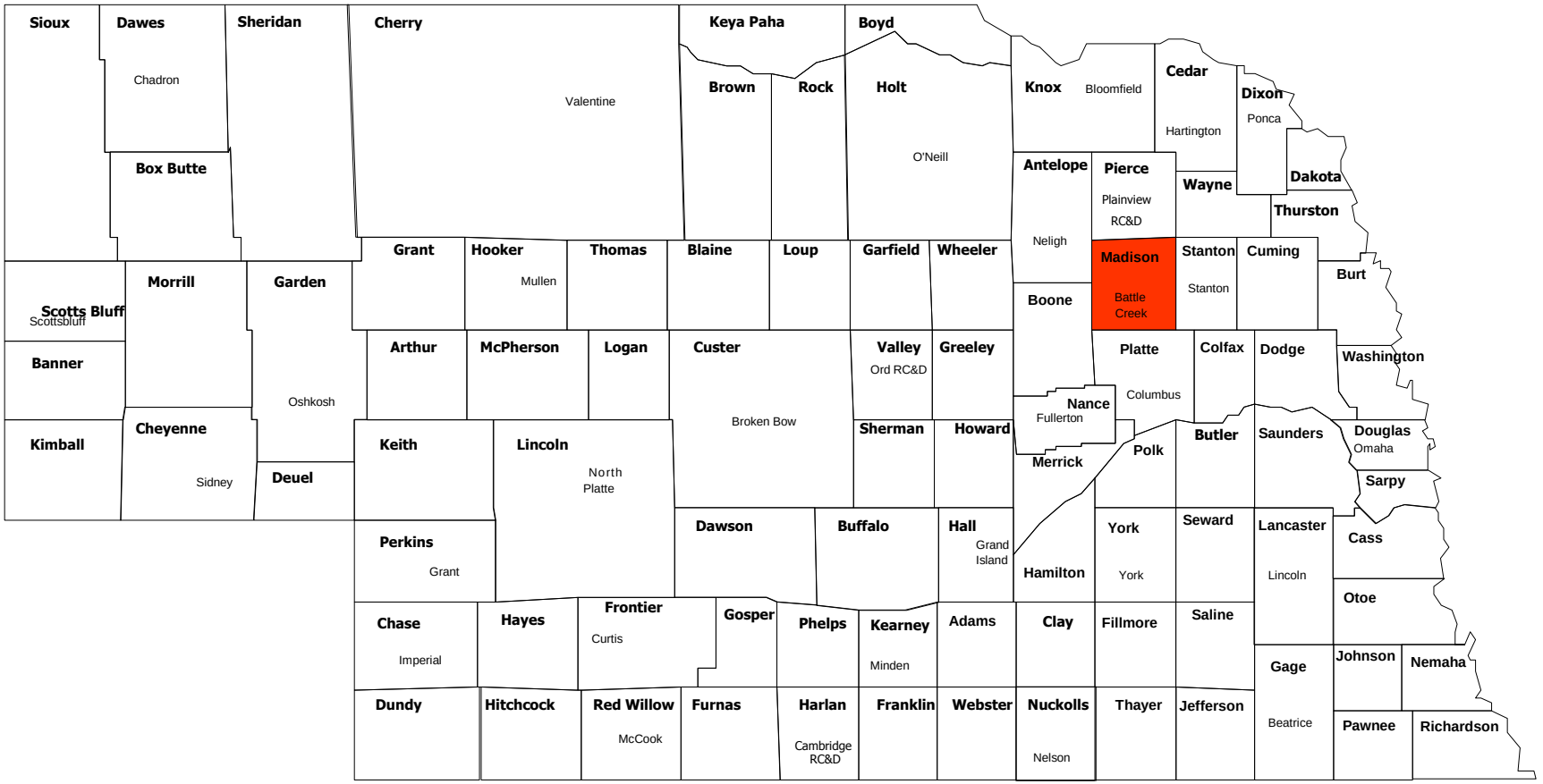
Importance of Improving Soil Health

2016 Sorghum Symposium

Dan Gillespie
NRCS Nebraska No-till Specialist

Madison County, Nebraska

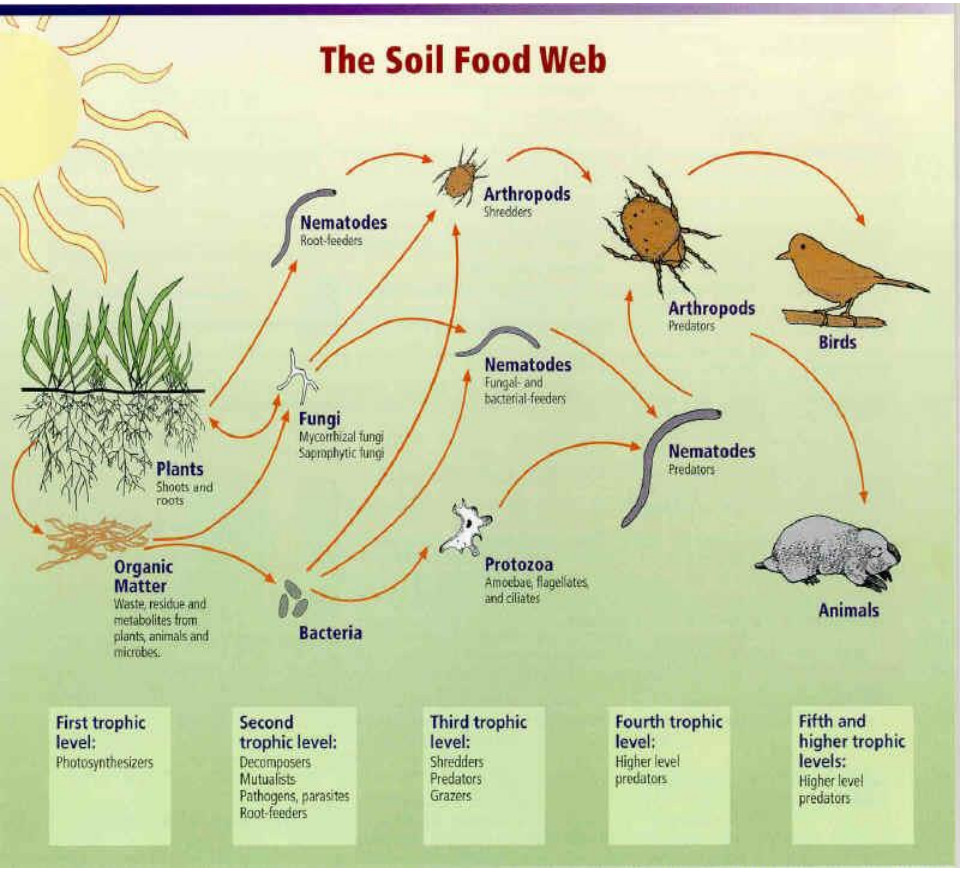


Loess Hills, Silty Clay Loams, 4-16% slopes, 65-70% Irr.
Annual Rainfall 26.66"

Soil Health Principles
Raising the Soil Health Bar

1. Keep the Soil Covered as Much as Possible- Residue is Armor
2. Manage Soils More by Disturbing Them Less - Continuous No-till Systems
3. Keep Plants Growing Throughout the Year to Feed the Soil…Cover Crops
4. *Use Plant Diversity to Increase Diversity in the Soil*
5. *Livestock Integration…Putting a Turbocharger on the System!*

The Soil Food Web
Working Toward A Higher Quality No-till
The "Below Ground" Players…



- **Bacteria**-5:1 C:N Ratio

  Decomposer of simple carbon chains (low carbon residue).

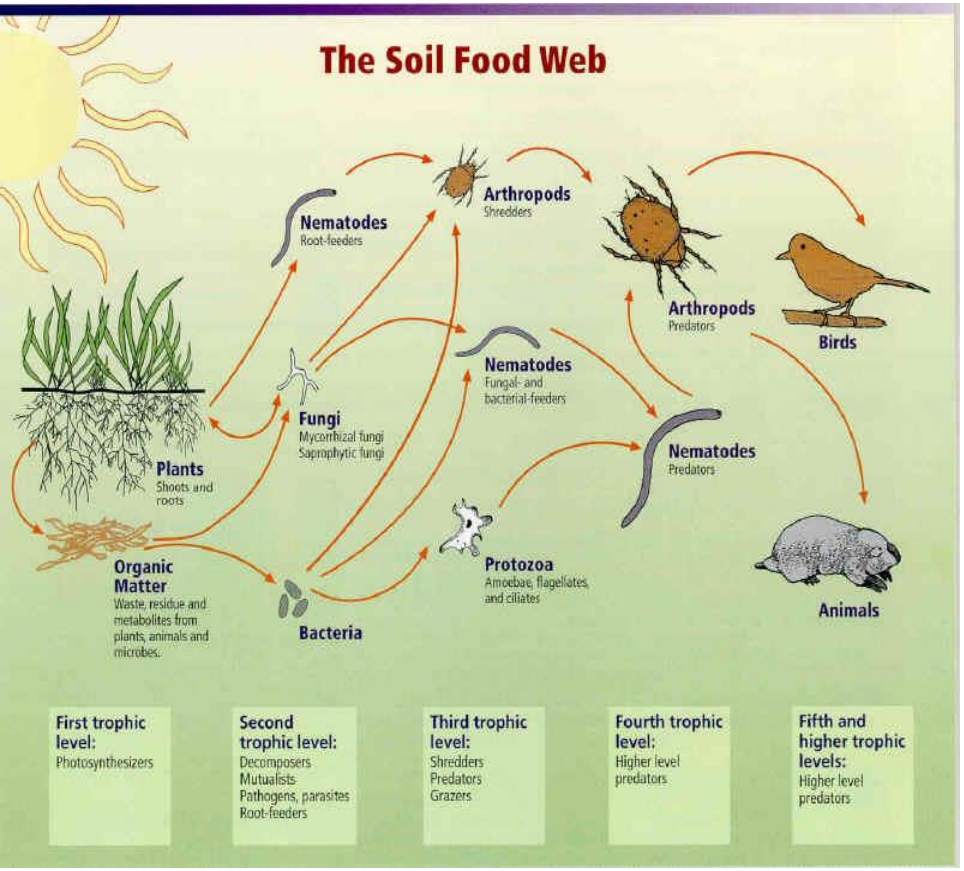
  Little bag of fertilizer.

  One bacterium can produce 5 billion offspring in 12 hours (food available).

  Feed on root exudates.

Soil Biology Primer

The Soil Food Web
Working Toward A Higher Quality No-till
The "Below Ground" Players…



- **Protozoa**- 30:1 C:N Ratio

  Mineralize nutrients by eating the little guys (fungi and bacteria).

  Consumes an average of 10,000 bacteria per day.

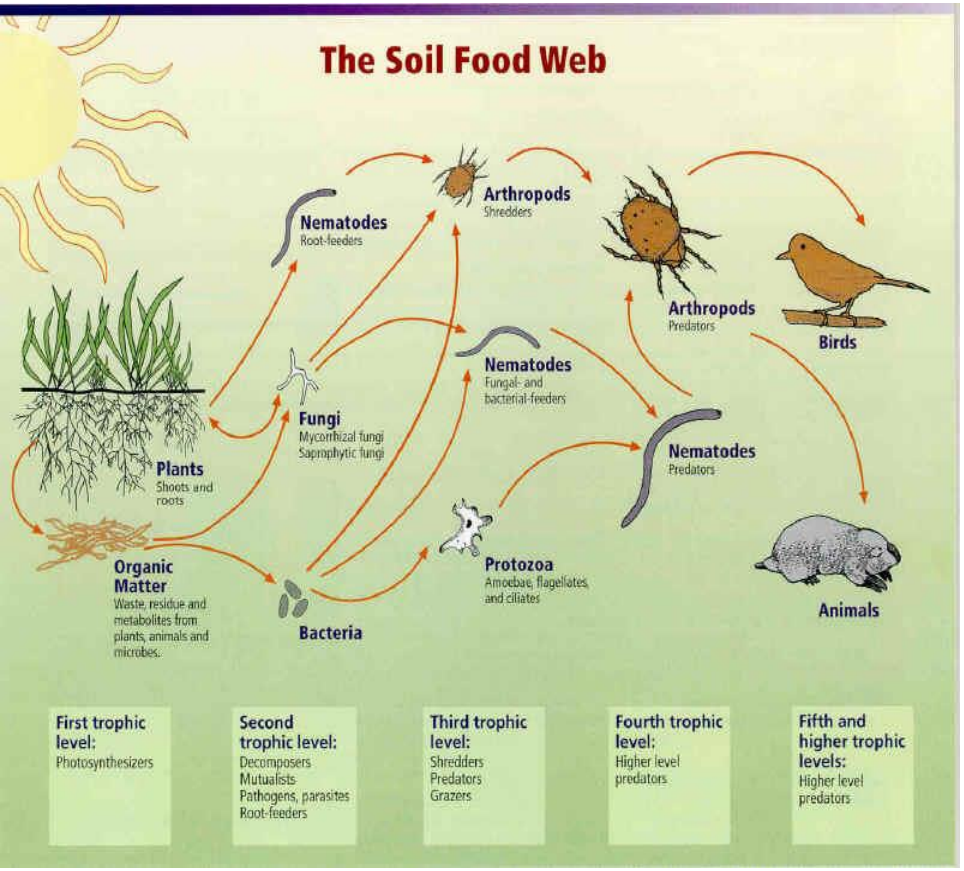
  Amoebae – large

  Ciliates – medium

  Flagellates - small

Soil Biology Primer

The Soil Food Web
Working Toward A Higher Quality No-till
The "Below Ground" Players…



- **Fungi**-

  Saprophytic-primary decomposer of complex carbon chains (high carbon chains)…residue…70:1

  Mycorrhizal-transports nutrients to multiple plants

  Forms the soil glue (glomalin) along with the plant roots exudates.

Soil Biology Primer

Dr. Wendy Taheri. USDA-ARS Brookings, SD
https://www.youtube.com/watch?v=BZxs5-ZMcIk

- Increase Yields

AMF colonization 23% yield increase across all management practices. Lekberg & Koide 2005.

- Free Phosphorus

Plants feel need for P, exude sugars and hormones to AMF who in turn extract P and provide to plant. With P fertilizers applied plant feels no need for P, no sugars exuded…hence no P extracted for plant.
In low AMF environment plants exude sugars and hormones to attract and build AMF colonies. Advantage of cover crops is the AMF colonies are pre-existing for crop seedlings to tap into. Think Turbocharged root systems...several plants share the same fungal colonies.

- Drought Tolerance

150 to 215% increase of water uptake with optimal AMF colonization…microscopic hyphae!!

- Bio Control

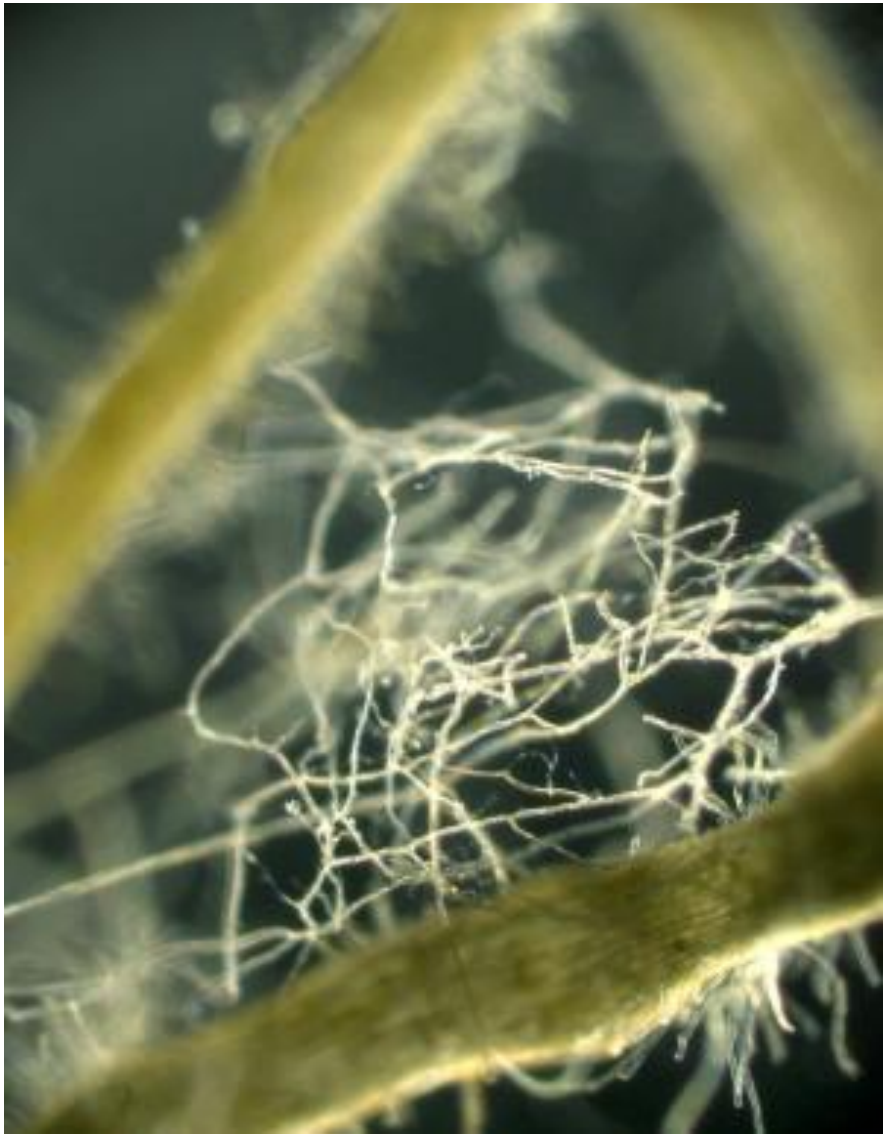
Plant cells colonized by arbuscules are “occupied territory”, no room for pathogens. SCN 36% reduction. Root Knot 22% reduction, Stunt nematodes 21% *reduction…only killed the females?*
AMF protect host plants from other fungal diseases: Phytophthora, Fusarium, Pythium, Rhizoctonia, Verticillium, Anthracnose…Take All Disease, Root Rot disease complexes.

- 23 Species AMF

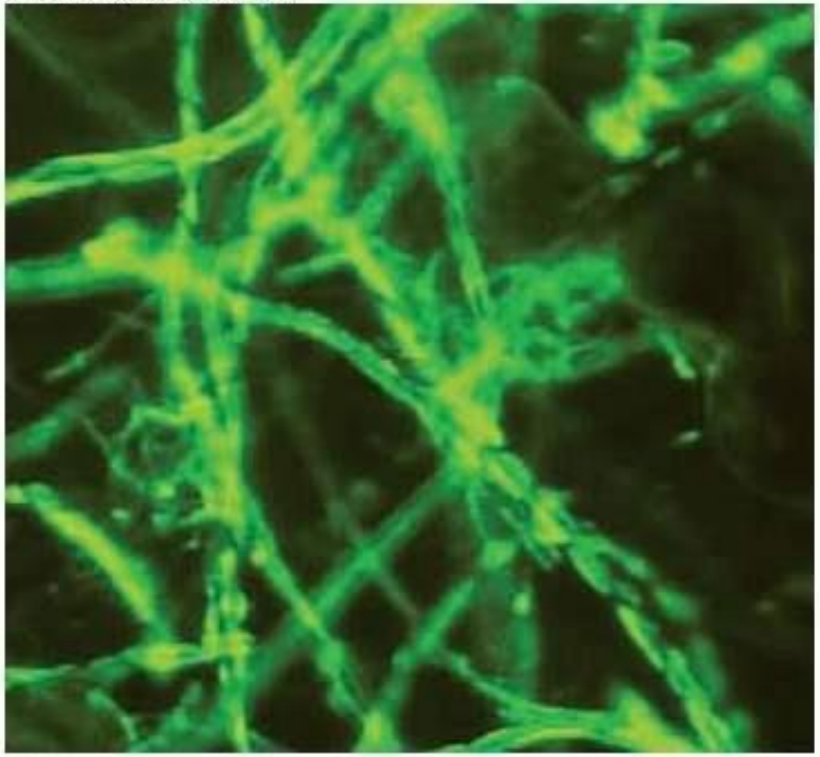
Most plants usually host from 12-15 species….the importance of diverse cover crop host plants.

Glomalin *is a glycoprotein, a sugar-protein compound that may be the trigger for formation of soil. "The more glomalin in a particular soil, the better that particular soil probably is."*

Kristine Nichols

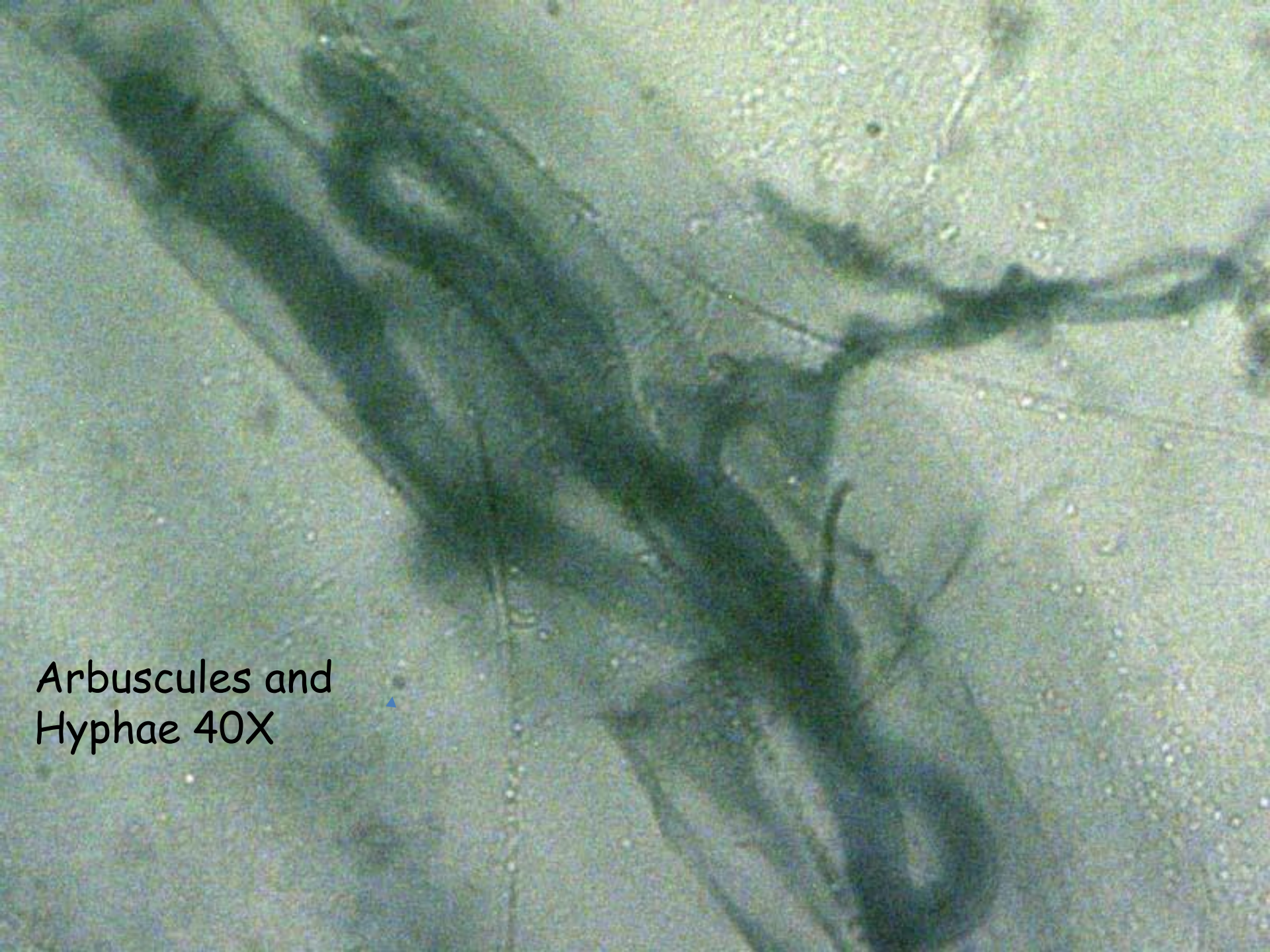


KRISTINE NICHOLS (D1139-1)



Thin, threadlike strands of mycorrhizal hyphae from pot cultures have an abundant amount of glomalin—seen on their surface as bright green spots here after a laboratory procedure. Glomalin is also present on mycorrhizal hyphae found on the roots of native and nonnative grasses and crops in rangeland and cropland studies.

Extraradical Spore and Hyphae 10X


Arbuscules and
Hyphae 40X


Mother Natures Cover Crop…if You Don't, She Will!!


Aerial Seeding…irregular application is an issue…
that can be compounded by Mother Nature
04.12.2011 23:07


04.12.2011 23:06


JOHN DEERE
750
JOHN DEERE


04.16.2012 01:29


03.29.2012 01:22

April 16 nodulation…what would May 15 provide?


Sandy, Low Organic Matter Soils Benefit Most From Cover Crops


06.13.2012 21:25


10.13.2011 21:41


HOFFRITZ
FRANCE
THERMO
HYGRO REL %
05.17.2012 04:30

.45” rain from May 28 to Aug 3rd.


Evaporative Losses??
Ten degrees higher at 4" depth,
How much higher on the surface?
113 degrees soil biology dies...
HOFFRITZ
FRANCE
THERMO
HYGRO REL. %
05.17.2012 04:47

.45” rain from May 28 to Aug 3rd.

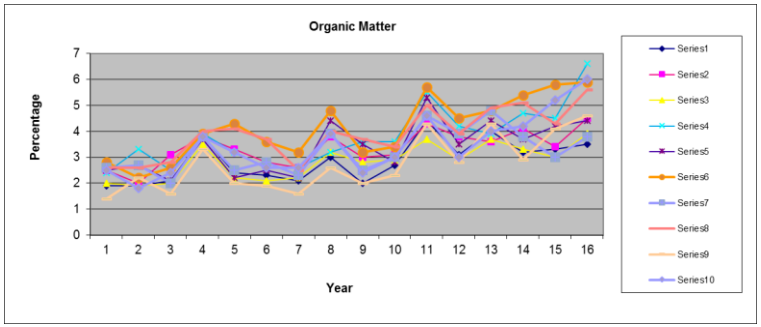

08.21.2013 04:09

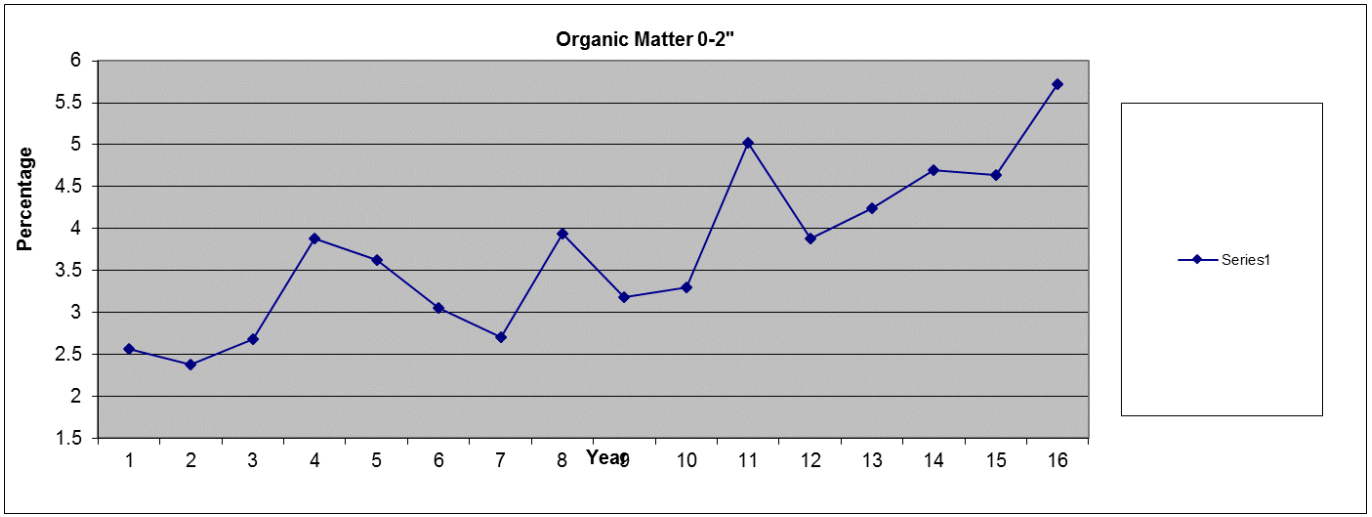

08.21.2013 04:05

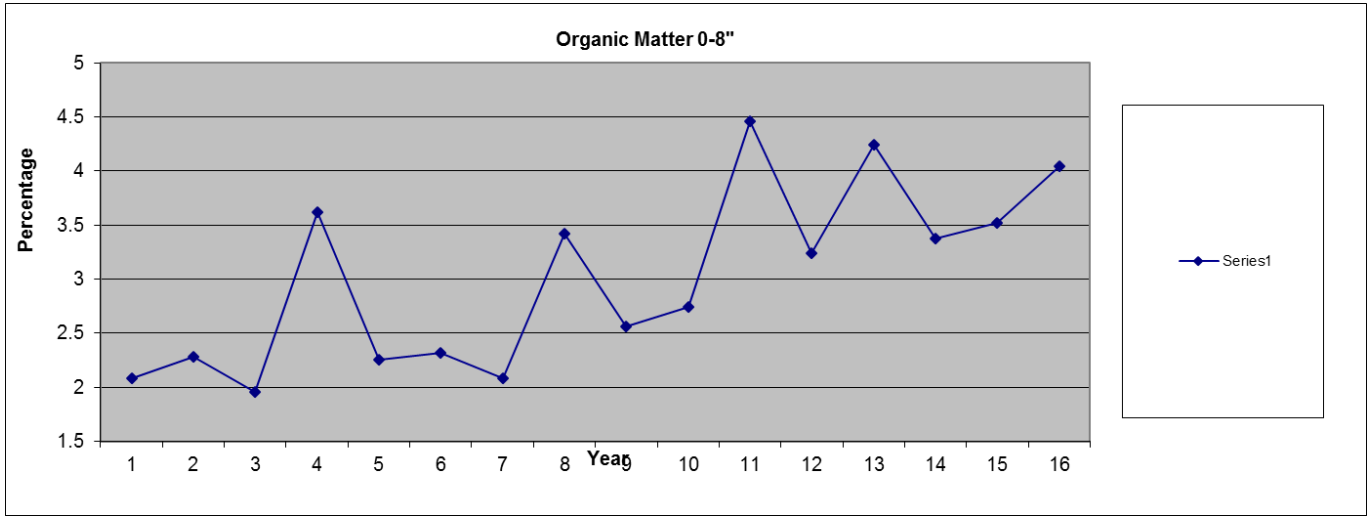
Wayne Co. NE


Soil Organic Matter…Matters!!
Bulk Density

Grower:	Dan Gillespie																	
Field	Home Place																	
Year:	2016	Element:	OM															
	Sample	Depth	Year	1999	2000	2001	2002	2003	2005	2006	2007	2008	2009	2011	2012	2013	2014	2015	2016
	1A	0-8"		1.9	1.9	2.1	3.8	2.4	2.3	2.1	3	2	2.7	4.4	3.1	4	3.2	3.3	3.5
	1B	0-2"		2.5	2	3.1	3.8	3.3	2.8	2.6	3.8	3	3.1	4.3	3.8	3.6	4.1	3.4	4.5
	2A	0-8"		2	1.9	2	3.5	2.2	2.1	2.2	3.2	2.8	2.9	3.7	2.9	3.7	3.3	3	3.9
	2B	0-2"		2.4	3.3	2.5	3.9	3.2	2.6	2.6	3.2	3.6	3.6	5.5	4.2	3.9	4.7	4.5	6.6
	3A	0-8"		2.5	2.7	2.1	3.7	2.2	2.5	2.2	4.4	3.5	2.8	5.3	3.5	4.4	3.7	4.2	4.4
	3B	0-2"		2.8	2.2	2.6	3.9	4.3	3.6	3.2	4.8	3.2	3.4	5.7	4.5	4.8	5.4	5.8	5.9
	4A	0-8"		2.6	2.7	2	3.8	2.5	2.8	2.3	3.9	2.5	3	4.6	3.9	4.8	3.8	3	3.8
	4B	0-2"		2.6	2.6	2.8	4	4.1	3.7	2.5	4	3.7	3.4	5	3.9	4.9	5.1	4.3	5.6
	5A	0-8"		1.4	2.2	1.6	3.3	2	1.9	1.6	2.6	2	2.3	4.3	2.8	4.3	2.9	4.1	4.6
	5B	0-2"		2.5	1.8	2.4	3.8	3.2	2.6	2.6	3.9	2.4	3	4.6	3	4	4.2	5.2	6
		Average 0-8"		**2.08**	**2.28**	**1.96**	**3.62**	**2.26**	**2.32**	**2.08**	**3.42**	**2.56**	**2.74**	**4.46**	**3.24**	**4.24**	**3.38**	**3.52**	**4.04**
		Average 0-2"		**2.56**	**2.38**	**2.68**	**3.88**	**3.62**	**3.06**	**2.70**	**3.94**	**3.18**	**3.30**	**5.02**	**3.88**	**4.24**	**4.70**	**4.64**	**5.72**


Organic Matter
Percentage
Year
Series1
Series2
Series3
Series4
Series5
Series6
Series7
Series8
Series9
Series10


Organic Matter 0-2"
Percentage
Year
Series1


Organic Matter 0-8"
Percentage
Year
Series1

No added N

Applied 25 # N

WARD Laboratories, Inc.

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Account No. : 1705

Plant Analysis Report

DUNLAP, BRYAN
BD AG ENTERPRIZES
PO BOX 391
NEWMAN GROVE NE 68758-0391

Invoice No. : 1185991
Date Received : 07/22/2015
Date Reported : 07/23/2015
Lab Number : 10052

Results For : DAN GILLESPIE
Location : CORN
Sample ID : 1 HOME NE

Plant Type : Corn
Stage : Tassel

	Result Dry Basis	Sufficiency Levels (Deficient / Low / Sufficient / High)
Nitrogen ,% N	3.18	
Phosphorus, % P	0.265	
Potassium, % K	2.40	
Calcium, % Ca	0.432	
Magnesium, % Mg	0.203	
Sulfur, % S	0.19	
Zinc, ppm Zn	22	
Iron, ppm Fe	94	
Manganese, ppm Mn	52	
Copper, ppm Cu	9.2	
Boron, ppm B	6.0	
Chloride, % Cl	0.14	
Molybdenum, ppm Mo	0.18	

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4007 Cherry Ave., P.O. Box 788
Kearney, Nebraska 68848-0788

WARD Laboratories, Inc.

Ag Testing - Consulting

Account No. : 1705

Plant Analysis Report

DUNLAP, BRYAN
BD AG ENTERPRIZES
PO BOX 391
NEWMAN GROVE NE 68758-0391

Invoice No. : 1185991
Date Received : 07/22/2015
Date Reported : 07/23/2015
Lab Number : 10053

Results For : DAN GILLESPIE
Location : CORN
Sample ID : 2 HOME SWC

Plant Type : Corn
Stage : Tassel

	Result Dry Basis	Sufficiency Levels (Deficient / Low / Sufficient / High)
Nitrogen ,% N	2.85	
Phosphorus, % P	0.328	
Potassium, % K	2.43	
Calcium, % Ca	0.388	
Magnesium, % Mg	0.128	
Sulfur, % S	0.20	
Zinc, ppm Zn	18	
Iron, ppm Fe	97	
Manganese, ppm Mn	44	
Copper, ppm Cu	8.2	
Boron, ppm B	5.1	
Chloride, % Cl	0.13	
Molybdenum, ppm Mo	0.42	

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Account No. : 1705

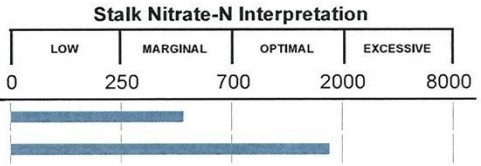
Plant Analysis Report

DUNLAP, BRYAN
BD AG ENTERPRIZES
PO BOX 391
NEWMAN GROVE NE 68758-0391

Invoice No. : 1193512
Date Received : 10/16/2015
Date Reported : 10/20/2015

Results For : DAN GILLESPIE

Lab #	Location	Sample ID	Stalk Nitrate-N ppm N Dry Basis
19032	CORN STALK	NE	497
19033	CORN STALK	NW	1857



Iowa State University Extension Publication PM 1584

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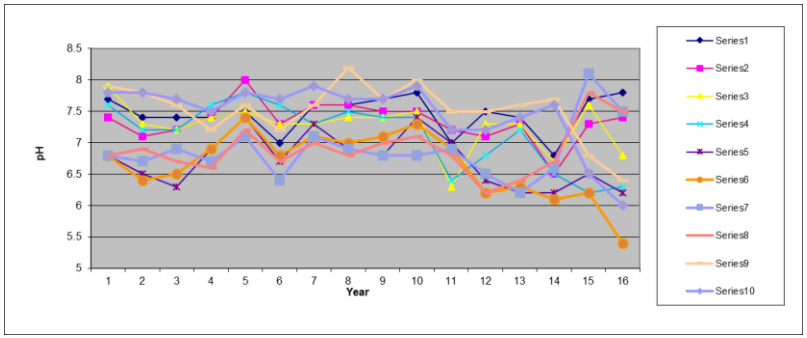
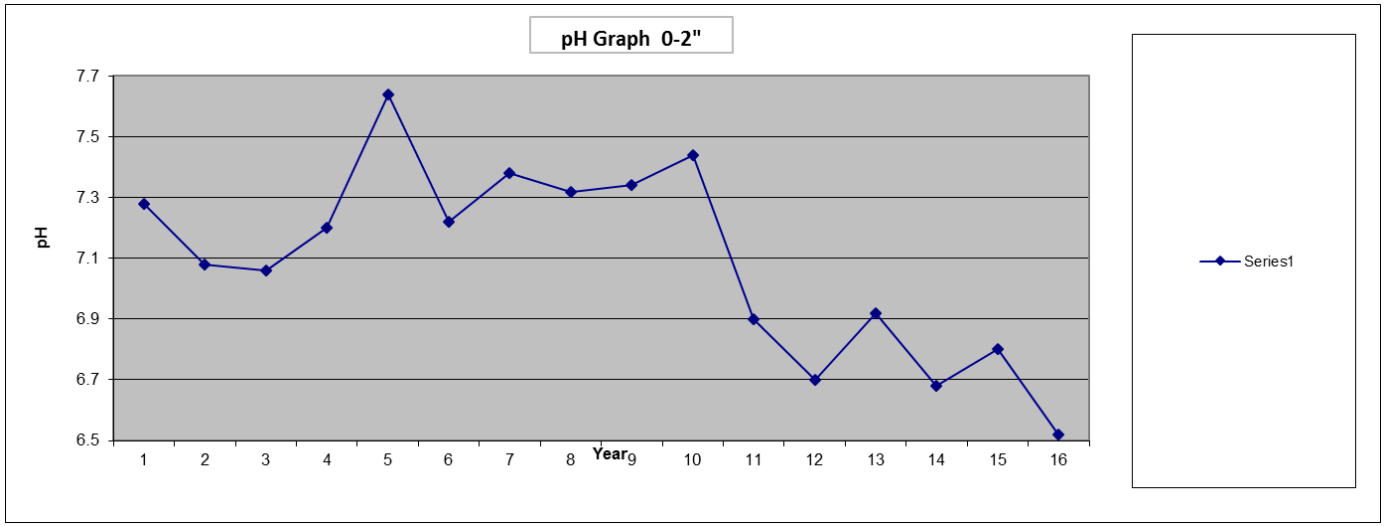
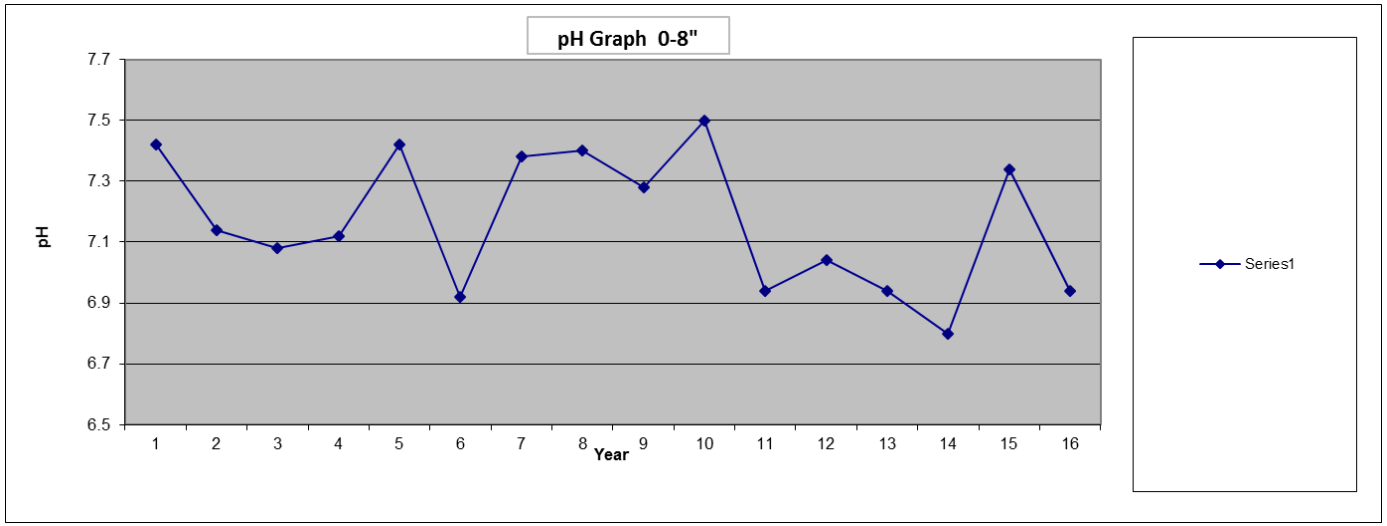
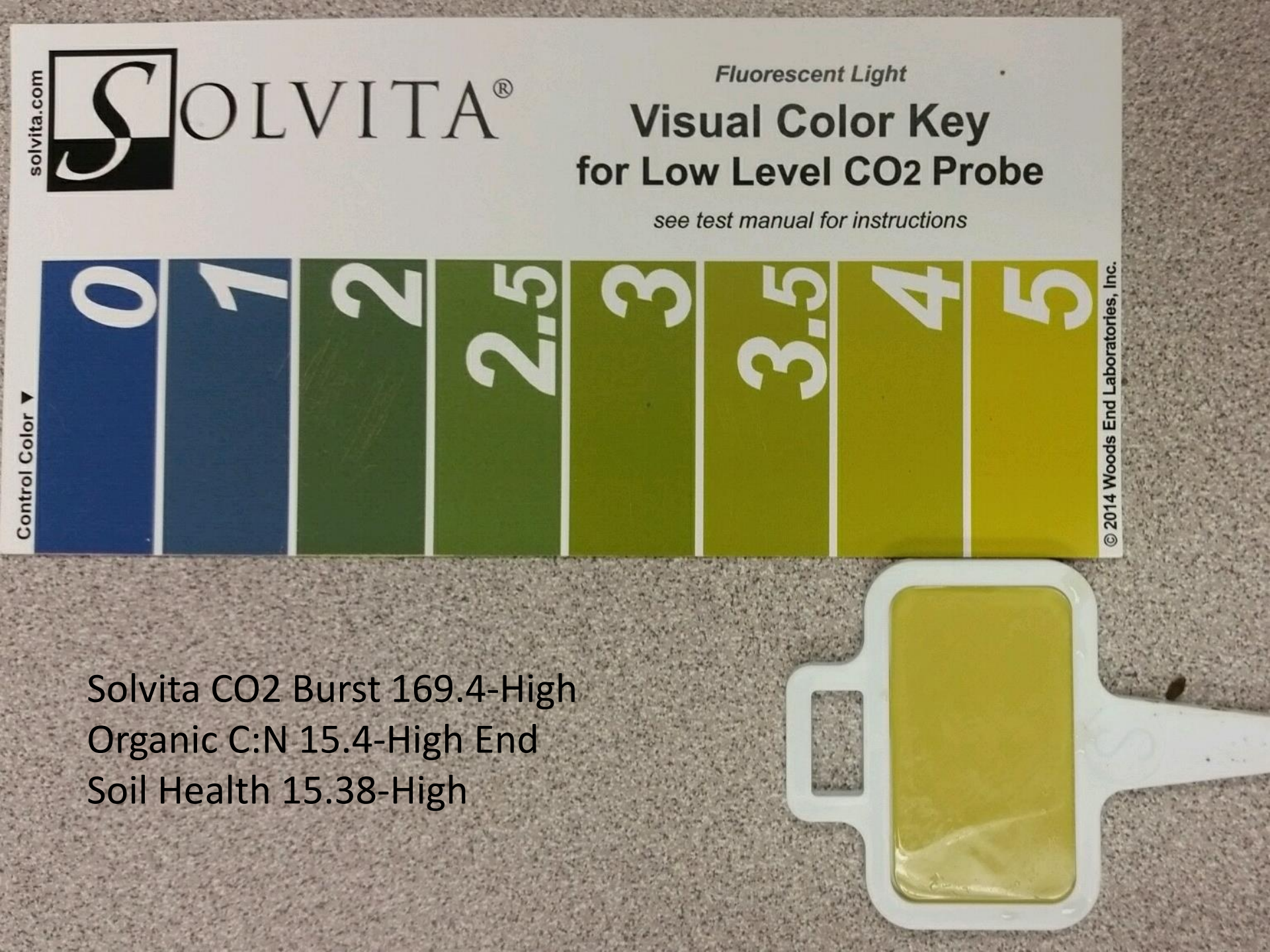
Kearney, Nebraska 68848-0788

Grower:	Dan Gillespie																	
Field	Home Place																	
Year:	2016	Element:		pH														
		Sample	Depth	Year	1999	2000	2001	2002	2003	2005	2006	2007	2008	2009	2011	2012	2013	2014	2015	2016
		1A	0-8"		7.7	7.4	7.4	7.4	7.5	7	7.6	7.6	7.7	7.8	7	7.5	7.4	6.8	7.7	7.8
		1B	0-2"		7.4	7.1	7.2	7.4	8	7.3	7.6	7.6	7.5	7.5	7.2	7.1	7.3	6.5	7.3	7.4
		2A	0-8"		7.9	7.3	7.2	7.4	7.5	7.3	7.3	7.4	7.4	7.5	6.3	7.3	7.3	6.7	7.6	6.8
		2B	0-2"		7.6	7.2	7.2	7.6	7.8	7.6	7.3	7.5	7.4	7.4	6.4	6.8	7.2	6.5	6.2	6.3
		3A	0-8"		6.8	6.5	6.3	6.9	7.4	6.7	7.3	6.9	6.8	7.4	7	6.4	6.2	6.2	6.5	6.2
		3B	0-2"		6.8	6.4	6.5	6.9	7.4	6.8	7.1	7	7.1	7.3	6.9	6.2	6.3	6.1	6.2	5.4
		4A	0-8"		6.8	6.7	6.9	6.7	7.1	6.4	7.1	6.9	6.8	6.8	6.9	6.5	6.2	6.6	8.1	7.5
		4B	0-2"		6.8	6.9	6.7	6.6	7.2	6.7	7	6.8	7	7.1	6.8	6.2	6.4	6.7	7.8	7.5
		5A	0-8"		7.9	7.8	7.6	7.2	7.6	7.2	7.6	8.2	7.7	8	7.5	7.5	7.6	7.7	6.8	6.4
		5B	0-2"		7.8	7.8	7.7	7.5	7.8	7.7	7.9	7.7	7.7	7.9	7.2	7.2	7.4	7.6	6.5	6
		Average 0-8"			**7.42**	**7.14**	**7.08**	**7.12**	**7.42**	**6.92**	**7.38**	**7.40**	**7.28**	**7.50**	**6.94**	**7.04**	**6.94**	**6.80**	**7.34**	**6.94**
		Average 0-2"			**7.28**	**7.08**	**7.06**	**7.20**	**7.64**	**7.22**	**7.38**	**7.32**	**7.34**	**7.44**	**6.90**	**6.70**	**6.92**	**6.68**	**6.80**	**6.52**


pH
Year
Series1
Series2
Series3
Series4
Series5
Series6
Series7
Series8
Series9
Series10


pH Graph 0-2"
pH
Year
Series1


pH Graph 0-8"
pH
Year
Series1



Solvita CO2 Burst 169.4-High
Organic C:N 15.4-High End
Soil Health 15.38-High

WARD Laboratories, Inc.

Ag Testing - Consulting

Account No. : 59501

Biological Soil Analysis Report

GILLESPIE, DAN
203 E PARK ST
BATTLE CREEK NE 68715

Invoice No. : 1196967
Date Received : 11/17/2015
Date Reported : 11/25/2015
Lab No. : 8206

Results For : DAN GILLESPIE
Sample ID 1 : GRMPS 1
Sample ID 2 : GRMPS 1

Haney - Soil Health Analysis

1:1 Soil pH	7.7
1:1 Soluble Salts, mmho/cm	0.44
Excess Lime Rating	2
Organic Matter, %LOI	3.7
Solvita CO2 Burst	
CO2-C, ppm C	169.4
Water Extract	
Total Nitrogen, ppm N	22.4
Organic Nitrogen, ppm N	17.3
Total Organic Carbon, ppm C	266
H3A Extract	
Nitrate, ppm NO3-N	3.6
Ammonium, ppm NH4-N	0.7
Inorganic Nitrogen, ppm N	4.3
Inorganic (FIA) Phosphorus, ppm P	5.6
Total (ICAP) Phosphorus, ppm P	10
Organic Phosphorus, ppm P	4.0
ICAP Potassium, ppm K	77
ICAP Calcium, ppm Ca	2840
ICAP Aluminum, ppm Al	160.40
ICAP Iron, ppm Fe	69.1
Calculations	
Organic C:Organic N	15.4
Nitrogen mineralization, ppm N	12.5
Organic Nitrogen Release, ppm N	17.3
Organic Nitrogen Reserve, ppm N	0.0
Phosphorus mineralization, ppm P	4.0
Organic Phosphorus Reserve, ppm P	< 0.1
Phosphorus Saturation Al/ Fe, %	4.2
Phosphorus Saturation Ca, %	0.3
Soil Health	
Soil Health Calculation	15.38
Cover Crop Suggestion	30% Legume 70% Grass

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WARD Laboratories, Inc.

Ag Testing - Consulting

Haney - Soil Health Analysis Contd.

Lab No. : 8206

Nutrient Quantity Available for Next Crop		Nitrogen Savings by using the Haney Test	
Nitrogen, lbs N/A	43.2	Traditional evaluation, lbs N/A	7.2
Phosphorus, lbs P2O5/A	29.3	Haney Test N evaluation, lbs N/A	43.2
Potassium, lbs K2O/A	91.9	Nitrogen Difference, lbs N/A	36.0
Nutrient Value, $/A	85.05	N savings, $/A	23.03

Fertilizer Recommendations, lbs/A

Crop	Yield Goal	Nitrogen N	Phosphorus P2O5	Potassium K2O	Lime, ECC T/A
Corn, BU	225	182	106	21	
Corn, BU	240	197	115	28	

NT Rec is .8 lbs N/ bu
225 = 180 lbs
240 = 192 lbs

Removal is .67 lbs N/ bu
225 = 151 lbs
240 = 161 lbs

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