Farming Forever!

Menoken Farm

By: Jay Fuhrer | Soil Health Specialist - /Retired NRCS/USDA | Bismarck, ND - USA
Burleigh County Soil Conservation District

BISMARCK, N.D. (KFYR) - Gov. Doug Burgum, R-N.D., has given North Dakota a target to reduce North Dakota’s carbon footprint. He said the state and all of its industries are aiming to be carbon neutral by 2030.

On the national scale, President Joe Biden recently called for nationwide carbon neutrality by 2050.

To help North Dakota reach it 20 years sooner than that, Burgum said North Dakota needs to cash in on what he calls “the geological jackpot.”

Elon Musk announces plan to take Carbon Dioxide out of the atmosphere and convert it into rocket fuel.

Bismarck Tribune January 12, 2022:
Summit Carbon Solutions plans to inject into the Oliver and Mercer Counties where its pipeline will end. Planning for a 2000 mile system across the Dakota’s, Minnesota, Nebraska and Iowa.

Carbon Comments

SCIENCE NOTE: SOIL CARBON

BRITISH SOCIETY OF SOIL SCIENCE

Highlights

- There is an urgent need to reduce atmospheric carbon dioxide (CO_2) concentrations.
- Supporting natural and agricultural systems to sequester carbon (C) can help achieve this.
- Many soils have the capacity to sequester C from the atmosphere, however the process is slow, easily-reversible and time-limited.
- The greatest and most rapid soil C gains can be achieved through land use change (e.g. conversion from arable land to grassland or woodland), but this can have implications for food production and the displacement or exporting of emissions.
- Increasing soil organic C contents through sustainable soil management (SSM) practices can improve soil health, the efficiency of food production and the delivery of multiple public goods and services.
- Where financial incentives are developed to encourage SSM practices and sequester C it is essential that funders provide ongoing support to these schemes.
- Given the uncertainties around the amount of additional C that can be sequestered in future, and the ease with which C gains can be lost, it is essential that the carbon stores in existing permanent grasslands, moorlands, peatlands, wetlands and woodlands are protected.

Introduction

Recent reports from the Intergovernmental Panel on Climate Change (IPCC) highlight how human activity is changing the climate in unprecedented and sometimes irreversible ways.

This science note aims to:

Carbon sequestration

Carbon store

Carbon sink

Carbon source

www.soils.org.uk

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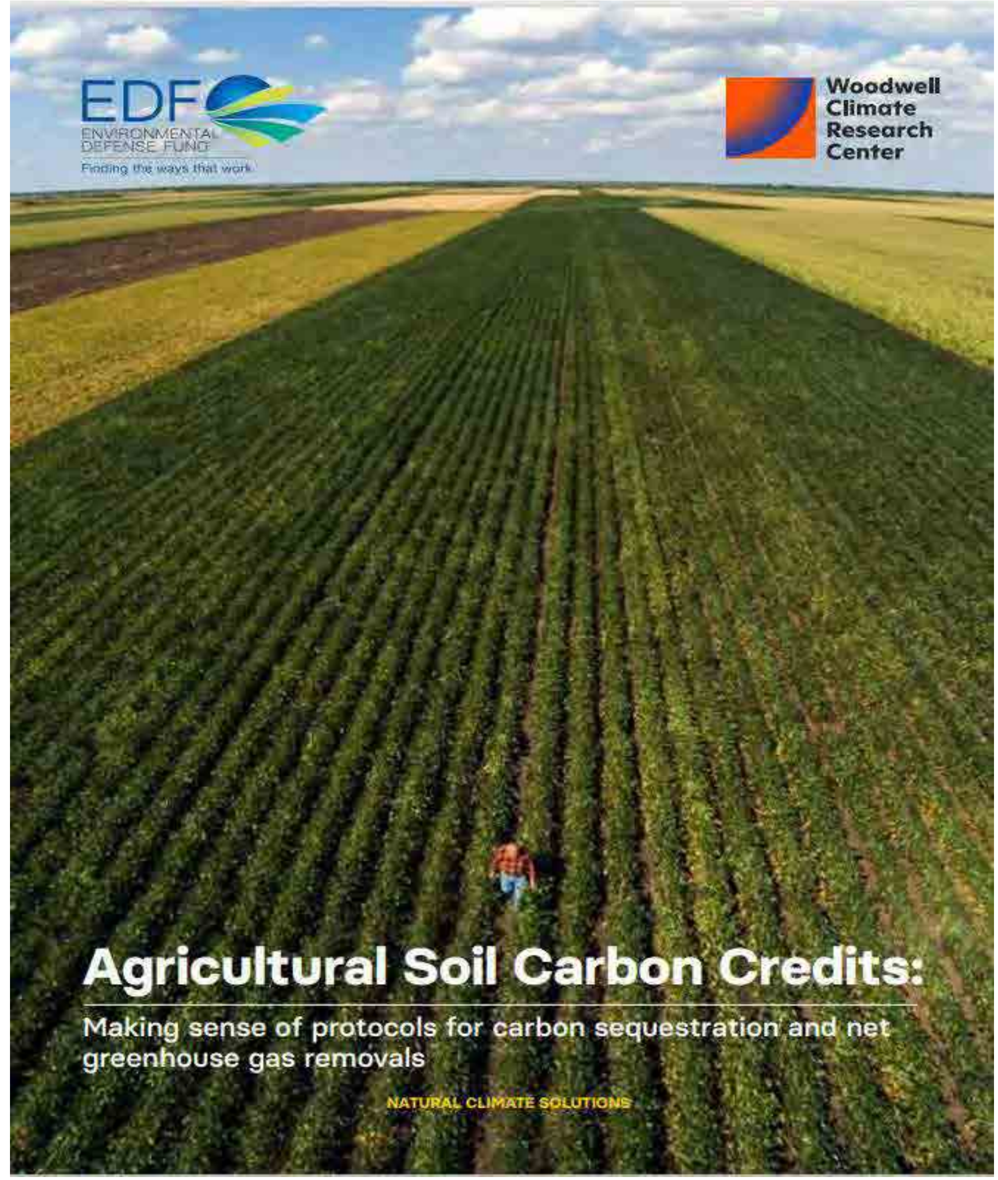


Voluntary **Carbon Credits** and the opportunity for co-benefits.

https://northcentralwater.org/

Radhika Fox (red coat), Assistant Administrator EPA
Day One WOTUS
Day Two 319 Grants and Cover Crops
Carbon Support

Farm Bureau, Farmers Union, Grain Growers, Corn Growers, Soybean Growers, ND Dept of Ag, Congressional Ag Policy Director, FFA, Conservation Districts.

Partnering with BEK Communications:

- Cameras
- Soil Moisture Monitoring
- Fiber Optic Line
- BEK Television
- **Carbon Data Transfer**

Menoken Farm YouTube Channel

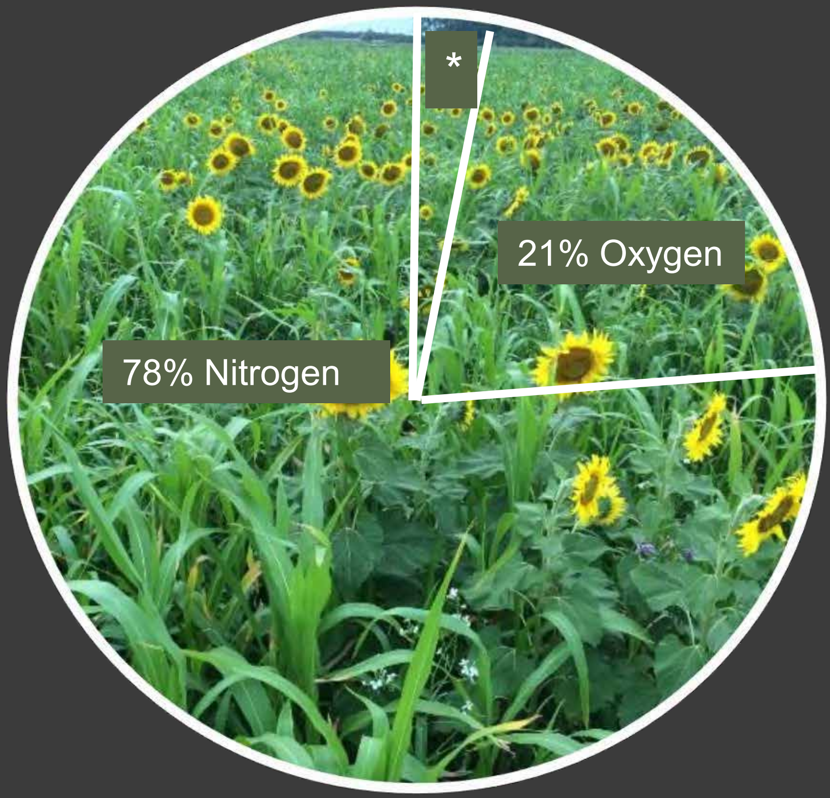
Geography	Views	Watch time (hours)	Average view duration
Total	513214	179603.8611	0:20:59
US	318935	118025.4607	0:22:12
CA	39055	14314.1159	0:21:59
AU	27556	9584.8321	0:20:52
GB	14035	5139.4627	0:21:58
ZA	4797	1460.2939	0:18:15
DE	4376	1342.5539	0:18:24
NZ	3219	1027.3916	0:19:08
SE	1606	526.2996	0:19:39
IE	1195	382.2895	0:19:11
NO	652	199.7242	0:18:22
NL	549	165.6408	0:18:06
IN	447	79.7368	0:10:42
FR	391	78.8586	0:12:06
DK	345	91.9287	0:15:59
AT	299	91.333	0:18:19
FI	194	55.5002	0:17:09
LT	184	50.3963	0:16:26
PT	165	41.2541	0:15:00
ID	157	34.417	0:13:09
MX	148	38.6718	0:15:40
PL	135	26.7018	0:11:52
ES	132	39.395	0:17:54
HU	115	11.0401	0:05:45
ZW	114	17.2998	0:09:06
MY	107	22.7719	0:12:46
BR	104	10.5827	0:06:06
RU	93	7.4574	0:04:48
AR	91	15.95	0:10:30
JP	84	7.6519	0:05:27
UA	76	23.7957	0:18:47

Analytical Data for 65 Countries

Carbon Impacts

Air

What Does Dry Air Consist Of?



Source: Scifun.Chem.Wisc.edu

- 78% Nitrogen N_2
- 21% Oxygen O_2
- 1% *
- Argon Ar
- Carbon Dioxide CO_2
- Neon Ne
- Helium He
- Methane CH_4
- Krypton Kr
- Nitrogen Oxide N_2O
- Hydrogen H_2
- Xenon Xe
- Ozone O_3

How Much Co2 Does It Take To Kill A Plant?
Plants can be killed by Co2 levels above 2000ppm, and breathing levels above that can be hazardous to humans and animals. Plants will be harmed if your CO2 concentration is below 250 PPM.

[Can Too Much Co2 Cause Plants To Die? | iLoveMyCarbonDioxide]

CO2 is produced when people breathe. Each exhaled breath by an average adult contains **35,000 to 50,000 parts per million** (ppm) of CO2 – 100 times higher than is typically found in the outside air (OSA).

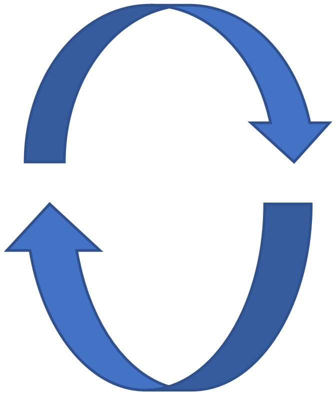
[how much co2 do humans produce by breathing - Lisbdnet.com]
lisbdnet.com/how-much-co2-do-humans-produce-by-breathing/

Carbon Dioxide PPM
March 11, 2019
Menoken Farm

Landscape Simplification

Civilization Critical: Energy, Food, Nature, and the Future

By Darrin Qualman



Agriculture Resource Concerns

Symptoms of Landscape Simplification

- Wind Erosion
- Water Erosion
- Salinity (we need to transpire water in lieu of evaporation)
- Water Quantity
- Water Quality
- Lack of Plant Diversity & Cover (Simplified Crop Rotations)
- Lack of Animal Diversity and Animal Impact
- Season Long Grazing
- Drought/Flood Same Year
- Exporting Carbon (old and new sunshine carbon)
- Carbon Deficient Soils

Factors Affecting the Balance between Gains and Losses of Organic Matter in Soils.

Reference: The Nature and Properties of Soils, Table 12.5

Factors Promoting Gains

- Green manures or cover crops
- Conservation tillage
- Return of plant residues
- Low temperature and shading
- Controlled grazing
- High soil moisture
- Surface mulches
- Application of compost & manure
- Appropriate nitrogen level
- High plant productivity
- High plant root:shoot ratio

Factors Promoting Losses

- Erosion
- Intensive tillage
- Whole plant removal
- High temperatures & sun exposure
- Overgrazing
- Low soil moisture
- Fire
- Applying only inorganic materials
- Excessive mineral nitrogen
- Low plant productivity
- Low plant root:shoot ratio

Landscape Simplification. Which Of The Following Examples Is Your Farm?


Is Your Farm Too Cold?


Is Your Farm Too Hot and Dry?

Is Your Farm Too Wet?
Denitrification

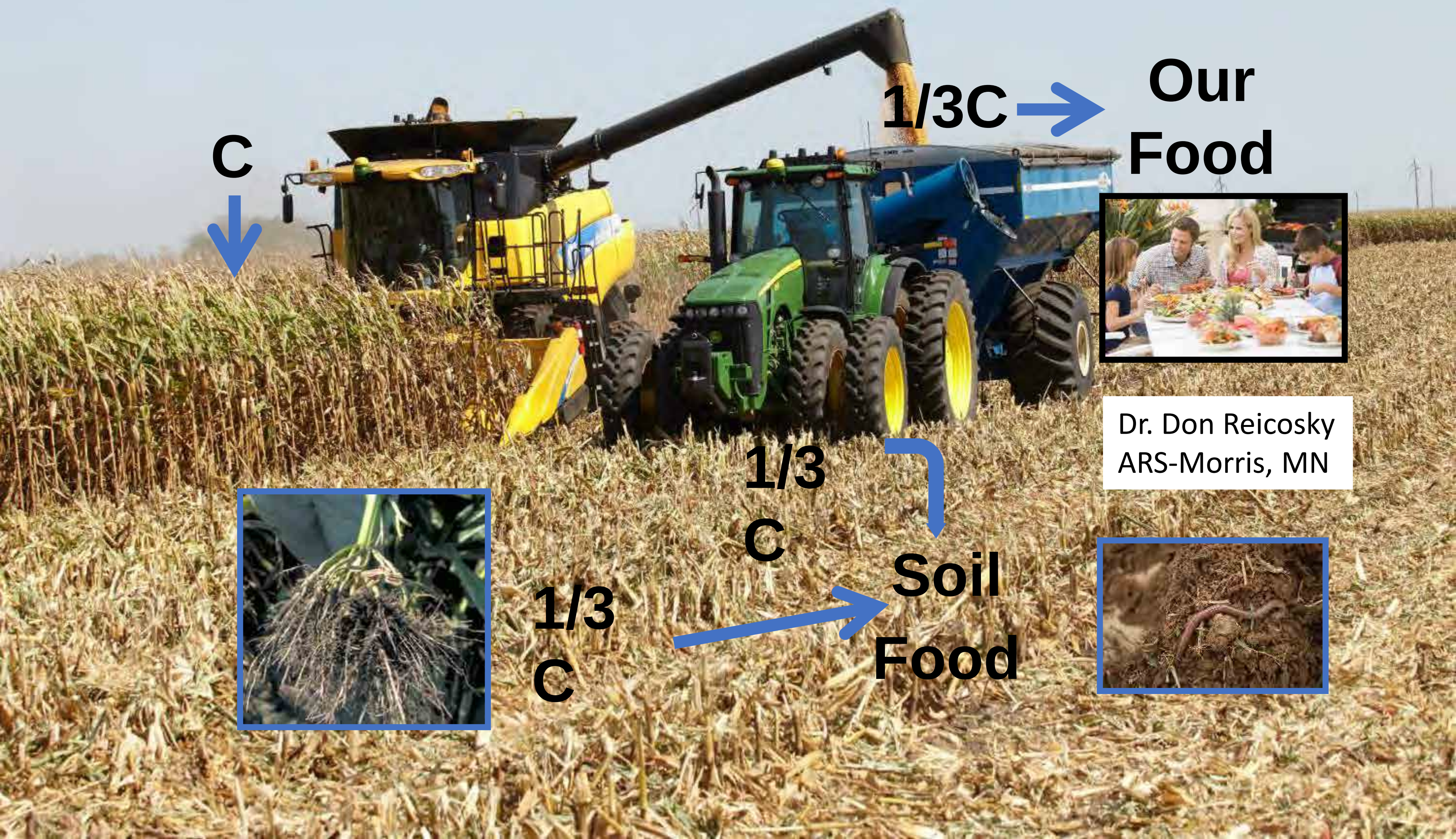
Carbon

Soil Health: the continued capacity of soil to function as a vital living ecosystem that sustains plants, animals, and humans.

Soil Health Principles:

- Soil Armor – keep the soil covered
- Minimize soil disturbance
- Maximize diversity of plants in the rotation – 4 crop types
- Maintain living roots in the soil - cover crops - perennials
- Integrate livestock

Agriculture is a carbon exporter from the landscape in the form of our food. About one third of the carbon fixed in photosynthesis is exported in the grain yield used for our consumption.



"Root exudation clearly represents a significant carbon cost to the plant (Marschner 1995), with young seedlings typically exuding about 30–40% of their fixed carbon as root exudates"
(Whipps 1990).

Source:

Regulation and function of root exudates

DAYAKAR V. BADRI & JORGE M. VIVANCO

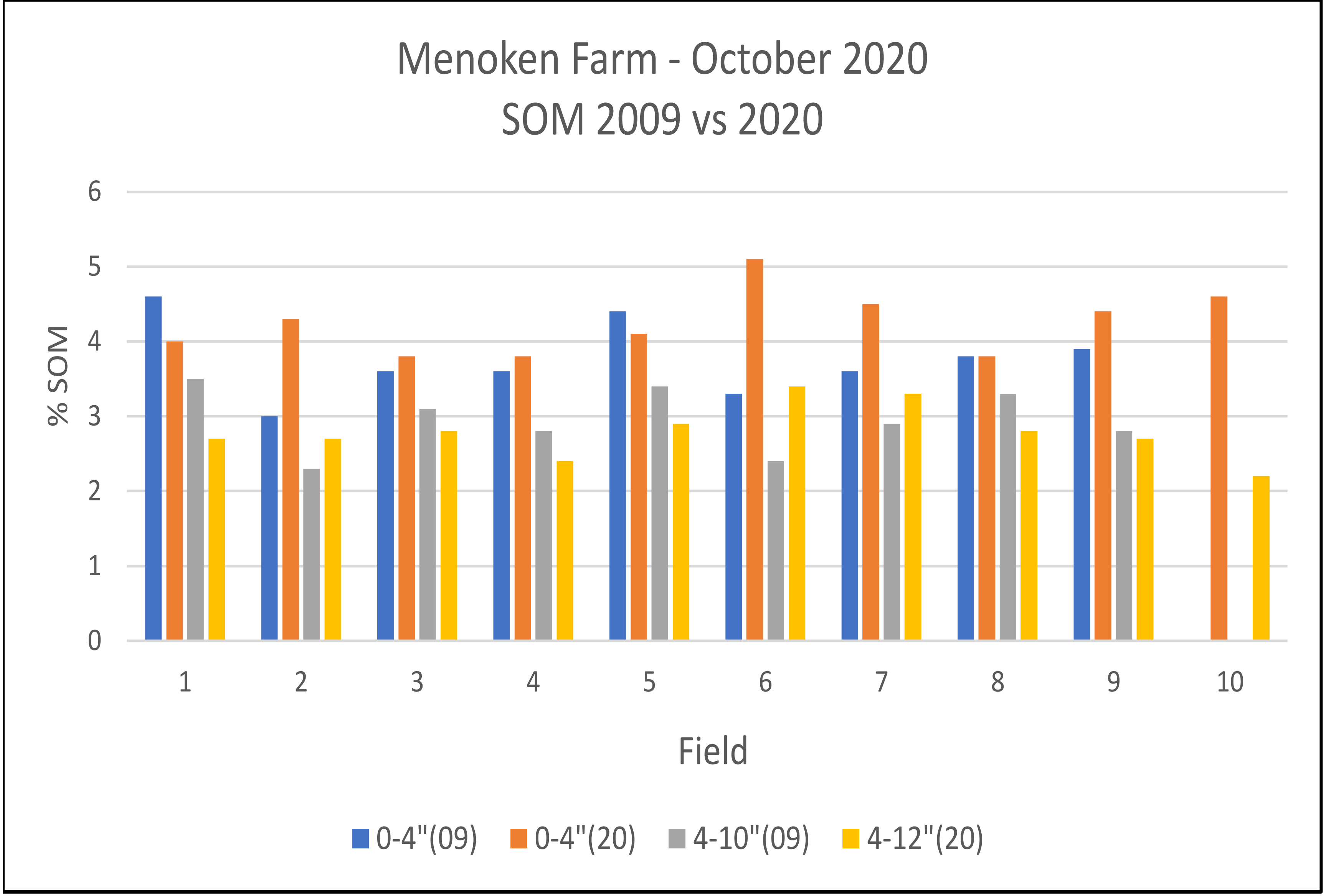
07 May 2009

Introduction

“For crops, belowground C allocation
was maximal during the first 1–2 months of growth and decreased very fast thereafter.“

“Despite its fundamental role for carbon (C) and nutrient cycling, rhizodeposition remains ‘the hidden half of the hidden half’: it is highly dynamic and rhizodeposits are rapidly incorporated into microorganisms, soil organic matter, and decomposed to CO2. Therefore, rhizodeposition is rarely quantified and remains the most uncertain part of the soil C cycle and of C fluxes in terrestrial ecosystems”

Source:
Carbon input by roots into the soil: Quantification of rhizodeposition from root to ecosystem scale
Johanna Pausch1,2 | Yakov Kuzyakov2,3,4
14 July 2017, Page 1 Abstract



Field 6 has the most crop diversity, cover crop, and livestock integration.

Menoken Farm Cropping History

Year	Field 1	Field 2	Field 3	Field 4	Field 5	Field 6	Field 7	Field 8	Field 9	Field 10
2009	Soybean WSCC	Pea WSCC	Pea	Pea WSCC	Pea WSCC	Pea WSCC	Pea WSCC	Pea/Canola WSCC	Flax/Lentil WSCC	Three Sisters: Corn+Beans+Squash
2010	Canola CSCC	CSCC	Sp Wheat	Corn	Corn	Corn	Corn	Sp Wheat	Corn	Three Sisters: Corn+Beans+Squash
2011	W Triticale, H Vetch, Winter Pea WSCC	Corn	Sp Wheat	Pea CSCC	Pea CSCC	CSCC	Pea CSCC	Pea CSCC	Corn	Winter Triticale, H Vetch, Winter Pea
2012	Corn	PGCC Cash Crops: Wht & Lentil. CC:Turnip, W Pea, Sub Clover, Rye Gr, WSCC	Sp Wheat	CSCC	Sp Wheat	Corn	Sp Wheat CSCC	WSCC	PGCC Cash Crops: Canola & Pea. CC: Sub Clover, Rye Gr, Turnip.	W Triticale, H Vetch, Forage Pea WSCC
2013	PGCC Cash Crop: Canola, Pea. CC: Sub Clover, Rye Gr, Turnip.	Corn	Sp Wheat	Corn	CSCC W Triticale	WSCC	Sunflower + 12 Broadleaf Covers	Corn	W Triticale, Turnip, Radish, H Vetch, Sw Cl. Seeded Fall of 12.	Sunflower + 12 Broadleaf Covers.
2014	Perennial Gr 21 Species.	WSCC	Sp Wheat. Dormant	WSCC	Corn	Corn	CSCC	Sunflower + 12 Broadleaf Covers.	Sunflower + 12 Broadleaf Covers.	Perennial Grass
2015	Perennial Gr 21 Species.	Sunflower	Sp Wheat	CSCC	Soybean	WSCC	Corn	Sp Wheat	corn	CS Grass. Dormant Seeded 11/16
2016	Perennial Gr 21 Species.	Forage Pea Rolled. WSCC	Sp Wheat	Sundan	Sp Wheat CSCC	Corn	Pea CSCC After Harvest	Corn	CSCC	WS Grasses and Forbs
2017	Perennial Gr 21 Species.	Corn	Sp Wheat	Pea. Fall Seeded Cereal Rye CC.	CSCC	Pea WSCC. Fall Seeded Cereal Rye CC.	Sp Wheat. Fall Seeded Cereal Rye CC.	Sp Wheat/Soybean Relay.Soybean seeded into Wht prior to boot. Fall Seeded Cereal Rye & Camelina CC.	Corn. Fall Seeded Cereal Rye CC.	Perennial Grass
2018	Perennial Gr 21 Species.	Soybean	Sp Wheat	CSCC Planted Green.	Corn	Canola. Planted Green. Fall Seeded Cereal Rye.	Soybean. Planted Green.	Corn RR. Planted Green.	Pea CC Rolled Rye. WSCC Planted Green.	Perennial Grass
2019	Corn 60" and 30" With Annual & Perennial Covers.	Sp Wheat 15" 4 Gals Bioinoculant Seed Trench Applied	Sp Wheat	Corn 30' 4 Gals Bioinoculant Seed Trench Applied	WSCC. Fall Seeded Cereal Rye.	Soybean Planted Green	Flax/Pinto Bean Grazed. Seeded to SW CL Cover.	Soybean RR	WSCC	Perennial Grass
2020	Corn with 3 gallons bio inoculant seed trench applied. Fall seeded cereal rye.	Seed Perennials w	Sp Wheat	inoculant dry seed coating applied. Fall seeded cereal	Cereal Rye. Soybean Planted Green with 3 gallons per acre bio inoculant seed	Flax with dry bi	15" Planted Green with 3 gallons per acre bio inoculant	per acre bio inoculant applied in the seed trench. Fall seeded cereal rye.	gallons per acre bio inoculant seed trench applied . Fall seeded 60" RR	Perennial Grass

Soil Health Principles

1. Soil Armor
2. Minimize Soil Disturbance
3. Plant Diversity
4. Continual Live Plant/Root
5. Livestock Integration

Principles to Practices, Allowing Us To Armor Up.

- Covers After Harvest
- Covers with 60” Corn
- Covers with Soybean and Canola (broadleaf crops)


2021 Drought
Bismarck, ND
This Is Us
Summer of 2021

Cover After Harvest

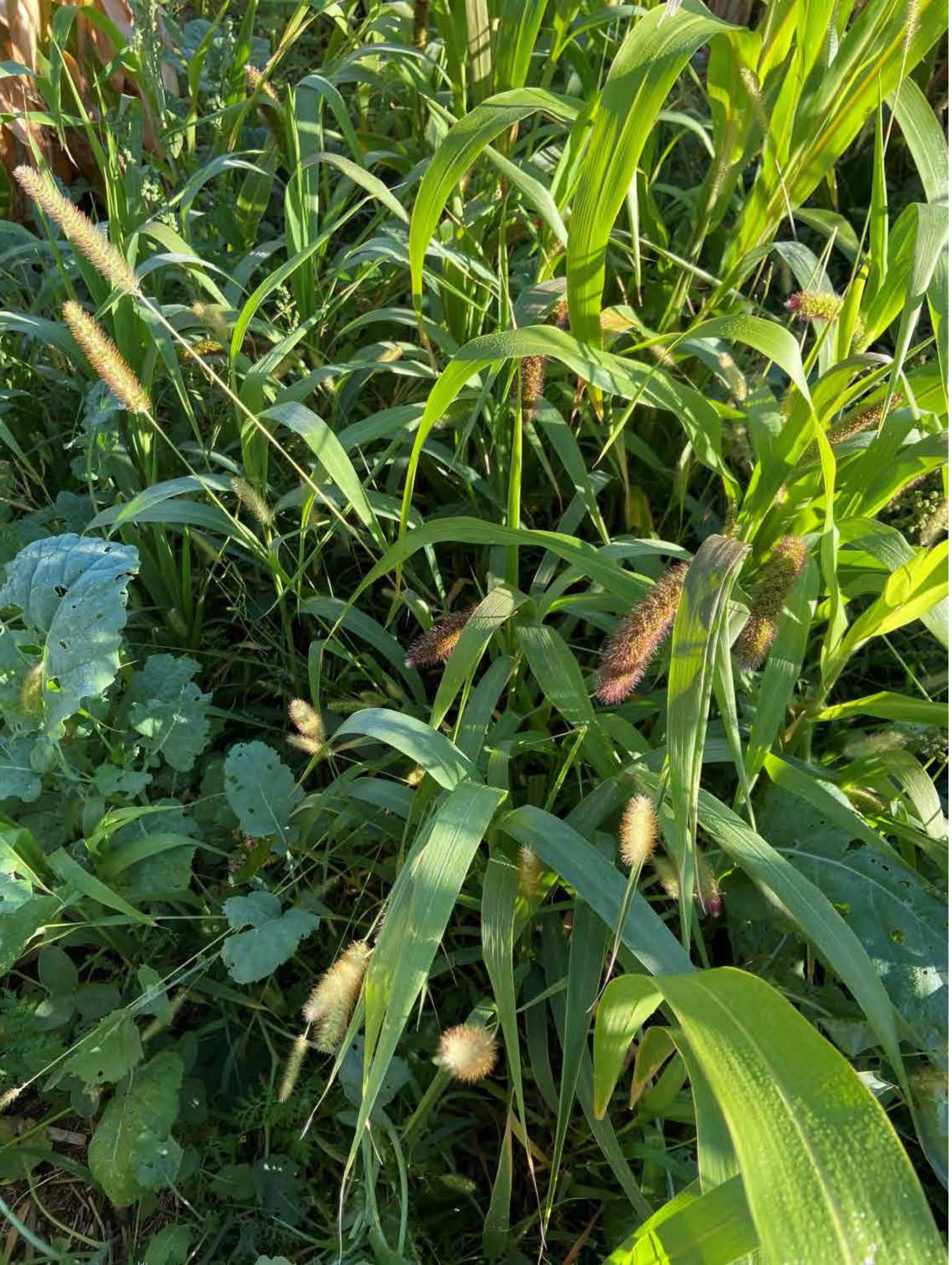
Fall Seeded Cover Crop Mixtures
Brown and Green Armor
Menoken Farm


Menoken Farm
September 2021
Setting the Planting Green
Stage with Cereal Rye

Covers with 60” Corn

Menoken Farm 2021

Menoken Farm 2021



Cover Crop Specie List

- Sunflower
- Sorghum Sudan
- German Millet
- Collards
- Italian Rye Grass
- Soybean
- Canola
- Subclover
- Radish
- Buckwheat
- Phacelia
- Cowpea
- Turnip
- Field Pea


Menoken Farm
2019

Menoken Farm 2020
60 Inch Corn with Perennial Covers year 2.

Covers with Soybean and Canola Planting Green with Cereal Rye.


Menoken Farm
Spring 2020

Soybean Harvest 2020
45% average precipitation

Self Education

- A Soil Owner's Manual: by Jon Stika
- The Buffalo Harvest: Frank Mayer
- Growing A Revolution: by David Montgomery
- Dirt to Soil: by Gabe Brown
- Forty Chances: by Howard Buffett
- Humus Chemistry: by F.J. Stevenson
- Soil Microbiology, Ecology, and Biochemistry: by Eldor Paul
- The Soil Will Save Us: by Kristin Ohlson
- The Nature and Properties of Soils – 14th Edition : by Brady and Weil
- Journals of Lewis and Clark
- Buffalo Bird Women's Garden : by Gilbert Wilson
- The One Straw Revolution: by Masanobu Fukuoka
- Managing Cover Crops Profitably 3rd Edition
- A Sand County Almanac: by Aldo Leopold
- Soil Biology Primer: by Elaine Ingham
- Life in the Soil: by James Nardi
- An Agricultural Testament: by Sir Albert Howard
- Dirt – The Erosion of Civilizations: by David Montgomery

- Early Settlement of North Dakota: by Clement Lounsberry
- 1491: by Charles Mann
- Civilization Critical: by Darrin Qualman

www.menokenfarm.com

Click on the Learn tab.

YouTube Channel

Menoken Farm

Podcasts

Menoken Farm

Weigh Em Up!

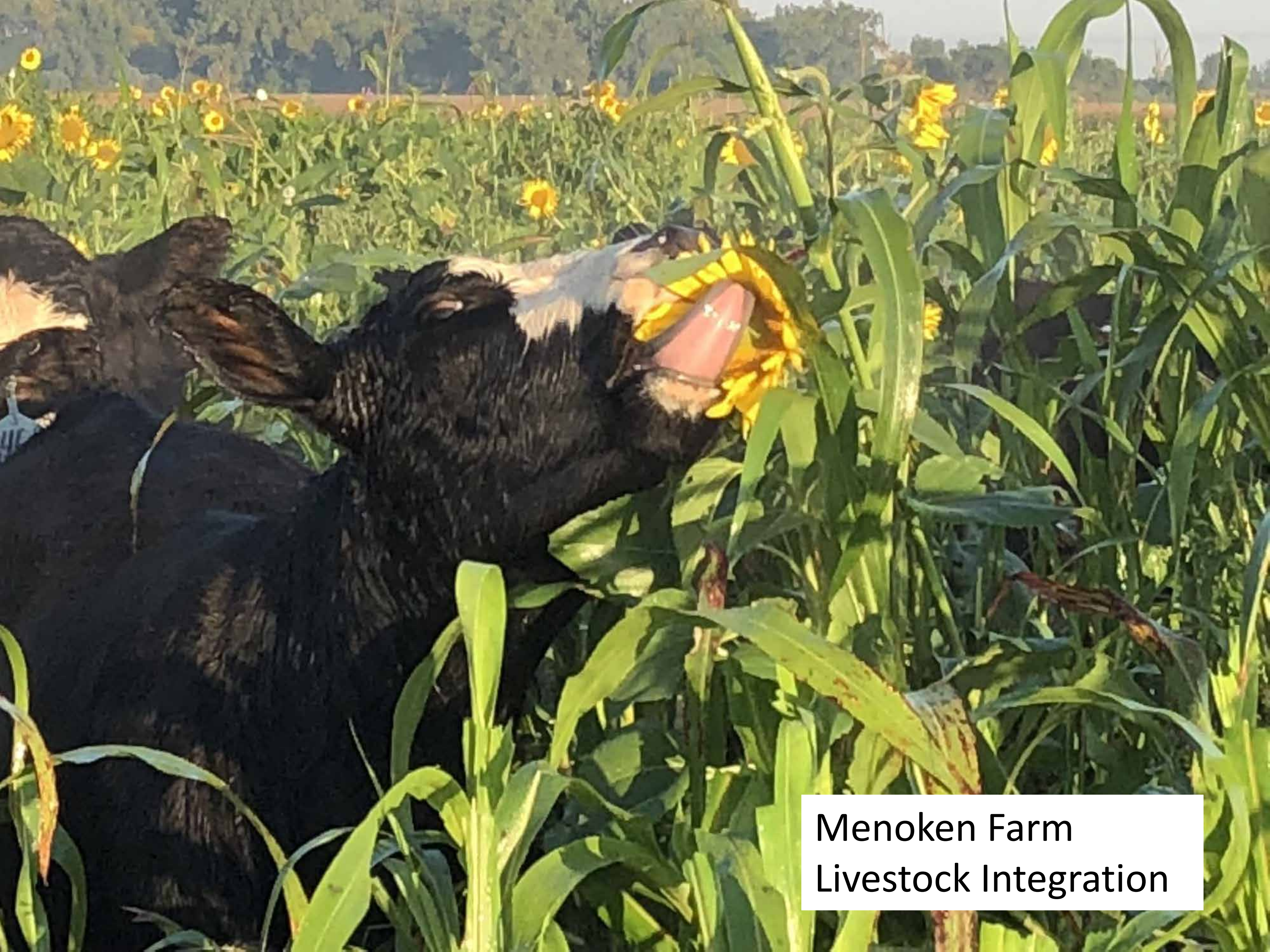
Menoken Farm

By: Jay Fuhrer | Soil Health Specialist - /Retired NRCS/USDA | Bismarck, ND - USA
Burleigh County Soil Conservation District

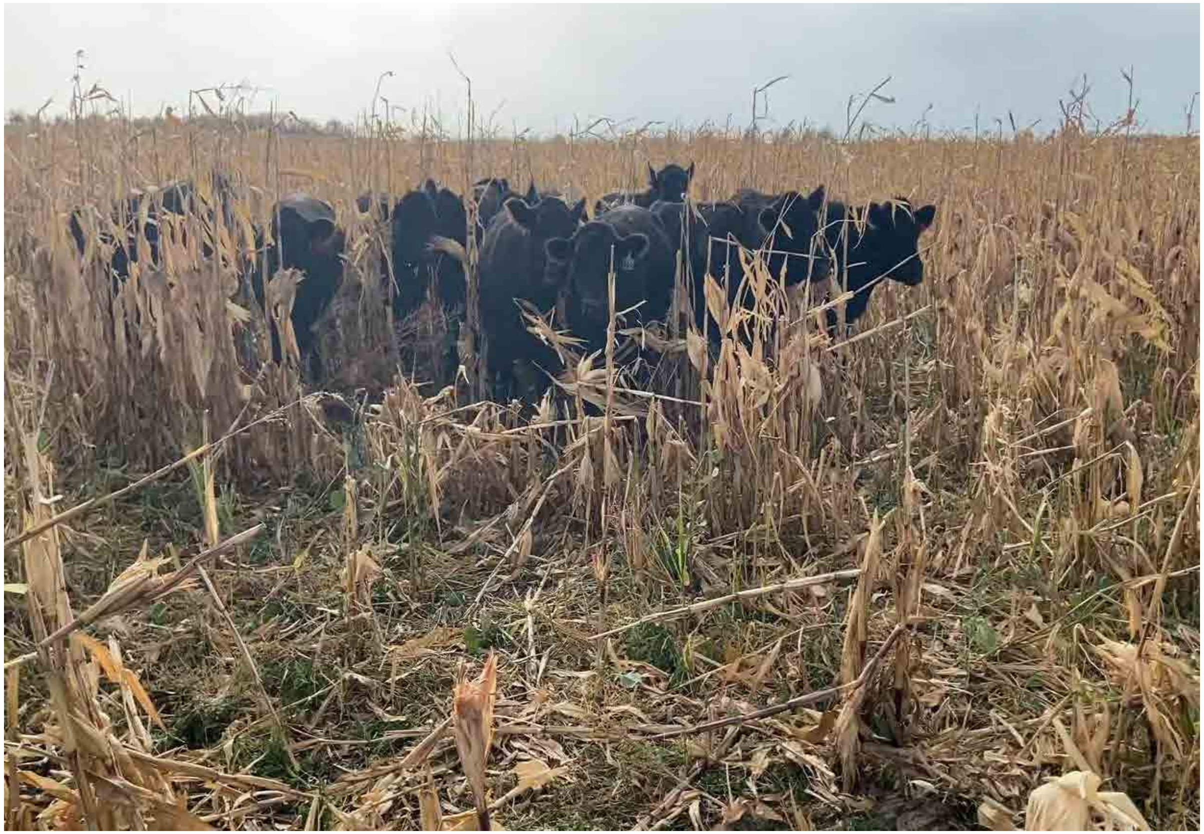
Weigh Em Up!


Menoken Farm Scale


Every Green Plant is a Carbon Inlet


Menoken Farm
Livestock Integration

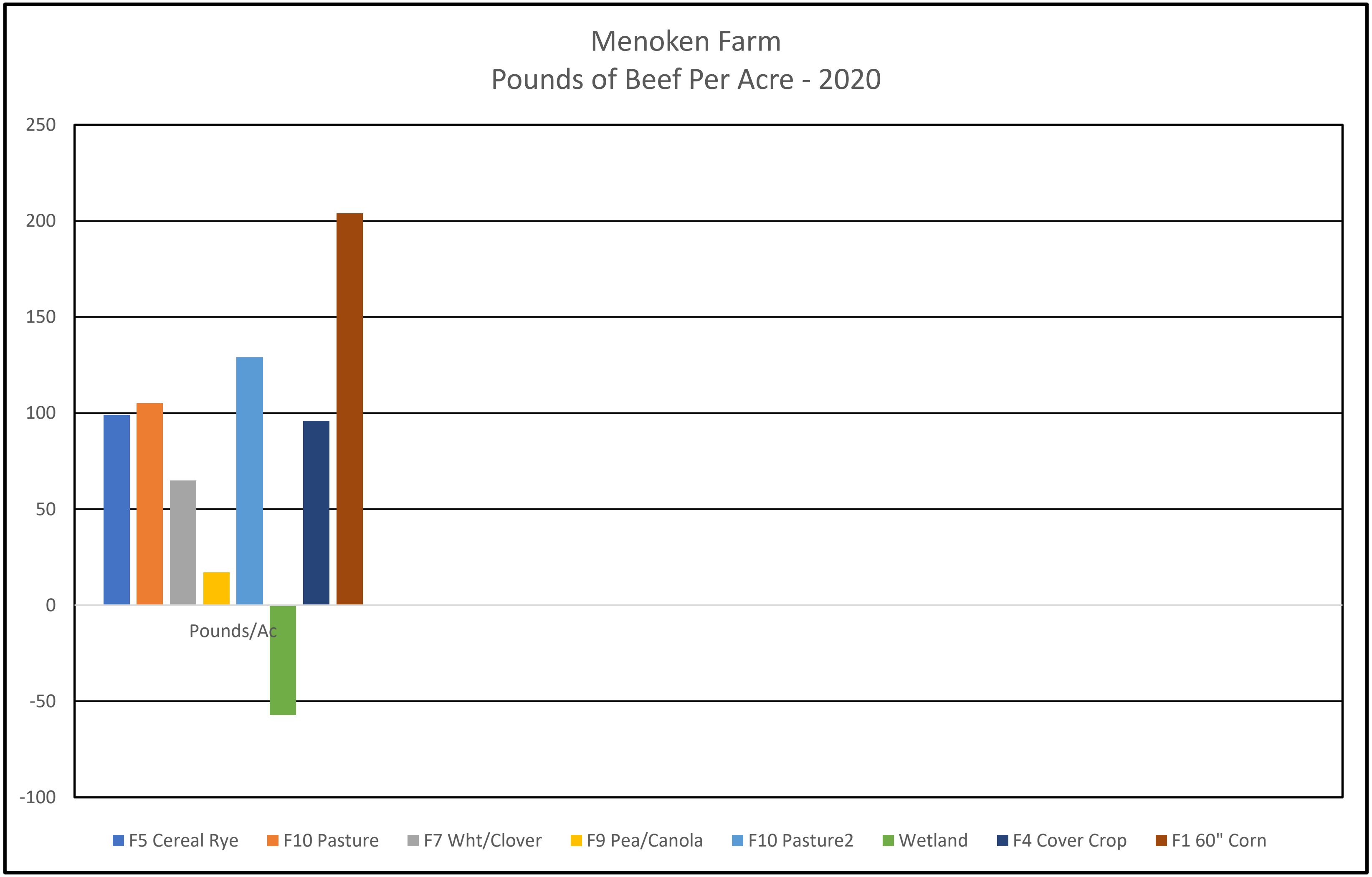
Grazed 14 days
Spring of 2020
Started on the
Planting Green
Fields, May 20th



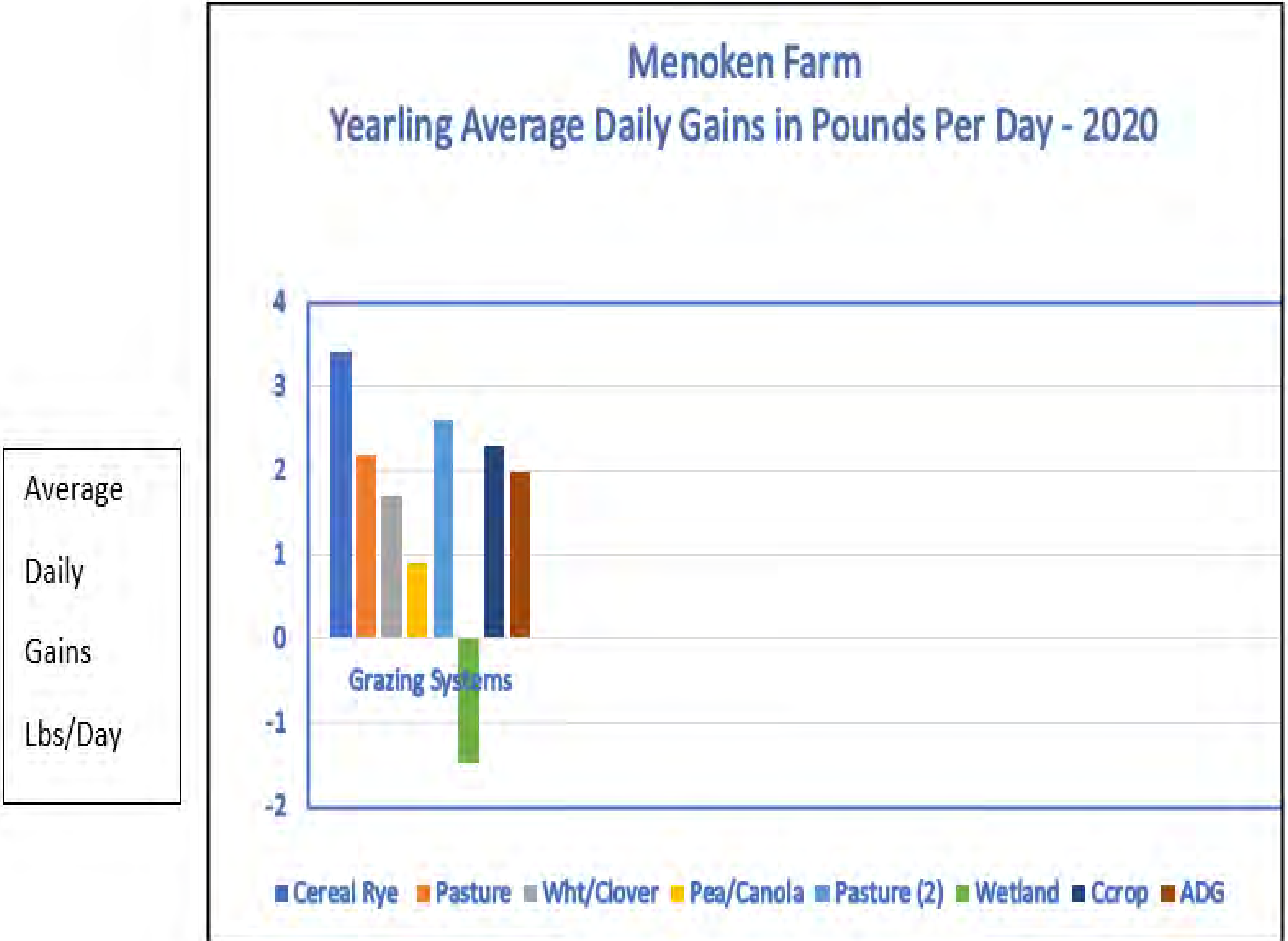
Menoken Farm 2021
60” Corn and Covers
ADG = 2.8 lbs/day
Low = 1.3 lbs/day
High = 3.9 lbs/day

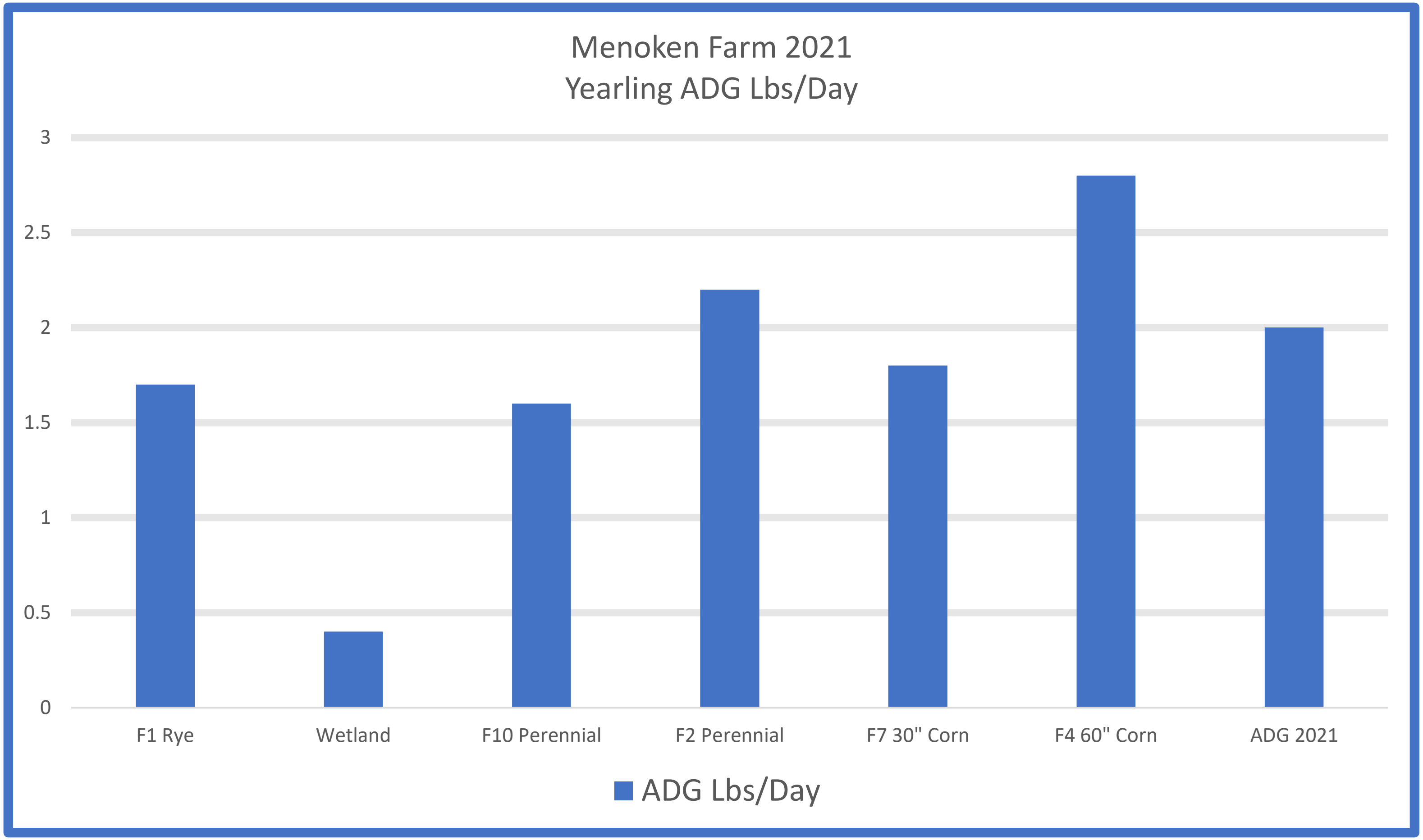
Cover Crop Clipping Weight = 3,400 lbs dry weight per acre, average 3 sites.

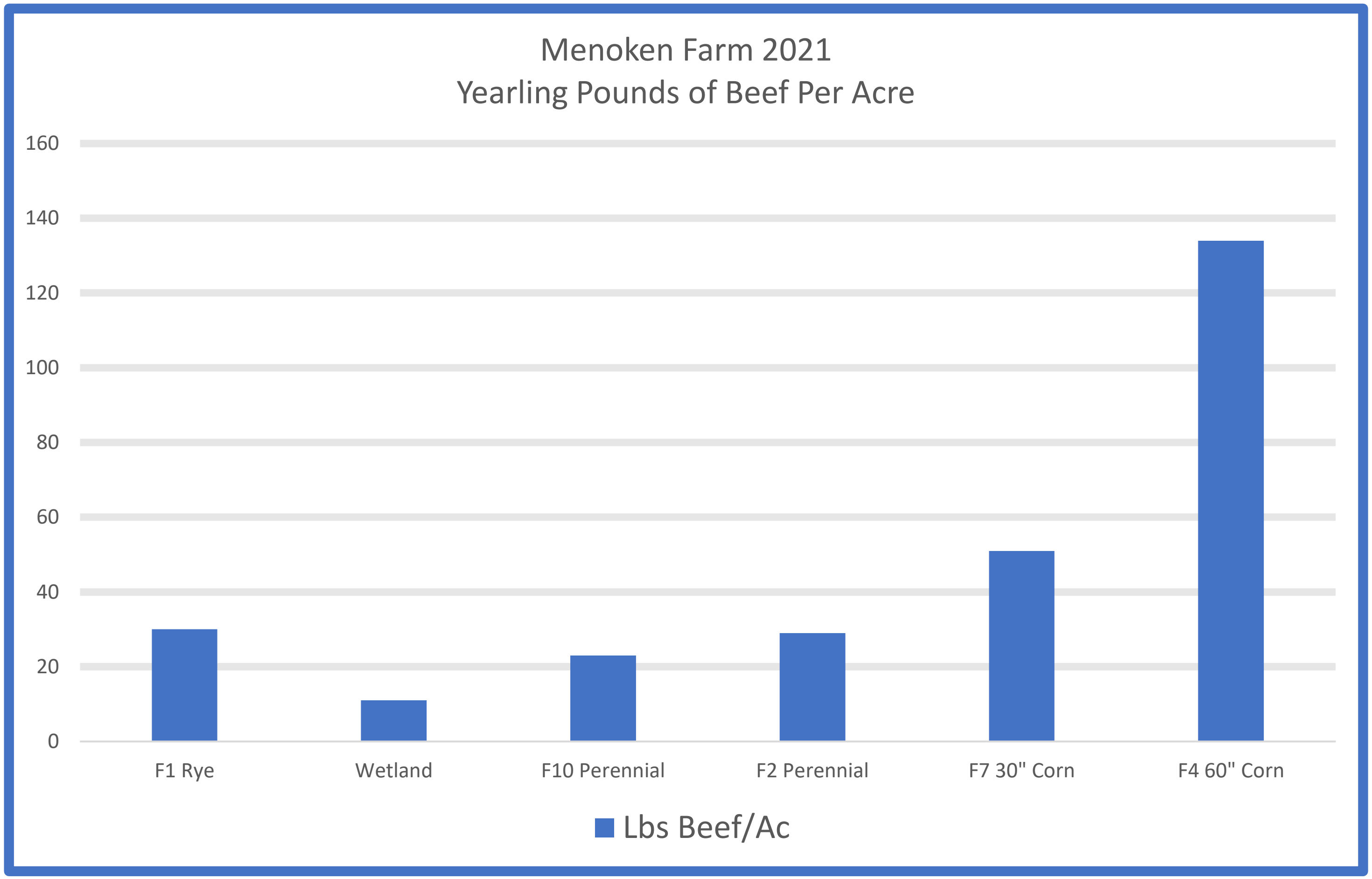
20% No Green Plant		0 lbs
50% Cover Crop:	3,400 lbs x 50% =	1,700 lbs
30% Corn:	40 bushels x 60 lbs per bushel =	2,400 lbs
	Total Dry Weight =	4,100 lbs

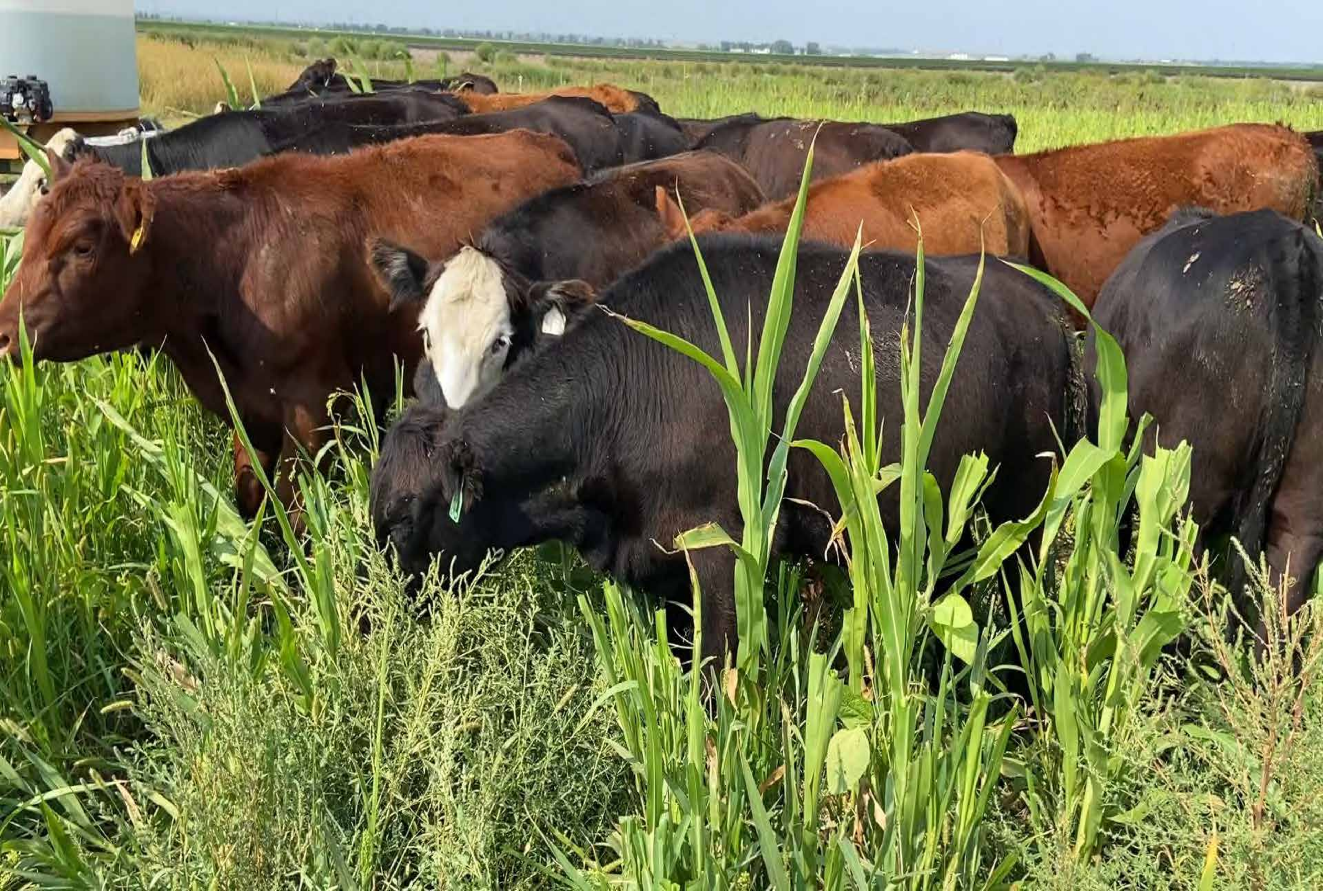


Menoken Farm
Pounds of Beef Per Acre - 2020
250
200
150
100
50
0
-50
-100
Pounds/Ac
F5 Cereal Rye
F10 Pasture
F7 Wht/Clover
F9 Pea/Canola
F10 Pasture2
Wetland
F4 Cover Crop
F1 60" Corn


Average
Daily
Gains
Lbs/Day
Menoken Farm
Yearling Average Daily Gains in Pounds Per Day - 2020
4
3
2
1
0
-1
-2
Grazing Systems
Cereal Rye
Pasture
Wht/Clover
Pea/Canola
Pasture (2)
Wetland
Ccrop
ADG


Menoken Farm 2021
Yearling ADG Lbs/Day
3
2.5
2
1.5
1
0.5
0
F1 Rye
Wetland
F10 Perennial
F2 Perennial
F7 30" Corn
F4 60" Corn
ADG 2021
ADG Lbs/Day


Menoken Farm 2021
Yearling Pounds of Beef Per Acre
160
140
120
100
80
60
40
20
0
F1 Rye
Wetland
F10 Perennial
F2 Perennial
F7 30" Corn
F4 60" Corn
Lbs Beef/Ac



Worm Juice Analysis
Molecular Research
DNA Lab
Shallow Water, Texas

- Fungi - 5 Phylum

- Bacteria – 12 Phylum

- Approximately 370
  total species.

Three Applications of Worm Juice

1. Seed Coating
2. 2-3 Weeks, 8 oz/plant, soil applied
3. 4-5 Weeks, 8 oz/plant, soil applied

Milpa Garden

Central America in origin with
40+ species.

Green Cover Seeds
https://greencoverseed.com

Dry seed inoculant on the right side of the white spade. Supplied by Overton Environmental.

Planting Soybean at Menoken Farm into a live cover
No seed coating
4 gallons per acre liquid vermicompost extract

Wheat Plant Analysis

Field Two
15 Inch Wheat


Field Two – 15 Inch Wheat
Field Three – 7.5 Inch Wheat

WARD Laboratories, Inc.

Ag Testing - Consulting

Account No. : 21172 **Plant Analysis Report**

FUHRER, JAY
BURLEIGH CO SOIL CONS DIST
916 E INTERSTATE AVE STE 6
BISMARCK ND 58503-0548

Invoice No. : 1294109
Date Received : 07/30/2019
Date Reported : 08/01/2019

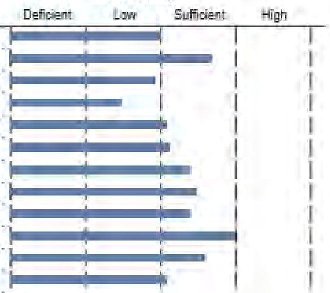
Lab Number : 7436

Results For BURLEIGH CO SOIL CONS DIST
Location : WHEAT
Sample ID : 2 MIDDLE WJ

Plant Type : Wheat
Stage : FEEKE10

	Result Dry Basis
Nitrogen, % N	1.76
Phosphorus, % P	0.336
Potassium, % K	1.48
Calcium, % Ca	0.224
Magnesium, % Mg	0.186
Sulfur, % S	0.167
Zinc, ppm Zn	28
Iron, ppm Fe	109
Manganese, ppm Mn	54
Copper, ppm Cu	10.0
Boron, ppm B	4.8
Molybdenum, ppm Mo	0.58

Sufficiency Levels



Reviewed By : Nick Ward 8/1/2019 Copy 1 Page 1 of 1

WARD Laboratories, Inc.

Ag Testing - Consulting

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FUHRER, JAY
BURLEIGH CO SOIL CONS DIST
916 E INTERSTATE AVE STE 6
BISMARCK ND 58503-0548

Invoice No. : 1294109
Date Received : 07/30/2019
Date Reported : 08/01/2019

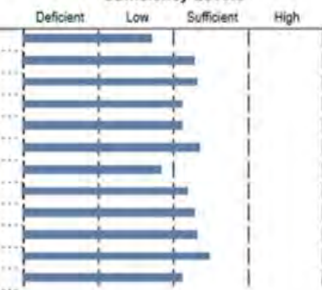
Lab Number : 7437

Results For BURLEIGH CO SOIL CONS DIST
Location : WHEAT
Sample ID : 2 EAST NO WJ

Plant Type : Wheat
Stage : FEEKE10

	Result Dry Basis
Nitrogen, % N	1.61
Phosphorus, % P	0.257
Potassium, % K	1.81
Calcium, % Ca	0.323
Magnesium, % Mg	0.182
Sulfur, % S	0.203
Zinc, ppm Zn	18
Iron, ppm Fe	65
Manganese, ppm Mn	47
Copper, ppm Cu	6.6
Boron, ppm B	4.4
Molybdenum, ppm Mo	0.78

Sufficiency Levels



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Field 3 Comparison
Wheat Biology Analysis

WARD Laboratories, Inc.

Ag Testing - Consulting

Account No. : 21172 **Plant Analysis Report**

FUHRER, JAY
BURLEIGH CO SOIL CONS DIST
916 E INTERSTATE AVE STE 6
BISMARCK ND 58503-0548

Invoice No. : 1294109
Date Received : 07/30/2019
Date Reported : 08/01/2019

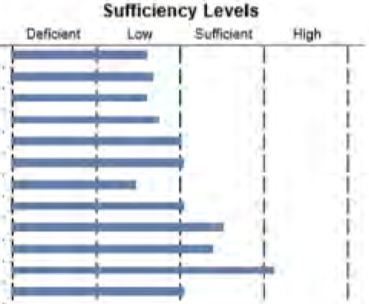
Lab Number : 7438

Results For BURLEIGH CO SOIL CONS DIST
Location : WHEAT
Sample ID : 3 WESTST NO WJ

Plant Type : Wheat
Stage : FEEKE10

	Result Dry Basis
Nitrogen, % N	1.57
Phosphorus, % P	0.183
Potassium, % K	1.40
Calcium, % Ca	0.267
Magnesium, % Mg	0.151
Sulfur, % S	0.154
Zinc, ppm Zn	15
Iron, ppm Fe	38
Manganese, ppm Mn	64
Copper, ppm Cu	7.0
Boron, ppm B	6.4
Molybdenum, ppm Mo	0.37

Sufficiency Levels



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Wheat: Soil Biology Analysis

WARD Laboratories, Inc.
Ag Testing - Consulting

Account No. : 21172

Biological Soil Analysis Report

FUHRER, JAY
BURLEIGH CO SOIL CONS DIST
916 E INTERSTATE AVE STE 6
BISMARCK ND 58503-0548

Invoice No. : 1294073
Date Received : 07/30/2019
Date Reported : 08/01/2019
Lab No. : 11324

Results For : BURLEIGH CO SOIL CONS DIST
Sample ID 1 : 2 MIDDLE
Sample ID 2 : WJ

PLFA Soil Microbial Community Analysis

Functional Group Biomass & Diversity

Total Living Microbial Biomass, Phospholipid Fatty Acid (PLFA) ng/g	2589.74
Functional Group Diversity Index	1.345

Total Biomass	Diversity	Rating
< 500	< 1.0	Very Poor
500+ - 1000	1.0+ - 1.1	Poor
1000+ - 1500	1.1+ - 1.2	Slightly Below Average
1500+ - 2500	1.2+ - 1.3	Average
2500+ - 3000	1.3+ - 1.4	Slightly Above Average
3000+ - 3500	1.4+ - 1.5	Good
3500+ - 4000	1.5+ - 1.6	Very Good
> 4000	> 1.6	Excellent

Functional Group	Biomass, PLFA ng/g	% of Total Biomass
Total Bacteria	1095.69	42.31
Gram (+)	809.23	31.25
Actinomycetes	199.08	7.69
Gram (-)	286.46	11.06
Rhizobia	0.00	0.00
Total Fungi	179.42	6.93
Arbuscular Mycorrhizal	49.47	1.91
Saprophytes	129.94	5.02
Protozoa	1.62	0.06
Undifferentiated	1313.02	50.70

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WARD Laboratories, Inc.
Ag Testing - Consulting

Account No. : 21172

Biological Soil Analysis Report

FUHRER, JAY
BURLEIGH CO SOIL CONS DIST
916 E INTERSTATE AVE STE 6
BISMARCK ND 58503-0548

Invoice No. : 1294073
Date Received : 07/30/2019
Date Reported : 08/01/2019
Lab No. : 11325

Results For : BURLEIGH CO SOIL CONS DIST
Sample ID 1 : 2 EAST
Sample ID 2 : NO WJ

PLFA Soil Microbial Community Analysis

Functional Group Biomass & Diversity

Total Living Microbial Biomass, Phospholipid Fatty Acid (PLFA) ng/g	1531.56
Functional Group Diversity Index	1.08

Total Biomass	Diversity	Rating
< 500	< 1.0	Very Poor
500+ - 1000	1.0+ - 1.1	Poor
1000+ - 1500	1.1+ - 1.2	Slightly Below Average
1500+ - 2500	1.2+ - 1.3	Average
2500+ - 3000	1.3+ - 1.4	Slightly Above Average
3000+ - 3500	1.4+ - 1.5	Good
3500+ - 4000	1.5+ - 1.6	Very Good
> 4000	> 1.6	Excellent

Functional Group	Biomass, PLFA ng/g	% of Total Biomass
Total Bacteria	761.77	49.74
Gram (+)	595.55	38.89
Actinomycetes	152.41	9.95
Gram (-)	166.22	10.85
Rhizobia	0.00	0.00
Total Fungi	25.35	1.66
Arbuscular Mycorrhizal	0.00	0.00
Saprophytes	25.35	1.66
Protozoa	0.00	0.00
Undifferentiated	744.44	48.61

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Field 3 Comparison
Wheat Biology Analysis

WARD Laboratories, Inc.

Ag Testing - Consulting

Account No. : 21172

Biological Soil Analysis Report

FUHRER, JAY
BURLEIGH CO SOIL CONS DIST
916 E INTERSTATE AVE STE 6
BISMARCK ND 58503-0548

Invoice No. : 1294073
Date Received : 07/30/2019
Date Reported : 08/01/2019
Lab No. : 11326

Results For : BURLEIGH CO SOIL CONS DIST
Sample ID 1 : 3 WEST
Sample ID 2 : NO WJ

PLFA Soil Microbial Community Analysis

Functional Group Biomass & Diversity

Total Living Microbial Biomass, Phospholipid Fatty Acid (PLFA) ng/g	2235.39
Functional Group Diversity Index	1.077

Total Biomass	Diversity	Rating
< 500	< 1.0	Very Poor
500+ - 1000	1.0+ - 1.1	Poor
1000+ - 1500	1.1+ - 1.2	Slightly Below Average
1500+ - 2500	1.2+ - 1.3	Average
2500+ - 3000	1.3+ - 1.4	Slightly Above Average
3000+ - 3500	1.4+ - 1.5	Good
3500+ - 4000	1.5+ - 1.6	Very Good
> 4000	> 1.6	Excellent

Functional Group	Biomass, PLFA ng/g	% of Total Biomass
Total Bacteria	1105.06	49.43
Gram (+)	856.04	38.29
Actinomycetes	203.46	9.10
Gram (-)	249.02	11.14
Rhizobia	0.00	0.00
Total Fungi	40.40	1.81
Arbuscular Mycorrhizal	0.00	0.00
Saprophytes	40.40	1.81
Protozoa	0.00	0.00
Undifferentiated	1089.93	48.76

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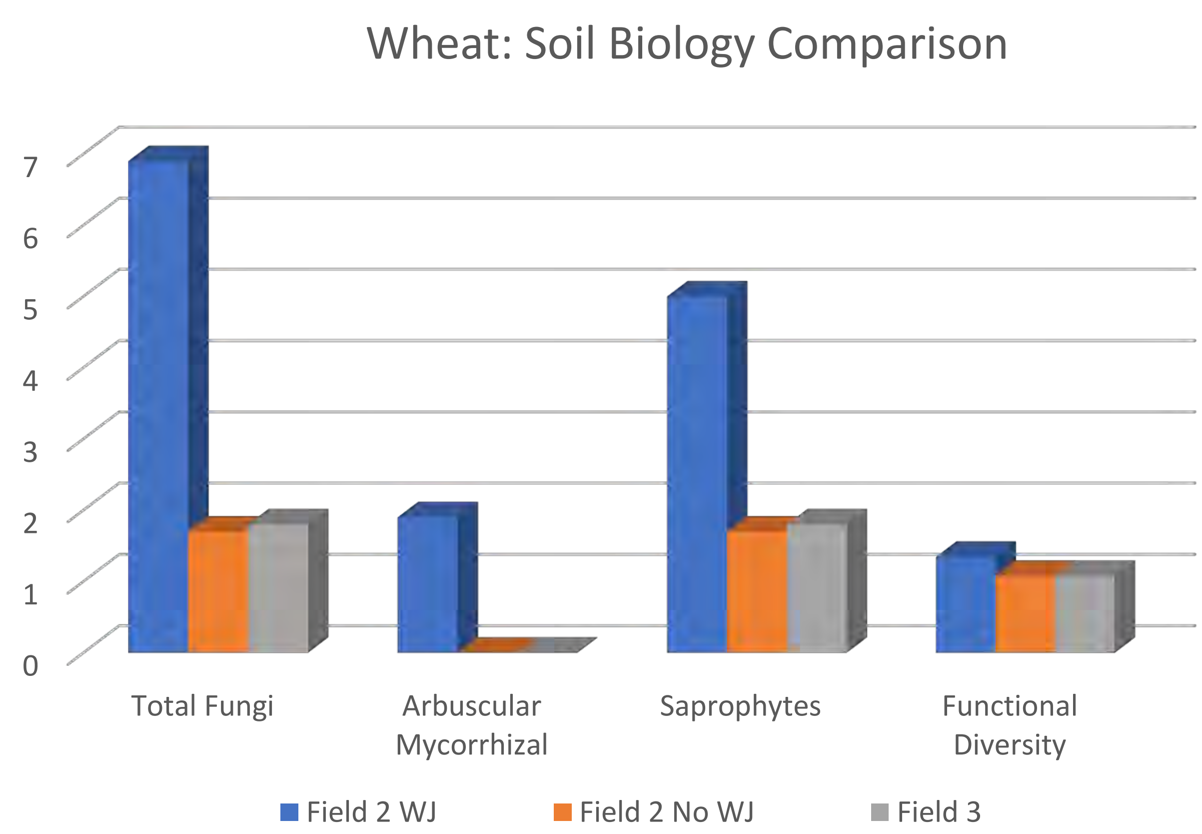
Wheat: Soil Biology Comparison
7
6
5
4
3
2
1
0
Total Fungi
Arbuscular Mycorrhizal
Saprophytes
Functional Diversity
Field 2 WJ
Field 2 No WJ
Field 3

Corn: Plant Analysis


No Bio Inoculant Applied
Bio Inoculant Applied


No Bio Inoculant Applied
Bio Inoculant Applied

WARD
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Account No. : 21172 — Plant Analysis Report

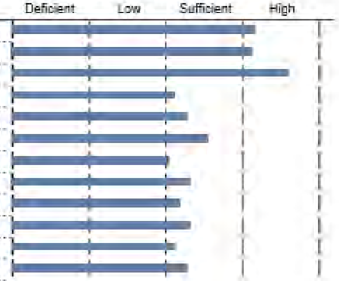
FUHRER, JAY
BURLEIGH CO SOIL CONS DIST
916 E INTERSTATE AVE STE 6
BISMARCK ND 58503-0548

Invoice No. : 1294109
Date Received : 07/30/2019
Date Reported : 08/01/2019
Lab Number : 7440

Results For BURLEIGH CO SOIL CONS DIST
Location : CORN
Sample ID : 5 MIDDLE WJ

Plant Type : Corn
Stage : Tassel

	Result Dry Basis
Nitrogen,% N	3.57
Phosphorus, % P	0.380
Potassium, % K	3.43
Calcium, % Ca	0.328
Magnesium, % Mg	0.205
Sulfur, % S	0.210
Zinc, ppm Zn	20
Iron, ppm Fe	113
Manganese, ppm Mn	47
Copper, ppm Cu	10.0
Boron, ppm B	6.5
Molybdenum, ppm Mo	0.89

Sufficiency Levels


Reviewed By : Nick Ward 8/1/2019 Copy 1 Page 1 of 1

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Account No. : 21172 — Plant Analysis Report

FUHRER, JAY
BURLEIGH CO SOIL CONS DIST
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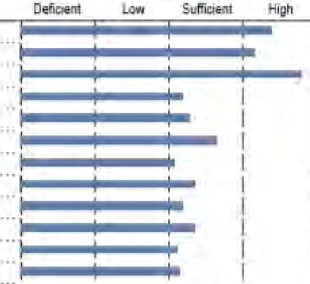
BISMARCK ND 58503-0548

Invoice No. : 1294109
Date Received : 07/30/2019
Date Reported : 08/01/2019
Lab Number : 7439

Results For BURLEIGH CO SOIL CONS DIST
Location : CORN
Sample ID : 4 EAST NO WJ

Plant Type : Corn
Stage : Tassel

	Result Dry Basis
Nitrogen,% N	3.86
Phosphorus, % P	0.394
Potassium, % K	3.71
Calcium, % Ca	0.364
Magnesium, % Mg	0.209
Sulfur, % S	0.221
Zinc, ppm Zn	21
Iron, ppm Fe	128
Manganese, ppm Mn	47
Copper, ppm Cu	10.8
Boron, ppm B	6.3
Molybdenum, ppm Mo	0.80

Sufficiency Levels


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Corn: Soil Biology Analysis

WARD Laboratories, Inc.

Ag Testing - Consulting

Account No. : 21172

Biological Soil Analysis Report

FUHRER, JAY
BURLEIGH CO SOIL CONS DIST
916 E INTERSTATE AVE STE 6
BISMARCK ND 58503-0548

Invoice No. : 1294073
Date Received : 07/30/2019
Date Reported : 08/01/2019
Lab No. : 11328

Results For : BURLEIGH CO SOIL CONS DIST
Sample ID 1 : 4 MIDDLE
Sample ID 2 : WJ

PLFA Soil Microbial Community Analysis

Functional Group Biomass & Diversity

Total Living Microbial Biomass, Phospholipid Fatty Acid (PLFA) ng/g	2666.12
Functional Group Diversity Index	1.43

Total Biomass	Diversity	Rating
< 500	< 1.0	Very Poor
500+ - 1000	1.0+ - 1.1	Poor
1000+ - 1500	1.1+ - 1.2	Slightly Below Average
1500+ - 2500	1.2+ - 1.3	Average
2500+ - 3000	1.3+ - 1.4	Slightly Above Average
3000+ - 3500	1.4+ - 1.5	Good
3500+ - 4000	1.5+ - 1.6	Very Good
> 4000	> 1.6	Excellent

Functional Group	Biomass, PLFA ng/g	% of Total Biomass
Total Bacteria	1301.71	48.82
Gram (+)	795.17	29.82
Actinomycetes	212.10	7.96
Gram (-)	506.55	19.00
Rhizobia	0.00	0.00
Total Fungi	279.80	10.49
Arbuscular Mycorrhizal	126.77	4.75
Saprophytes	153.02	5.74
Protozoa	0.00	0.00
Undifferentiated	1084.62	40.68

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WARD Laboratories, Inc.

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Account No. : 21172

Biological Soil Analysis Report

FUHRER, JAY
BURLEIGH CO SOIL CONS DIST
916 E INTERSTATE AVE STE 6
BISMARCK ND 58503-0548

Invoice No. : 1294073
Date Received : 07/30/2019
Date Reported : 08/01/2019
Lab No. : 11327

Results For : BURLEIGH CO SOIL CONS DIST
Sample ID 1 : 4 EAST
Sample ID 2 : NO WJ

PLFA Soil Microbial Community Analysis

Functional Group Biomass & Diversity

Total Living Microbial Biomass, Phospholipid Fatty Acid (PLFA) ng/g	3331.70
Functional Group Diversity Index	1.279

Total Biomass	Diversity	Rating
< 500	< 1.0	Very Poor
500+ - 1000	1.0+ - 1.1	Poor
1000+ - 1500	1.1+ - 1.2	Slightly Below Average
1500+ - 2500	1.2+ - 1.3	Average
2500+ - 3000	1.3+ - 1.4	Slightly Above Average
3000+ - 3500	1.4+ - 1.5	Good
3500+ - 4000	1.5+ - 1.6	Very Good
> 4000	> 1.6	Excellent

Functional Group	Biomass, PLFA ng/g	% of Total Biomass
Total Bacteria	1658.39	49.78
Gram (+)	1203.55	36.12
Actinomycetes	271.40	8.15
Gram (-)	454.84	13.65
Rhizobia	0.00	0.00
Total Fungi	178.91	5.37
Arbuscular Mycorrhizal	72.40	2.17
Saprophytes	106.51	3.20
Protozoa	4.67	0.14
Undifferentiated	1489.74	44.71

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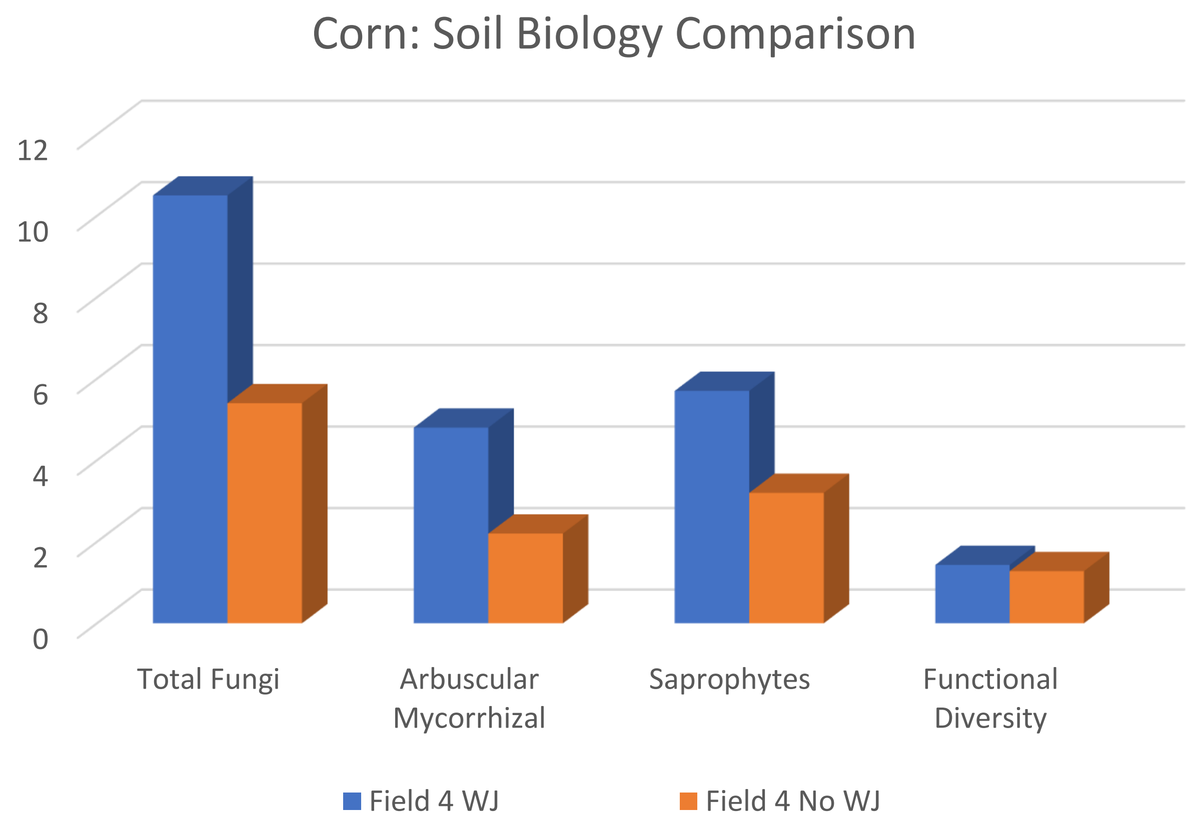
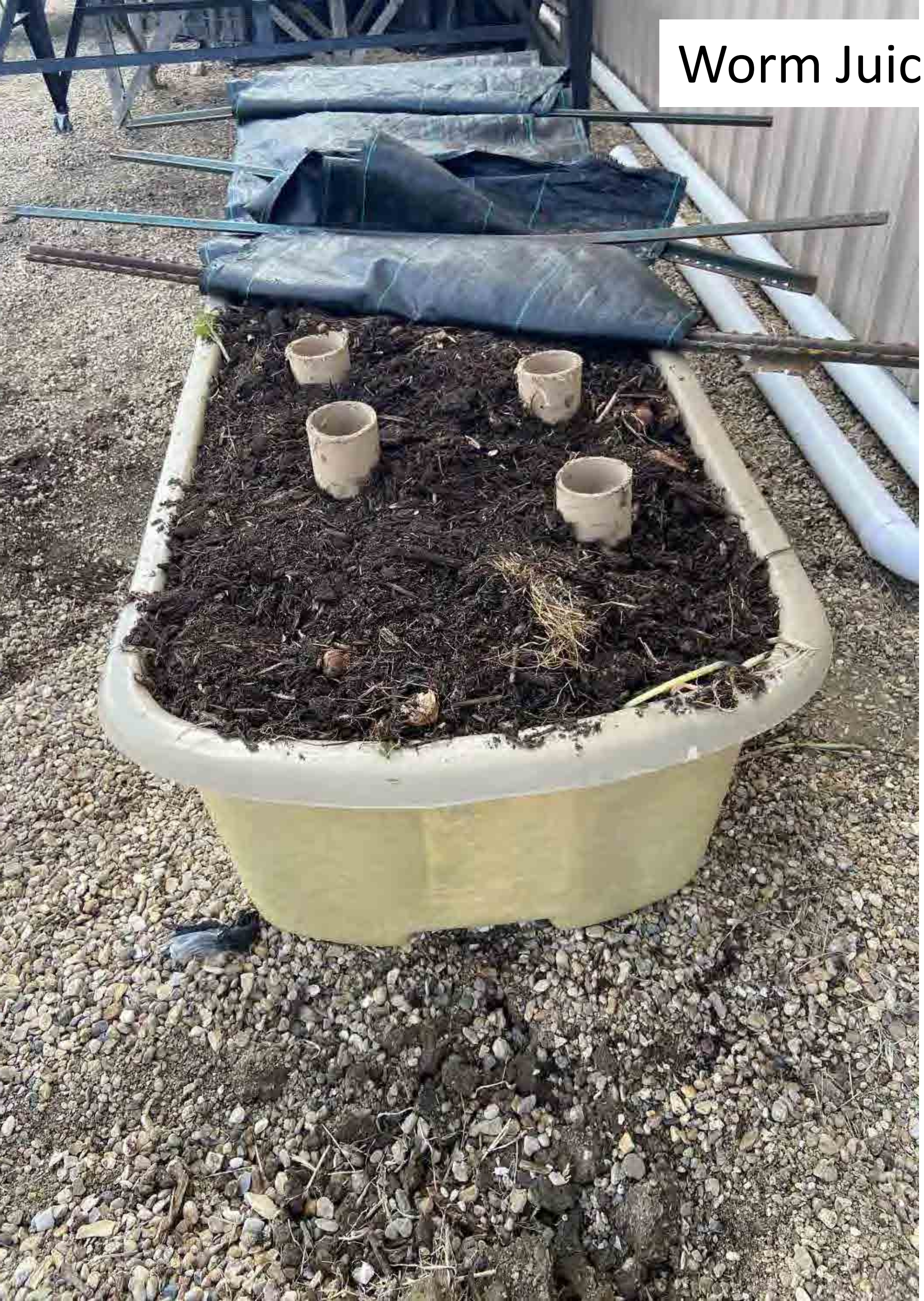
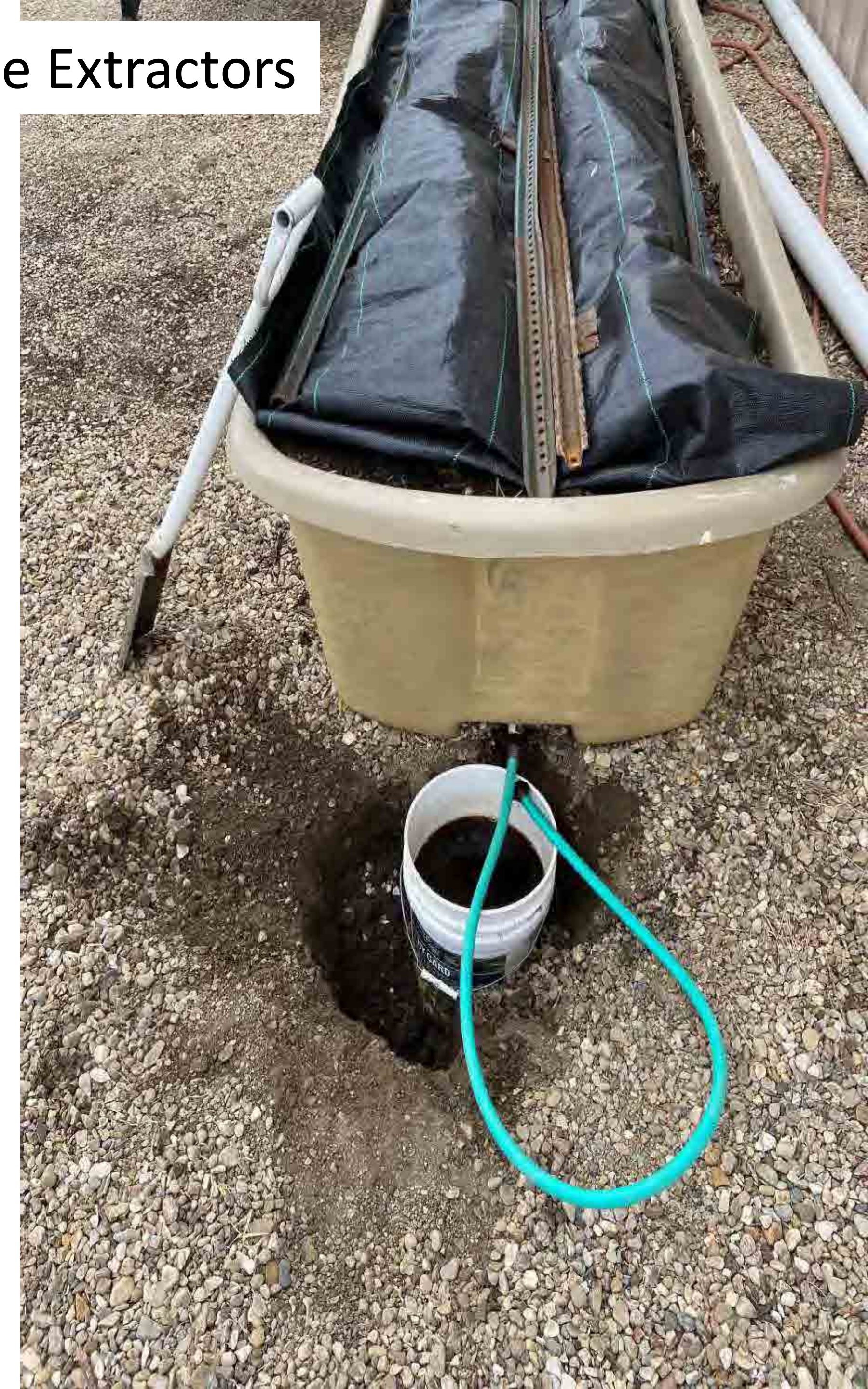

Corn: Soil Biology Comparison
12
10
8
6
4
2
0
Total Fungi
Arbuscular Mycorrhizal
Saprophytes
Functional Diversity
Field 4 WJ
Field 4 No WJ

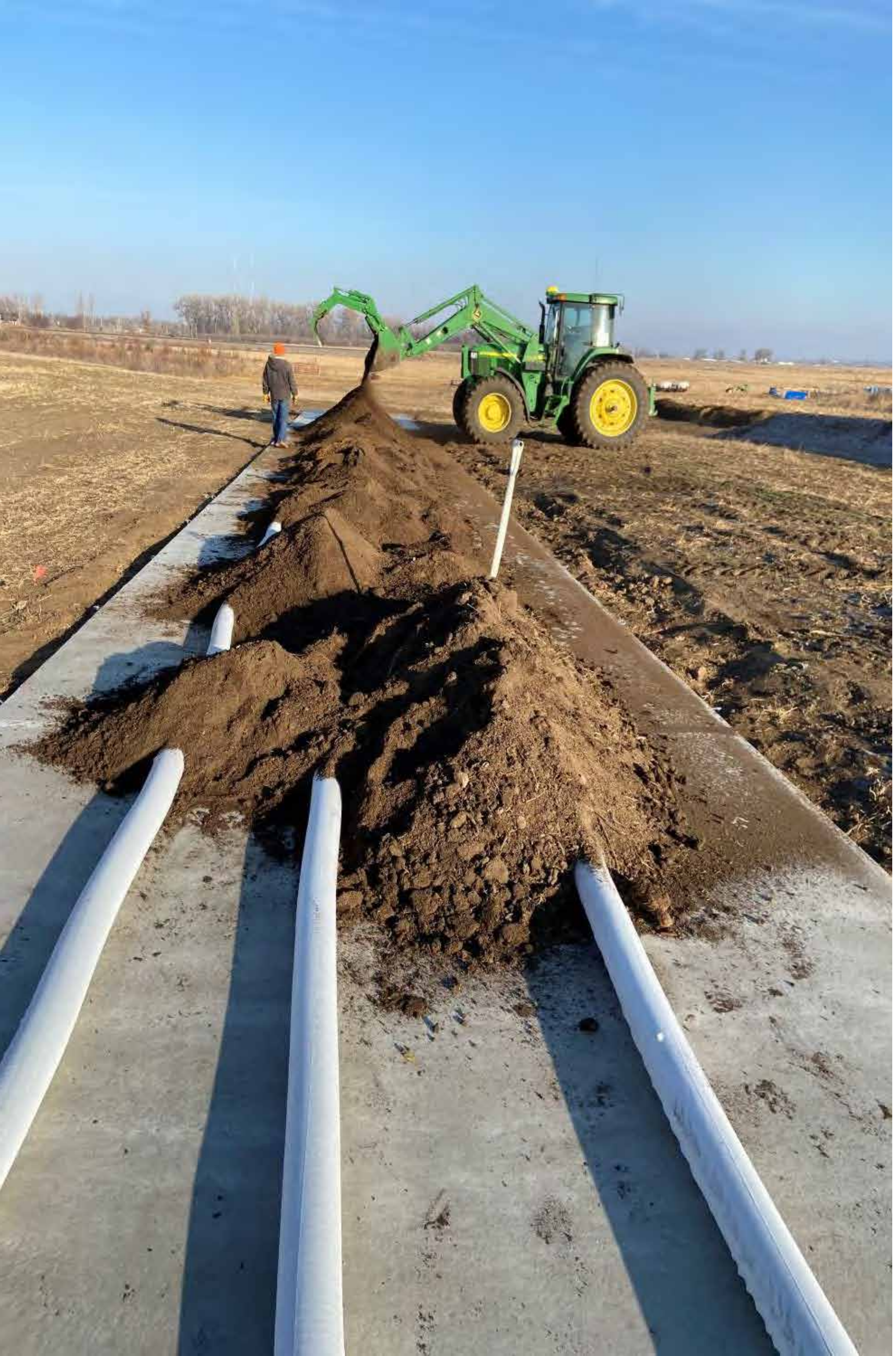
Old Assembly Line
Compost to Vermicompost to Extract

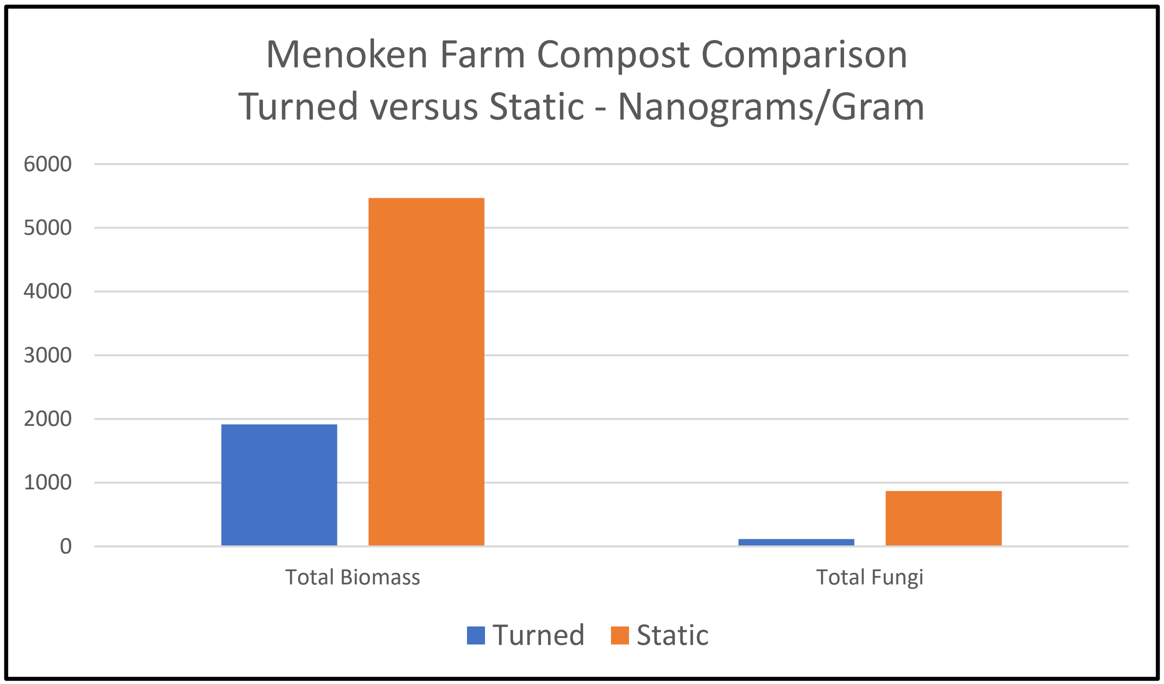
Worm Juice Extractors





120’ Length x 12’ width
2 Slope


Menoken Farm Compost Comparison
Turned versus Static - Nanograms/Gram
6000
5000
4000
3000
2000
1000
0
Total Biomass
Total Fungi
Turned
Static

Self Education

- A Soil Owner's Manual: by Jon Stika
- The Buffalo Harvest: Frank Mayer
- Growing A Revolution: by David Montgomery
- Dirt to Soil: by Gabe Brown
- Forty Chances: by Howard Buffett
- Humus Chemistry: by F.J. Stevenson
- Soil Microbiology, Ecology, and Biochemistry: by Eldor Paul
- The Soil Will Save Us: by Kristin Ohlson
- The Nature and Properties of Soils – 14th Edition : by Brady and Weil
- Journals of Lewis and Clark
- Buffalo Bird Women's Garden : by Gilbert Wilson
- The One Straw Revolution: by Masanobu Fukuoka
- Managing Cover Crops Profitably 3rd Edition
- A Sand County Almanac: by Aldo Leopold
- Soil Biology Primer: by Elaine Ingham
- Life in the Soil: by James Nardi
- An Agricultural Testament: by Sir Albert Howard
- Dirt – The Erosion of Civilizations: by David Montgomery

- Early Settlement of North Dakota: by Clement Lounsberry
- 1491: by Charles Mann
- Civilization Critical: by Darrin Qualman

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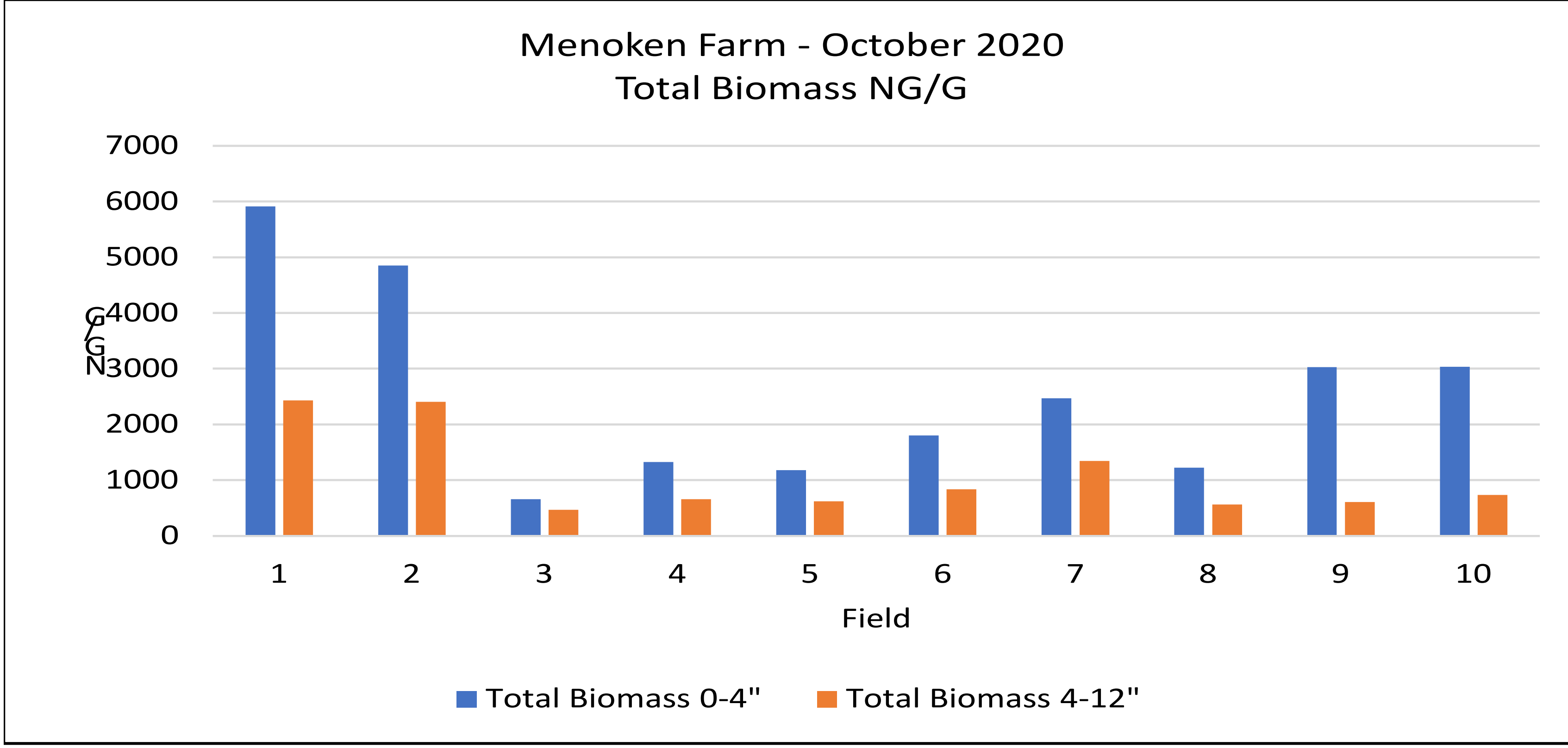


Comments:

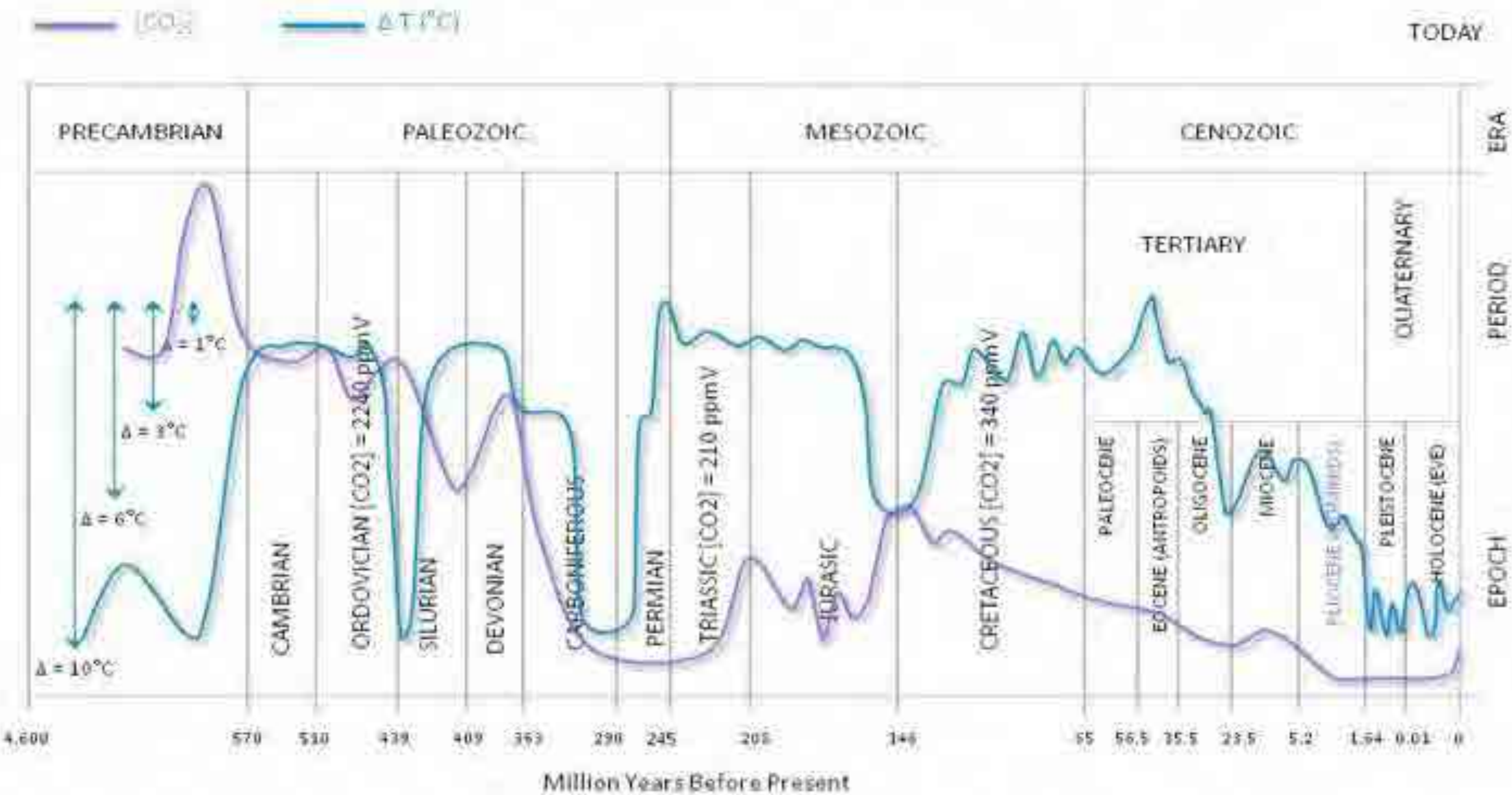
Highest Total Biomass 0-4” was field 1E with 6070 ng/g. 60” corn with cover crops.

Lowest Total Biomass 0-4” was field 3E with 643 ng/g. Wheat monoculture.

Highest Total Biomass 4-12” was field 2E with 3997 ng/g. History of winter feeding.

Lowest Total Biomass 4-12” was field 6W with 376 ng/g. 3 years of low residue crop?

Geological Timescale: Concentration of CO_2 and Temperature fluctuations



1- *Analysis of the Temperature Oscillations in Geological Eras* by Dr. C. R. Scotese © *2002*. 2- Ruddiman, W. F. 2001. *Earth's Climate: past and future*. W. H. Freeman & Sons. New York, NY. 3- Mark Pagani *et all*. *Marked Decline in Atmospheric Carbon Dioxide Concentrations During the Paleocene*. Science; Vol. 309, No. 5734; pp. 600-603. 22 July 2005. *Conclusion and Interpretation* by Nasif Nahle ©2005, 2007.