

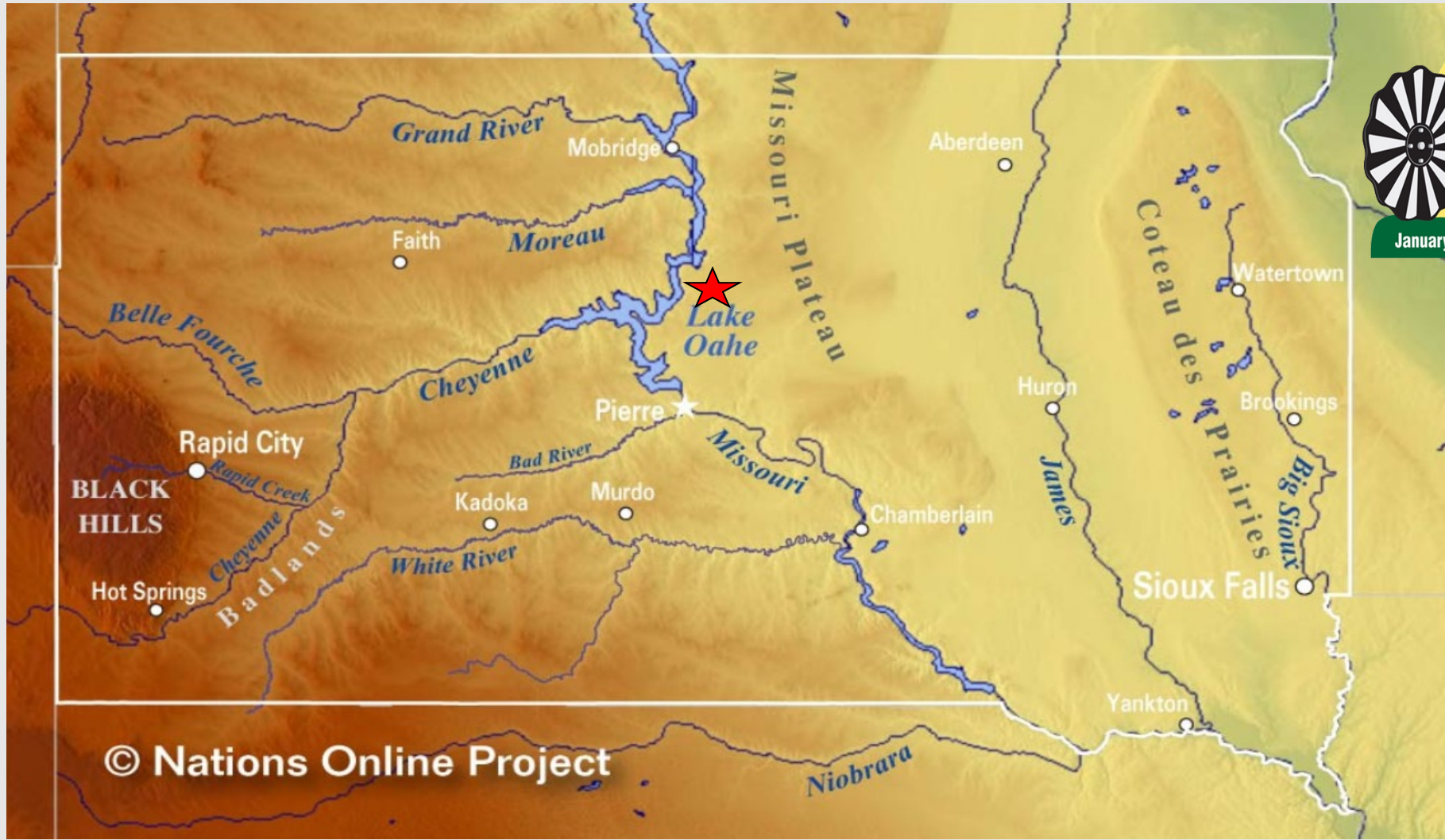


The Power of Diversity in Long Term No-Till

Dan Forgey



18.5 inches average rainfall



31st Annual
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January 10-13, 2023 • St. Louis, Mo.

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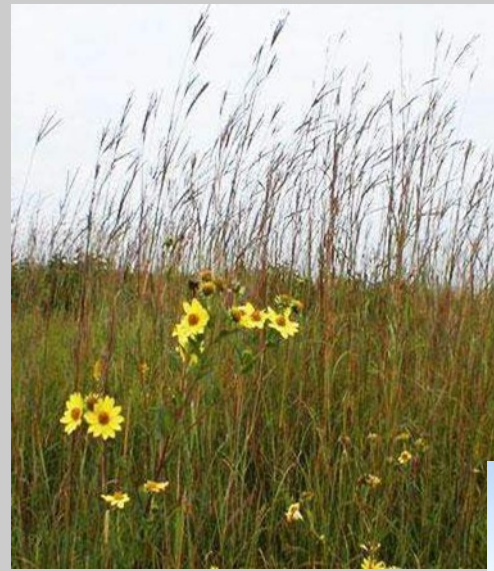
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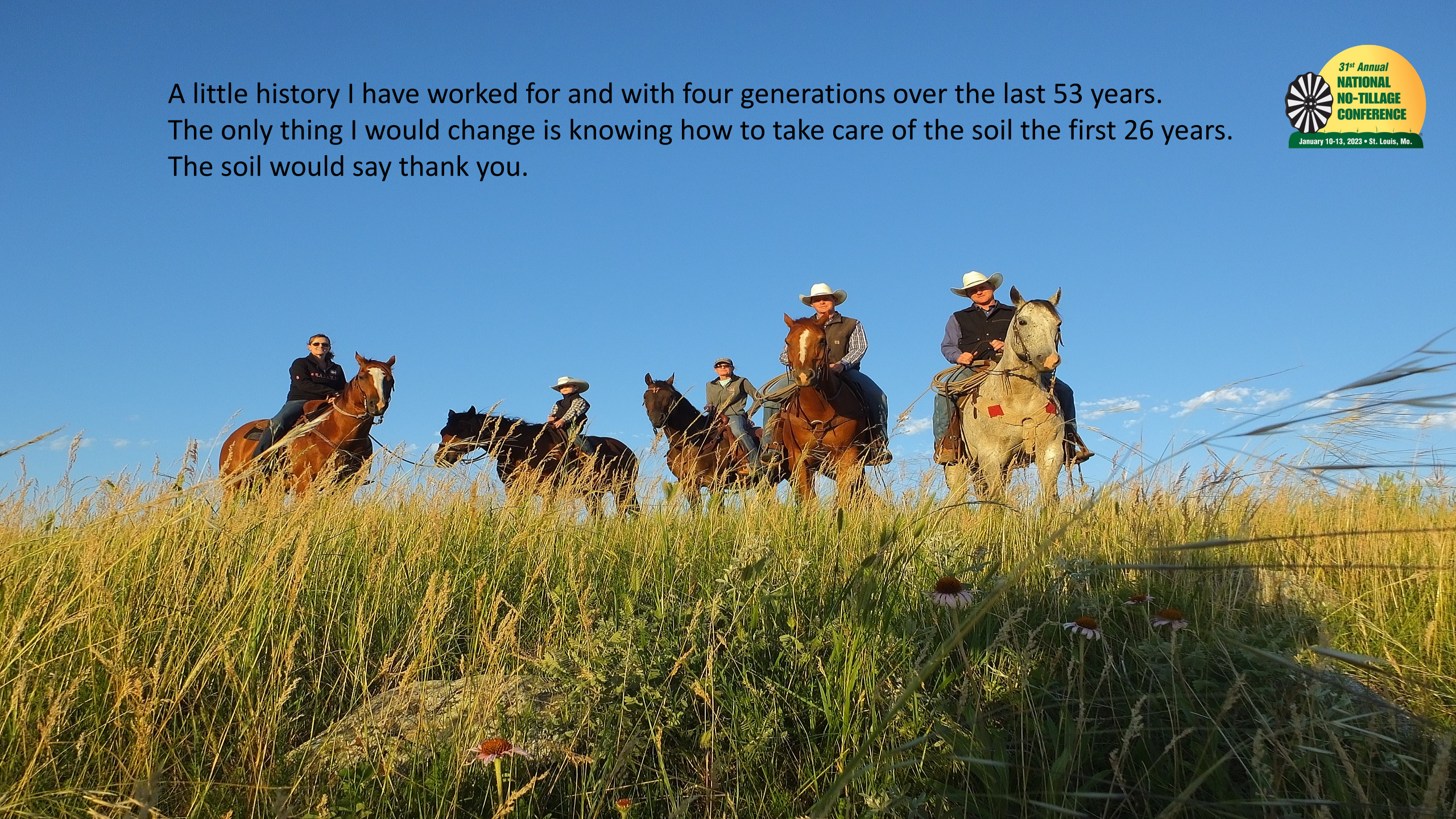
Cultivating Solutions for Growth
DAWN

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

**850 Mother Cows
(we background the calves)**



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.





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.



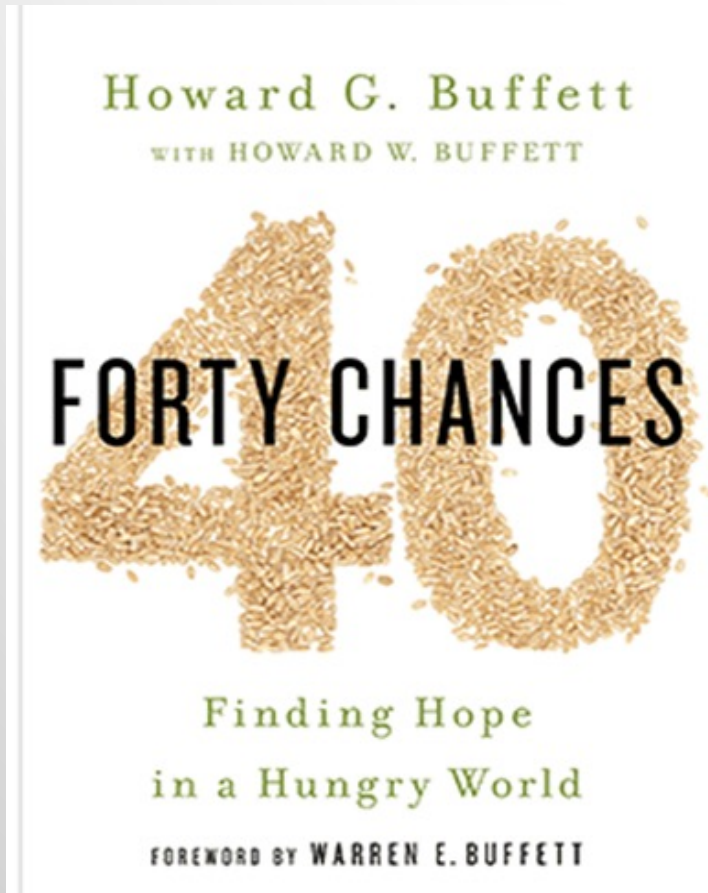
Our Farm 2022

10,500 Acres Farm Ground
600 Acres Under Pivot



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





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!

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.



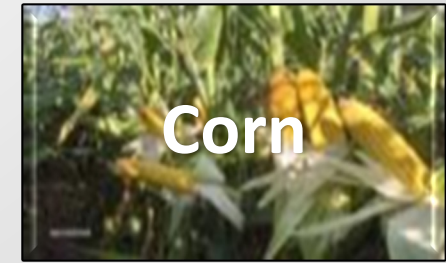


On average the soil was worked 14 times in four years. We harvested 3 crops in 4 years.

We considered our self's good farmers.

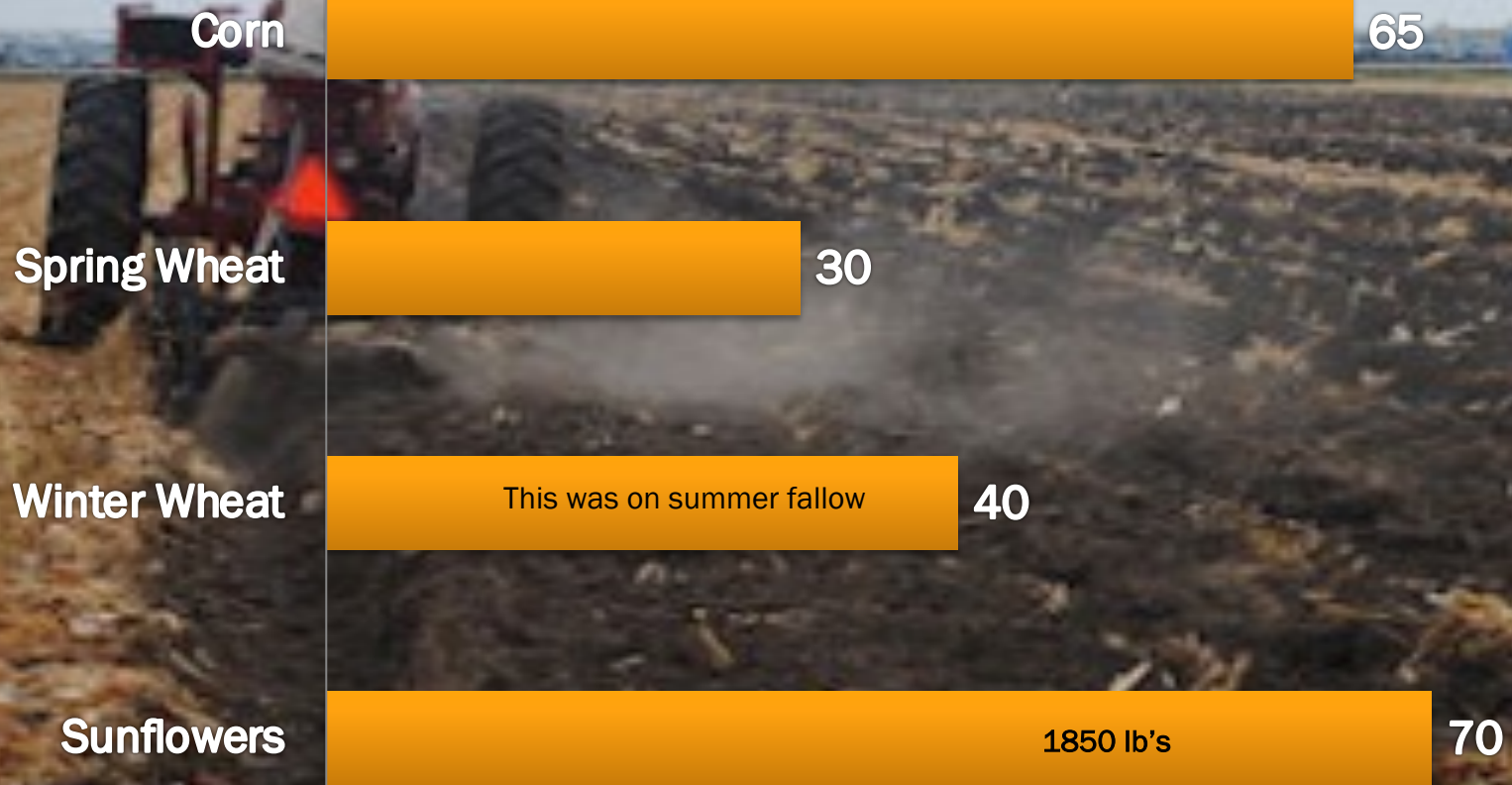
Farming in the 70's and 80's

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

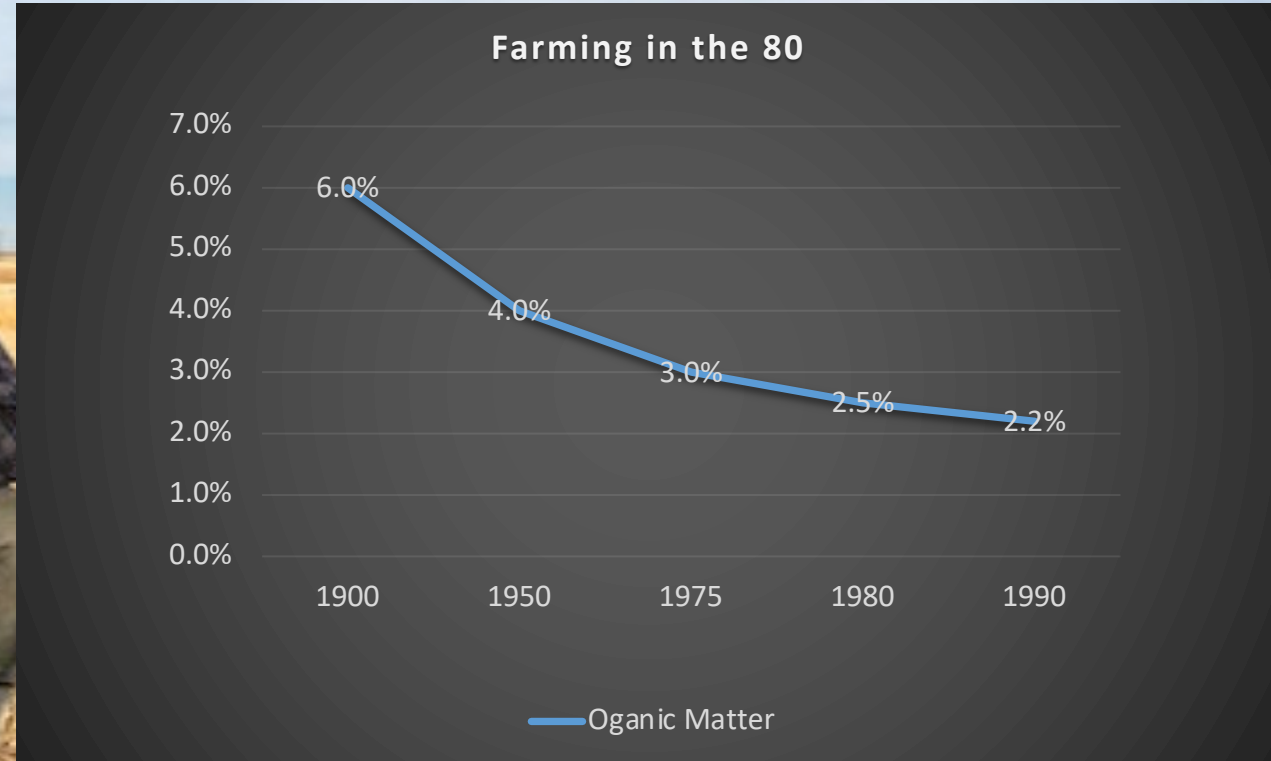


Yields in the early years

■ 1968 - 1993



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

Sept.1 2020 to Sept.1 2021 12.7 inches moisture

We had 70% normal crop yields with a good sunflower yield.

We were very nervous about 2022 in which we should have been.



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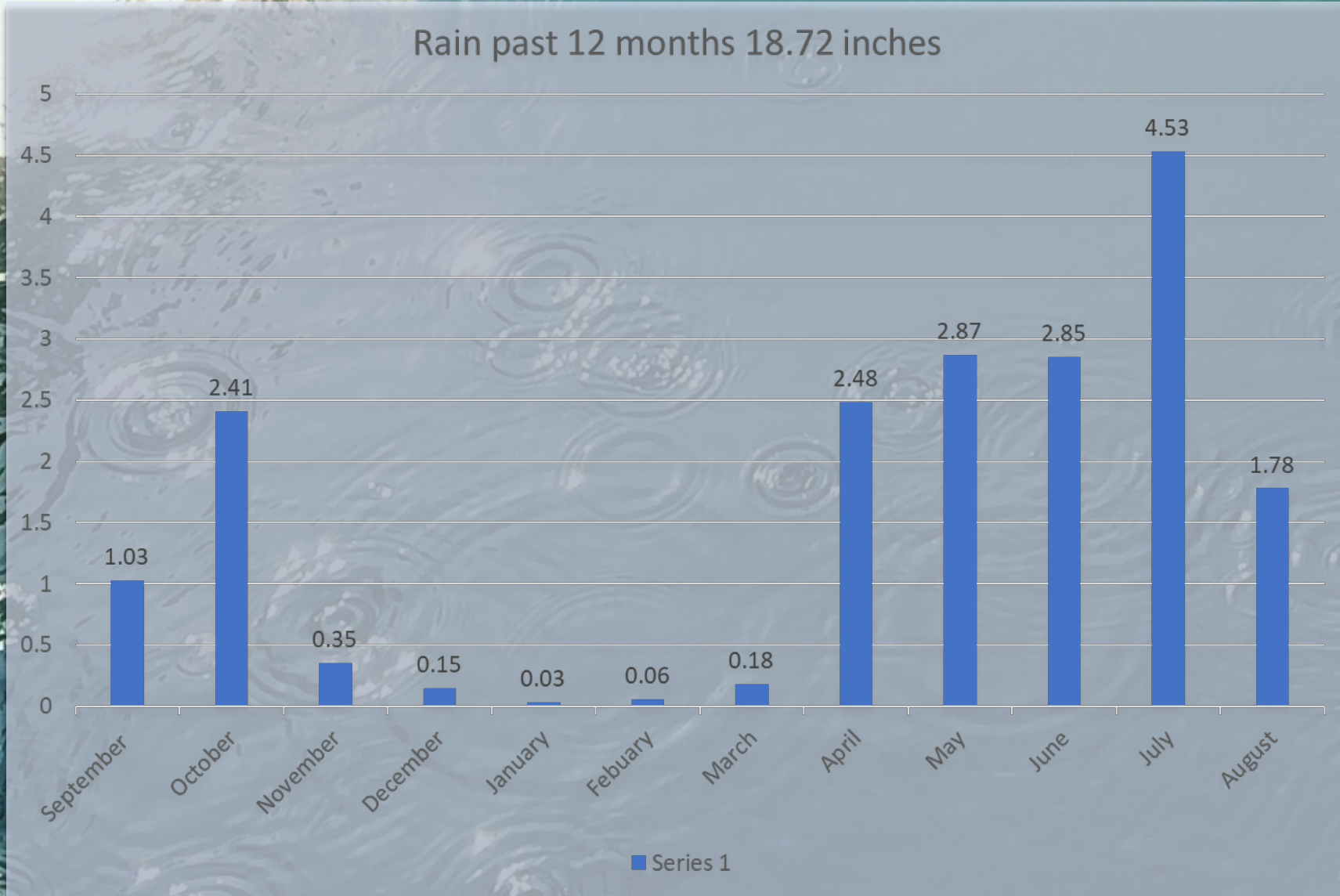
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Sept. 2021 to Sept. 2022



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



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



Sunflowers 2022

Best field 3,600 lbs. acre

Farm 2022 average 3,400 lbs. acre

Average N with residual 3.5 lbs./100

16% above farm average



Soybeans 2022

Best 2022 dryland field 68 bushel

Farm 2022 average 62 bushel

12% above farm average



Spring wheat 2022
Best field 82 bushels acre
Farm 2022 average 77 bushels acre
Average N with residual 1.6 lbs. bushel
Average protein 14.8

20% above farm average



Winter Wheat 2022

Best field 109 bushels acre

Farm 2022 average 90 bushels acre

Average N with residual 1.7 lbs. bushel

Average protein 13.1%

17% above farm average



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



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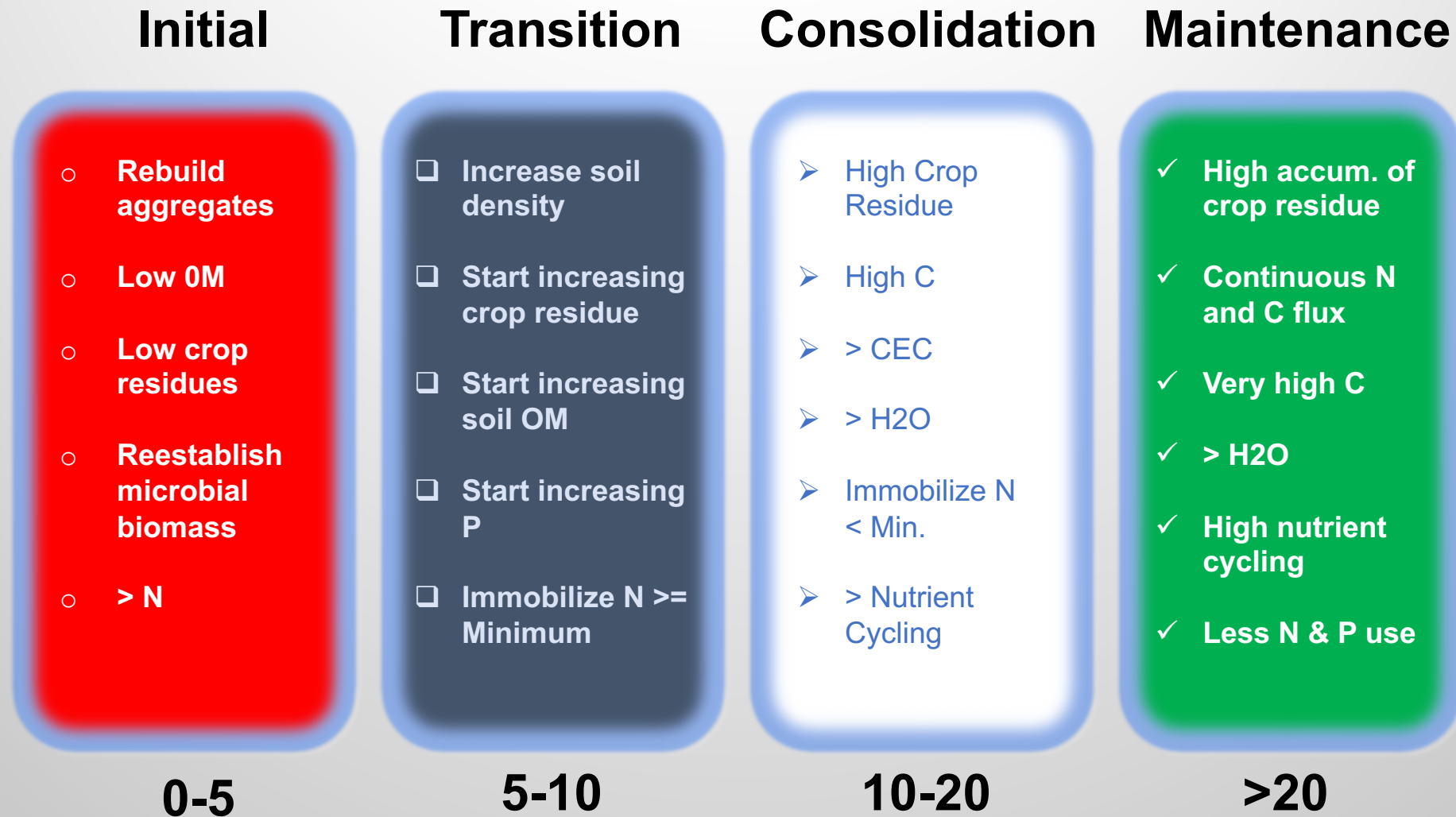
DAWN

Corn dryland 2022
Best field 220 bushels
Farm 2022 average 194 bushels
Average N with residual .7 lbs. bushel

14% above farm average



Evolution of a continuous no till systems: 4 phases



Don Reicosky Retired Soil Scientist

Source: Sa, 2004

Time (years)

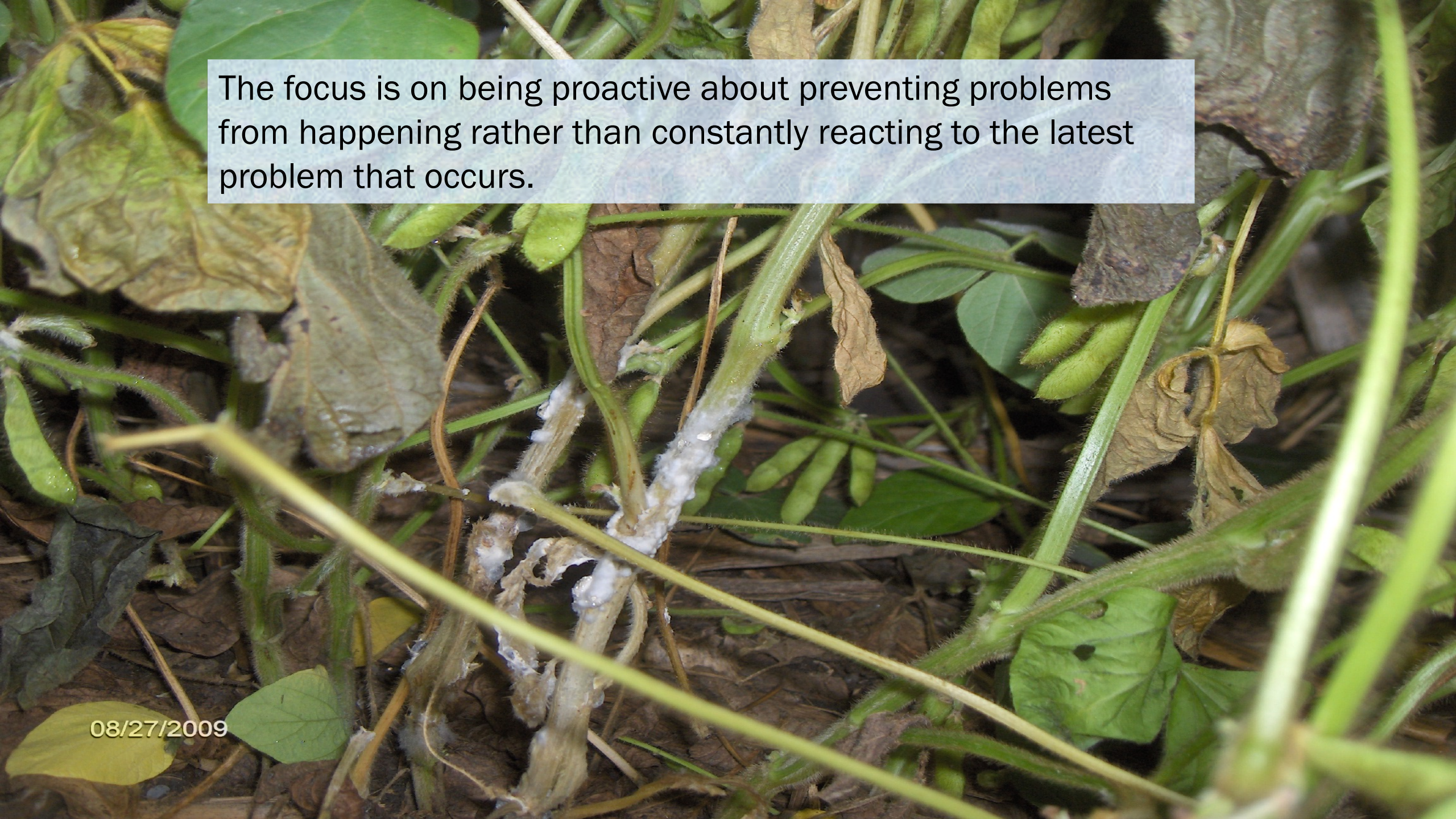
Crops we have raised on our farm

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

73% high residue crops
27% low residue crops

We could tell we were losing soil structure



A close-up photograph of a plant stem, possibly a bean, showing a white, fuzzy, cottony growth. The growth is concentrated on the stem and appears to be a pest or a disease. The plant has green leaves and stems, some of which are damaged or withered. The background is dark and out of focus.

The focus is on being proactive about preventing problems from happening rather than constantly reacting to the latest problem that occurs.

08/27/2009



Spring Wheat

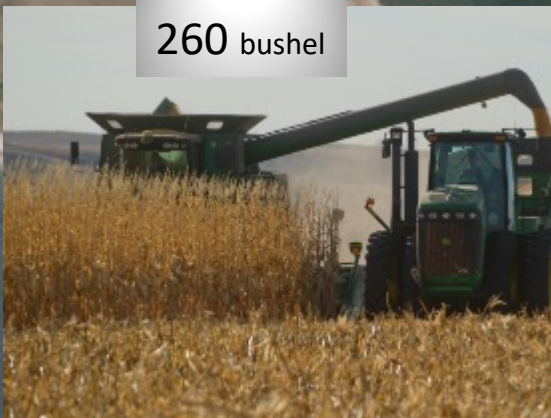
90 bushel



Covers after SW



Cattle mid Nov.



Corn

260 bushel



Corn

240 bushel



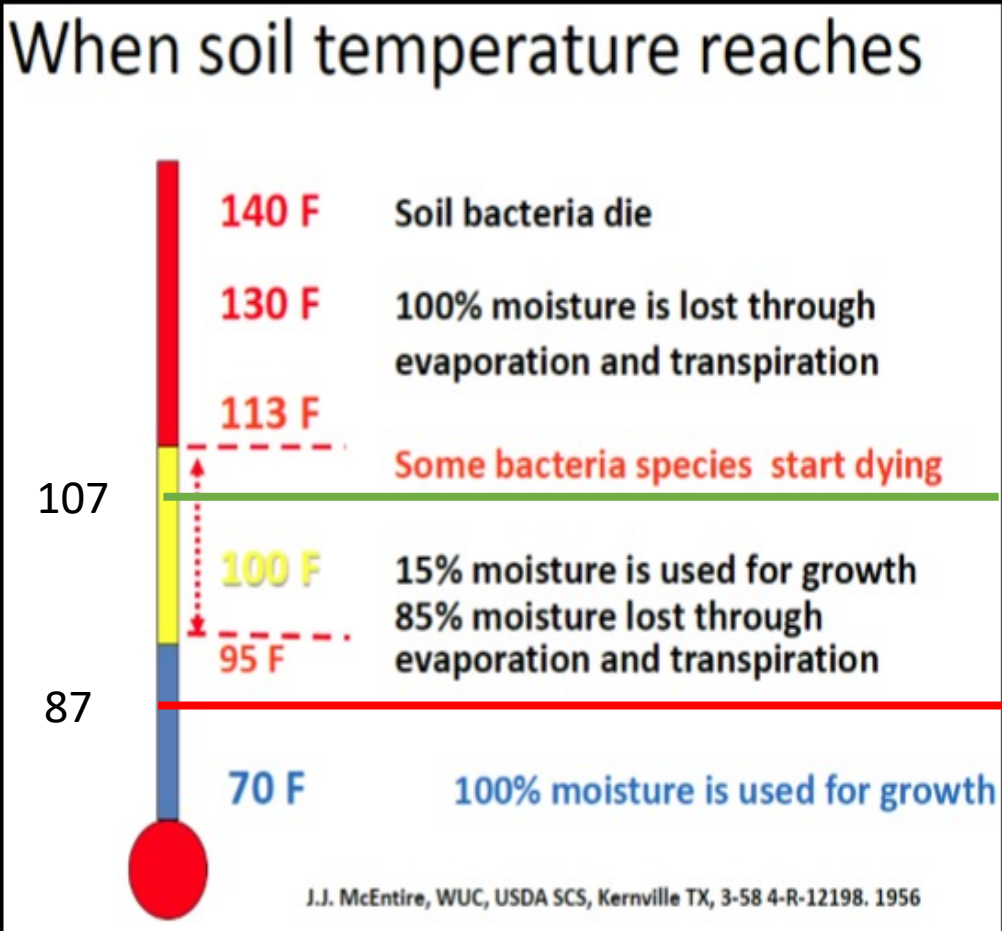
Soybeans

80 bushel

Spring Wheat – Flax – Winter Wheat – Corn - Sunflowers



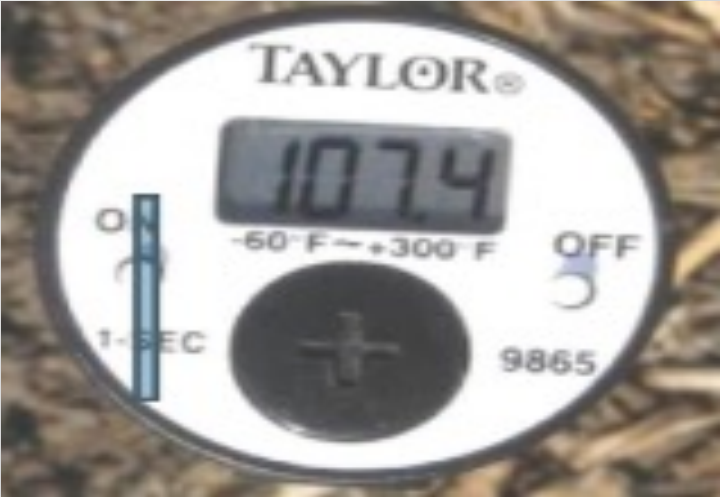
Crop yields are limited more often by hot and dry, not cool and wet.



With residue



Without residue



For Hot Dry Summers

Water needs for Corn based on soil temperature:

- 75 degrees Fahrenheit – 1 Inch water/week
- 85 degrees Fahrenheit – 2 inch water/week
- 95 degrees Fahrenheit – 4 inch water/week

2X Water requirements for every 10⁰F increase

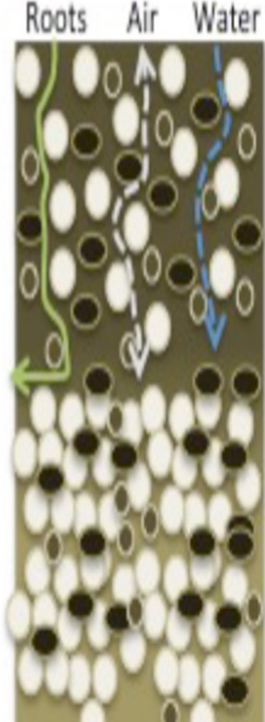
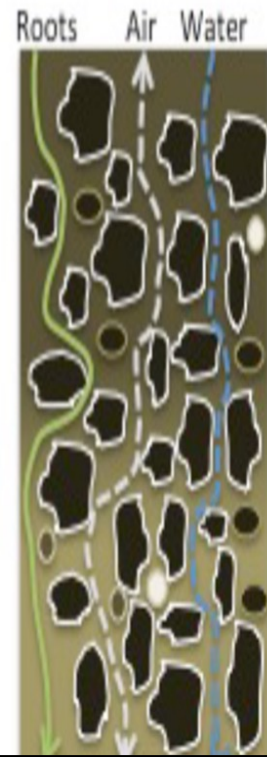
- 1" Rain = 8 bu. Corn, 6 bu. Wheat and 3.5 bu. soybeans
- 22" water needed for 200 bu. Corn
- Typical Ohio Rain = 19-23 inch/year in growing season
- 1" Rain fully used = 8 bu/A * \$4 = \$32/A

Heat and drought quickly increase yield losses!

By Elwynn Taylor, Iowa Ag. Climatologist

Highly Aggregated

Compacted Plow Layer



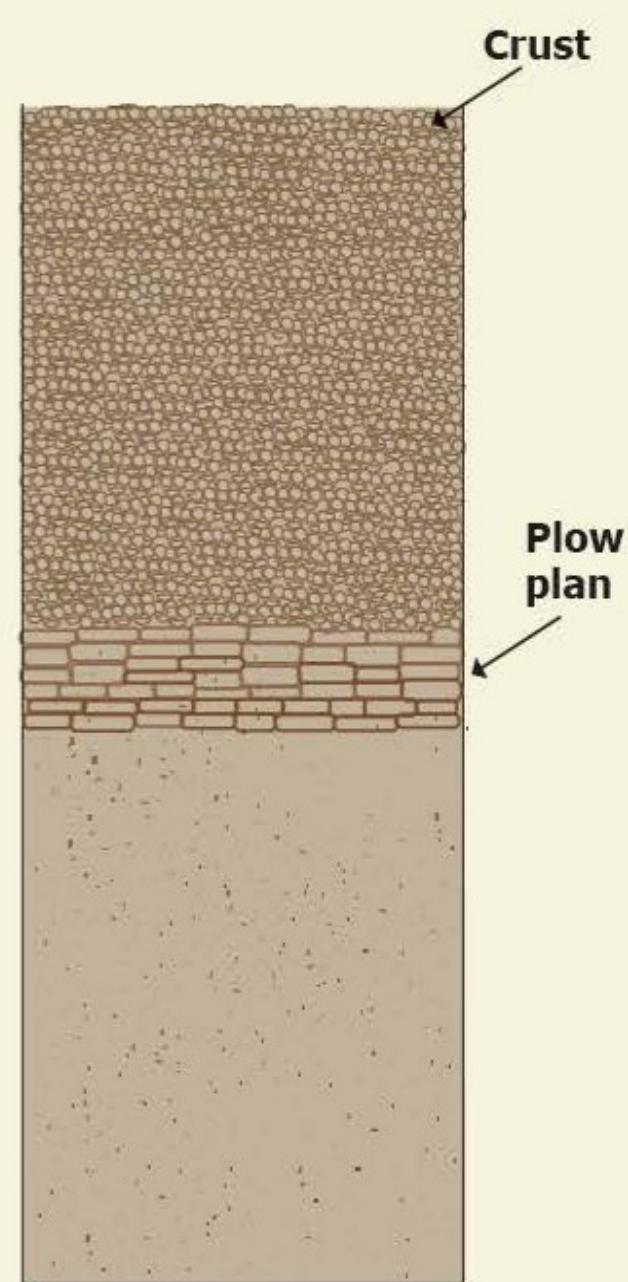
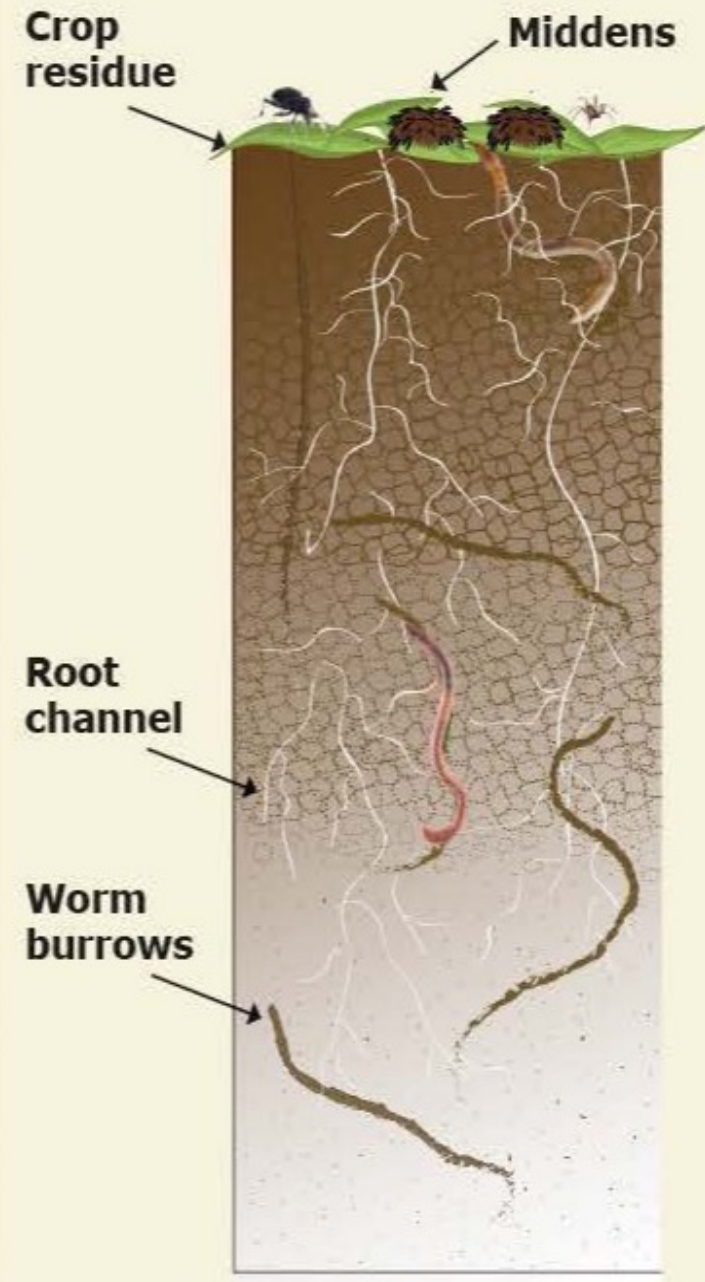
The more OM the deeper aggregates go.

This will happen with tillage and low OM soils.

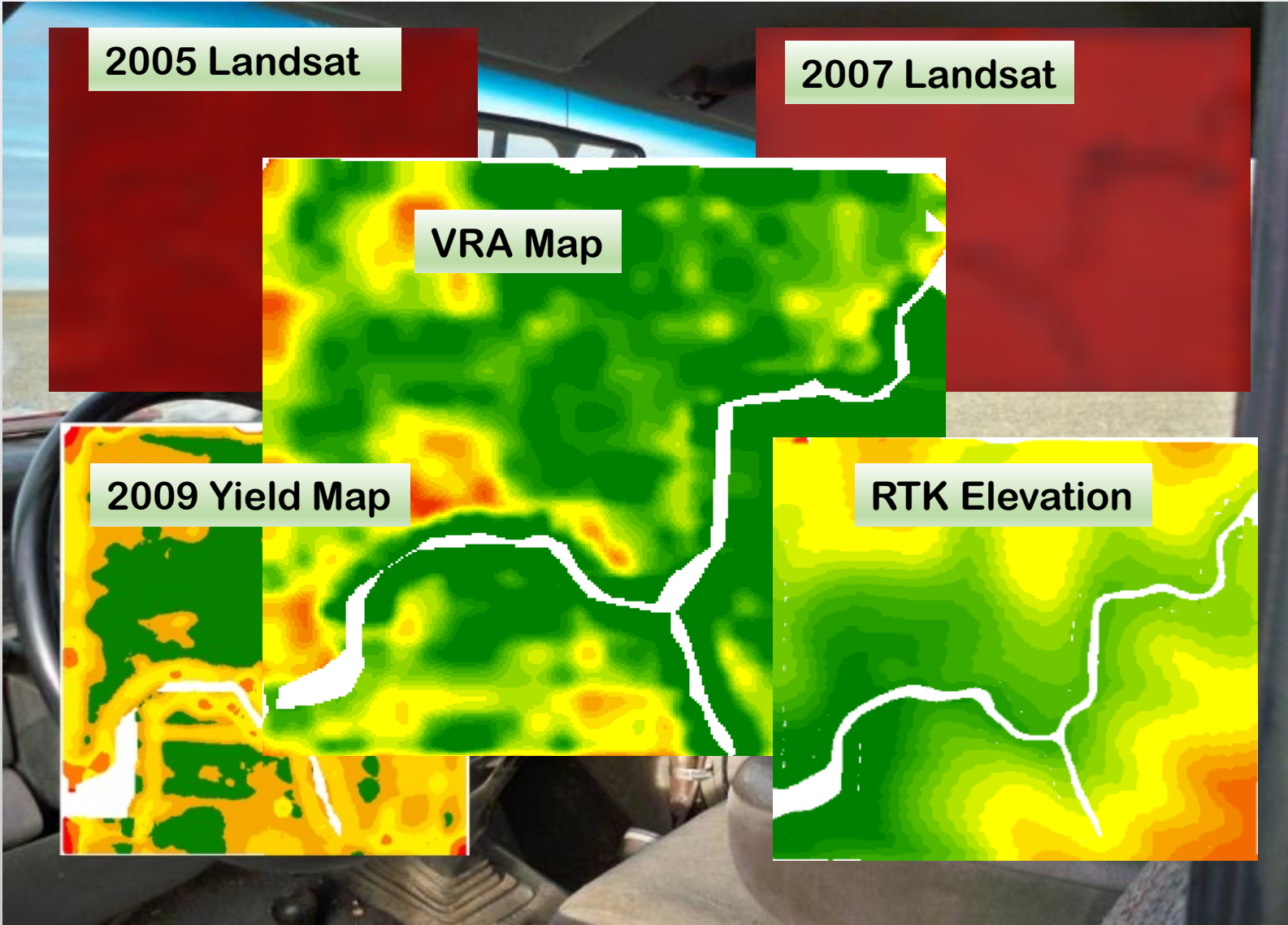
Root development, water and air movement within the soil are reduced when soils are compacted

No-till Ecosystem

Tilled Ecosystem



Sampling Zoned Field For VRA



Sample 0 to 6 inch
6 to 24 inch

There is nothing better than
the touch of your soil.



Assigning To A VRA Corn Map

We will VRA
Seed
Nitrogen
Phosphorus

Zone 1 145 bu



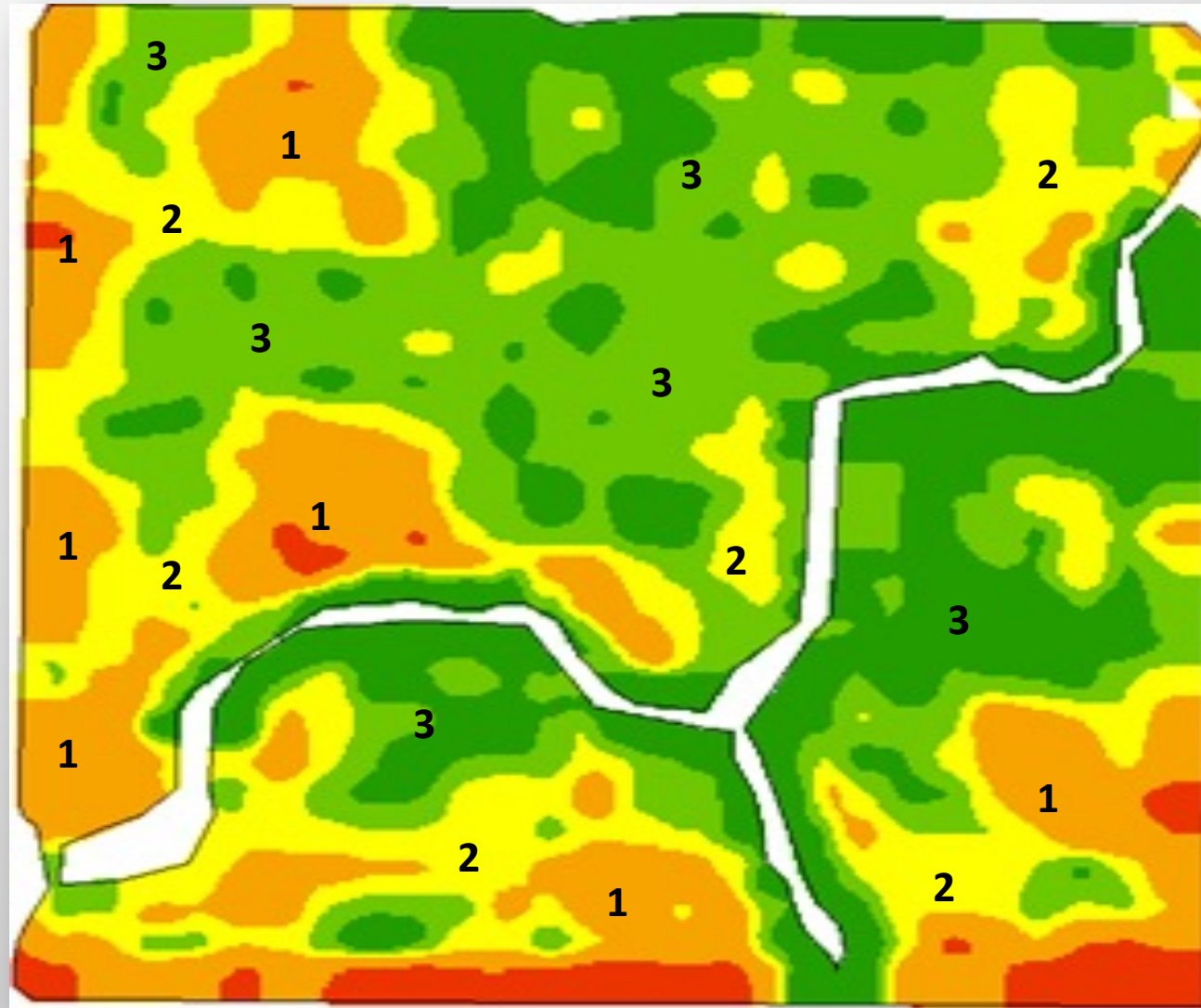
Zone 2 165 bu



Zone 3 185 bu



Corn population
22,000 to 28,000

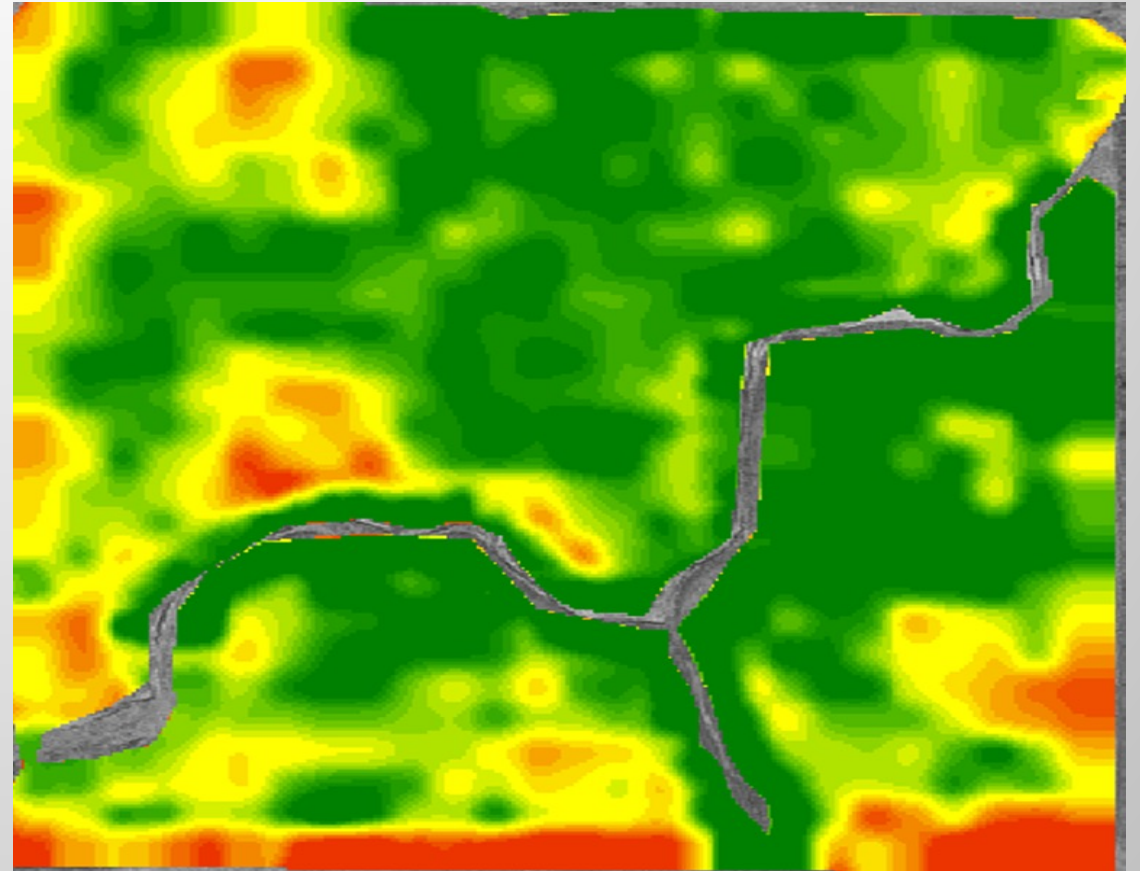


VRA Cover Crops

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)



Row Crop Fertilizer





Trash Whips

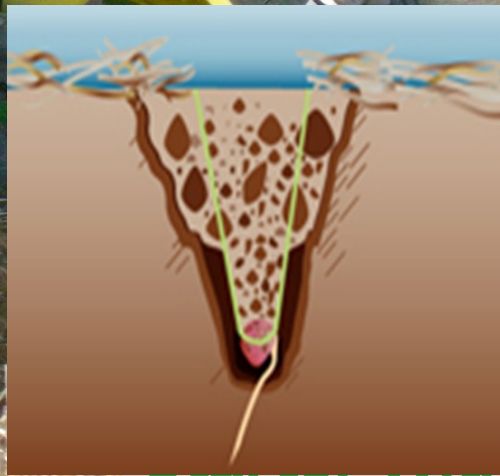
Seed Firmer With Mojo Wire

Closing Wheels

Mud Smith



Urea 3 inch's off row



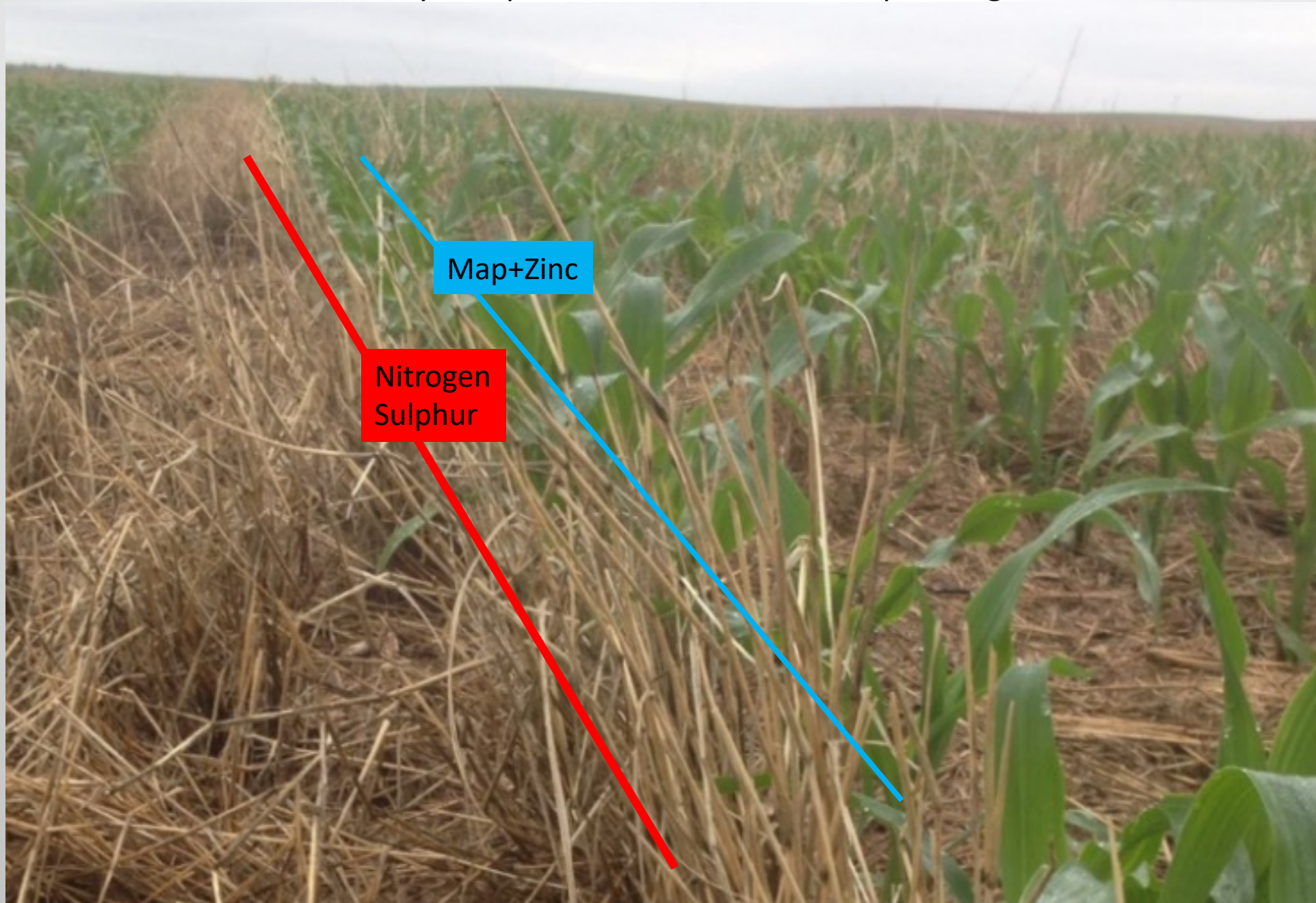
Control With The Seed



Went to 24 row planter
in 2021



We try and put all our fertilizer on at planting.



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

Seed + Starter



Urea

Starter



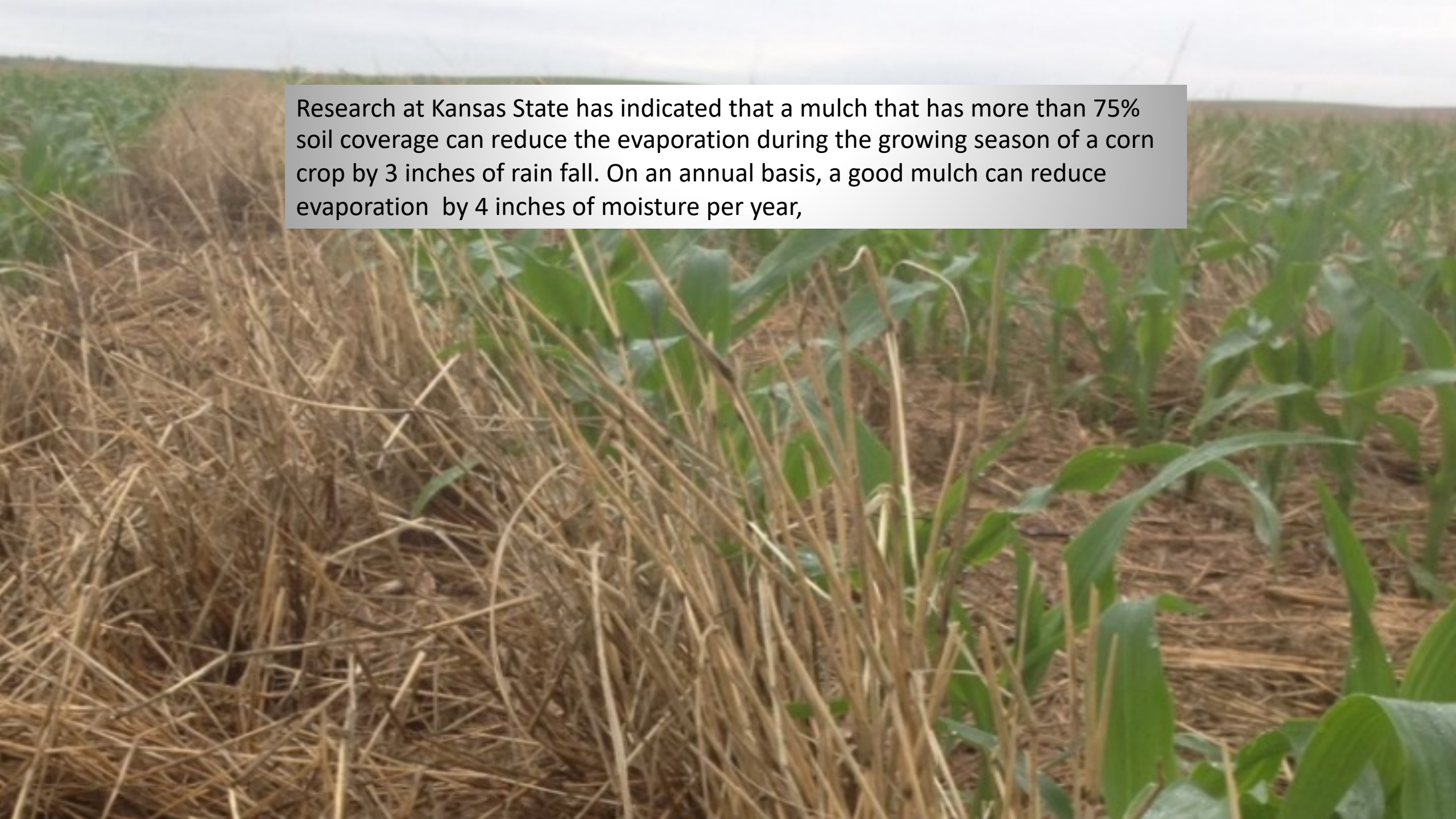


60 ft air seeder spring 2022



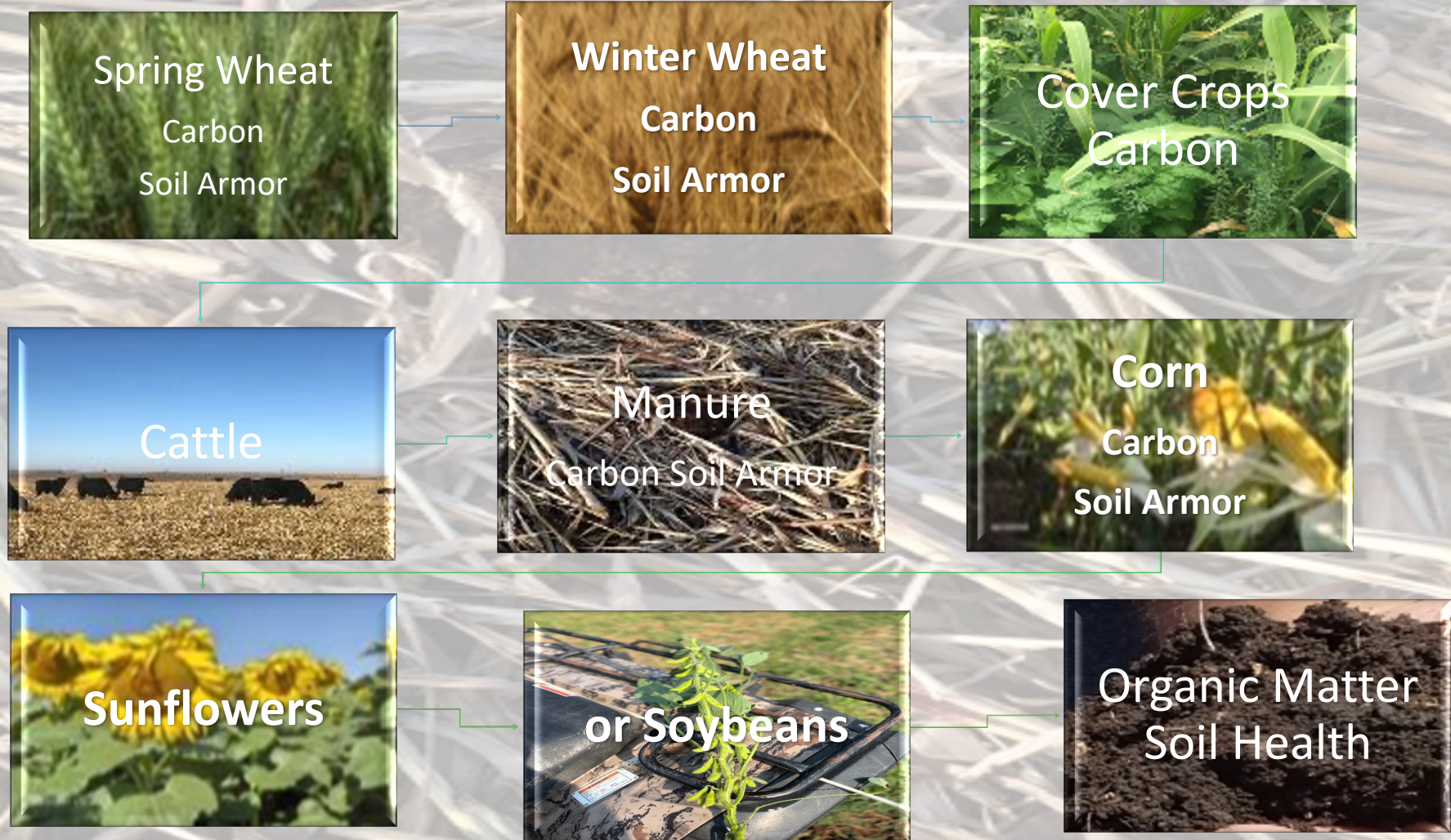
We will come back right at joint and stream UAN + ATS (when needed) to help finish our yield goal and assure adequate protein. We use 2.1 lbs. N/bushel





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,

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



First cover crop planted 2006 Canola – Indian Head Lentils

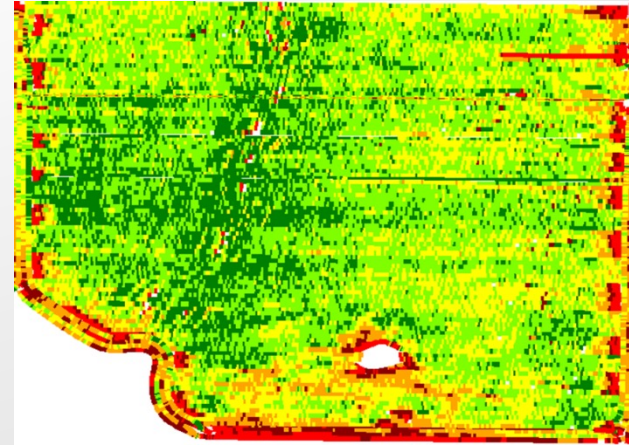
We received 13.7 inch's rain in 2006



2007 corn yield map

Yield 145 bushel

C:N 20/1



19.5 inch's moisture 2007



Color	Minimum	Maximum
■	152.82	or Greater
■	139.46	152.82
■	121.80	139.46
■	93.77	121.80
■	51.39	93.77
■	Less than	51.39

Cover Crop on Field Pea Stubble 2008

Up In Three Days



Oats 14 lbs.

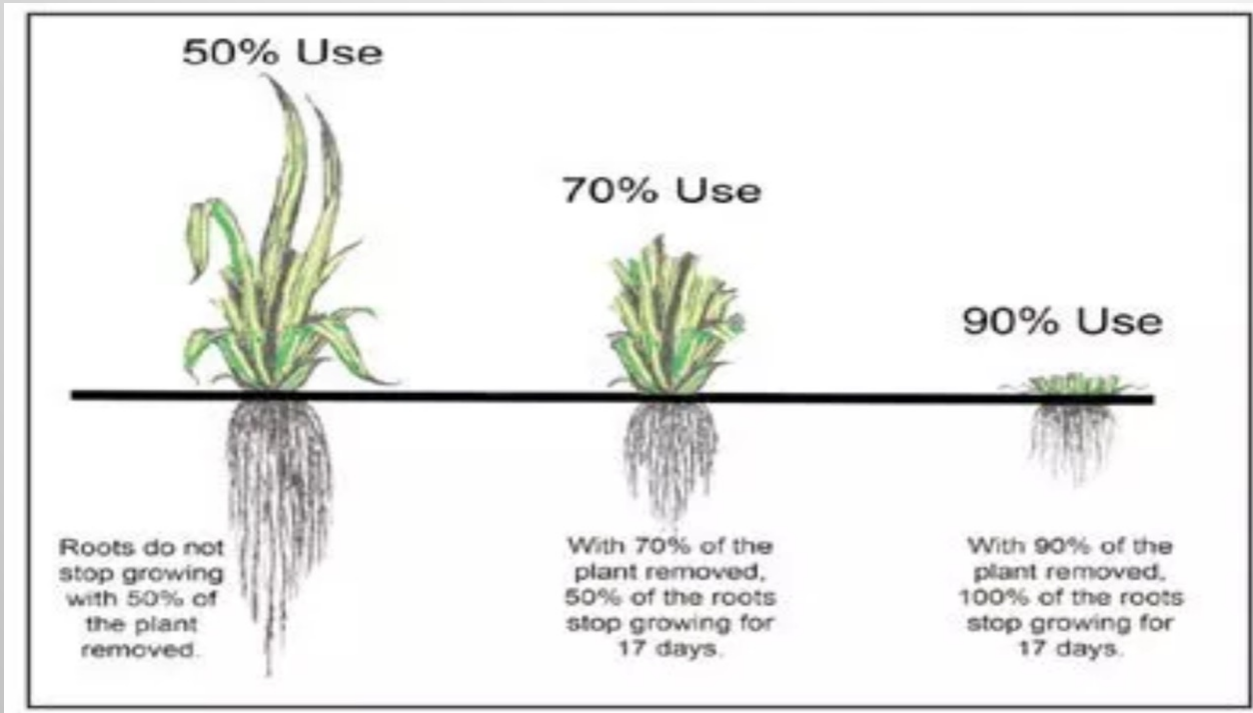
Turnips .5 lb.

Radishes 1 lb.

Lentils 10 lbs.

Fall/winter grazing of cover crops can increase livestock's plane of nutrition at a time when pasture forage quality can be low, and increases the soil biological activity on the cropland, improving the nutrient cycling.

Proper grassland management improves soil health.





Toby Stroh
Assistant Professor of Agriculture

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

Biomass 8,000 lbs. Grazed 66% = 5,280lbs. grazed 2,720 not grazed





SORGHUM-SUDANGRASS HYBRIDS

Mowing whenever stalks reach 3 to 4 feet tall and leaving six inches of stubble, increases root mass five to eight times compared with unmowed stalks, and force the roots to go deeper.

In addition, tops grow back and they will tiller and it will cause the roots to burrow 10 to 16 inches deep compared to 6 to 8 inches deep for unmowed plants.

Sudan grass

(Sorghum bicolor L. Moench)

- Warm Season, grass
- Annual
- Upright plant architecture
- Common names: Sudan grass, Sorghum
 - *Note: These were formerly separate species that have been combined*
- Medium water use
- Fair salinity tolerance
- Seeding depth: 1 inch
- Crude protein: hay 7-11%, silage 6-17%
- C:N ratio: 48 - 63
- Benefits from arbuscular mycorrhizal associations
- Self pollinator (wind)
- Stress conditions that limit growth (e.g., drought, frost) can contribute to prussic acid accumulation in leaves



Forestry Images



Harvesting carbon 3 weeks after haying



We harvest 3 ton of forage and then let the bull graze.
We plant 50% forage sorghum 30% pearl millet 20% piper Sudan grass





\$1.65 cost/day at 20* temp



Cost /day with feed wagon	\$1.65
Cover crop cost / day	<u>\$0.75</u>
Saving/day	\$0.90

\$585 saving / day

Net \$172/acre





Full season graze 2016-2017

Carbon Farming

Full season cover crops mix

		<i>Cost/ Lb</i>	<i>Full Seeding Rate</i>	<i>% Seeding rate</i>	<i>Seeding rate</i>	<i>Seed Cost</i>	
Grass	BMR Sorghum	\$ 1.05	21	16%	3.36	\$ 3.53	forms arbuscular mycorrhizal association
	BMR Corn	\$ 0.45	20	16%	3.2	\$ 1.44	forms arbuscular mycorrhizal association
	Piper Sudan	\$ 1.00	20	15%	3	\$ 3.00	forms arbuscular mycorrhizal association
	Oats	\$ 0.18	65	15%	9.75	\$ 1.76	forms arbuscular mycorrhizal association
	Forage barley	\$ 0.24	65	10%	6.5	\$ 1.56	forms arbuscular mycorrhizal association
Brassica	Kale	\$ 2.60	3	8%	0.24	\$ 0.62	Crude Protein 30%
	Collard	\$ 1.90	3	7%	0.21	\$ 0.40	
	Turnip	\$ 1.25	4	6%	0.24	\$ 0.30	Crude Protein 16%
Broadleaf	Flax	\$ 0.30	26	20%	5.2	\$ 1.56	Benefits arbuscular mycorrhizal
	Buckwheat	\$ 0.60	26	10%	2.6	\$ 1.56	Enhance soil P 24/1 pollinator
Legume	Forage Pea	\$ 0.38	50	11%	5.5	\$ 2.09	
				134%	39.8	\$ 17.82	

	C/N	38/1
	Grazing	9.2
Rating 10 good 1 poor	Drought	7.2
	Diversity	10
	OM increase	8.6
	Residue	6



Grazing cover crop
Planted July 7

Growth August 12



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



Ward Laboratories

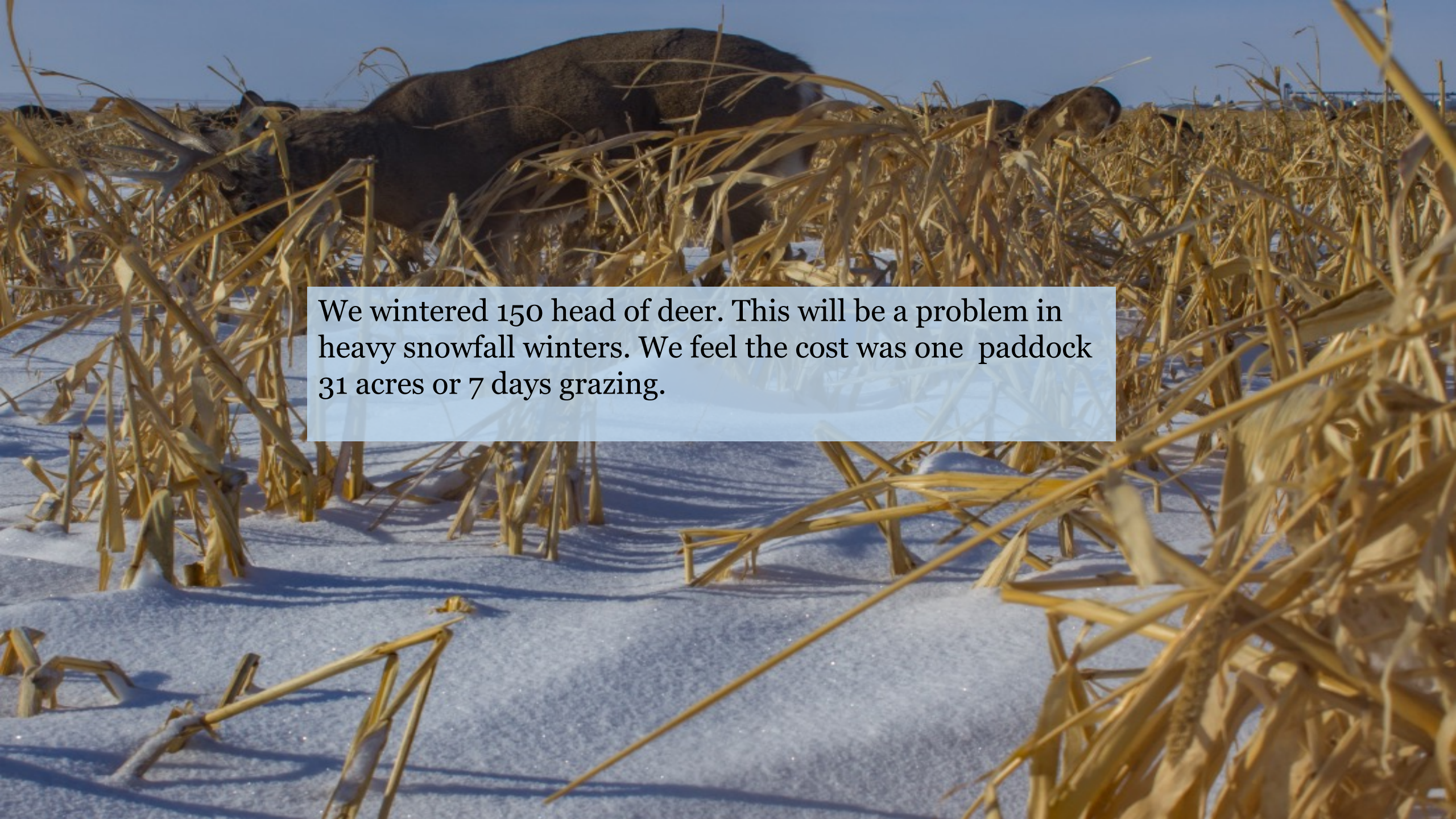
Cover Crop Yield, Ton/A @ 100 % Dry Matter

	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





		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

A photograph showing a deer in a field of dry, yellow corn stalks. The ground is covered in a layer of snow, and the sky is clear and blue. The deer is positioned in the middle ground, partially obscured by the stalks. A semi-transparent blue box with white text is overlaid on the center of the image.

We wintered 150 head of deer. This will be a problem in heavy snowfall winters. We feel the cost was one paddock 31 acres or 7 days grazing.

Heifers on full season covers November 15



Prevent plant going to spring wheat



Prevent plant going to corn



Rye flown and drilled on haled corn and soybeans that were under pivot



Four year old switch grass and big blue.



Carbon and Soil Organic Matter

Carbon is a key ingredient in soil organic matter (57% by weight).

Plants produce organic compounds by using sunlight energy and combining carbon dioxide from the atmosphere with water from the soil.

Soil organic matter is created by cycling or these organic compounds in plants, animals and microorganisms into the soil.

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

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

Water Holding Capacity

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

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

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.

Benefits of Healthy Soil: Value of Soil Organic Matter (SOM)

LOCAL (June 2022)

Nutrient	Fertilizer Replaced	Value of having 1% SOM (per Acre)
Nitrogen	UREA	1,000lbs × \$0.86/lb N = \$860
Phosphorus	MAP	100lbs × \$2.20/lb P = \$220
Potassium	POTASH	100lbs × \$0.61/lb K = \$61
Sulfur	AMS	100lbs × \$1.15/lb S = \$115
Carbon	--	10,000lbs × \$0.002/lb C = \$20
Total		\$1,276/acre

NATIONAL (May 2022)

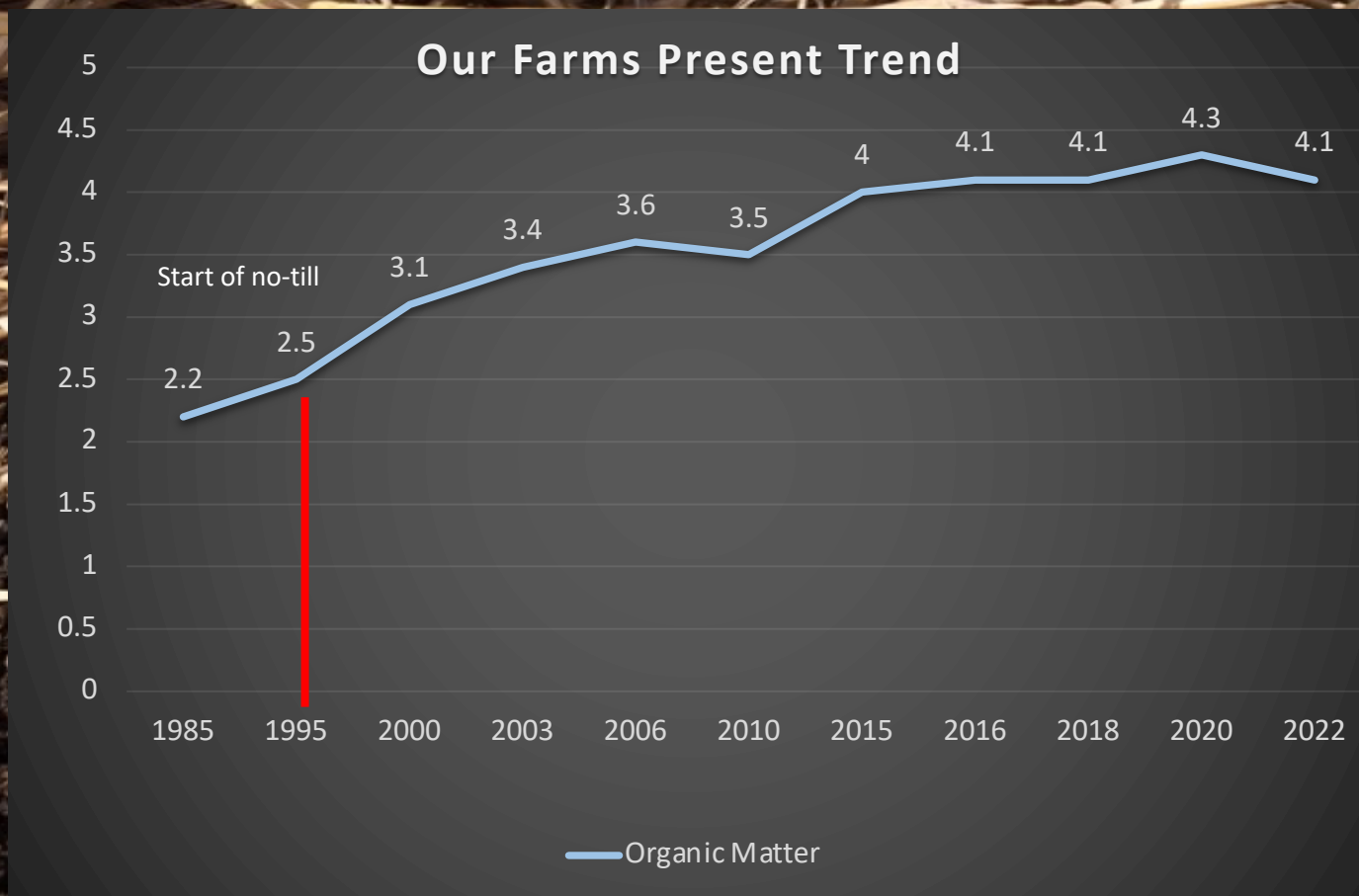
Nutrient	Fertilizer Replaced	Value of having 1% SOM (per Acre)
Nitrogen	UREA	1,000lbs × \$1.08/lb N = \$1,080
Phosphorus	MAP	100lbs × \$2.38/lb P = \$238
Potassium	POTASH	100lbs × \$0.60/lb K = \$60
Sulfur	AMS	100lbs × \$1.15/lb S = \$115
Carbon	--	10,000lbs × \$0.002/lb C = \$20
Total		\$1,513/acre

Compare to
\$680 in 2010!

Notes:

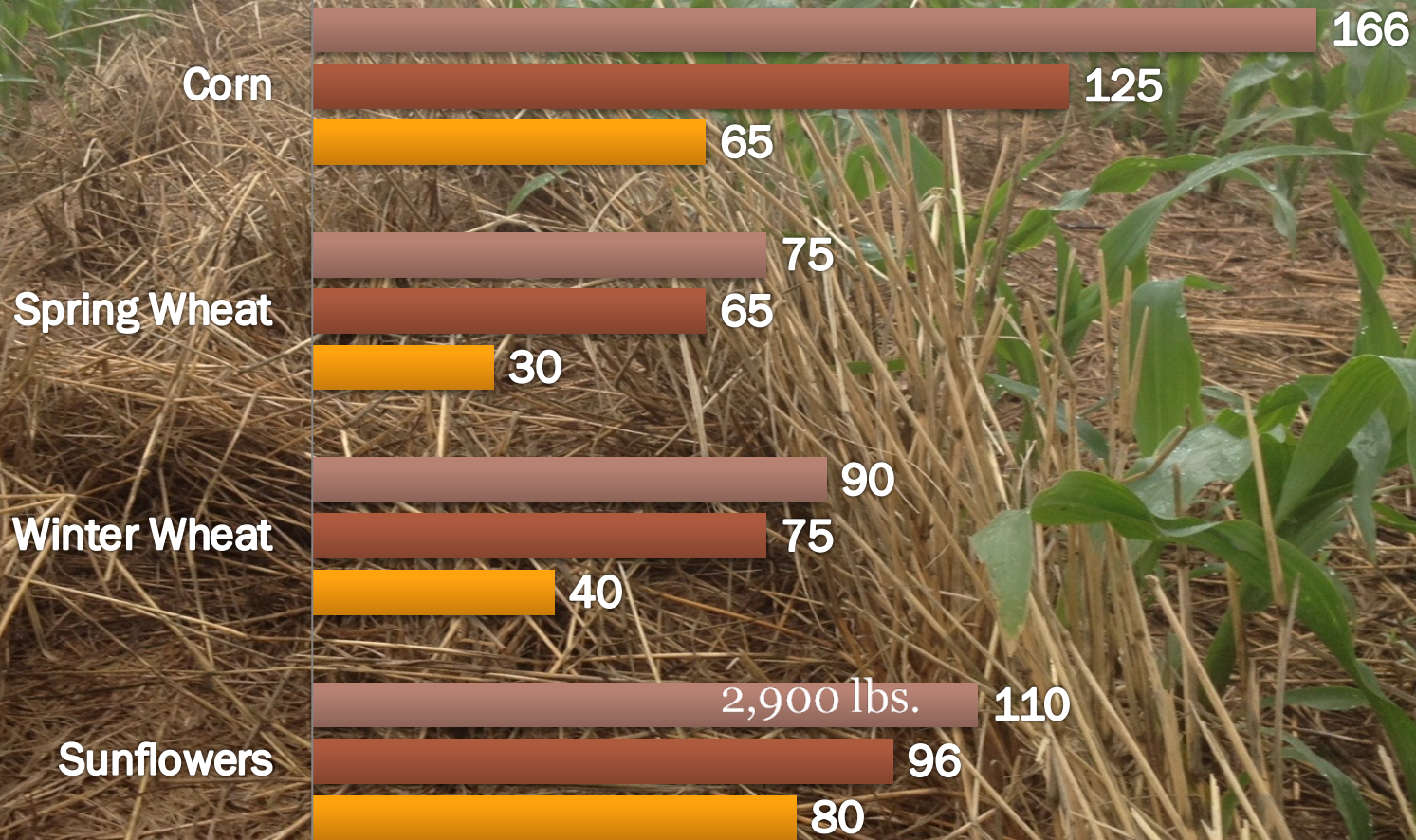
- Assuming 2,000,000 pounds soil in top 6 inches
- Assuming a C:N:P:K:S nutrient ratio of 100:10:1:1:1
- Calculations for 1% SOM, with 50% of the SOM from Carbon
 - Thus, 20,000lbs SOM & 10,000lbs C

How much organic matter is in the soil? How much do we need?



Yield Goals

■ 2011-2022 ■ 2002-2010 ■ 1996-2001



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



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

Central South Dakota Spring 2014



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 —

We live in such a fragile world



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

