ISSUE

HTTP://WWW.NRCS.USDA.GOV/WPS/PORTAL/NRCS/DETAIL/SOILS/HEALTH/ASSESSMENT/?CID=STELPRDB1237387

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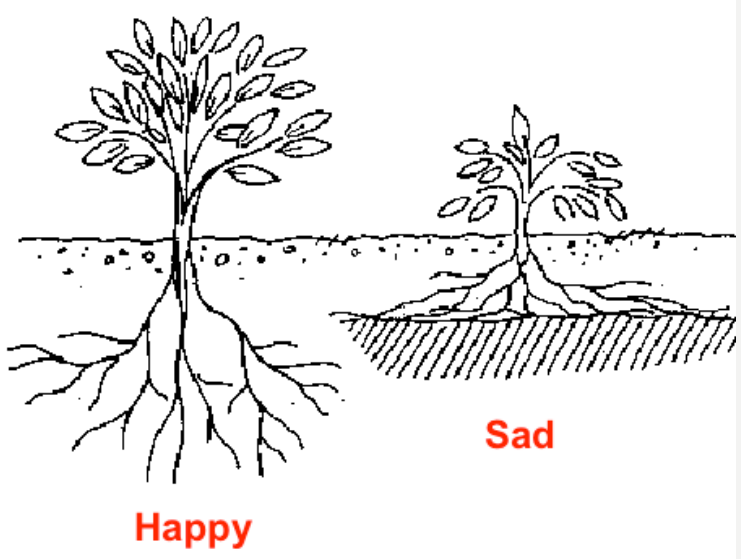
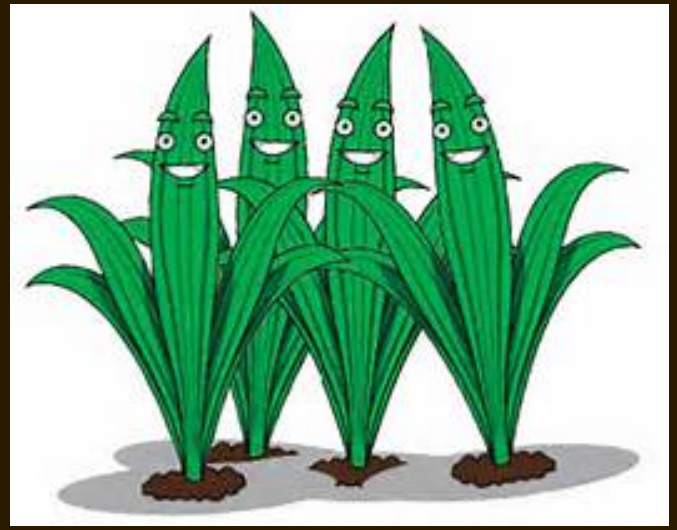
PRACTICES TO IMPROVE SOIL HEALTH

- REDUCE OR ELIMINATE TILLAGE
- COVER CROPS
- NUTRIENT MANAGEMENT
- INTEGRATED PEST MANAGEMENT





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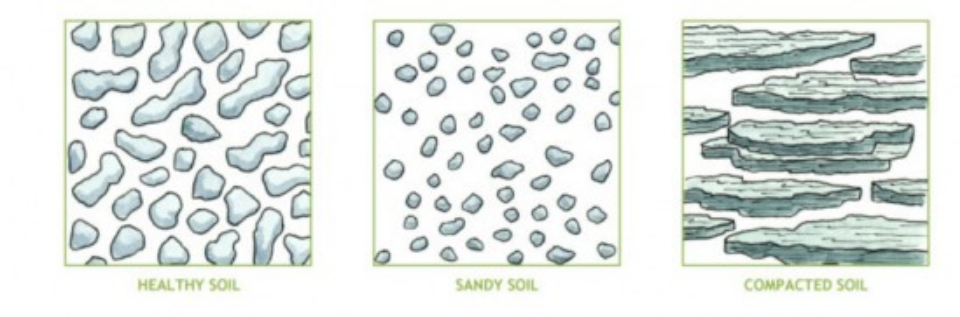

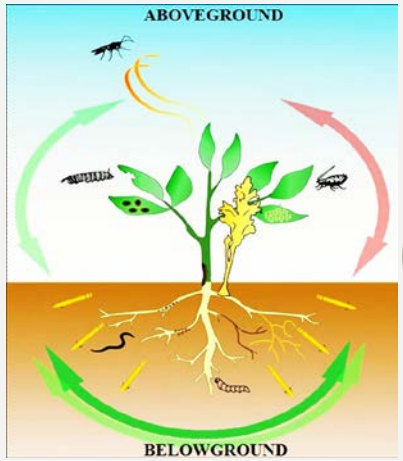

WHAT NEEDS CONSIDERED TO IMPROVE SOIL HEALTH

SOIL STRUCTURE

SOIL ORGANIC MATTER

MICROORGANISMS

BULK DENSITY/COMPACTION

INFILTRATION

WATER HOLDING CAPACITY

SOIL TEMPERATURE

REDUCE EROSION

SOIL HEALTH TESTS

Soil Quality Test Kit Guide

- **Bulk Density**
- **Respiration**
- **Infiltration**
- **Stability**
- **Earthworm**
- **Slake**

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- http://www.bing.com/videos/search?q=Organic+Farming+FIELD+CROPS+YOUTUBE&view=detail&&mid=7D2656FDFEFFC9D2150E7D2656FDFEFFC9D2150E 19 min-Weed Contr

PUT IT ALL TOGETHER!!

NO-TILL

COVER CROPS

INTEGRATED PEST MANAGEMENT

NUTRIENT MANAGEMENT-LEGUMES

Additional practices:

- Organic No-till
- Buffer strips
- Irrigation water management

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•QUESTIONS?

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THANK YOU FOR YOUR ATTENTION!

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