

Cronin Farms

Gettysburg, South Dakota

Dan Forgey



1

Corey-Tregg -Casey
The Power of Diversity in Long Term No-till
Mike and Monty



2

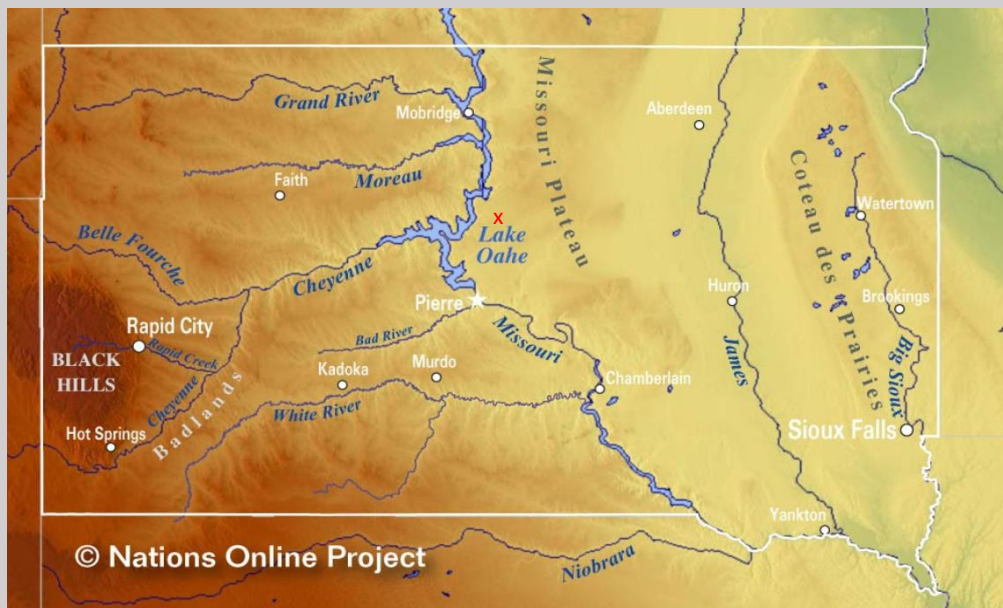
We must ask ourself which way should we be taking care of the land?

Sustainable: of, relating to, or being a method of harvesting or using a resource so that the resource is not depleted or permanently damaged.

Regenerative Agriculture: is a system of farming principles and practices that increases biodiversity, enrich soils, improves watersheds and enhances the ecosystem.

3

18.5 inches average rainfall



4

This land was tall grass prairie when homesteaded

We have planted 340 acres back to grass that never should have been farmed.



5



The night before the family photo the Barnes family had a hard rain. The rain soaked the roof it collapsed covering everything the family owned.

One year earlier he had lost his wife, he was raising his three children on his own.

You can see why they were not smiling.

6

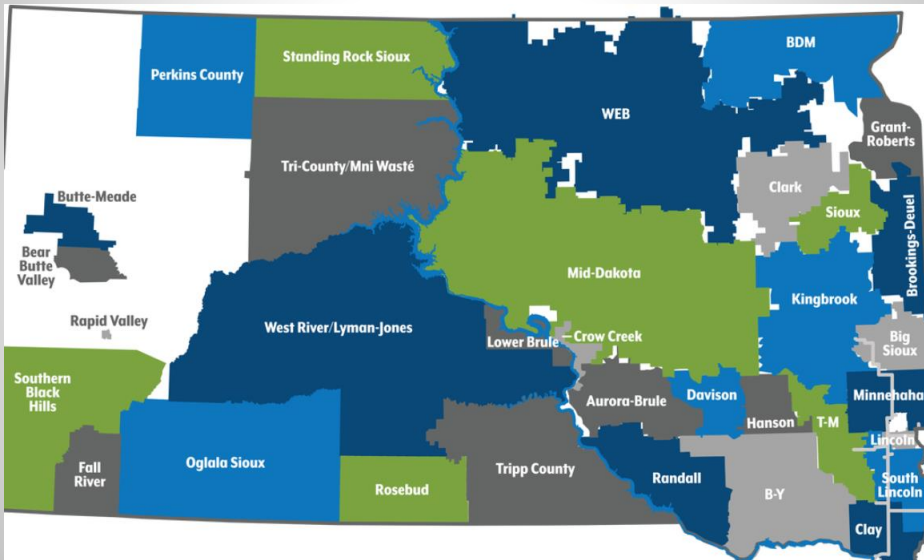
Lake Oahe

It has an area of 370,000 acres



7

There are 33 Rural Water Systems across the state who provide water.



8

The Wichita Eagle

K-State: We can solve our water crisis together, or all starve together | Commentary

The Atlantic

GARDEN CITY, Kan.—A century after the Dust Bowl, another environmental catastrophe is coming to the High Plains of western Kansas. The signs are subtle but unequivocal: dry riverbeds, fields of sand, the sound of irrigation motors straining to pump from dwindling aquifers.

The Next Disaster Coming to the Great Plains

Acute scarcity drives the search for water underground. But the West's major aquifers are in trouble, too.



Kansas town taps ranch water 70 miles away, ignites legal fight

By Daniel Cusick | 07/15/2022 07:04 AM EDT



The Ogallala Aquifer provides 70-80% of the water used in Kansas each day.

Pending Water Crisis Plagues Western Kansas

Aquifer water levels across western and central Kansas drop more than a foot on average this last year.

Estimates show that if pumping trends continue, more than 2/3 of the water under Kansas will be gone in 40 years.



Near Garden City, Kan., the High Plains Aquifer is giving out. Matthew Staver for The New York Times

We need to learn how to manage our water.



11

A little history I have worked for and with four generations over the last 53 years.
The only thing I would change is knowing how to take care of the soil the first 26 years.

The soil would say thank you.



12

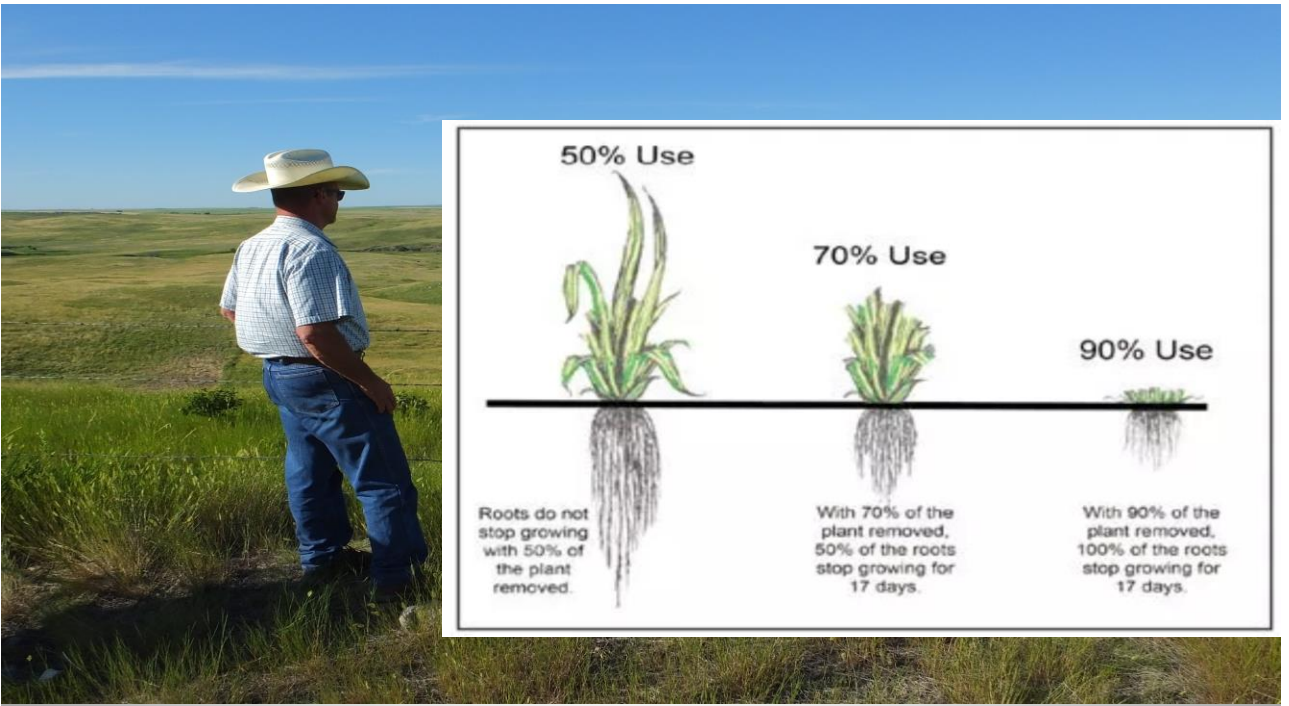
8,500 Acres of Grass Which is on the Missouri River Breaks

850 Mother Cows (they background the calves)

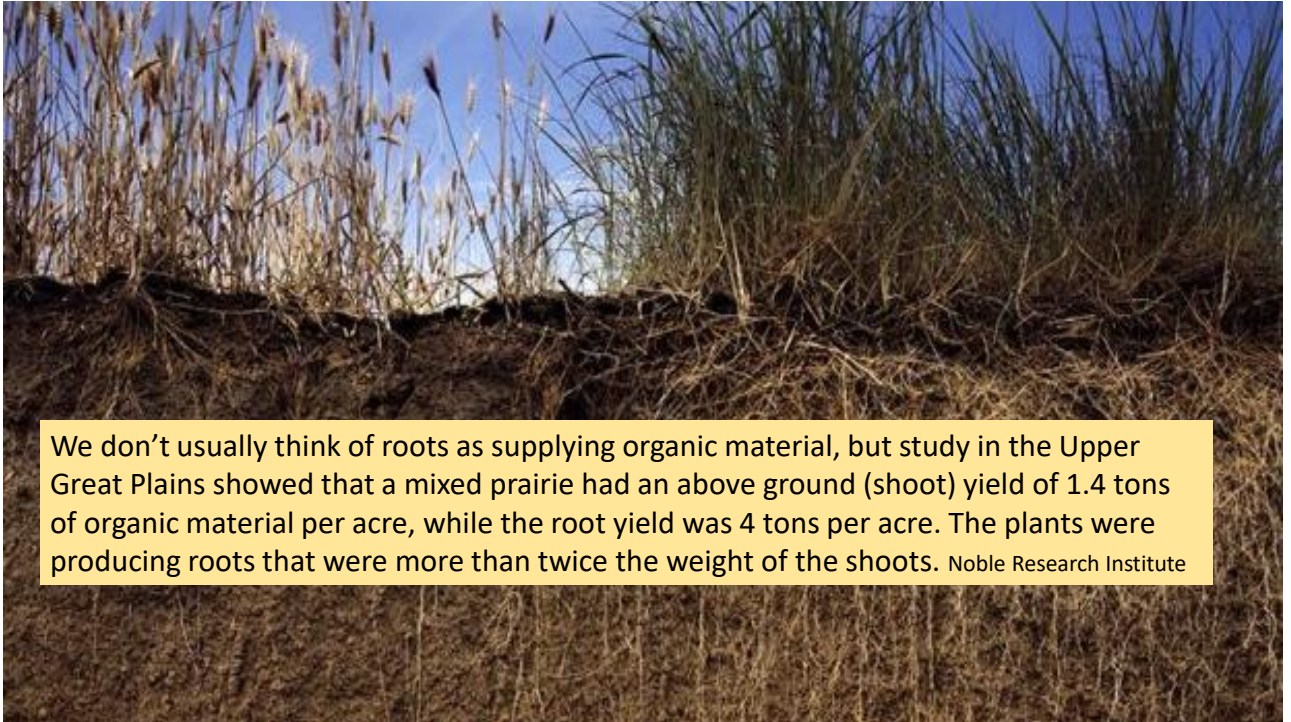
On wet years if the grass is good, they will run yearlings.



13

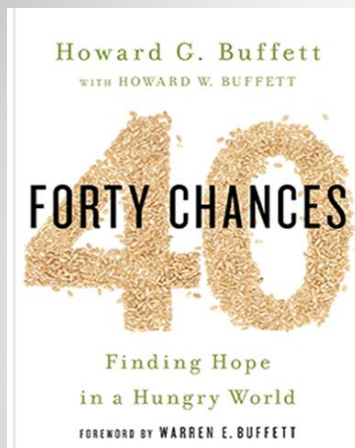


14



We don't usually think of roots as supplying organic material, but study in the Upper Great Plains showed that a mixed prairie had an above ground (shoot) yield of 1.4 tons of organic material per acre, while the root yield was 4 tons per acre. The plants were producing roots that were more than twice the weight of the shoots. Noble Research Institute

15



I have had 53 years to try and get it right. What is sad is the first 26 years I did everything I could to destroy our soils.

The story I will tell I lived it. It been my whole life and I would not trade it for anything.

How it all started in my journey on learning the importance of soil health.

So much to do so little time!

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17



18



Farming in the 70's and 80's

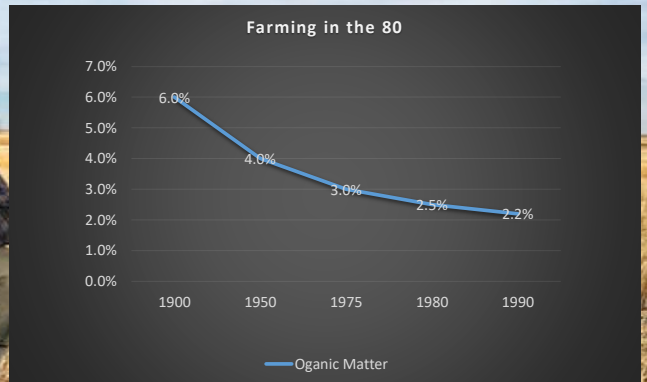
No one had to teach us. We already knew how to raise 35-bushel wheat and 50-bushel corn.



On average the soil was worked 14 times in four years. We harvested 3 crops in 4 years.

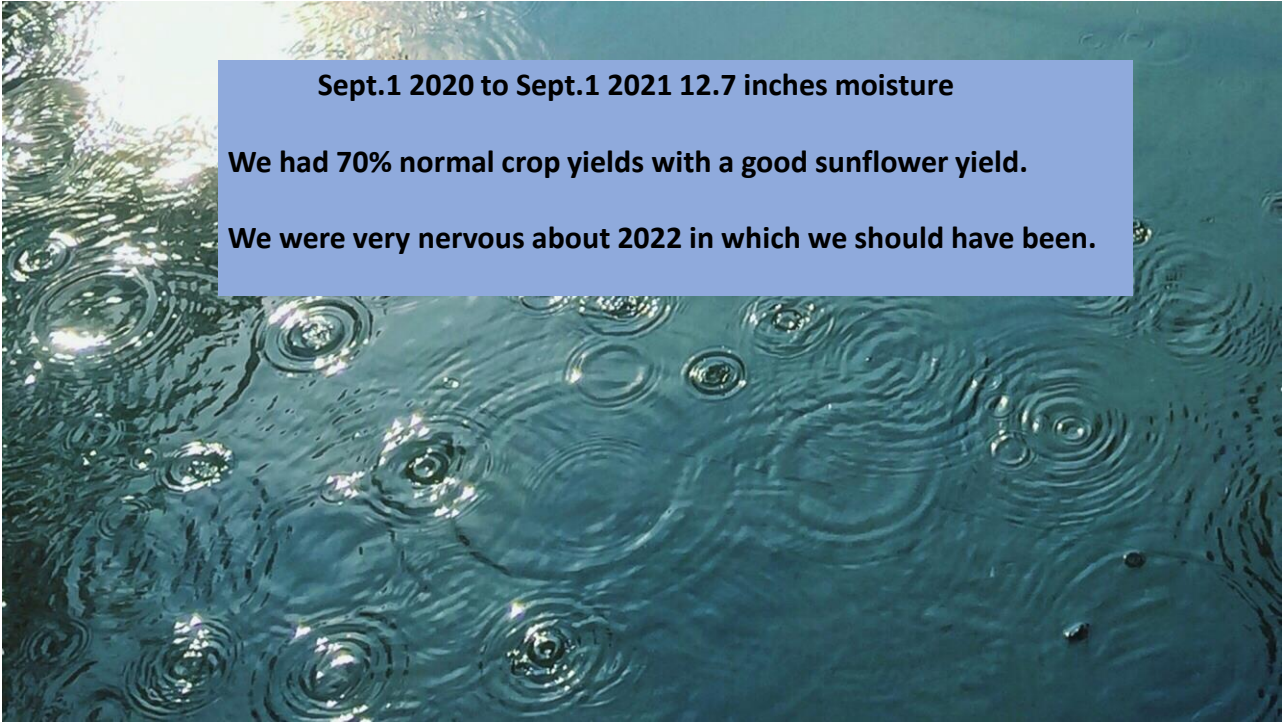
We considered our self's good farmers.

In my 50 plus years in agriculture, there is one thing I know how to do.



Change happens when the pain of staying the same is greater than the pain of change.

Tony Robbins



21



22

Our Farm 2022

10,500 Acres Farm Ground
600 Acres Under Pivot



We have been 100% No-Till since 1993, we have learned to work with and love heavy residue which we feel is the driving force to our success.



23

Corn requires 9 inches of moisture for vegetative growth and adds 10 bushels of yield for each additional inch above the vegetative requirement.

Yield goal 140 bushel
23 inches of moisture

Wheat uses 5.5 inches of moisture devoted to vegetative growth and each inch of moisture will add 5 bushel of yield.

Yield goal 75 bushel
20.5 inches of moisture



24

Looking back on 2022 and saying thanks to the soil.
It truly paid us back.



25

Soil Health: Difficult to build
Hard to maintain
Easy to destroy

Looking back, it seems easy. At the time there was more questions than answers.



26

Sunflowers 2022

Best field 3,600 lbs. acre

Our average yield was 16% above
our farm average

Average N with residual 3.5 lbs./100



27

Soybeans 2022

Best 2022 dryland field 68 bushel

Average yield on the farm was 12% above normal



28

Spring wheat 2022

Best field 82 bushels acre

Our average yield was 20% above normal yield

Average N with residual 1.6 lbs. bushel

Average protein 14.8

We use 2.1 lbs. of N/bushel for yield goal



29

Winter Wheat 2022

Best field 109 bushels acre

Our average yield was 17% above normal yield

Average N with residual 1.7 lbs. bushel

Average protein 13.1%

We use 2.1 lbs. of N/bushel for yield goal



30

Harvesting winter wheat in 2022 working with the soil armor for 2023 corn.



31

Corn dryland 2022

Best field 220 bushels

Our average yield was 14% above normal yield

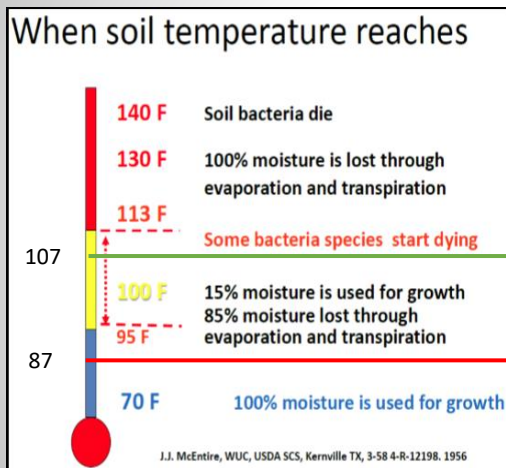
Average N with residual .7 lbs. bushel

We use .9 lbs. of N/bushel for yield goal



32

Crop yields are limited more often by hot and dry, not cool and wet.



With residue



Without residue



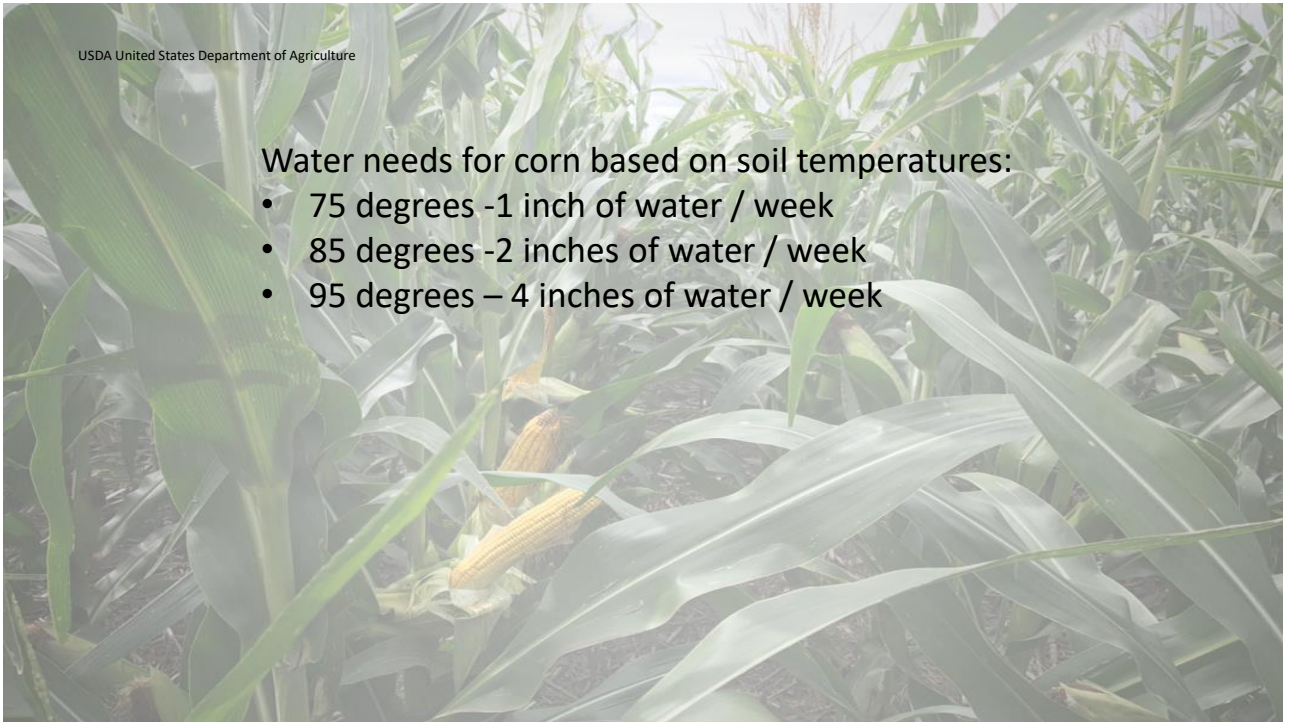
33

Corn field 7/25/21

Air temperature 101*



34

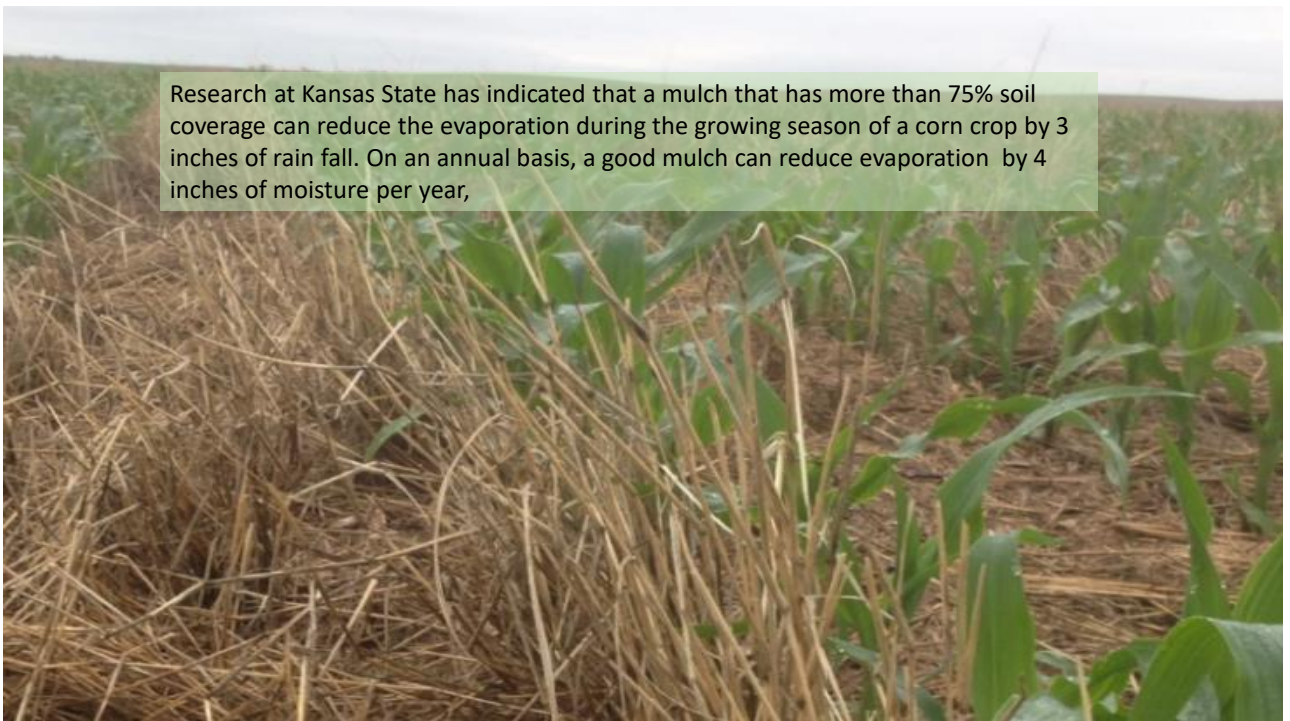


USDA United States Department of Agriculture

Water needs for corn based on soil temperatures:

- 75 degrees -1 inch of water / week
- 85 degrees -2 inches of water / week
- 95 degrees – 4 inches of water / week

35



Research at Kansas State has indicated that a mulch that has more than 75% soil coverage can reduce the evaporation during the growing season of a corn crop by 3 inches of rain fall. On an annual basis, a good mulch can reduce evaporation by 4 inches of moisture per year,

36



The power of soil cover

Grazed cover crop field, we try and leave 25% to 30% of residue to protect the soil

37



Spring Wheat – Flax – Winter Wheat – Corn - Sunflowers

38

Source USDA



Why is rainfall so destructive to bare cropland? In a normal rainfall, rain drops hit the ground going as fast as 20 miles per hour. The impact of millions of rain drops hitting the bare surface can be incredible, dislodging soil particles and splashing them 3 to 5 feet away. A heavy rainstorm may splash as much as 90 ton of soil per acre. However, the majority of the soil splashed is not immediately lost from the field. Most of the splashed particles don't leave the field; they clog surface pores, which in turn reduces water infiltration, increase water runoff, and increase erosion.

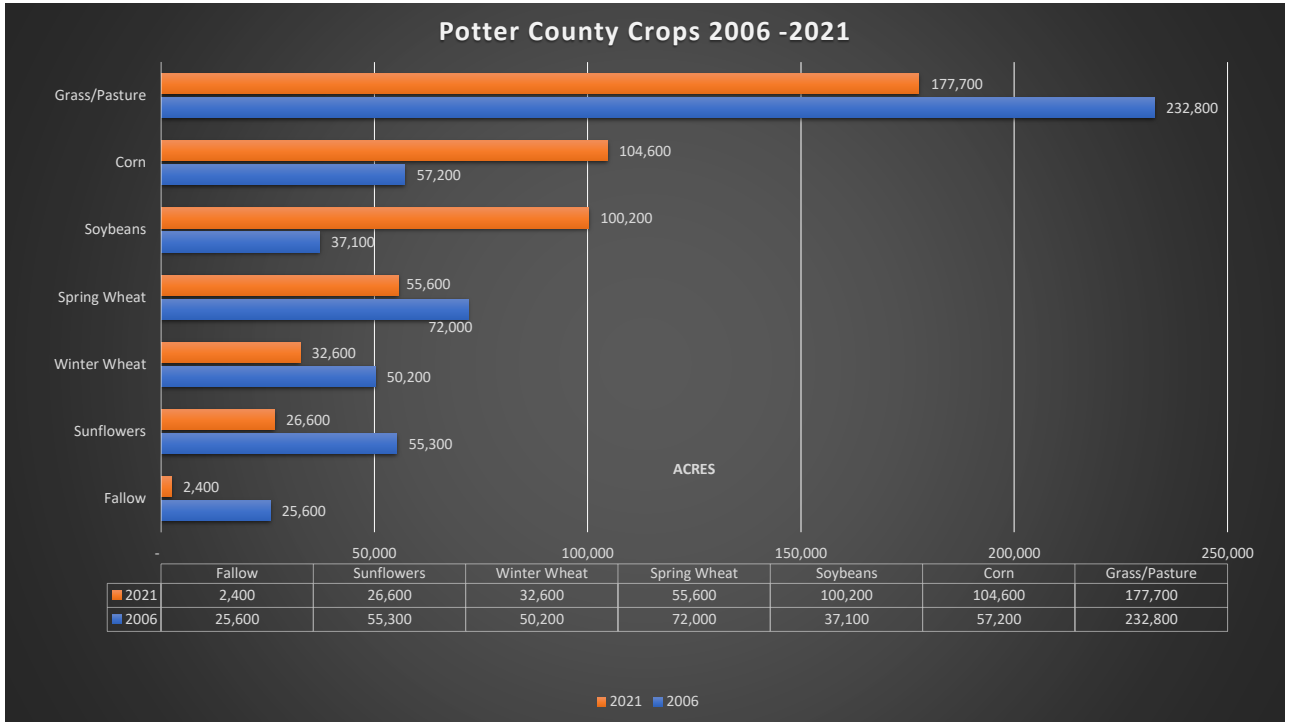
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Crops we have raised on our farm

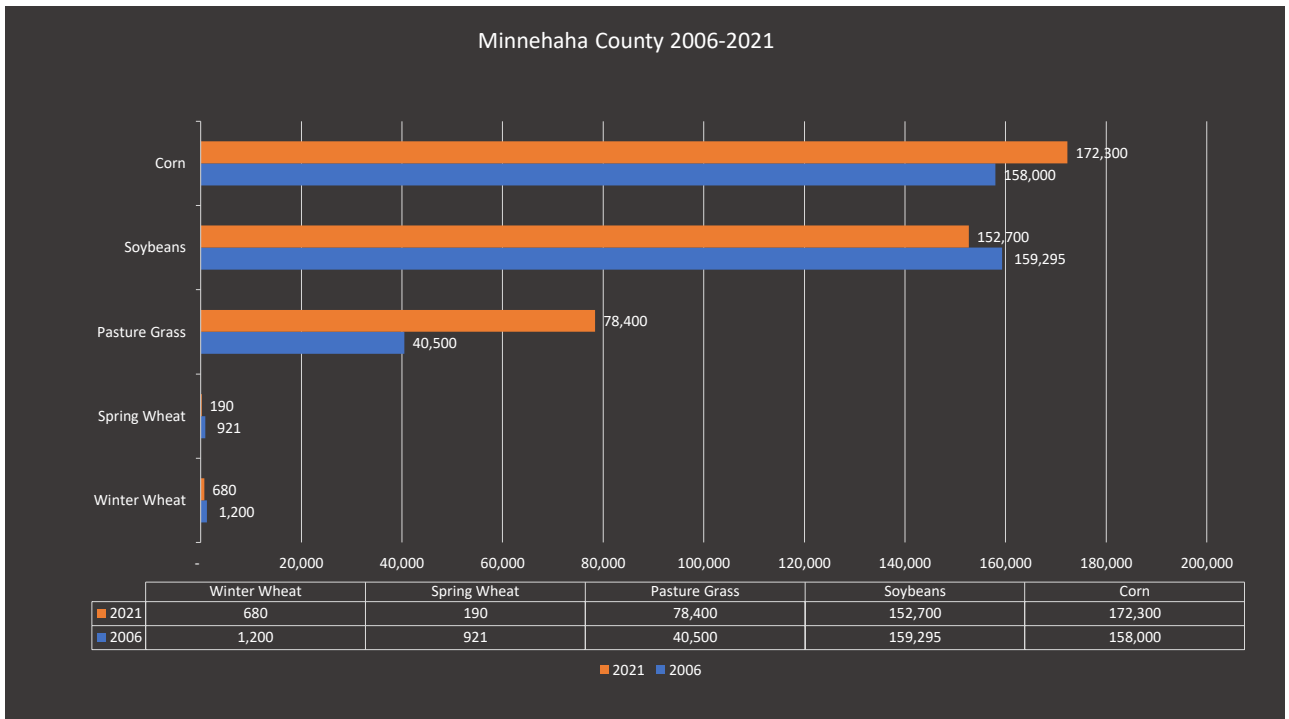
- | | |
|-------------------------------|--------------------------------------|
| 1. Spring Wheat | 8. Flax (grain-seed) |
| 2. Winter Wheat | 9. Willow Creek WW (seed-forage) |
| 3. Corn | 10. Forage Peas (seed-forage) |
| 4. Sunflowers | 11. Oats (seed-grain) |
| 5. Soybeans | 12. Forage Barley (seed) |
| 6. Field Peas | 13. German Millet +Piper Sudan grass |
| 7. Lentils | 14. Full Season Grazing Cover Crop |
| 8. White Wonder Millet (Seed) | |

73% high residue crops
27% low residue crops

40



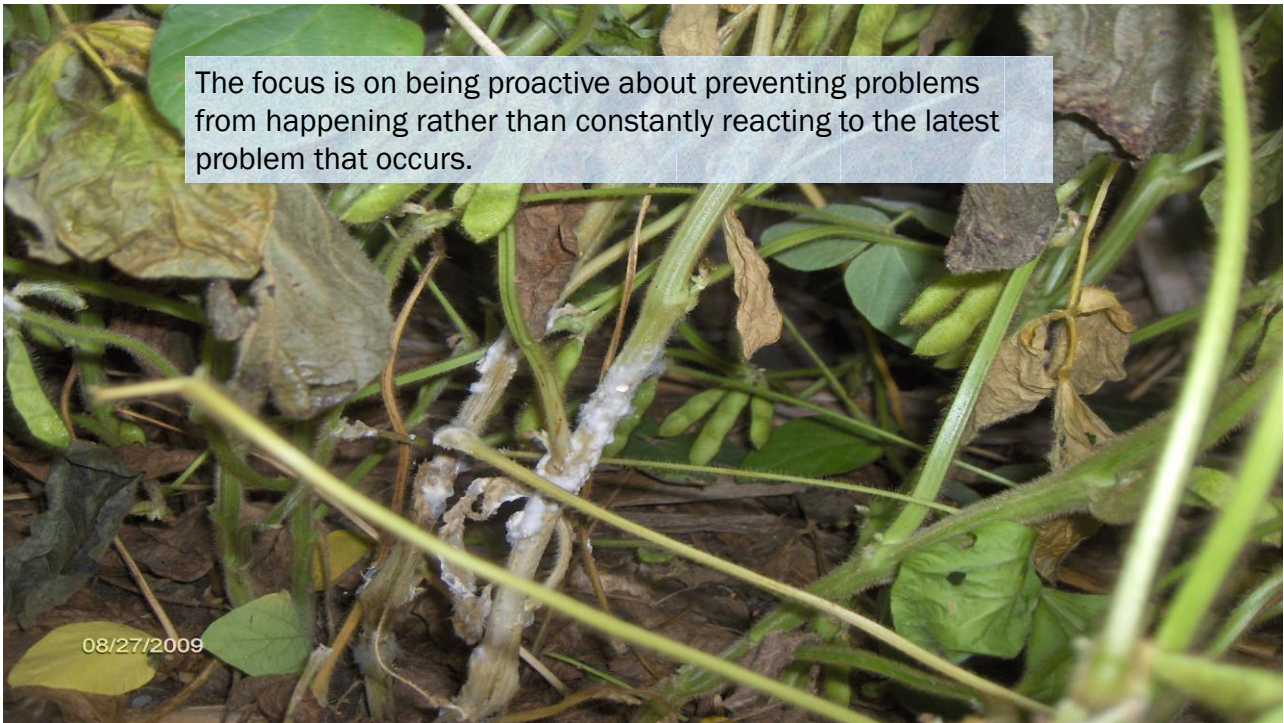
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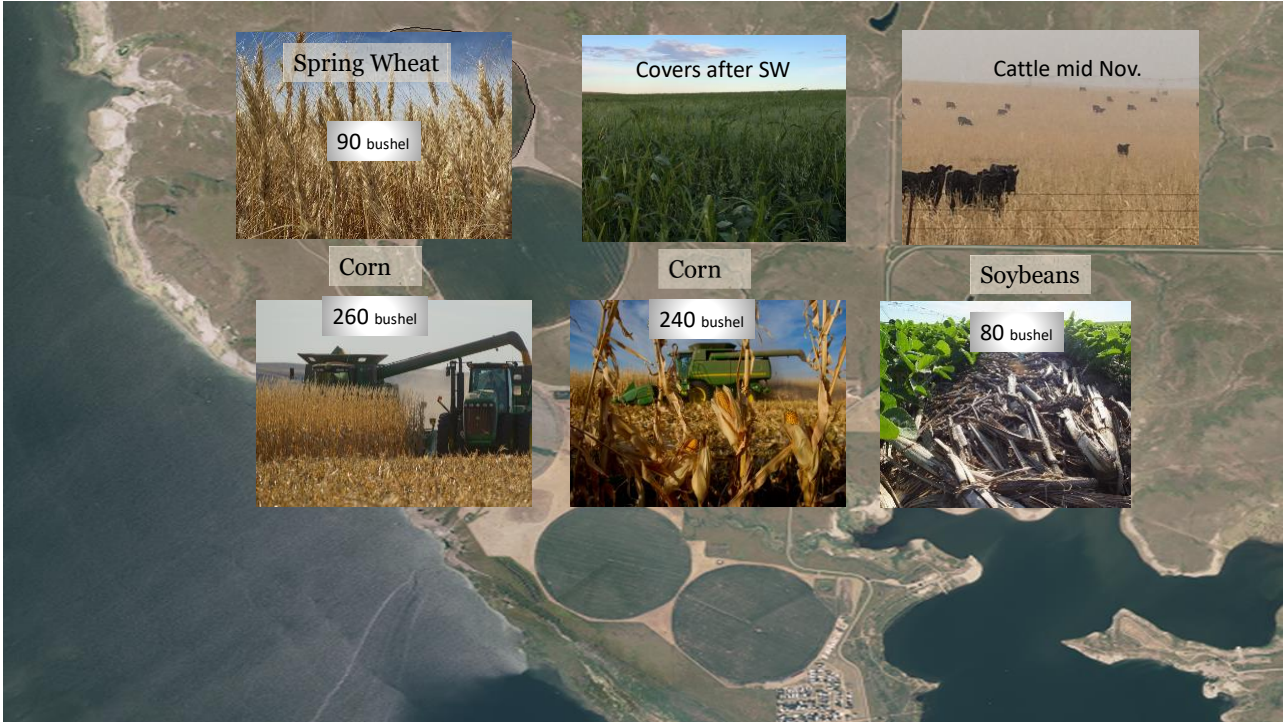
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46



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48

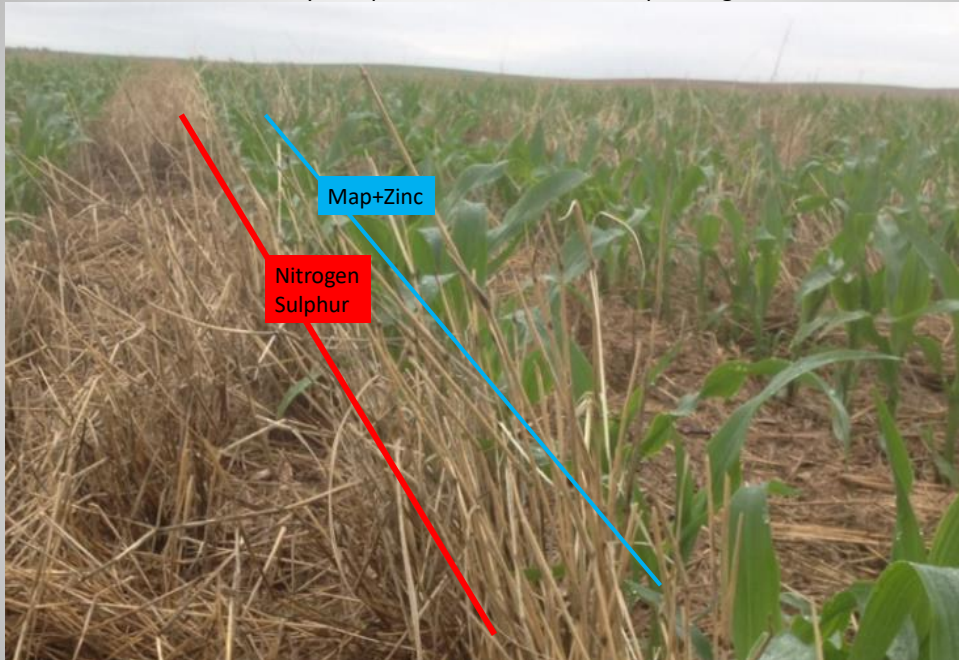


We went to 24 row planter in 2021



49

We try and put all our fertilizer on at planting.



50



51

In 2003 we purchased a drill that could mid-row band urea when planting small grain. This is where we wanted to be with fertilizer placement.

Urea (20-inch centers)

Seed + Starter (10-inch centers)

Urea

Starter



52

We will come back right at joint and stream UAN + ATS (when needed) to help finish our yield goal and assure adequate protein. We use 2.1 lbs. N/bushel



53

Tregg Cronin

Jay Fuhrer NRCS



"If you have more carbon entering the soil than leaving, your kids will probably farm your land. If you have more carbon leaving then entering, they probably will not."

54

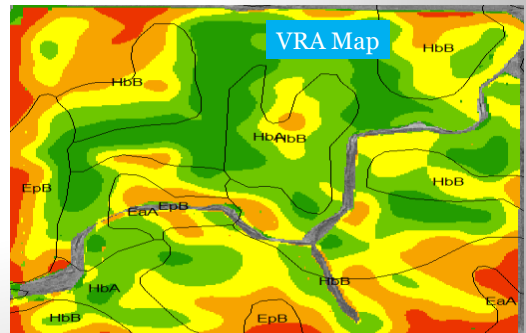
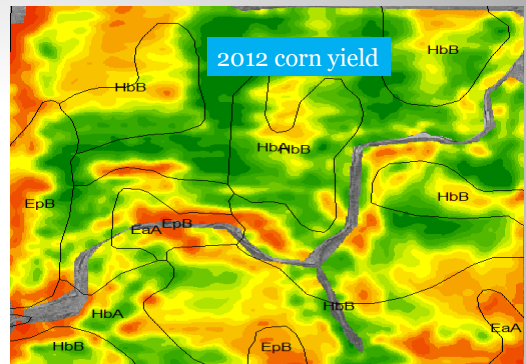
By doing this we started putting more carbon into our system. We want 75% high residue crops.



55

Web Soil Survey

You need to know what your soils will hold
 This field will hold 11.3 inches H₂O in top 5 foot



56

Benefits of Organic Matter

Nutrient Supply
Each percent of OM release 20 to 30 lbs. of N
4 to 6 lbs. phosphorus
2 to 3 lbs. sulfur

Water Holding Capacity
Organic Matter acts like a sponge. It will hold up to 90% of its weight in water.

Soil Structure Aggregation
Organic matter causes soil to form aggregates which helps with water infiltration.

Erosion Prevent
Increasing soil organic matter from 1 to 3 percent can prevent erosion by 20 to 30 percent because of water infiltration.

Managing Cover Crop Profitability Third Edition

A study of soils in Michigan say a crop yield increase of about 12% for ever 1% organic matter increase.

In Maryland researcher saw an increase 80 bushel per acre when organic matter increase from 0.8% to 2%

57

Water holding capacity

Organic matter acts like sponge. It will hold up to 90% of its weight in water.

Soil structure aggregation

Organic matter causes soil to form aggregates to help with water infiltration

58

Soil Organic Matter & Available Water Capacity



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

Inches of Water/One Foot of Soil
1 acre inch = 27,150 gallons of water

Berman Hudson
Journal Soil and Water Conservation 49(2) 189 194 189.
March April 1994 –
Summarized by:
Dr. Mark Liebig, ARS, Mandan, ND
Hal Weiser, Soil Scientist, NRCS, Bismarck, ND

This is **AVAILABLE** water not simply water being held in the soil profile.

What does it mean on a practical side:

- The average increase in available water is .5"
- This amounts to an extra 13,575 gallons of available water
- Corn water use at it maximum growth rate in the summer uses .25" to .3" of water or 6,000 to 8,000 gallons
- This amount of extra water would be equivalent to 2 irrigation events to meet corn needs
- This would amount to decreasing the number of irrigation events needed or extending the time between irrigation events
- **It would also mean extra days between rainfall events before non-irrigated crops begin to stress**

59

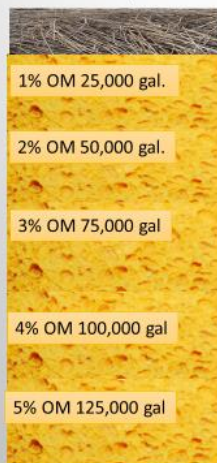
If you were going to clean a water spill off the kitchen counter, would you use a brick or a sponge?



3% OM ? gal.

Bulk density – Weight of dry soil per unit of volume, more compacted soil with less pore space will have a higher bulk density

You do this by gaining aggregation in your soils.



Storing water in the soil: Soil health initiatives emphasize water storage capacity of soils.

- Increasing soil organic matter increases water holding capacity.



Image: Wikimedia Commons, Wilsonbriggs

USDA-NRCS SOIL HEALTH INFOGRAPHIC SERIES #002

what's underneath

healthy soil has amazing water-retention capacity. Every 1% increase in organic matter results in as much as 25,000 gal of available soil water per acre.

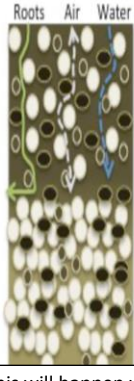
Want more soil secrets? Check out www.nrcs.usda.gov

Image: NRCS

60

Highly Aggregated

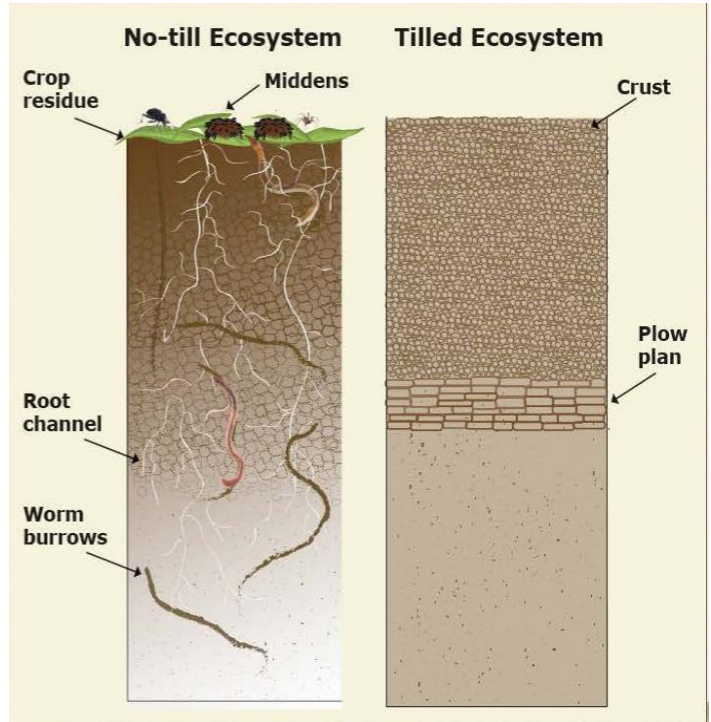
Compacted Plow Layer



The more OM the deeper aggregates go.

This will happen with tillage and low OM soils.

Root development, water and air movement within the soil are reduced when soils are compacted



61

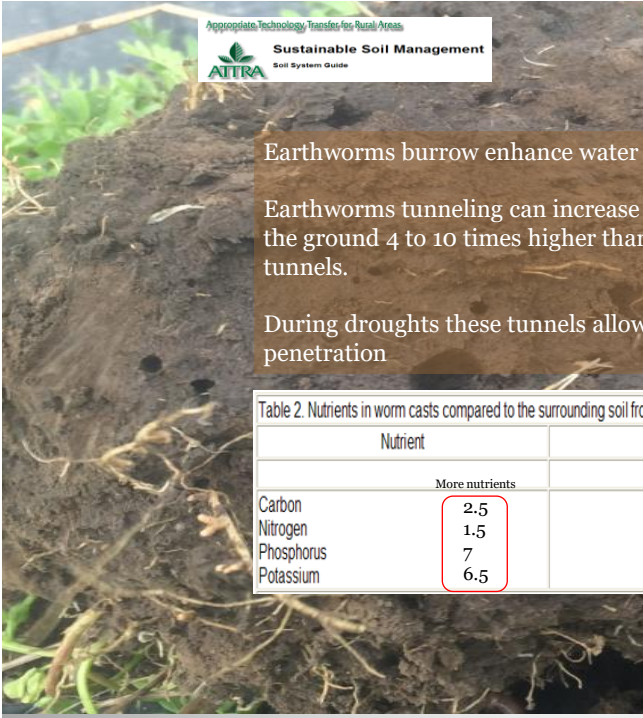


Letting earth worms tell you your soil health

...it may be doubted if there are any other animals which have played such an important part in the history of the world as these lowly organized creatures."

Charles Darwin (1809-1882)

62



Appropriate Technology Transfers for Rural Areas


Sustainable Soil Management

Soil System Guide

Earthworms burrow enhance water in

Earthworms tunneling can increase the depth of the ground 4 to 10 times higher than natural tunnels.

During droughts these tunnels allow for water penetration



Volunteer lentils September 2017

Nutrient	Worm casts		Soil
	More nutrients	Lbs/ac	Lbs/ac
Carbon	2.5	171,000	78,500
Nitrogen	1.5	10,720	7000
Phosphorus	7	280	40
Potassium	6.5	900	140

63

Working with covers on the farm

We first planted covers in 2006 and received a Sare Grant in 2007. With the help of the ARS, NRCS and SDSU. We were trying something new to us and hoping to learn from our mistakes.



64

2017 full season grazing mix.

Buckwheat	2.5	\$1.75	Enhance soil P
Flax	2.5	\$0.45	Benefits arbuscular mycorrhizal
Okra	.6	\$1.50	
BMR Sorghum	3.2	\$2.52	Forms arbuscular mycorrhizal association
BMR Corn	3	\$1.35	Forms arbuscular mycorrhizal association
Dwarf BMR	2.4	\$2.74	Forms arbuscular mycorrhizal association
Oats	9.7	\$0.65	Forms arbuscular mycorrhizal association
Forage Peas	6.5	\$1.17	Forms arbuscular mycorrhizal association
Lentils	1.5	\$0.36	Forms arbuscular mycorrhizal association
Cow Peas	2.5	\$2.19	Forms arbuscular mycorrhizal association
Rape	.6	\$0.60	
Kale	.5	\$1.32	Crude protein 30%
Turnips	.5	\$0.83	Crude protein 16%
Inoculant		\$1.75	
		<u>\$19.18</u>	

C/N Ratio 32/1

65



66



67



68



69

Question, is there any value to 30 lbs. of N when planting covers



70

Ward Laboratories**Cover Crop Yield, Ton/A @ 100 % Dry Matter**

	3 Way	12 Way N	12 Way no N
Lab sample number	11939	11940	11941
Yield Tons DM/A	3.89	4.13	2.45
Nutrient lbs/A			
Carbon, C	3505	3629	2165
Nitrogen, N	90.2	145.1	57.3
Phosphorus, P2O5	35.8	41.8	21.5
Potassium, K2O	200.5	218.2	120.2
Calcium, Ca	22.5	35.5	27.5
Magnesium, Mg	10.9	14.1	8.3
Ratio C:N	38.9	25.0	37.8

DATA

71

		Dry Biomass	RFV	RFQ	Protein	C/N Ratio
Three Way	Aug. 14	9,558	83	118	8.8%	31/1
	Nov. 28	7,758	75	102	7.3%	39/1
12 Way With N	Aug. 14	7,120	97	119	8.8%	31/1
	Nov. 28	8,237	88	131	11.0%	25/1
12 Way No N	Aug. 14	7,620	108	140	8.3%	32/1
	Nov. 28	4,898	85	107	7.3%	38/1

72

**2017 Corn N Study – Cronin Farms
Following Diverse Full Season Cover Crop**

N Treatment	Sideband N	Yield	Net Return	Lbs N/bu	Protein %
9 lbs/ac	N	133	\$357	0.29	7.7
60 lbs/ac	Y	157	\$404	0.57	8.6
69 lbs/ac	N	149	\$378	0.66	8.3
120 lbs/ac	Y	185	\$458	0.81	9.1
129 lbs/ac	N	181	\$443	0.88	9.1
180 lbs/ac	Y	176	\$409	1.19	9.2

Soil N in top 2 feet = 30 lbs/ac
Corn price = \$2.80/bu
N Price = \$0.40/lb

UAN Stream bared 5/2/17 Temp 46* Hum.74 %
5/9/17 .21 inches of rain
Urea 2x3 5/4/17 at planting

73



Toby Stroh
Assistant Professor of Agriculture

When you graze cover crops you do not lose residue you just cycle it faster.

Biomass 8,237 lbs. Grazed 66% = 5,455 lbs. grazed 2,810 not grazed



74

2018 Corn N Study – Cronin Farms

Following Corn that was followed by a Diverse Full Season Cover Crop

N Treatment	Yield	Net Return	Lbs N/bu
7 lbs/ac	126.7	\$378	0.55
57 lbs/ac	158.9	\$453	0.76
87 lbs/ac	154.8	\$433	0.97
104 lbs/ac	165.4	\$458	1.00
117 lbs/ac	163	\$447	1.10


Soil N in top 2 feet = 63 lbs/ac

Corn price = \$3.00/bu

N Price = \$0.35/lb



75

Planted 80 acres to corn 70 acres PP



Planted forage mix on PP
7/20/20

Grazed 350 head for 25 days
in Nov. and Dec. using electric
fence.

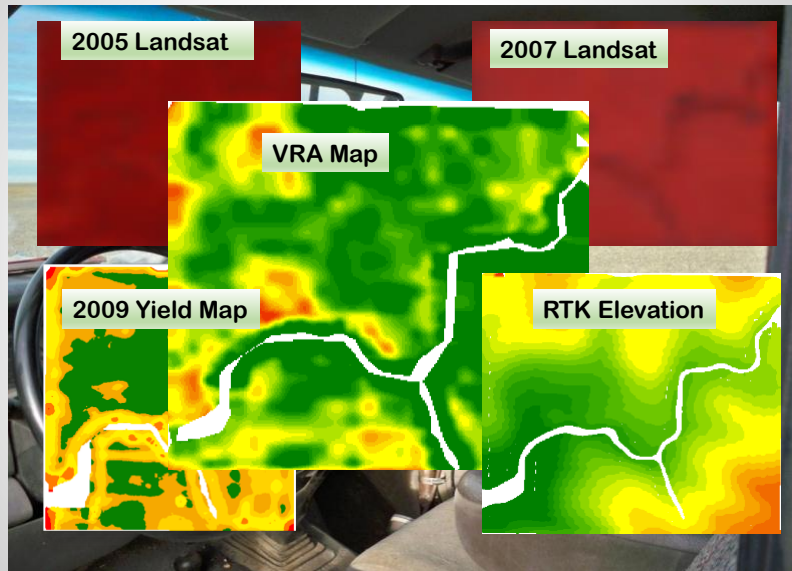
76

Heifers on full season covers November 15



77

Sampling Zoned Field For VRA



78

Sample 0 to 6 inch
6 to 24 inch

There is nothing better than
your hands on your soil.



79

Assigning To A VRA Corn Map

We will VRA
Seed
Nitrogen
Phosphorus

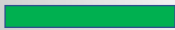
Zone 1 145 bu



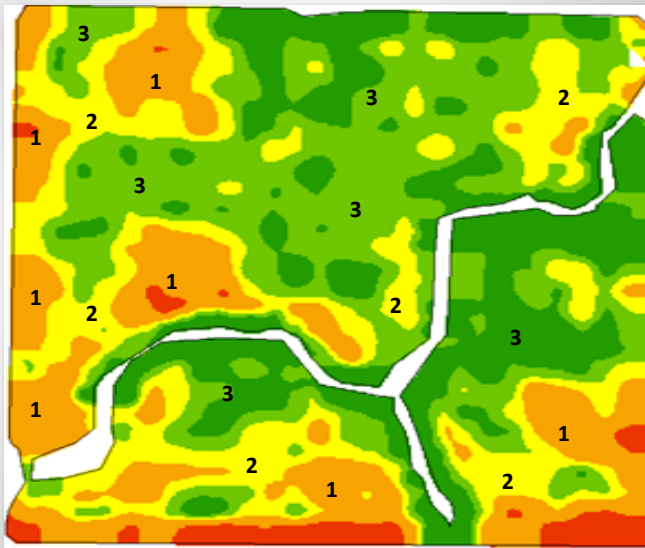
Zone 2 165 bu



Zone 3 185 bu



Corn population
22,000 to 28,000



80

These are not
our yields, just
an example of
how we achieve
yield goals

2022 6 year average

2016	162	
2017	140	
2018	195	
2019	180	
2020	170	
2022	185	
	<hr/>	
	172	
	2%	% above average
	175	

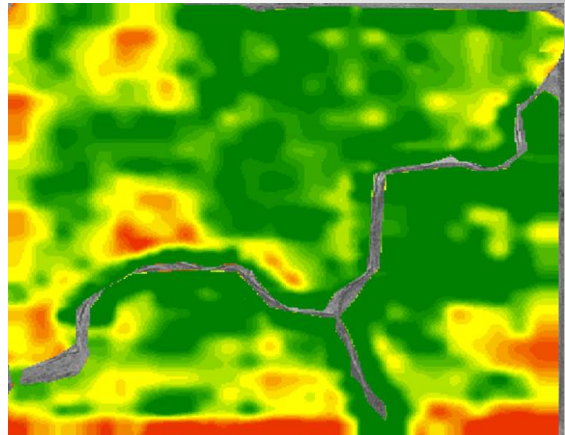
81

VRA VRA Cover Crops

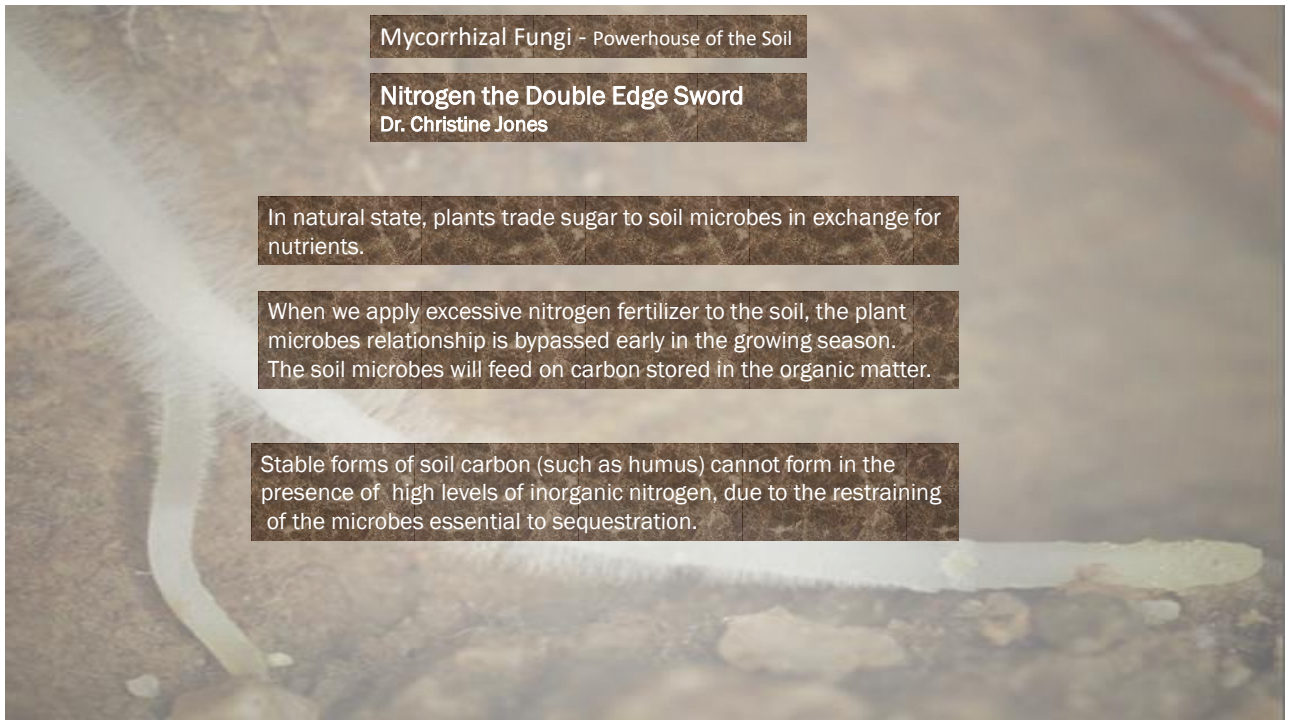
Tank 1 C/N 42/1 (high carbon oats – millet – flax)

Tank 2 C/N 36/1 (barley – sugar beets for salinity)

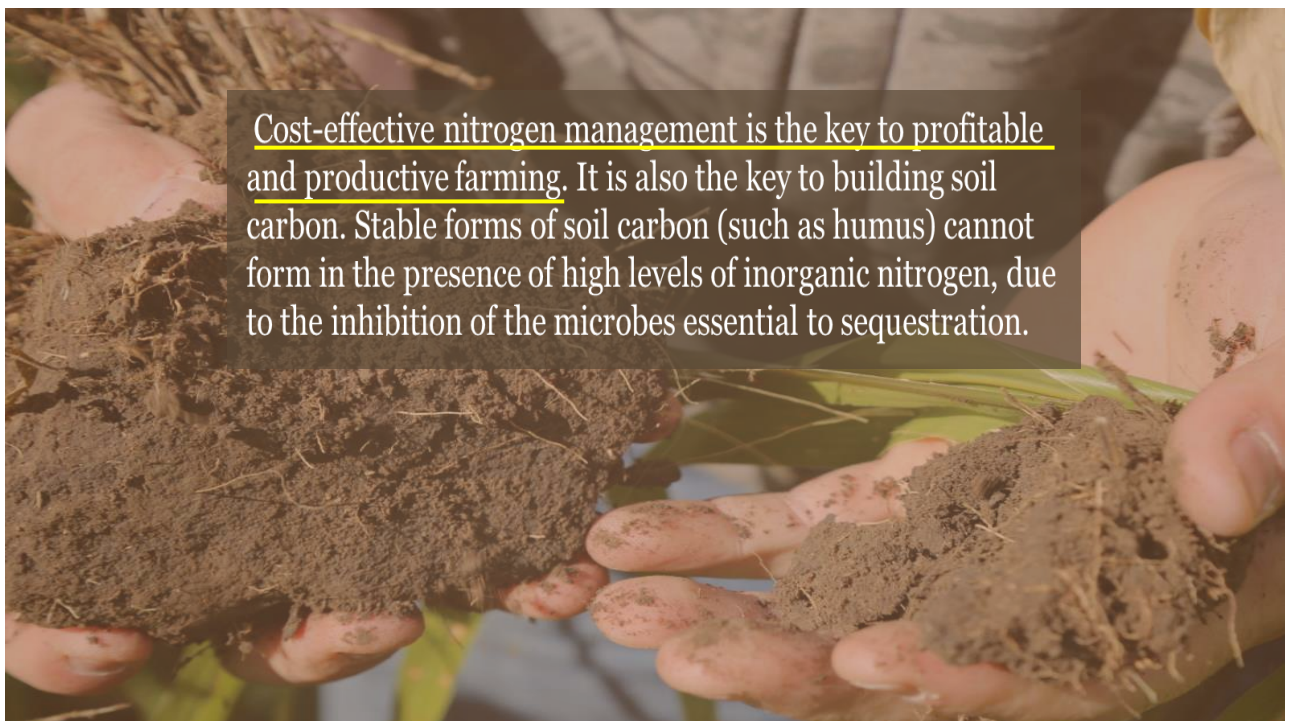
Tank 3 C/N 32/1 (flax – oats – lentils – collards – buckwheat)



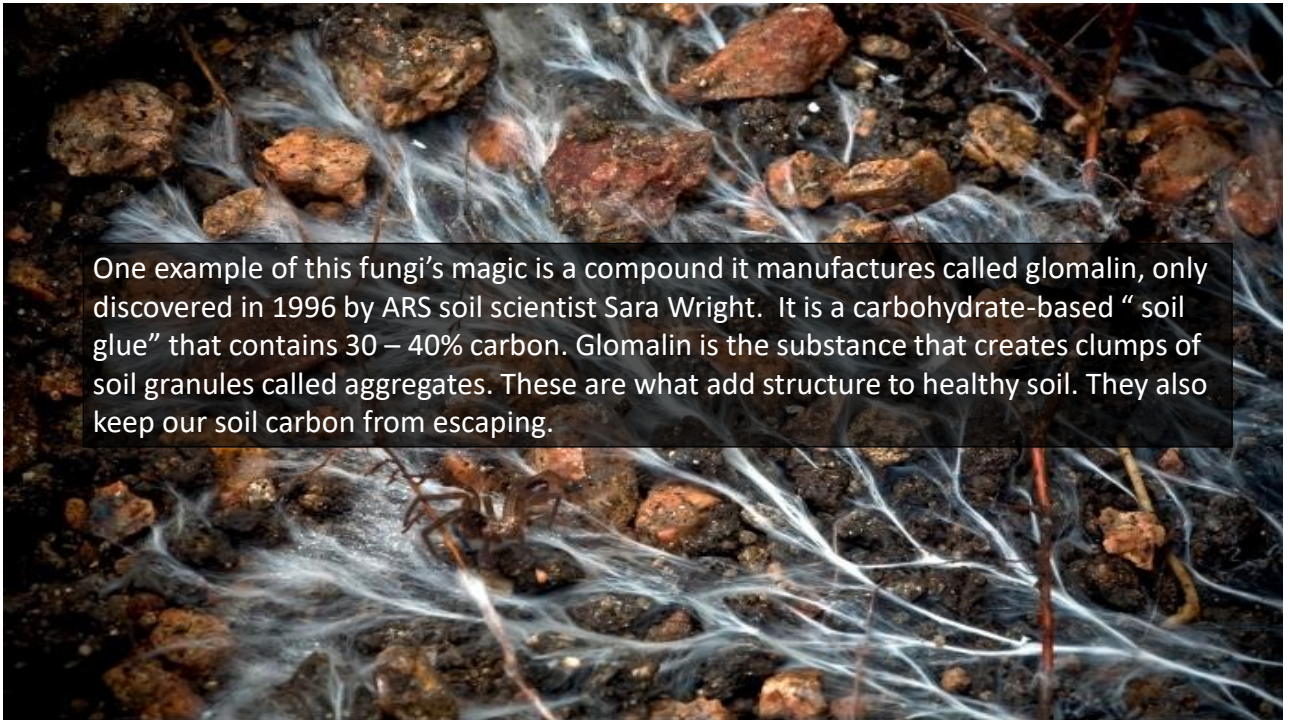
82



83



84



One example of this fungi's magic is a compound it manufactures called glomalin, only discovered in 1996 by ARS soil scientist Sara Wright. It is a carbohydrate-based "soil glue" that contains 30 – 40% carbon. Glomalin is the substance that creates clumps of soil granules called aggregates. These are what add structure to healthy soil. They also keep our soil carbon from escaping.

85



Mycorrhizal Fungi will take carbon (sugar) from the roots to the soil aggregates in exchange for nutrients organic nitrogen and organic phosphorus.

Soil Health: Difficult to build
Hard to maintain
Easy to destroy

86

Prevent plant 2020 planted to covers 7/15/20
Planted to corn 5/16/21



Sampled after covers fall 2020
there was 15 lbs. residual N.

Corn yield 2021 on a very dry
year 177 bushel

Sampled after corn fall 2021
there was 70 lbs. residual N.

87

Ball probe could not get in 7/2/21



Ball probe went in 54 inches this was
done after 1.5-inch rain 7/6/21



88

We had 10 inches of moisture in the soil profile

Covers planted 8/10/22

Picture taken 9/18/22



89

Covers are 6 weeks old, I could not get the soil probe in the ground.

It's all about management, you will not get there in one year, it is a long journey but one that you need to start.

We all have different rainfall, soils and farming and ranching practices.

When trying something new do it on a small scale, make sure it is what you want for your land.

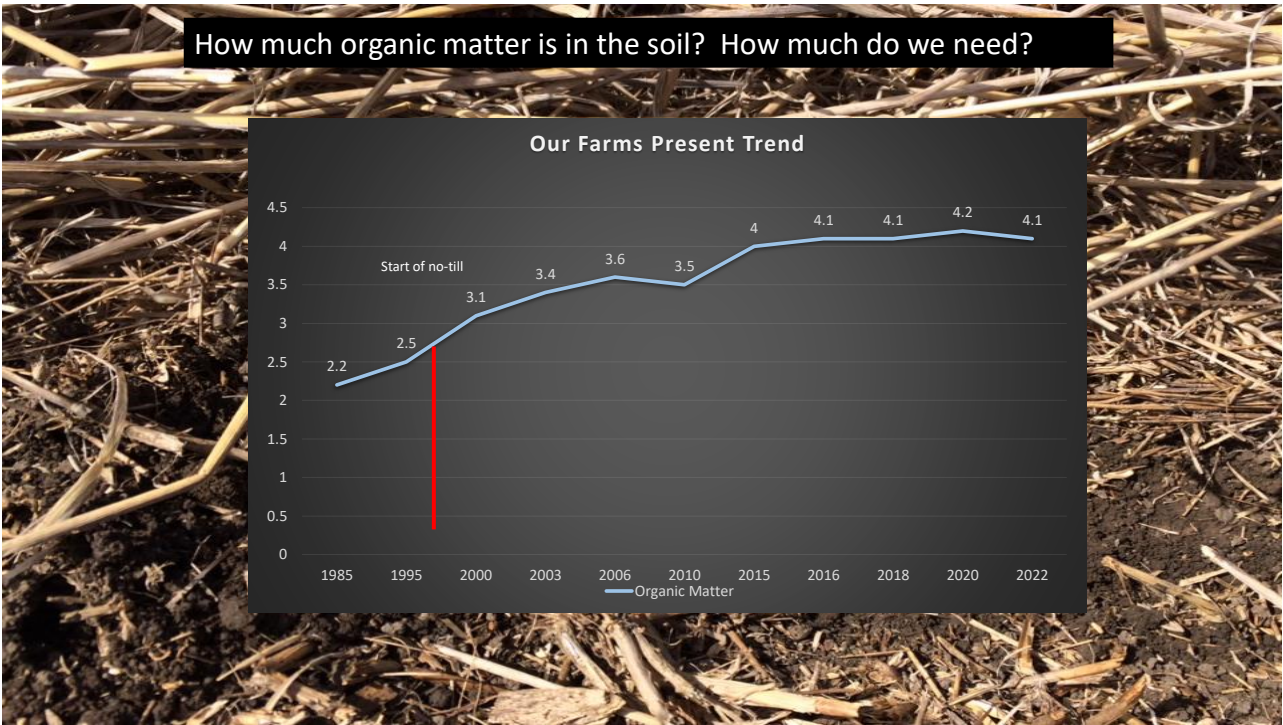


90



Letting flush of WW be food for the micros on a dry year

91



92



93

We have no excuse. We have the tools and the knowledge to stop this.



94

Soil Health: Difficult to build
Hard to maintain
Easy to destroy



95

This is the future.



Essentially, all life depends upon the soil... There can be no life without soil and no soil without life; they have evolved together.

— Charles Kellogg —

96

We live in such a fragile world



We need to be thinking of them. They are the future.

