Riley County Cover Crop Plot Results

Tom Roth

State Agronomist

Natural Resources Conservation Service (NRCS)

Purpose

- Evaluate cover crop species adaptation
- Measure forage quality and quantity
- Measure soil health parameters
- Measure soil microbiology parameters

Locations

Site Map
District: RILEY COUNTY CD
Field Office: MANHATTAN SERVICE CENTER
Agency: Natural Resources Conservation Service
Assisted By: Tom Roth
2017 Plots
2015 Plots
2016 Plots
2014, 2018 Plots
Legend
2016 Plot
CCPlot2015
2014_Plot
USDA
1,300 0 1,300 2,600 3,900 5,200
Feet
N

Plot Seeding Dates

	Warm Season Planting	Legume & Brassica Planting	Cereals	Oats and Radish	Dimensions
2014	08/22/2014	8/22/2014	09/18/2015	08/22/2015	180’ x 25’
2015	07/28/2015	7/28/2015	09/15/2015	08/22/2015	200’ x 10’
2016	08/18/2016	8/18/2016	09/22/2016	08/18/2016	300’ x 25’
2017	08/24/2017	8/24/2017	09/15/2017	08/05/2017	180’ x 12’
2018	7/2/2018	9/14/18	9/14/18	Not planted	150’x10’ 100’x5’

Equipment

Species and Mixes Planted

Annual Ryegrass
Dwarf Essex Rapeseed
Three species mix
Sorghum Sudan
Radish
Buckwheat
Crimson Clover
Mung Bean
Common Vetch
Woolly Pod Vetch
Sunn Hemp
Sainfoin
Cow Peas
Austrian Winter Peas
Chickling Vetch

Pearl Millett
Purple Top Turnips
Summer Grazing Mix
Cereal Killer
Fall Grazing
Winter Grazing
Cereal Rye
Triticale
Winter Barley
Winter Oats
Stockpile Grazing Mix
Oats and Radish
Oats, Radish, Soybeans and Corn
BMR Pearl Millet

Monthly Rainfall Totals

	2014	2015	2016	2017	2018
July					1.47
August	4.18	4.50	5.51	5.29	5.31
September	3.34	2.79	4.78	3.21	10.07
October	3.41	0.59	1.77	2.01	4.8
Total	**10.93**	**7.88**	**12.06**	**10.51**	**21.65**

Three Species Mix

Species	Composition of Mix
Cow Peas	13%
Pearl Millet	72%
Radish	8%

Four Species Mix

Species	Composition of Seed Mix
Cow Peas	8%
Sorghum Sudan	27%
Radish	3%
Sunn Hemp	42%

Grazing Mixes

Warm Season	Stockpile	Fall Freeze Out	Winter Grazing
Cowpeas	Cowpeas	Oats, Spring	Vetch, Common
Forage Soybean	Common Vetch	Radish	Rapeseed
Pearl Millet	Pearl Millet	Pea, Field	Radish, Oilseed
Sunn Hemp	Graza Radish	Barley	Pea, Winter
Sorghum Sudan	Winter Pea	Triticale	Barley
Grazer Radish	Sorghum Sudan	Lentils	Triticale, Winter
Mung Bean		Pea, Winter	Oats, Winter
		Rapeseed	Rye, Cereal
		Lupin	

Cover Crop Ratings

- Ratings are from the Midwest Cover Crop Council selection tool, found at: http://mccc.msu.edu/covercroptool/covercroptool.php#

- The scale is:

  1 = poor

  2 = fair

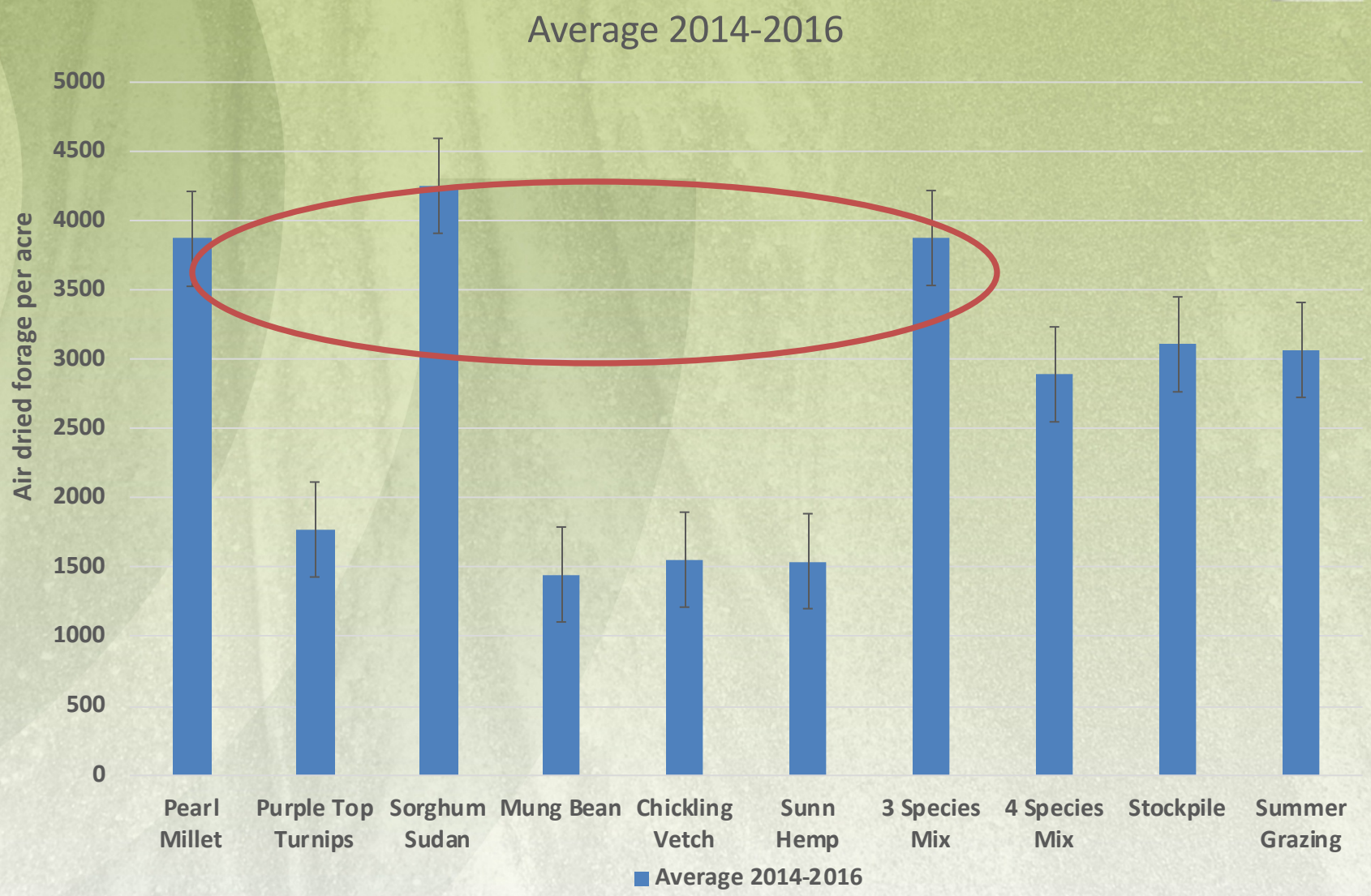
  3 = good

  4 = very good

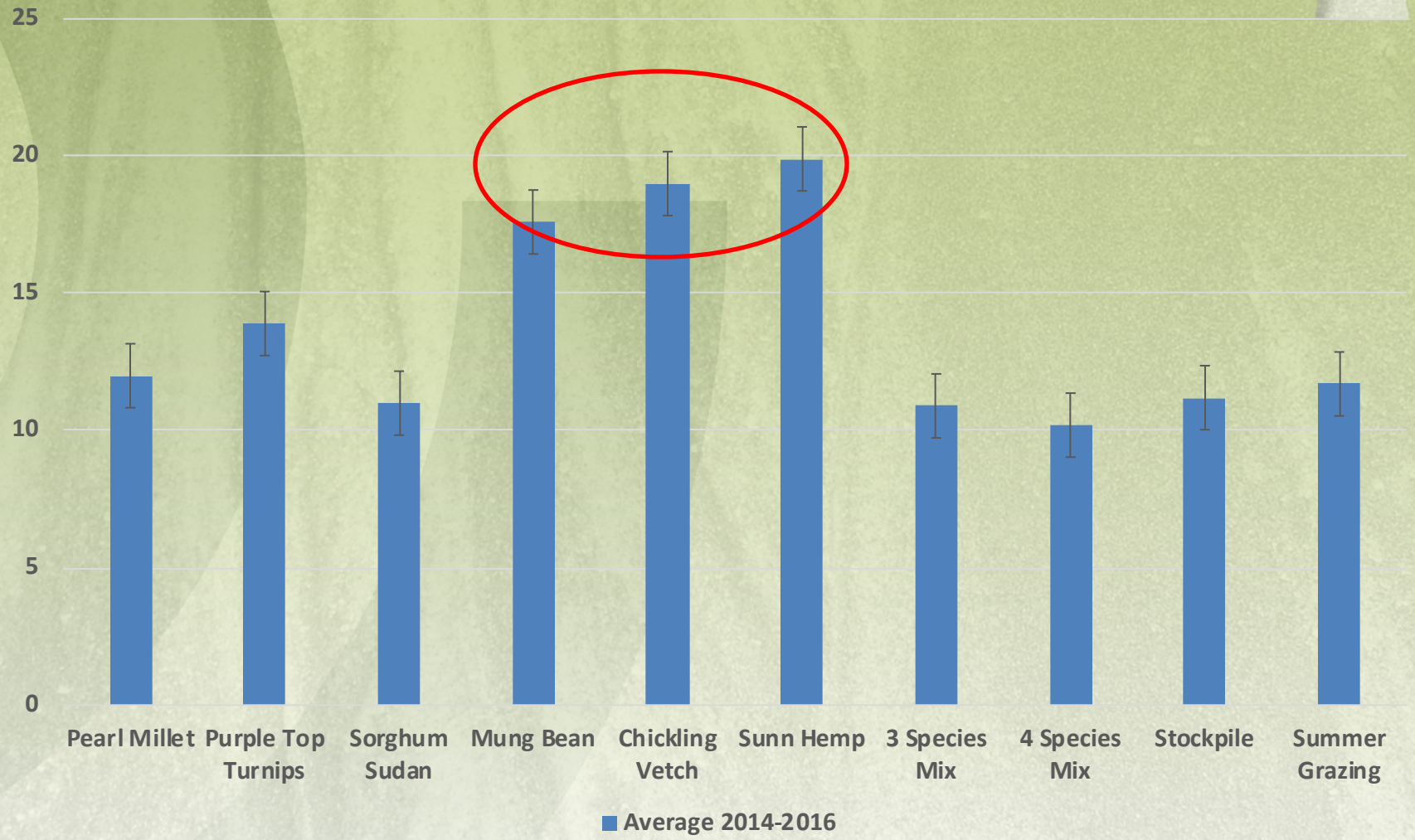
  5 = excellent

Cover Crop	Quick Growth	Biomass Yield	Forage Potential	Erosion Reduction	Loosen Subsoil	Loosen Topsoil	Weed Suppression	Tolerances	
								Heat	Drought
Annual Ryegrass	4	3	4	3	4	4	3	2	3
Pearl Millett	5	5	5	5	3	5	5	5	5
BMR Pearl Millett	5	5	5	5	3	5	4	5	5
BMR Sorghum	5	5	4	5	3	5	5	5	5
Cereal Rye	5	4	5	5	3	5	5	3	3
Winter Triticale	5	4	5	5	3	5	5	3	3
Winter Barley	5	3	5	5	3	5	4	3	3
Spring Oats	5	3	5	4	3	3	5	3	3
Brassicas									
Dwarf Essex Rape	4	2	4	3	3	3	3	3	3
Turnips	4	2	4	3	4	3	4	3	3
Yellow Mustard	5	3	1	3	3	3	3	3	3
Forage Radish	4	3	4	3	5	4	4	3	2
Legumes									
Mung Bean	4	4	3	3	3	3	3	4	3
Common Vetch	3	3	1	3	3	3	3	3	3
Woollypod Vetch	3	3	1	3	3	3	4	3	3
Sunn Hemp	4	5	2	4	4	4	5	5	4
Cowpeas	4	4	4	3	3	3	4	5	5
Winter Pea	3	3	4	3	3	3	3	1	3
Chickling Vetch	2	3	1	3	2	3	3	3	3
Crimson Clover	3	3	3	3	4	3	3	3	3

Cover crop biomass Production



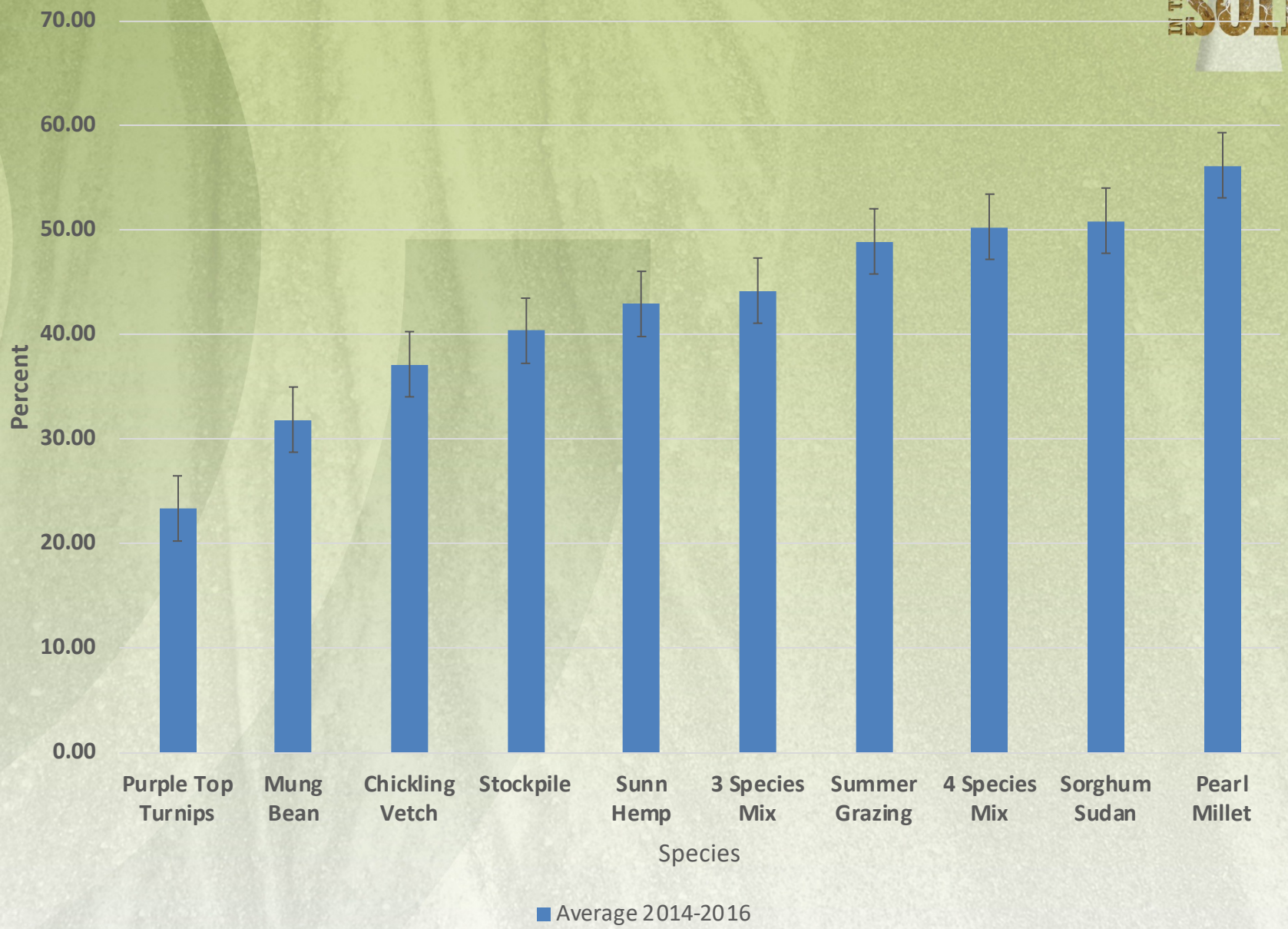
Crude Protein



Neutral Detergent Fiber

- Represents the slowly digested portion of the plant: hemicellulose, cellulose and lignin, which is cell wall material.

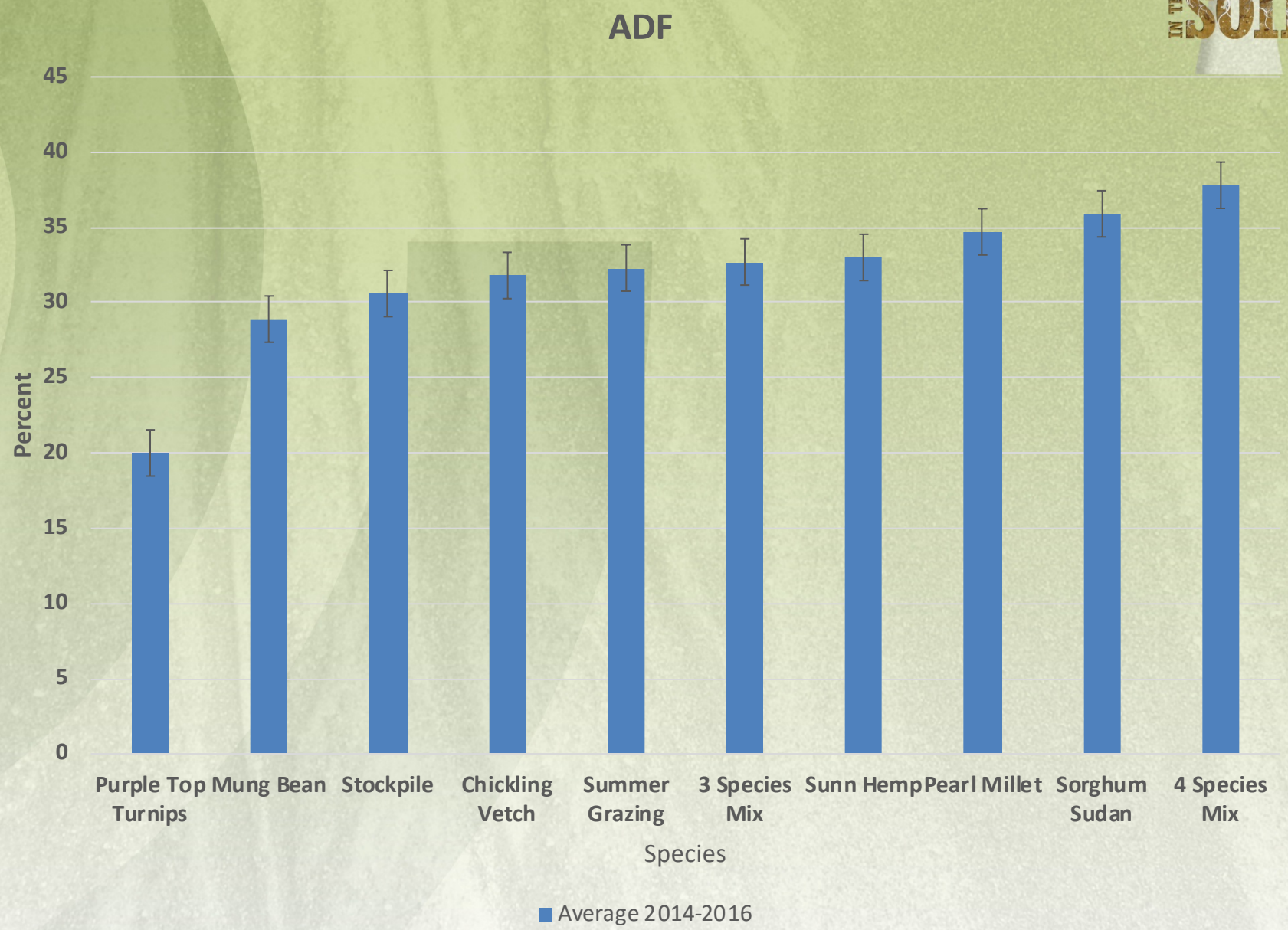
Neutral Detergent Fiber



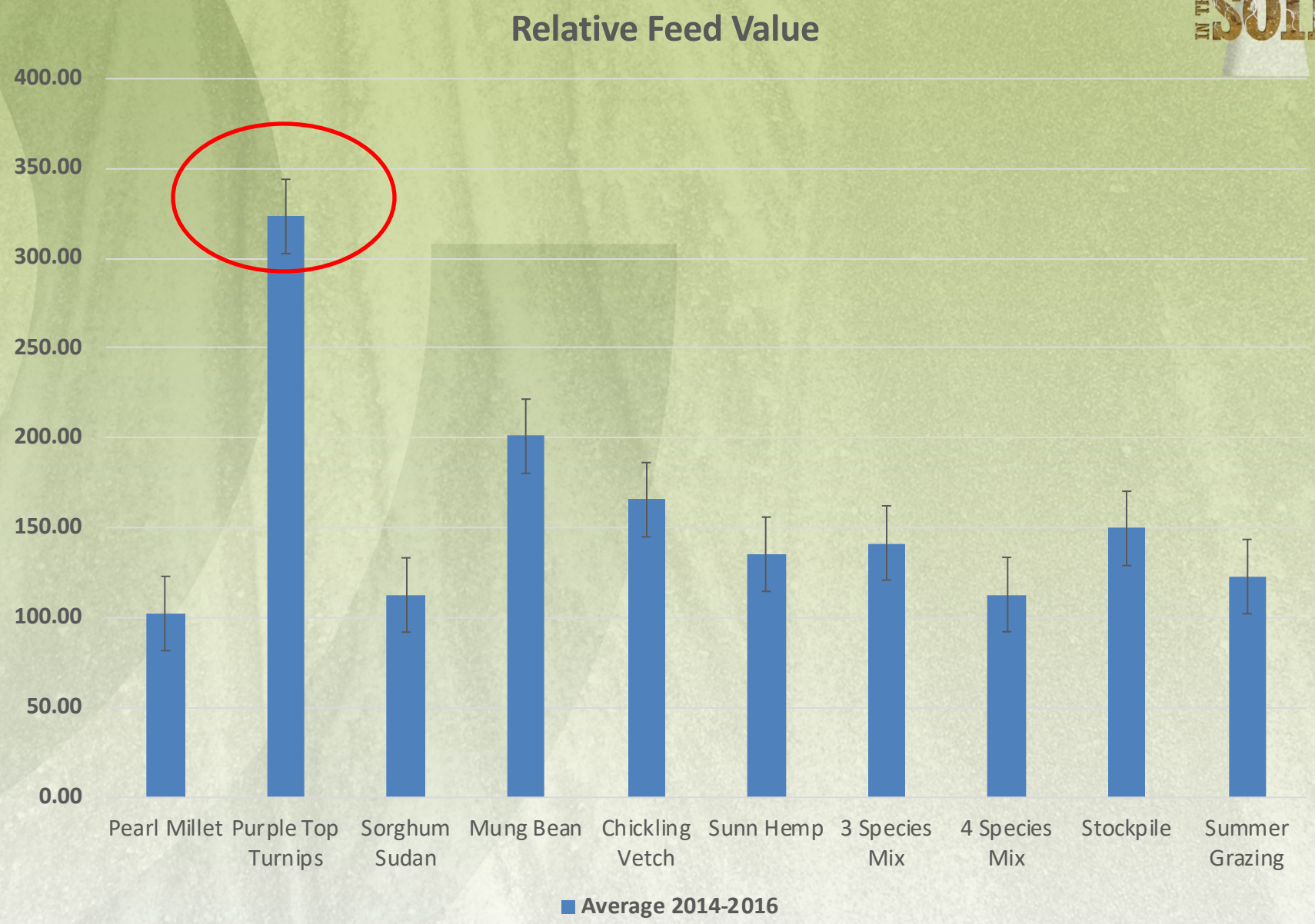
Acid Detergent Fiber

- Subfraction of NDF, consisting primarily of lignin and cellulose. The greater the ADF the more indigestible the forage.

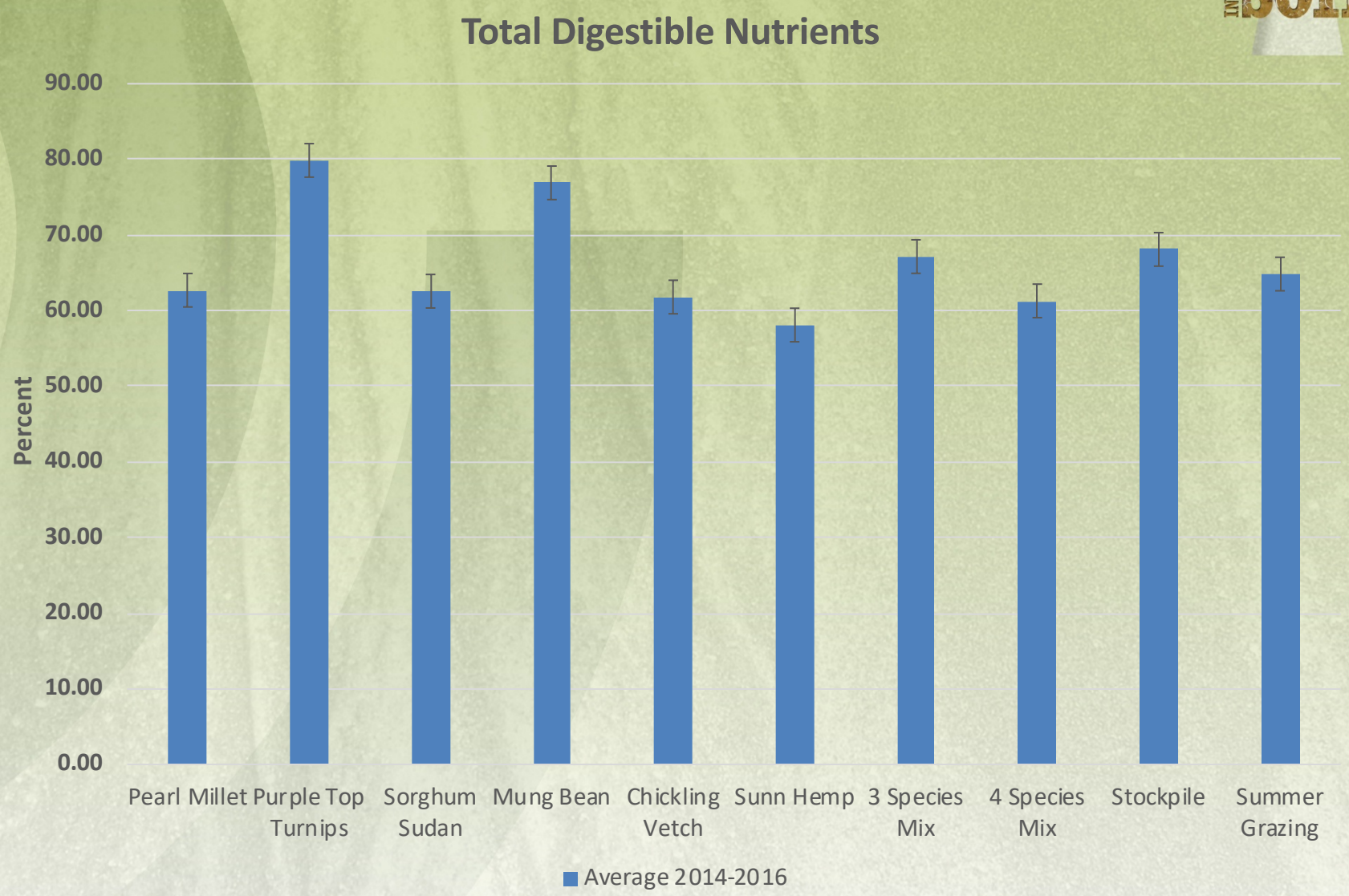
Acid Detergent Fiber



Relative Feed Value



Total Digestible Nutrients (TDN)



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Cereal Rye	5	4	5	5	3	5	5	3	3
Winter Triticale	5	4	5	5	3	5	5	3	3
Winter Barley	5	3	5	5	3	5	4	3	3
Spring Oats	5	3	5	4	3	3	5	3	3
Brassicas									
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Turnips	4	2	4	3	4	3	4	3	3
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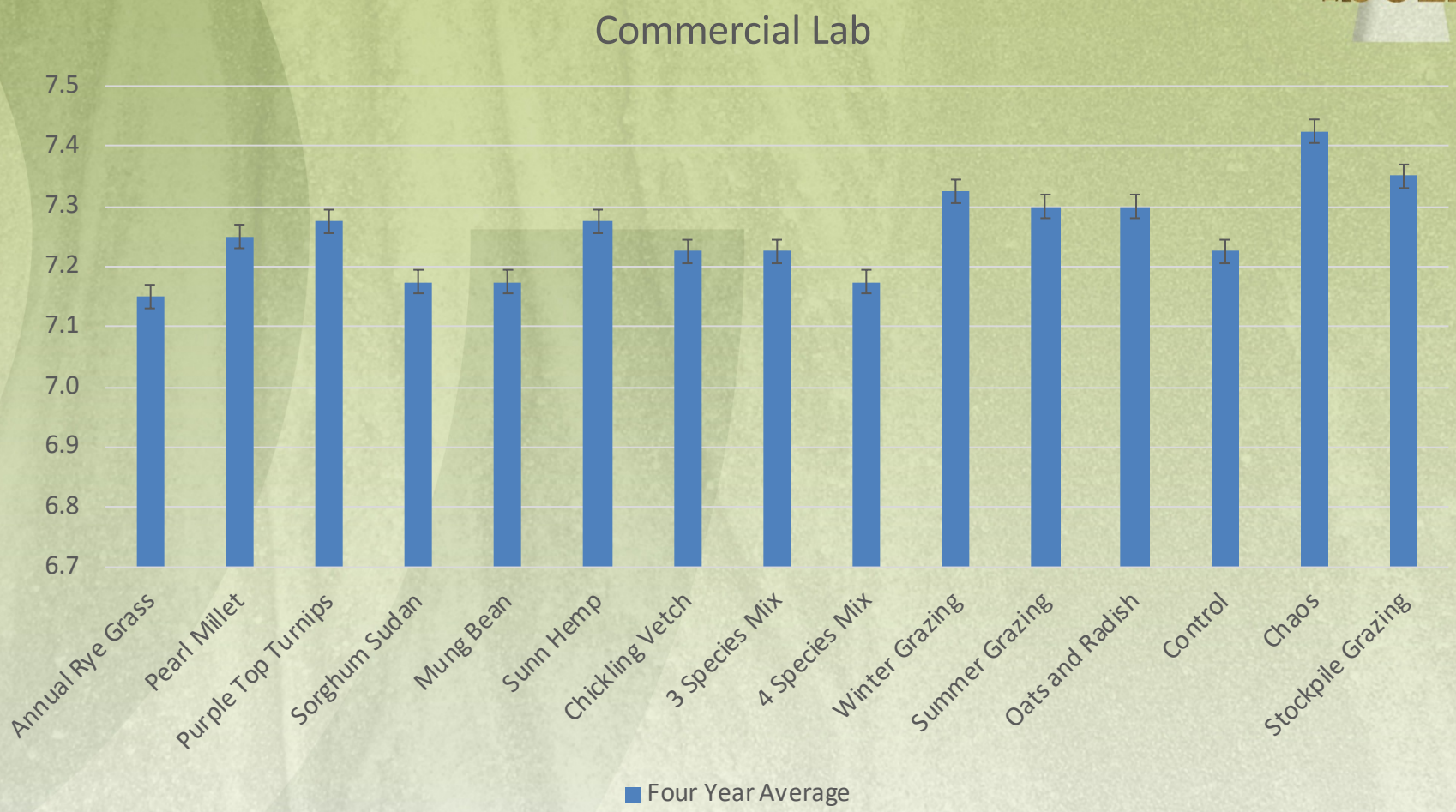
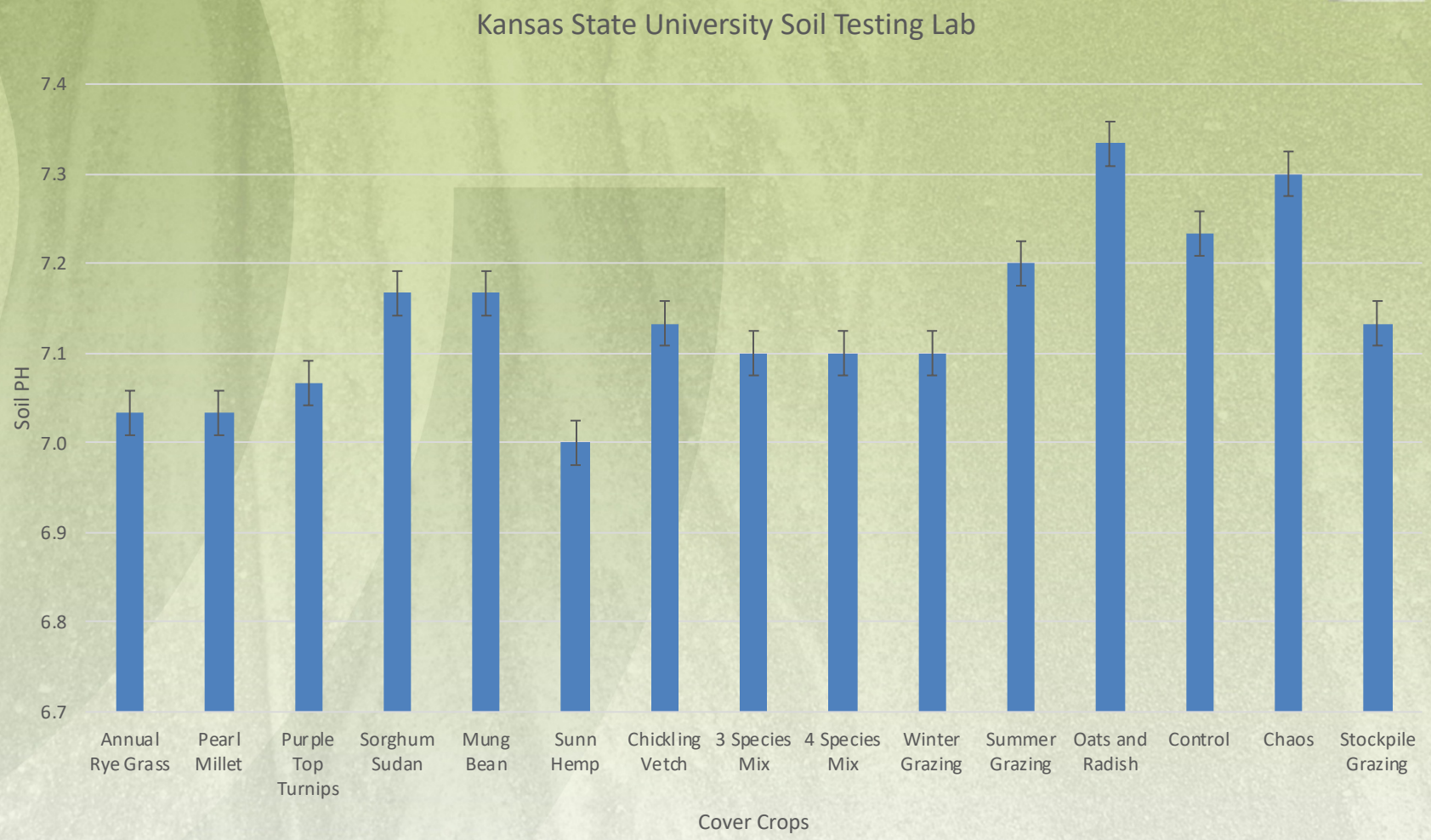
Forage Radish	4	3	4	3	5	4	4	3	2
Legumes									
Mung Bean	4	4	3	3	3	3	3	4	3
Common Vetch	3	3	1	3	3	3	3	3	3
Woollypod Vetch	3	3	1	3	3	3	4	3	3
Sunn Hemp	4	5	2	4	4	4	5	5	4
Cowpeas	4	4	4	3	3	3	4	5	5
Winter Pea	3	3	4	3	3	3	3	1	3
Chickling Vetch	2	3	1	3	2	3	3	3	3
Crimson Clover	3	3	3	3	4	3	3	3	3

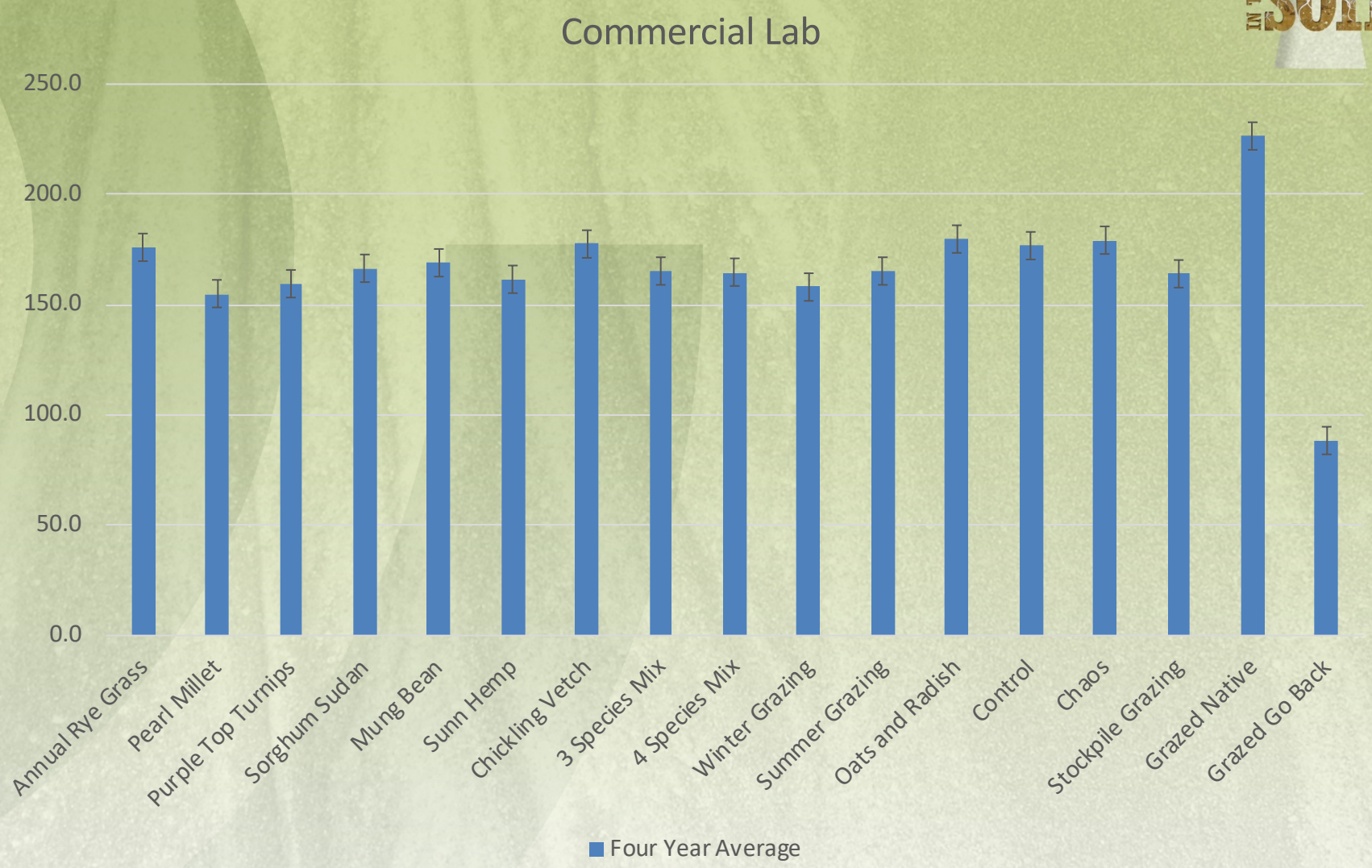
1:1 Soil PH


Commercial Lab
7.5
7.4
7.3
7.2
7.1
7.0
6.9
6.8
6.7
Annual Rye Grass
Pearl Millet
Purple Top Turnips
Sorghum Sudan
Mung Bean
Sunn Hemp
Chickling Vetch
3 Species Mix
4 Species Mix
Winter Grazing
Summer Grazing
Oats and Radish
Control
Chaos
Stockpile Grazing
Four Year Average

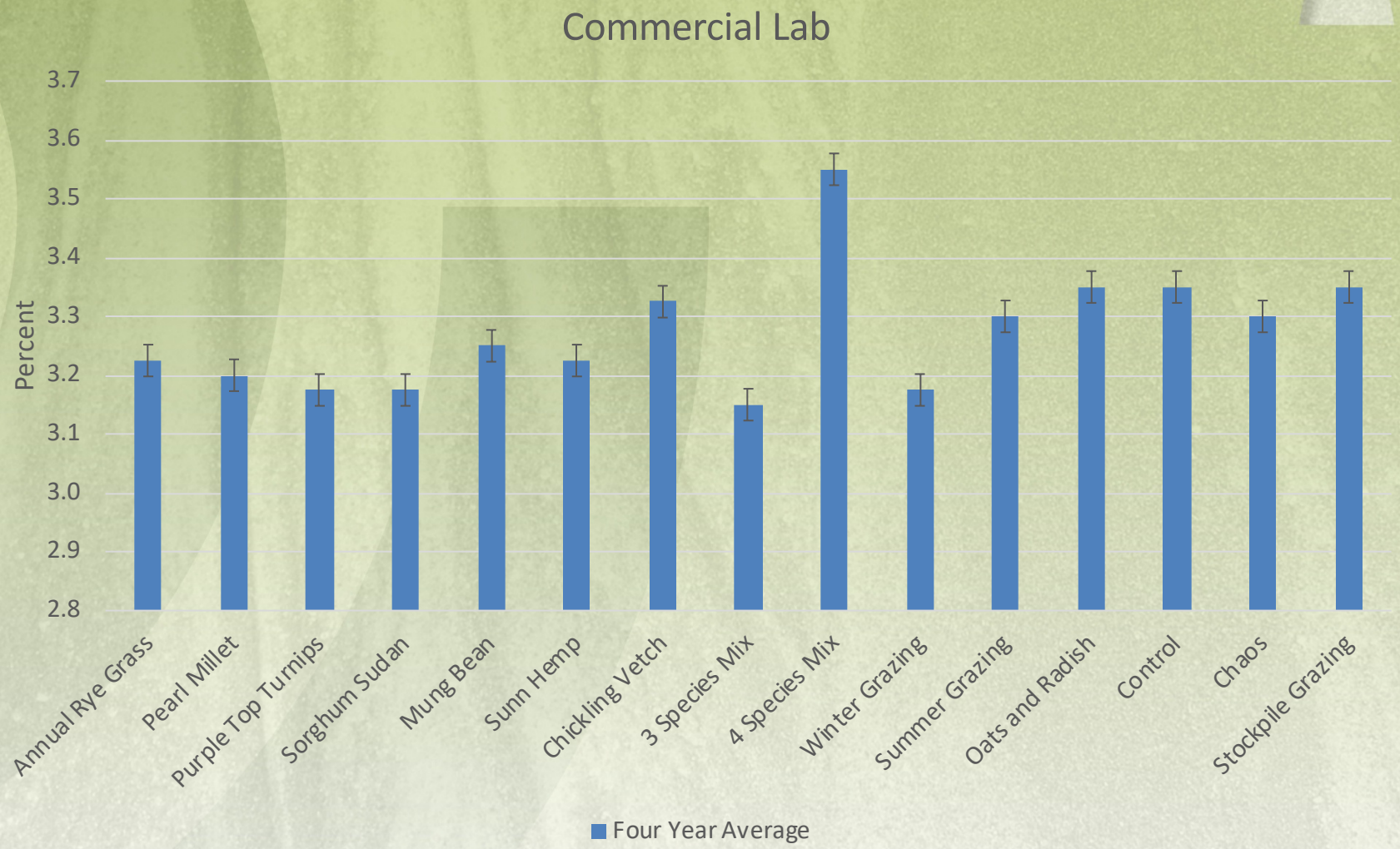
1:1 Soil PH


Kansas State University Soil Testing Lab
Soil PH
7.4
7.3
7.2
7.1
7.0
6.9
6.8
6.7
Annual Rye Grass
Pearl Millet
Purple Top Turnips
Sorghum Sudan
Mung Bean
Sunn Hemp
Chickling Vetch
3 Species Mix
4 Species Mix
Winter Grazing
Summer Grazing
Oats and Radish
Control
Chaos
Stockpile Grazing
Cover Crops

Water Soluble Carbon

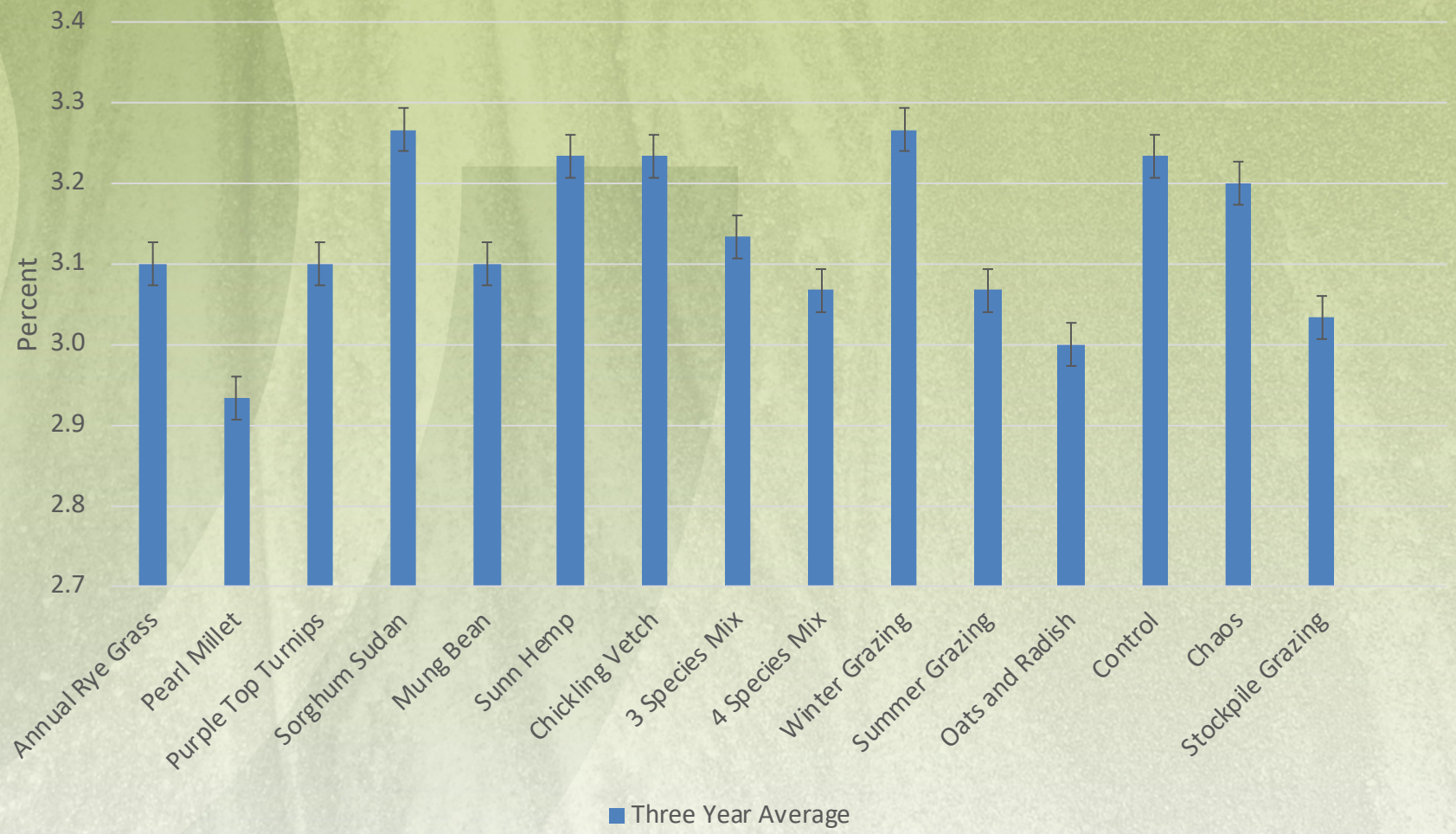


Organic Matter Percent Loss on Ignition (LOI)

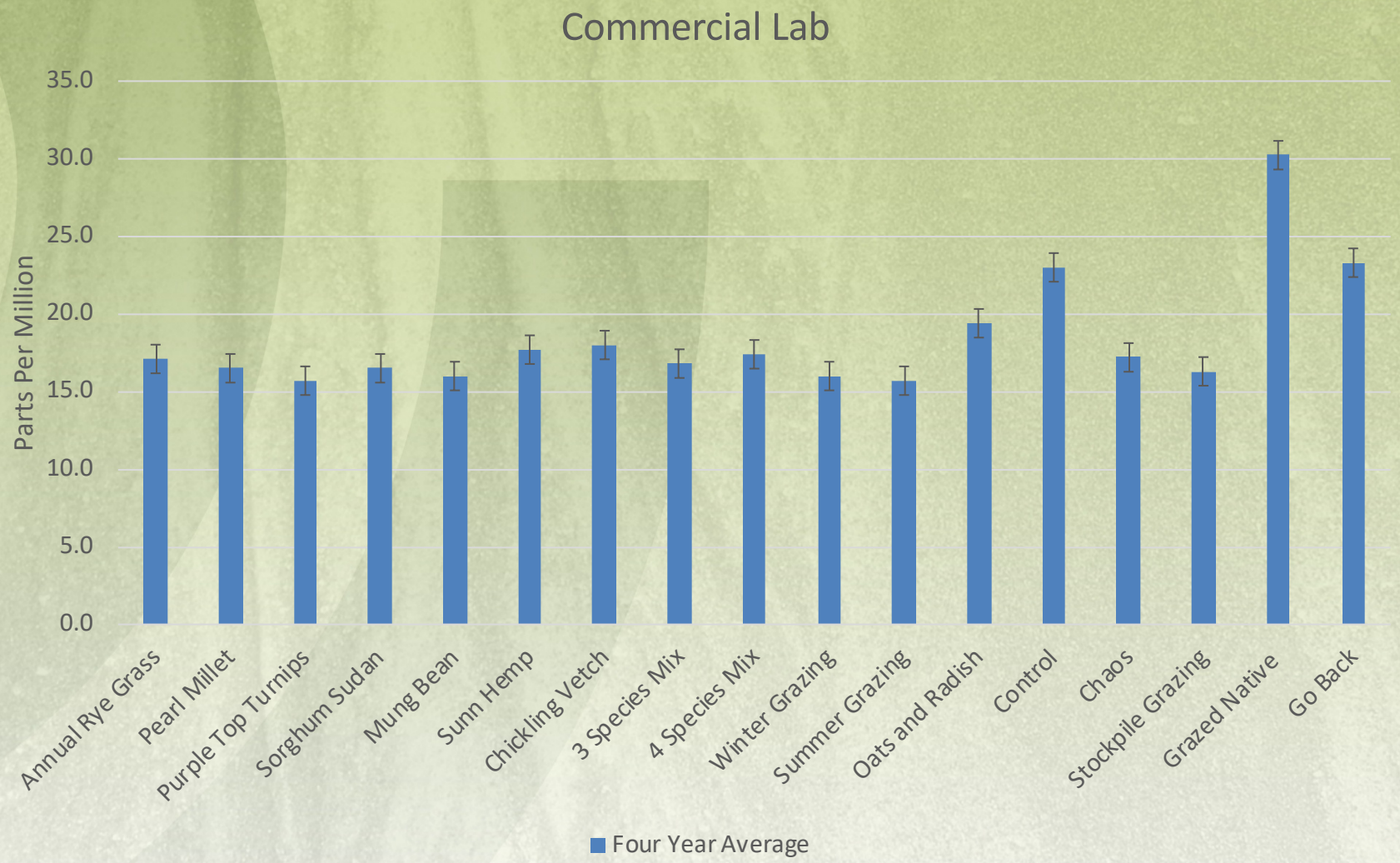


Organic Matter Percent Loss on Ignition (LOI)

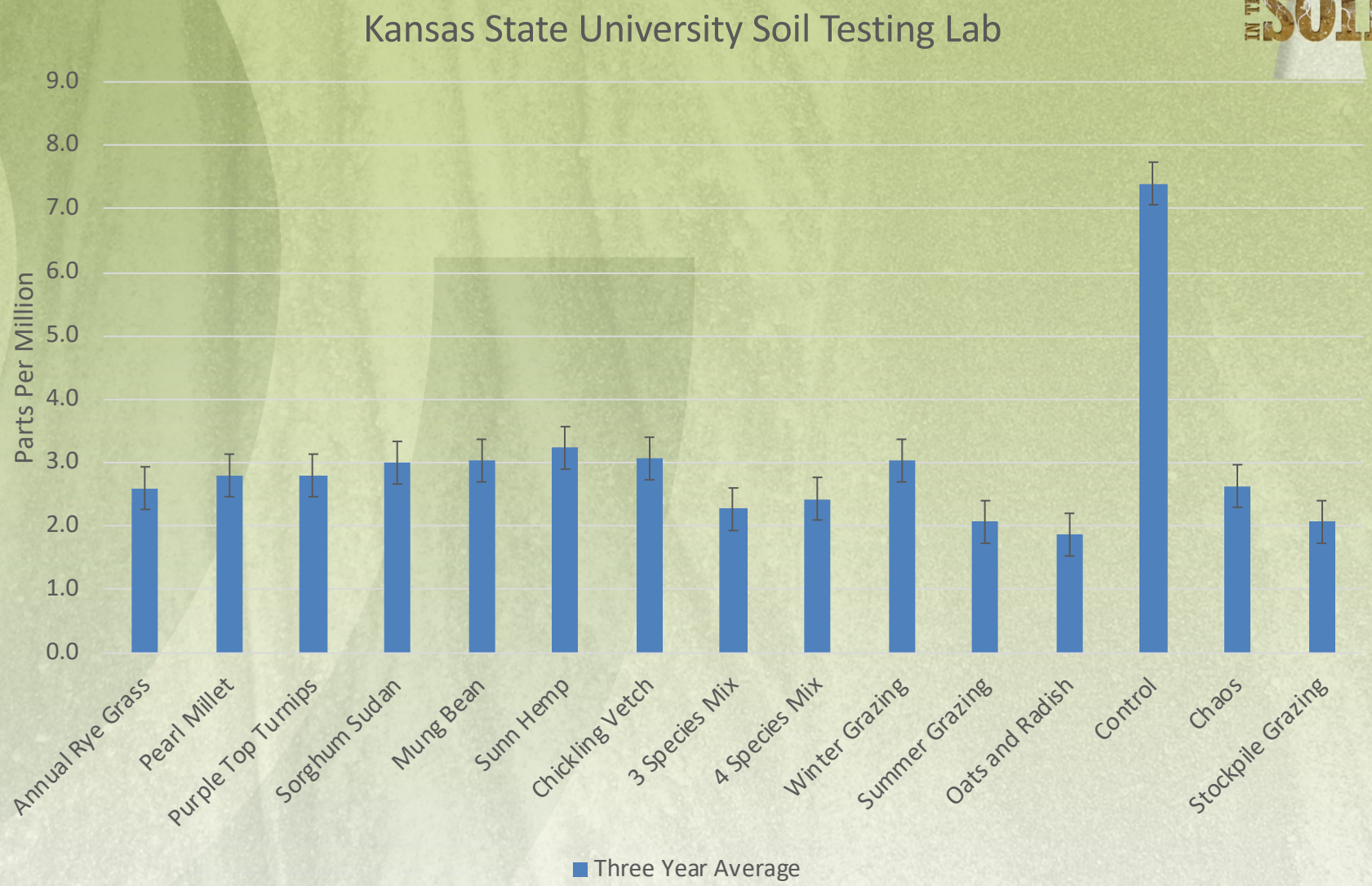
Kansas State University Soil Testing Lab



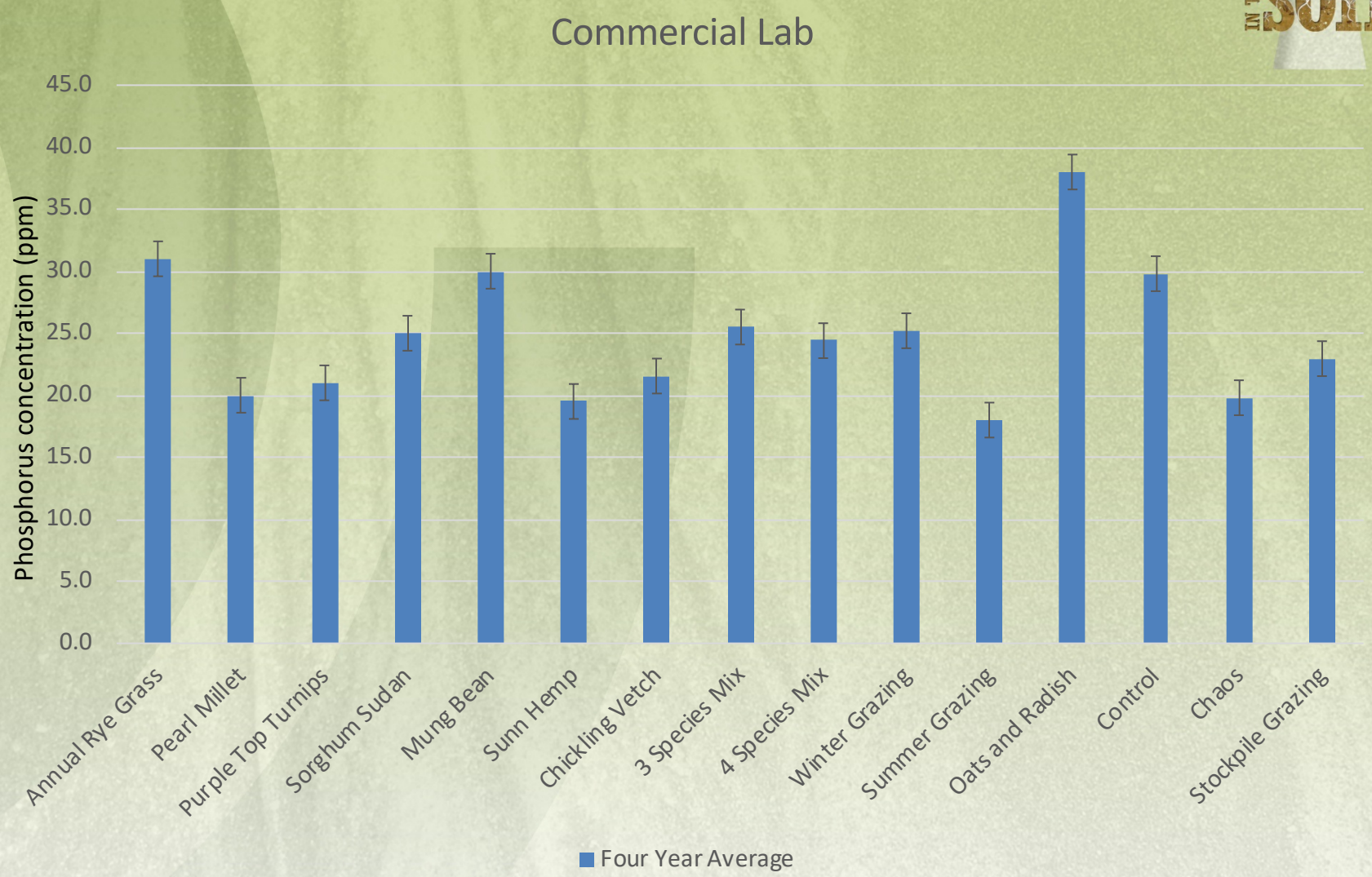
Water Extract Nitrogen



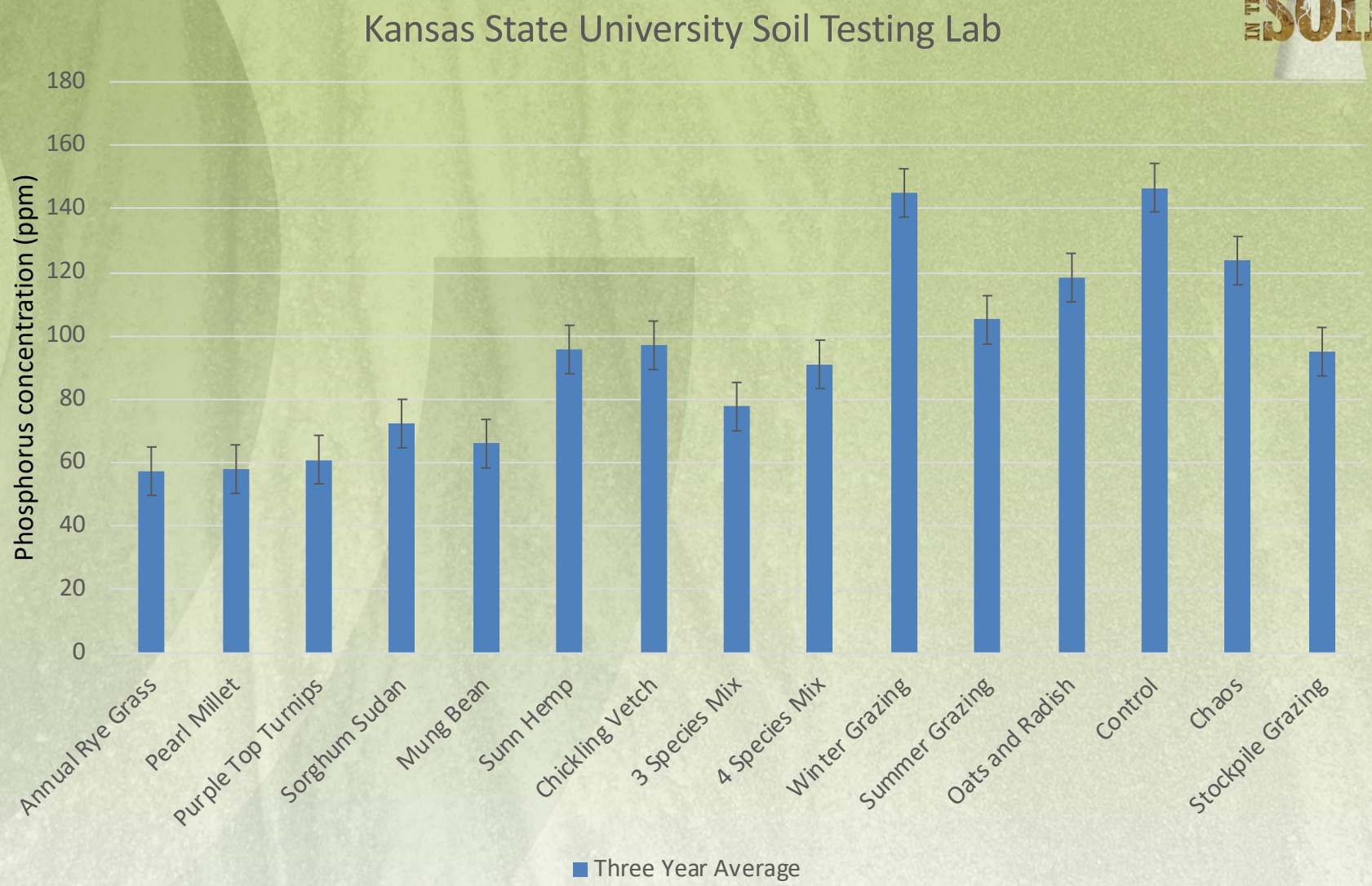
Nitrate Nitrogen



H3A Extract Phosphorus



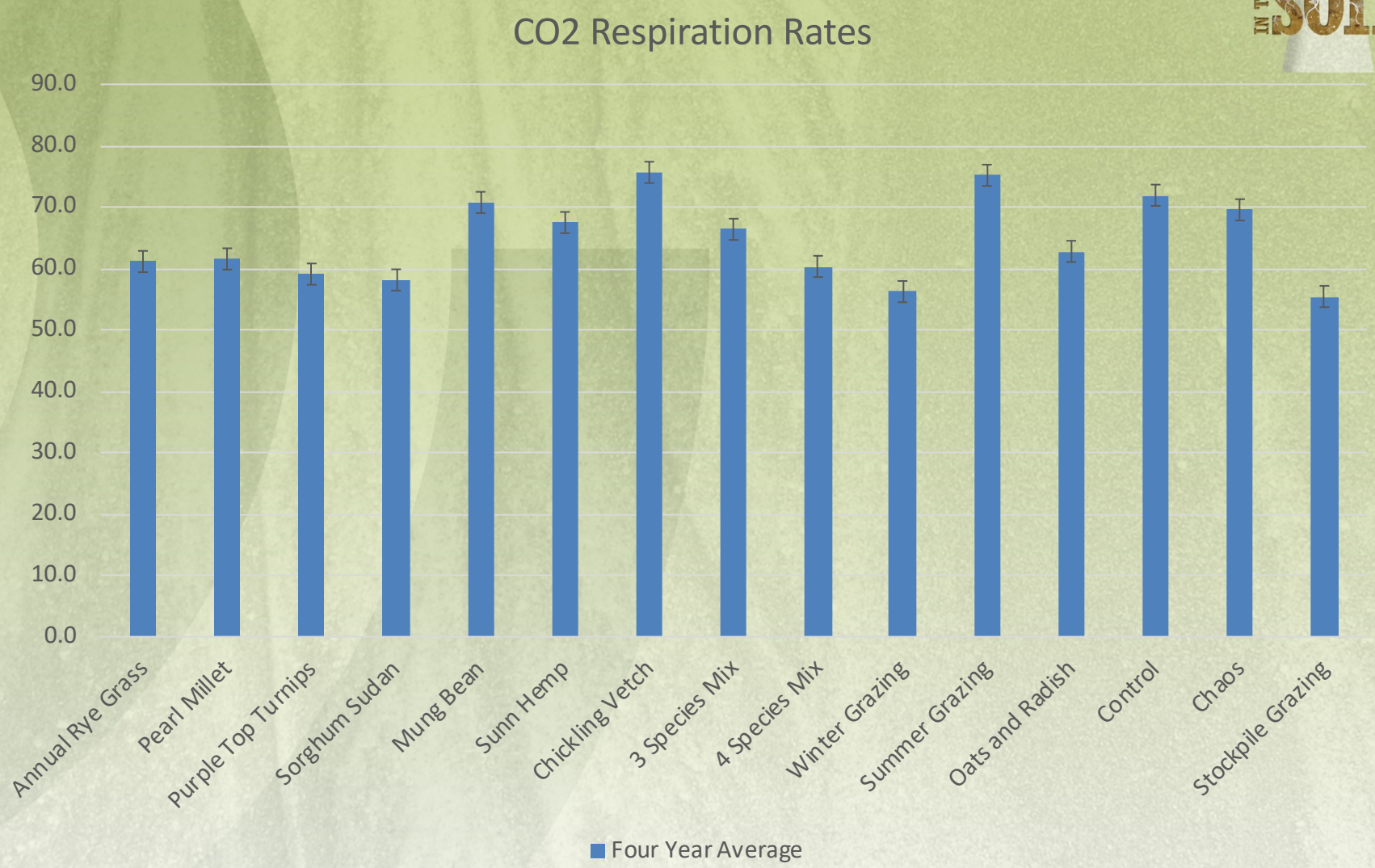
Phosphorus


Kansas State University Soil Testing Lab
Phosphorus concentration (ppm)
180
160
140
120
100
80
60
40
20
0
Annual Rye Grass
Pearl Millet
Purple Top Turnips
Sorghum Sudan
Mung Bean
Sunn Hemp
Chickling Vetch
3 Species Mix
4 Species Mix
Winter Grazing
Summer Grazing
Oats and Radish
Control
Chaos
Stockpile Grazing
Three Year Average

CO_2 Respiration Rates

- 0 - 5 Very Low
- 6 - 30 Moderately Low
- 31 - 60 Moderate/Average
- 61 - 100 Moderately High
- >100 High

Soil Respiration Rates

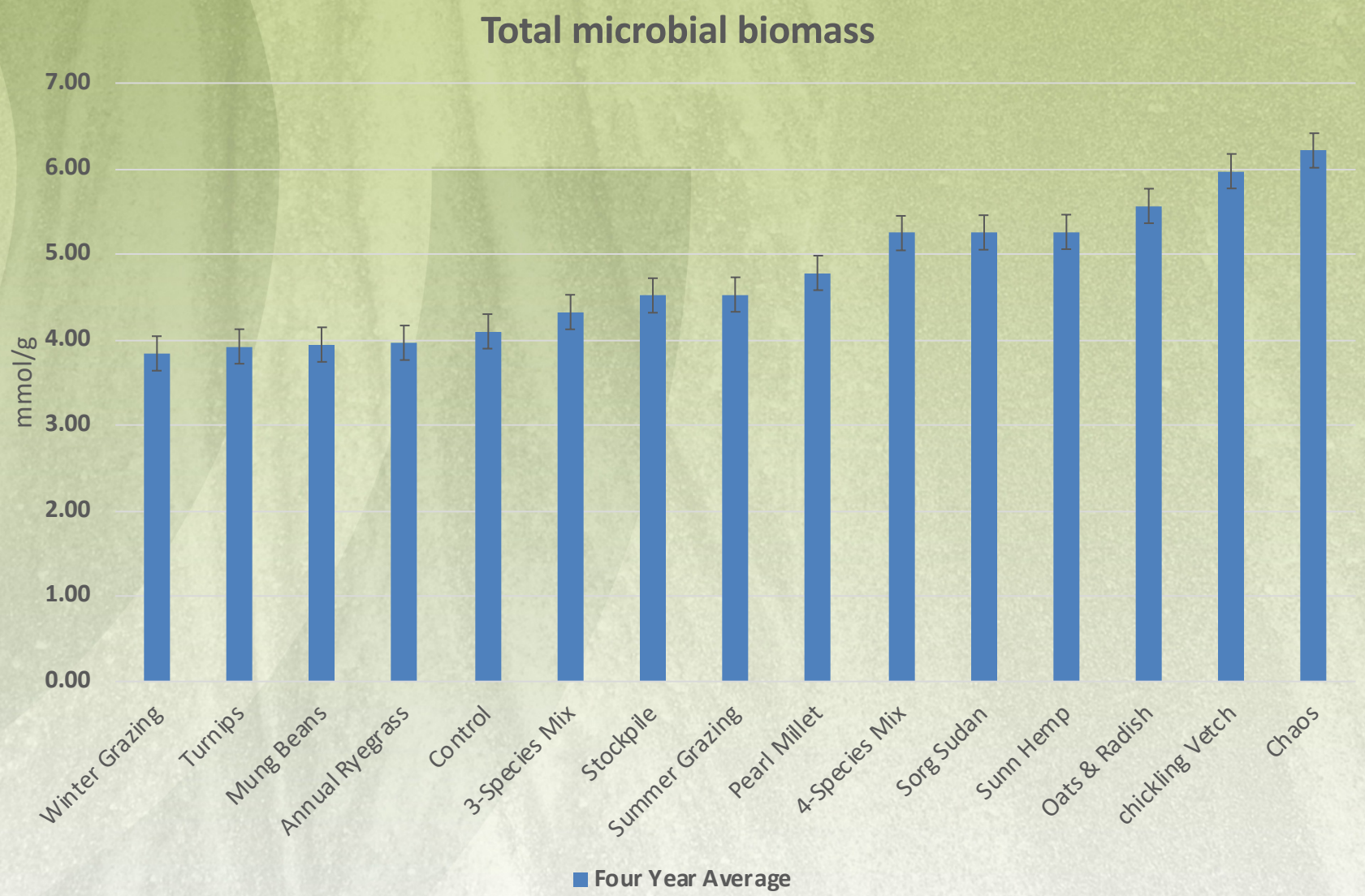


Soil Health Test Scores

Phospholipid Fatty Acid

- Found in living organisms from bacteria to plants and animals
- This includes bacteria, actinomycetes, arbuscular mycorrhizal fungi, and protozoa
- Fatty acids found in the cell membranes
- They degrade quickly when the organism dies

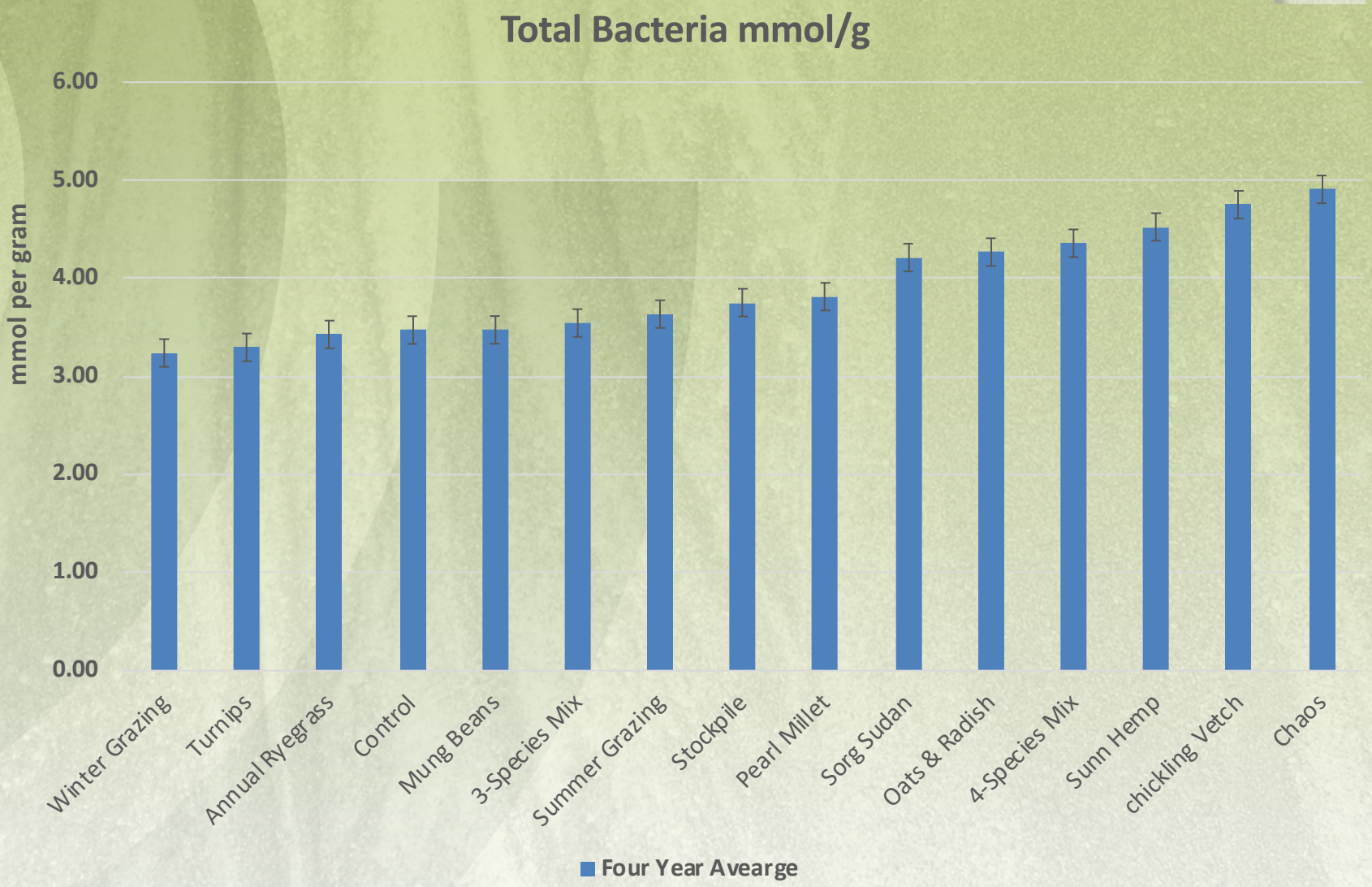
Total Living Microbial Biomass mmol/g



Soil Bacteria

- Actinomycetes - These are the organisms with characteristics common to both bacteria and fungi but yet possessing distinctive features to delimit them into a distinct category
- Fix Nitrogen
- Decompose residue

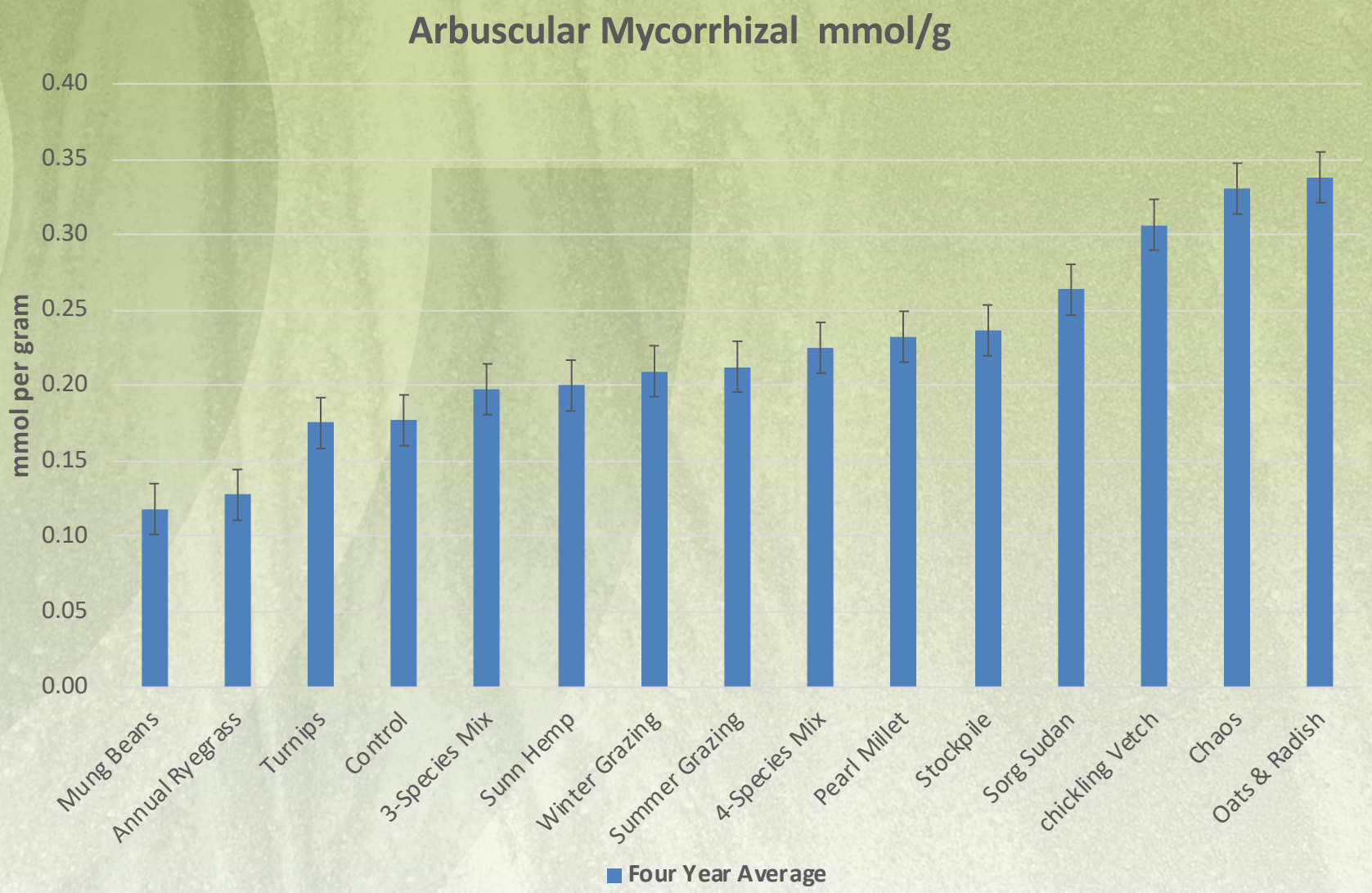
Bacteria


Total Bacteria mmol/g
mmol per gram
6.00
5.00
4.00
3.00
2.00
1.00
0.00
Winter Grazing
Turnips
Annual Ryegrass
Control
Mung Beans
3-Species Mix
Summer Grazing
Stockpile
Pearl Millet
Sorg Sudan
Oats & Radish
4-Species Mix
Sunn Hemp
chickling Vetch
Chaos
Four Year Avearge

Fungi

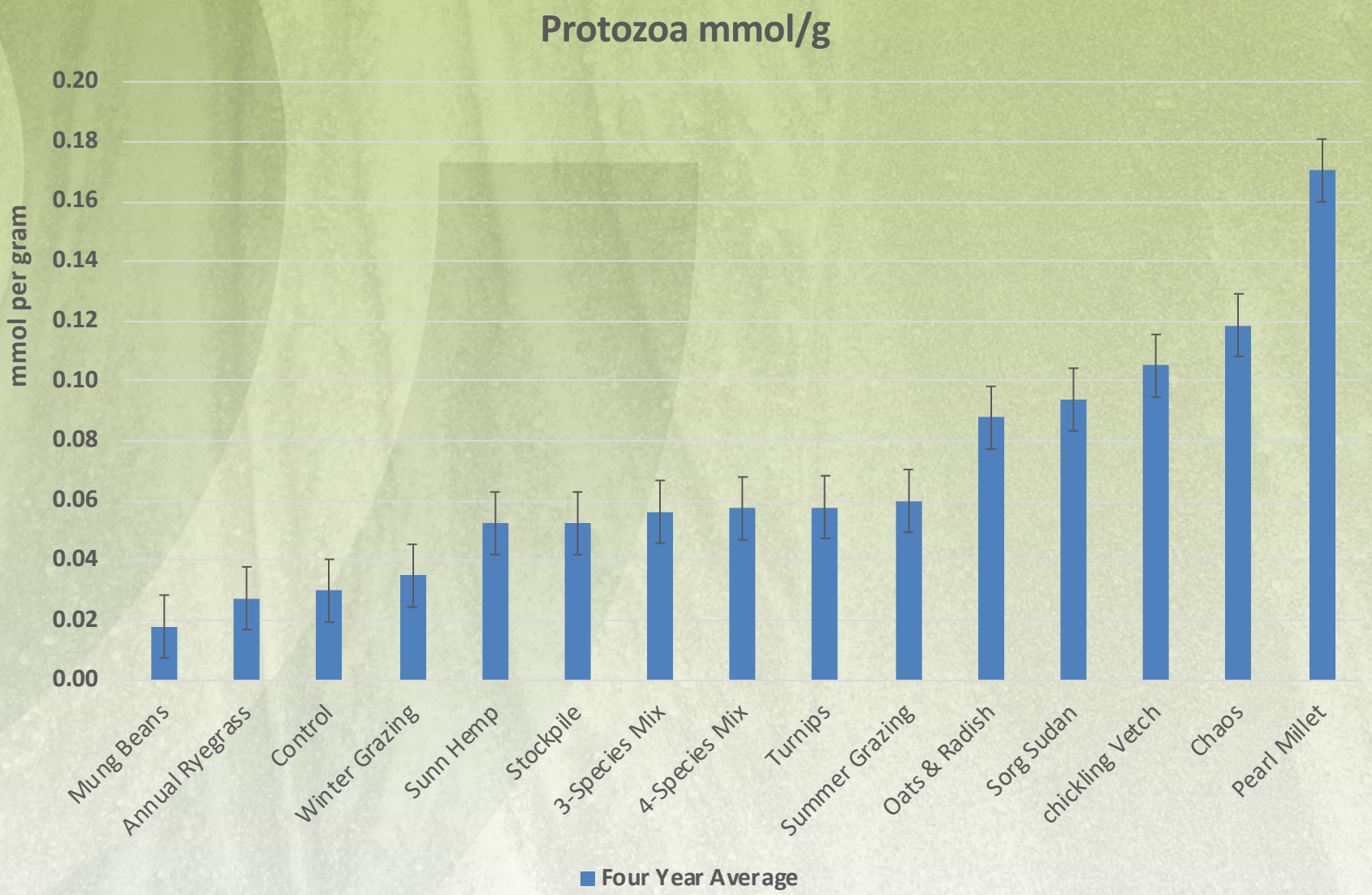
- Arbuscular - Symbiotic associations between arbuscular mycorrhizal fungi and plant roots.
- Can provide a range of benefits to the host plant.
  - improved nutrition
  - enhanced resistance to soil-borne pests and disease,
  - improved resistance to drought
  - better soil structure.

Arbuscular Mycorrhizal Fungi

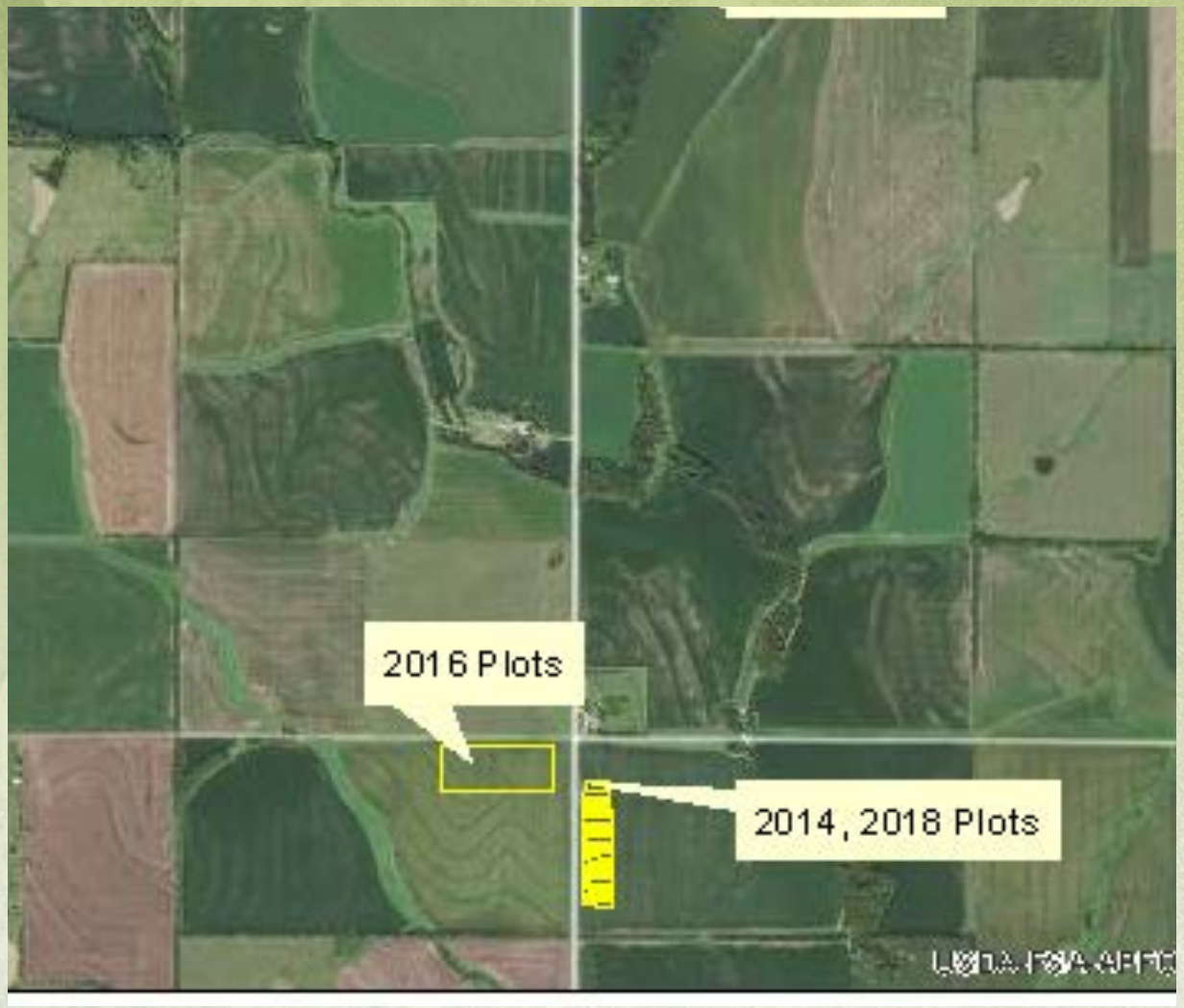


- Protazoa – Single celled animals that feed primarily on bacteria, but also eat other protozoa, soluble organic matter, and sometimes fungi.
- They play an important role in mineralizing nutrients, making them available for use by plants and other soil organisms.

Protozoa

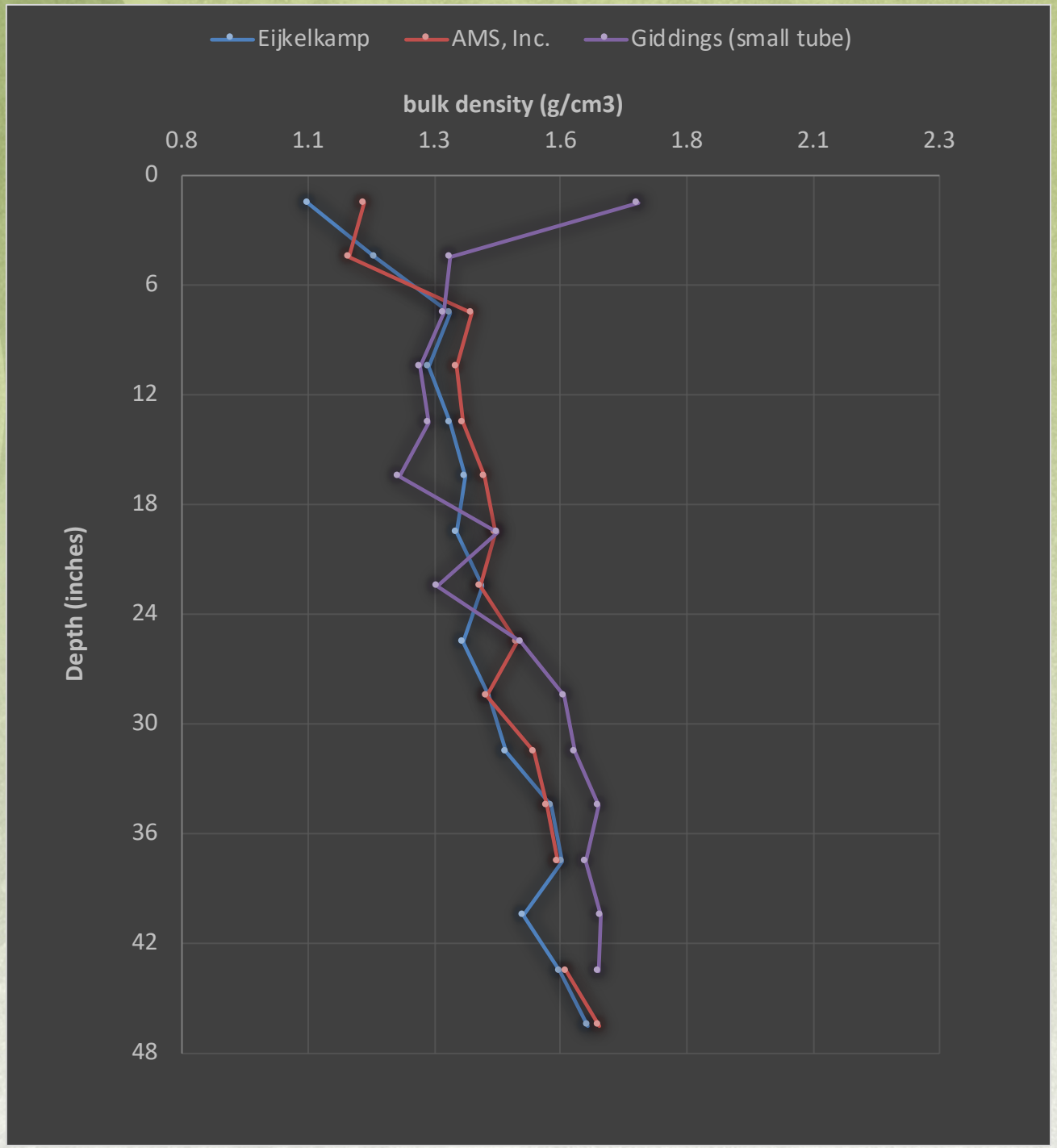

Protozoa mmol/g
mmol per gram
0.20
0.18
0.16
0.14
0.12
0.10
0.08
0.06
0.04
0.02
0.00
Mung Beans
Annual Ryegrass
Control
Winter Grazing
Sunn Hemp
Stockpile
3-Species Mix
4-Species Mix
Turnips
Summer Grazing
Oats & Radish
Sorg Sudan
chickling Vetch
Chaos
Pearl Millet
Four Year Average

2018 Location



PLFA Comparison 2014 to 2018

	2014	2018	2014	2018	2014	2018	2014	2018
	Total		Bacteria Total		AMF		Protozoa	
Winter Grazing	3.44	3.84	3.10	3.24	0.17	0.21	0.00	0.04
Sunn Hemp	3.38	5.26	3.26	4.52	0	0.20	0.00	0.05
4-Species Mix	2.13	5.25	2.06	4.36	0	0.23	0.00	0.06
Summer Grazing	2.84	4.53	2.47	3.64	0	0.21	0.00	0.06
chickling Vetch	4.45	5.97	3.84	4.75	0.22	0.31	0.04	0.11
Mung Beans	3.72	3.94	3.19	3.47	0.17	0.12	0.03	0.02
Annual Ryegrass	2.16	3.96	2.07	3.43	0	0.13	0.00	0.03
Pearl Millet	2.84	4.78	2.32	3.81	0.14	0.23	0.03	0.17
Stockpile	2.95	4.52	2.68	3.75	0.13	0.24	0.00	0.05
Turnips	4.12	3.92	3.43	3.30	0.17	0.18	0.06	0.06
3-Species Mix	3.03	4.32	2.82	3.54	0	0.20	0.02	0.06
Chaos	4.27	6.21	3.42	4.91	0.23	0.33	0.07	0.12
Oats & Radish	2.79	5.56	2.29	4.27	0.14	0.34	0.03	0.09
Sorg Sudan	6.58	5.25	5.39	4.21	0.37	0.26	0.13	0.09
Control	2.66	4.10	2.43	3.47	0.1	0.18	0.00	0.03



Redding Silt Loam
No-Till 12 years
Sampled 2015
Kluitenberg, Hellerich, Kohake, Nester, Roth and Religa

Acknowledgements

- Riley County Conservation District (Aubrey Evans)
- Mark Sylvester and Gary Sylvester
- State Conservation Commission
- Kevin C. Religa, Lisa R. Wainwright, Kathryn Davis, Angela Beavers, Myra Richardson, Dr. Gerard Kluitenberg, Dr. Deann Presley, Dr. Peter Tomlinson, Thomas Becker, Edward L. Erickson, Mark A. Janzen, Tracy W. Freeman, Kris R. Ethridge, Jason Waite, Fred Cummings and Alysia Towey

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(1) mail: U.S. Department of Agriculture
Office of the Assistant Secretary for Civil Rights
1400 Independence Avenue, SW
Washington, D.C. 20250-9410;

(2) fax: (202) 690-7442; or

(3) email: program.intake@usda.gov

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