“…haven’t you figured it out?”

From the winter issue of “the Practical Farmer”

The current project got underway in fall 2021 – but it isn’t the first time PFI members have tackled the question of fertilizer use on the farm…. From 1988-1993, farmers participating in PFI’s newly established Cooperators’ Program conducted 57 trials that compared their typical high fertilizer rate with a reduced rate of their choosing.

What's your Clover Worth? Investigating Nitrogen Credits Ahead of Corn

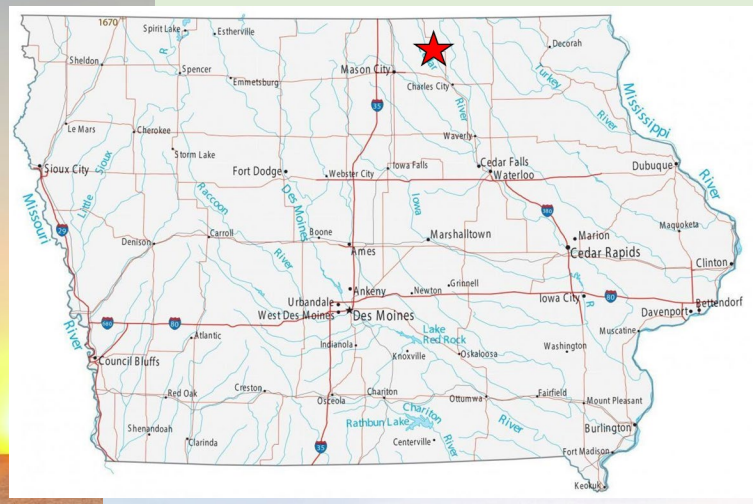
Alec & Rachel Amundson

Green Country Farms

Osage, IA

Who are we?

- Osage, IA
  - Mitchell & Floyd Co.
- Transition to the next generation
- Long history of conservation
  - No-till soybeans
  - Strip-till -> No-till
  - Cover Crops
  - Edge of field practices
    - CRP
    - Buffer strips
    - Bio-reactors
    - Tile water control structures
  - Small grains
    - Cereal Rye and Oats
    - Relay crop soybeans



OSAGE, IOWA
EST. GREEN COUNTRY 2017
FARMS

Why Clover?

- Cereal Rye works… now what?
  - Trying new things following small grain crop
- Can we grow nitrogen?
- PFI Small Grains Conference Feb. 2020
  - PFI Small Grain Cost Share/Oatly Program
    - Legume cover crop following a small grain
  - Learned about organic operations growing N

Year 1- 2018/2019 Bin field – Cereal Rye

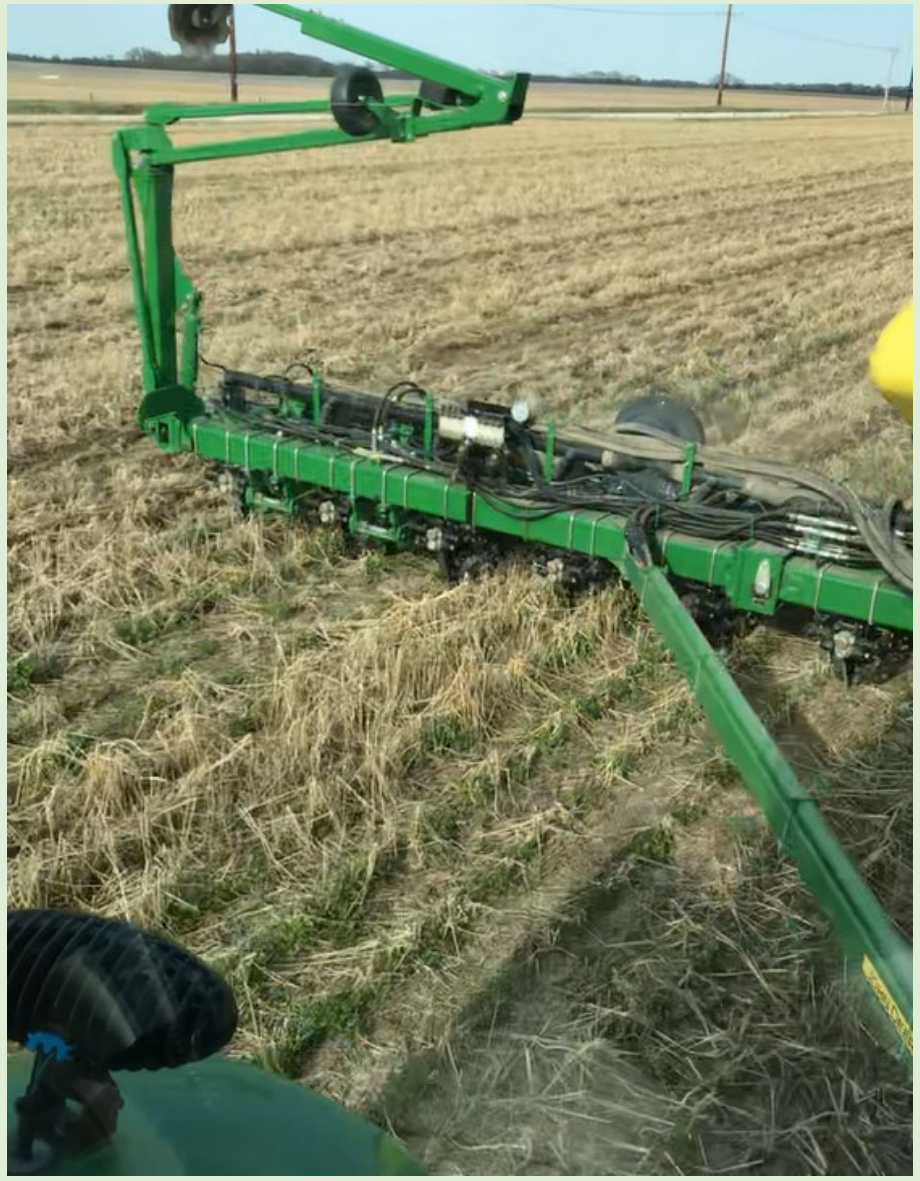
- Cereal Rye harvested 7/18 and sold for seed
- Sold straw to neighbor cattle producer
- Seeded diverse cover crop mix 8/1
  - 20 lb. Oats
  - 2 lb. radish
  - 2 lb. kale
  - 4 lb. medium red clover

August 8
1 week after seeding

September 14
6 weeks after seeding

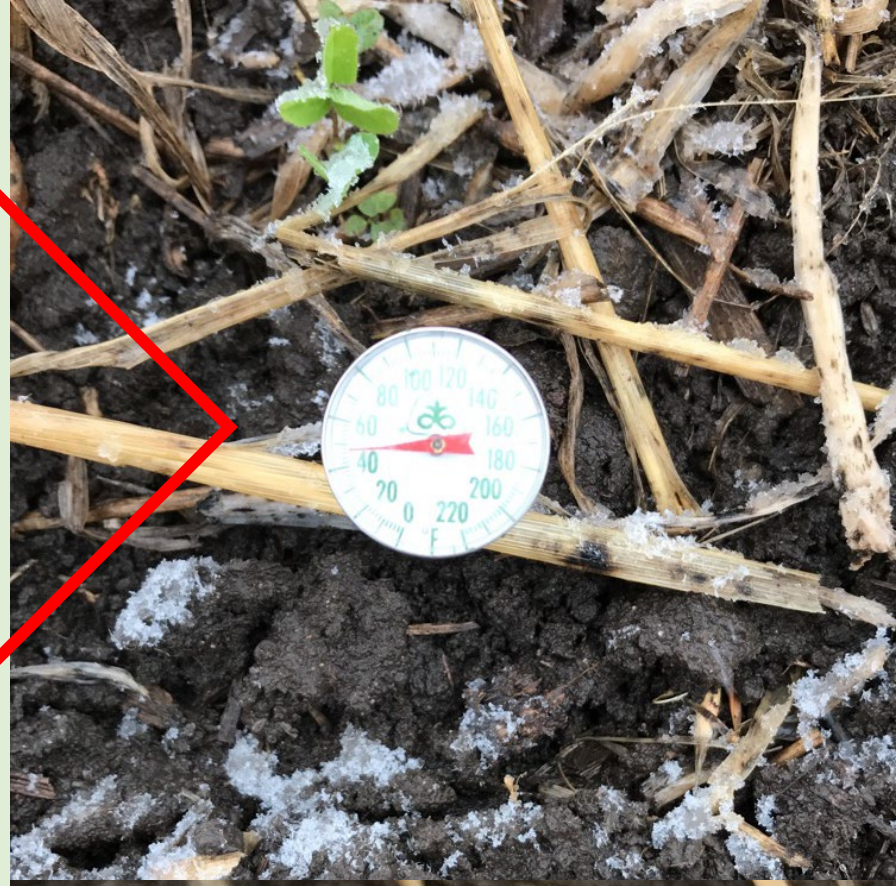
Year 1- 2018/2019 Bin field – Cereal Rye

- Spring 2019
  - Early spring = nice clover growth
  - Planted corn 4/26
  - Snowed on 4/28
  - Terminated cover crop 5/4 and finished planting
  - No difference in Nitrogen



Planting Day
Thick Cover
56° soil temp

2 days after
planting, AM snow
Furrow
48° soil temp



Planting Day
No cover
62° soil temp

2 days after
planting, PM snow
Furrow
44° soil temp

Year 1 – Lessons Learned

- Growing small grains leads to more cover crop opportunities
- Changes in soil
  - Tilth/Structure
  - OM increase??
- Strip-till might be a better option
- Have a planting/termination plan in place

Year 2- 2020/2021 40 – Cereal Rye

- 2020 Cereal Rye harvested for seed
  - frost seeded ~ 8 lb./ac. medium red clover 3/14
  - Harvested rye 7/23
  - Baled straw following harvest 7/27
  - Baled clover Late August
  - Strip-till 11/3/20 for 2021 corn crop


JOHN DEERE
Herd
SURE-FEED
BROADCASTER
BL 4880

Post Harvest- 9/5

Year 2- 2020/2021 40 – Cereal Rye

- Spring 2021
  - planted corn 4/27
  - Terminated clover 4/28
  - Left trial strip- sprayed 5/21 & 6/5
- Left N strips as a trial

Year 2- Lessons Learned

- Inconsistent stands
  - Spreader
  - Surface water
  - Thick canopy of rye
- Strip-till led to better emergence of corn
- Terminate early, terminate often (or be prepared to)
- Neighbors notice your “trials” quicker when on a hard surface road ☺

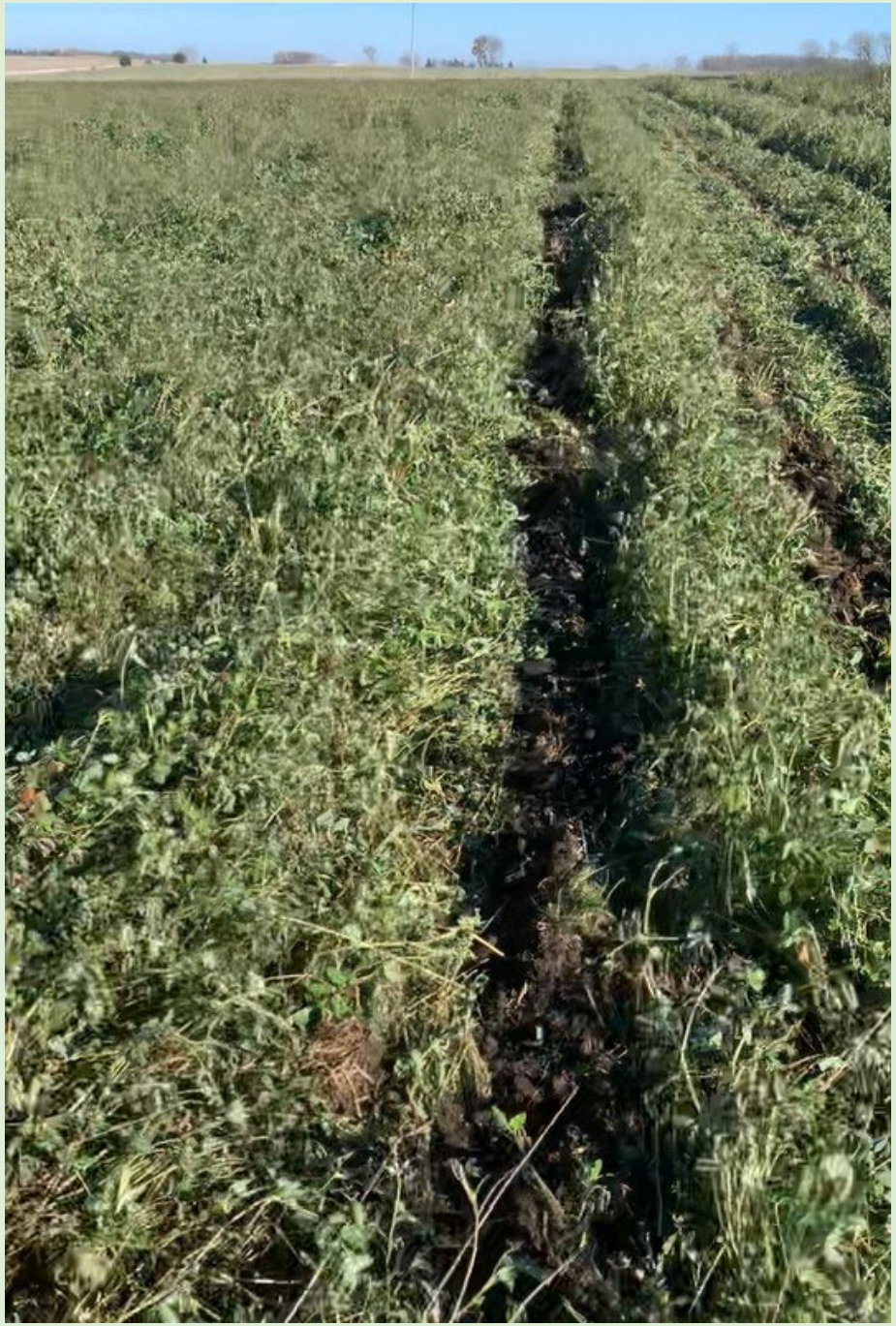
Year 3- 2021/2022 Hirota – Oats & Cereal Rye

- “Frost” seeded Medium Red Clover into cereal rye and oats 3/22
  - ~6 lbs/ac
  - Warm and dry
- Oats seeded 4/2
- “Super Seeder”
  - Sprayer frame
  - Gandy box


Grady

Year 3- 2021/2022 Hirota – Oats & Cereal Rye

- Oats harvested 8/3
- No clover harvest
- Strip-tilled 11/6



Year 3- 2021/2022 Hirota – Oats & Cereal Rye

- Strips freshened 5/13
- Corn planted 5/14
- Clover terminated 5/14, clean up 6/7
- “Official” PFI Nitrogen trial

Year 3- Lessons Learned

- Much better clover stand in oats, poor stand in rye
- Manage clover in the fall, too much material to strip-till or plant into
- Termination Plan B is a must!
- Nitrogen trial
- Assess water use of clover for termination timing

Year 4- 2022/2023 Adam's – Oats & Cereal Rye

- "Frost" seeded Medium Red Clover into cereal rye and oats 3/16
  - ~7 lbs./ac.
  - Mud and snow
- Oats "frost" seeded 3/29
  - Sat dormant for 3-4 weeks


JOHN DEERE 24T

Year 4- 2022/2023 Adam's – Oats

- Oat harvest 8/1
  - Straw baled 8/5
- Chopped for feed 10/3ish
  - 3.5 tons per acre
- Strip-tilled 11/6

Crude Protein - 18.7% DM
Relative Feed Value - 142

3.5 tons/ac wet tons

CLOVER

SAMPLE INFORMATION			
Lab ID:	32780 280	Version:	1.0
Crop Year:		Series:	
Feed Type:	GRASS FORAGE	Cutting#:	
Package:	BASIC NIR		

NIR ANALYSIS RESULTS	
Moisture	57.9
Dry Matter	42.1

PROTEINS	% SP	% CP	% DM
Crude Protein			18.7
Adjusted Protein			18.7
Soluble Protein		27.8	5.2
Ammonia (CPE)	17.3	4.8	0.90
ADF Protein (ADICP)		9.7	1.82
NDF Protein (NDICP)		19.2	3.59
NDR Protein (NDRCP)			
Rumen Degr. Protein		63.9	12.0
Amino Acid Protein, Total		68.4	12.81

FIBER	%NDFom	NDFom %DM	% NDF	% DM
ADF			74.9	31.5
aNDF		40.6		42.1
NDR (NDF w/o sulfite)				
Crude Fiber				
Lignin			15.3	6.43
NDF Digestibility (12 hr)	41.8	17.0	40.4	17.4
NDF Digestibility (24 hr)				
NDF Digestibility (30 hr)	53.4	21.7	52.0	21.9
NDF Digestibility (72 hr)				
NDF Digestibility (120 hr)	58.8	23.9	57.3	24.1
NDF Digestibility (240 hr)	62.0	25.2	60.4	25.4
uNDF (12 hr)	58.2	23.6		
uNDF (30 hr)	46.7	18.9	48.0	20.2
uNDF (120 hr)	41.2	16.7	42.7	18.0
uNDF (240 hr)	38.0	15.4	39.6	16.7

CARBOHYDRATES	% Starch	% NFC	% DM
Silage Acids		3.1	0.9
Ethanol Soluble CHO (ESC-Sugar)		36.2	10.7
Water Soluble CHO (WSC-Sugar)			15.7
Starch		3.0	0.9
Soluble Starch			
Soluble Fiber		47.5	14.0
Starch Dig. (7 hr, 4 mm)			
Crude Fat			2.64
Fatty Acids, Total			1.32
C16:0			0.32
C18:0			0.05
C18:1			0.07
C18:2			0.30
C18:3			0.53
Unsaturated Fatty Acids (RUFAL)			0.90
Fatty Acids (%Fat)			50.0

Values in bold were analyzed by wet chemistry methods.

MINERALS	
Ash (%DM)	10.6
Calcium (%DM)	1.26
Phosphorus (%DM)	0.32
Magnesium (%DM)	0.31
Potassium (%DM)	2.79
Sulfur (%DM)	0.21
Sodium (%DM)	
Chloride (%DM)	
Iron (PPM)	
Manganese (PPM)	
Zinc (PPM)	
Copper (PPM)	
Molybdenum (PPM)	

QUALITATIVE	
pH	5.76
Total VFA (%DM)	0.91
Lactic Acid (%DM)	0.41
Lactic as % of Total VFA	45
Acetic Acid (%DM)	0.50
Butyric Acid (%DM)	
1, 2 Propanediol (%DM)	
Nitrate Ion (%DM)	
Nitrate-Nitrogen, ppm	

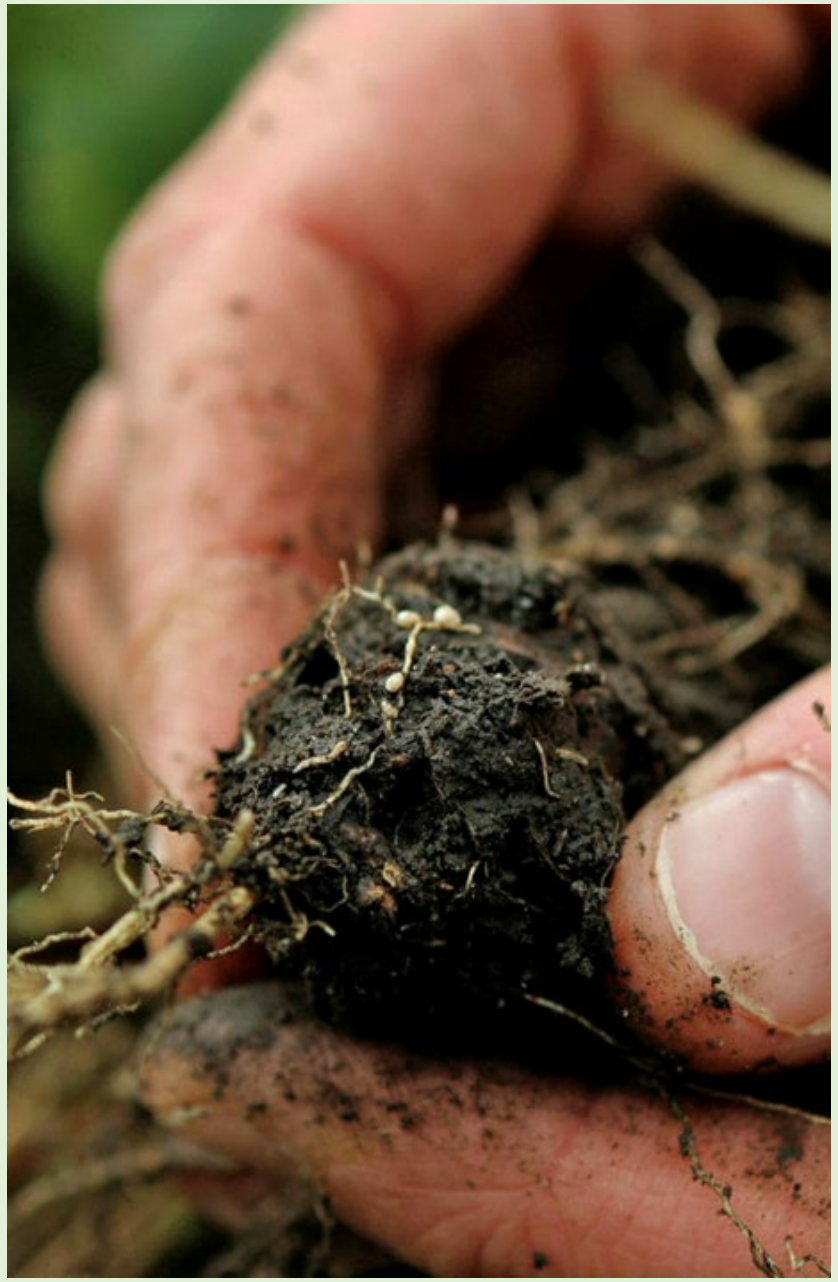
Soil Contamination Probability	Probable low to none
NIR Statistical Confidence	Good prediction potential

ENERGY & INDEX CALCULATIONS	
TDN (%DM)	59.1
Net Energy Lactation (Mcal/lb)	0.60
Net Energy Maintenance (Mcal/lb)	0.60
Net Energy Gain (Mcal/lb)	0.34
ME (Mcal/lb)	0.99
AA Protein as % of Total Protein	68.4
NDF Dig. Rate (Kd, %HR, Van Amburgh, Lignin*2.4)	5.12
NDF Dig. Rate (Kd, %HR, uNDF)	5.1
Starch Dig. Rate (Kd, %HR, Mertens)	
Relative Feed Value (RFV)	142
Relative Forage Quality (RFQ)	156
Milk per Ton (lbs/ton)	3063
Dig. Organic Matter Index (lbs/ton)	593
Non Fiber Carbohydrates (%DM)	29.6
Non Structural Carbohydrates, ESC (%DM)	11.6
Non Structural Carbohydrates, WSC (%DM)	16.6
DCAD (meq/100gdm)	
Summative Index % (Mass Balance)	98.9

Additional sample information, submitted documents and lab pictures linked to QR code

Clover as N source

- Medium Red Clover
  - Winter annual legume
  - Nodules fix atmospheric nitrogen
  - Improves soil tilth- tap root
  - Weed control- early growth
- Less GHG emissions/dependency on fossil fuels



Clover as N source

- https://cropwatch.unl.edu/2016/nitrogen-fixation-oversold-legume-cover-crops
- Legumes scavenge soil N before fixing their own
  - Amount of N released back in soil is dependent on plant concentration
  - Concentration dependent on plant size and maturity- accumulation of biomass
- Winter annual legumes (crimson clover, vetches) are around 3% N (18% to 20% crude protein)
  - perennial pasture legumes (red clover, white clover, alfalfa) up to 4% N (25% crude protein)
  - Summer annual legumes (cowpea, mungbean, soybean, sunn hemp) are often around 2% N (12% to 14% crude protein)

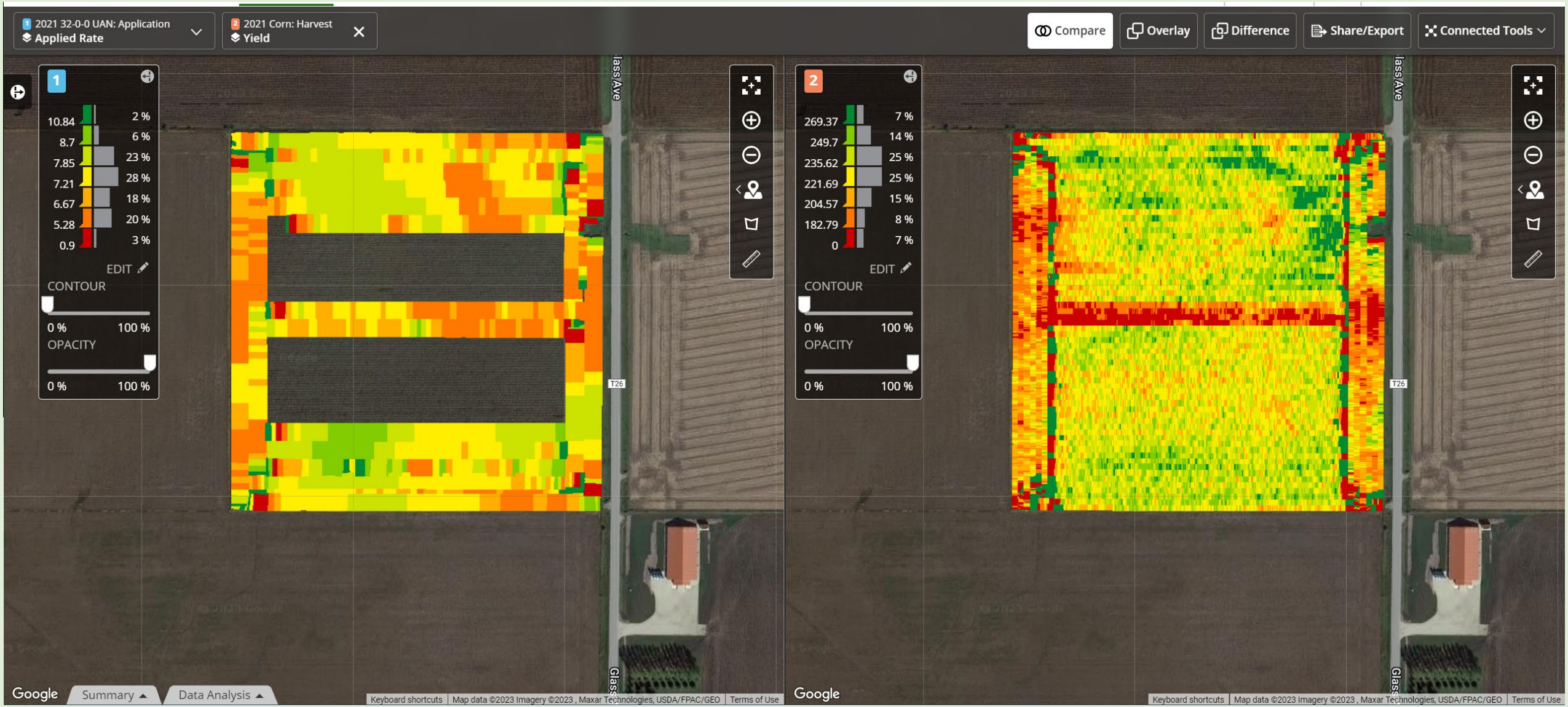
Clover as N source

- https://extension.psu.edu/management-of-red-clover-as-a-cover-crop
- In a Wisconsin study, red clover produced up to 160 lbs/ac of N
- A similar Pennsylvania study showed that a one-year-old red clover stand (without harvest) contributed 70 lbs of N year one and 50lbs year two
- Guidelines from Michigan use the following formula to calculate the pounds of nitrogen supplied per acre by a terminated red clover stand
  - 30 + 0.30 x % stand, where 100 percent is five to six plants per square foot after at least one year of growth
- Establish clover stand early and expect more benefits
- Cutting red clover may stimulate new growth & additional nitrogen fixation
  - If forage is removed from the field, some of the benefits will be lost

Clover as N source

- https://practicalfarmers.org/2018/12/grow-your-own-nitrogen/
- A 2013 Cornell University study found that much of that nitrogen is accessed by the cash crop grown two years after the legume cover crop
- As the residue from legume shoots and roots decomposes, the nitrogen in the residue becomes organic matter in the soil
  - Decomposition takes time
  - This builds soil's capacity to supply nitrogen
  - repeated use of legume cover crops can help farmers lessen their reliance on nitrogen fertilizer

2021 Nitrogen Trial (“unofficial”)



2021 Nitrogen Trial ("unofficial")

- 190 lbs. N
  - 15 lbs. w/ fall strip-till
  - 25 lbs. 32%+ATS w/ planter
  - 125 lbs. 32% @ V4 sidedress
  - 25 lbs. 32% @V9 Y-Drop
- 165 lbs. N
  - 15 lbs. w/ fall strip-till
  - 25 lbs. 32%+ATS w/ planter
  - 125 lbs. 32% @ V4 sidedress

Nitrogen Rates	Yield (bu/ac)	N use efficiency (lbs/bu)
190 lbs. N (North)	255.51 bu/ac	0.74 lbs/bu
165 lbs. N (North)	253.55 bu/ac	0.65 lbs/bu
190 lbs. N (South)	250.05 bu/ac	0.76 lbs/bu
165 lbs. N (South)	246.43 bu/ac	0.67 lbs/ac

North $ breakdown

1.96 bu/ac * $5.50 = $10.78/ac

25lbs * $0.40/lb = $10/ac savings

Plus app cost $12.50/ac

~$11.75 advantage to no additional N

South $ breakdown

3.62 bu/ac * $5.50 = $19.91/ac

~$10 N savings, $12.50 app cost

~$2.50 advantage to no additional N

2022 Nitrogen Trial (PFI Official)

2022 Nitrogen Trial (PFI Official)

- High Rate: 175 lbs. nitrogen
  - 20 lbs. w/ fall strip-till
  - 25 lbs. 32%+ATS w/ planter
  - 130 lbs. 32% w/ sidedress
- Mid Rate: 150 lbs. nitrogen
  - 20 lbs. w/ fall strip-till
  - 25 lbs. 32%+ATS w/ planter
  - 105 lbs. 32% w/ sidedress
- Low Rate: 125 lbs. nitrogen
  - 20 lbs. w/ fall strip-till
  - 25 lbs. 32%+ATS w/ planter
  - 80 lbs. 32% w/ sidedress
- Option to Y-drop remaining 25lbs

Nitrogen Rates	Yield (bu/ac)	N use efficiency (lbs/bu)
175 lb/ac	233.08 bu/ac	0.75 lbs/bu
150 lb/ac	224.69 bu/ac	0.67 lbs/bu
125 lb/ac	220.57 bu/ac	0.57 lbs/bu

High vs Low $ breakdown

12.50 bu/ac * $6.75/bu = $84.38/ac

50lbs/ac * $0.75/unit =

$37.50/ac loss to cut 50lbs

High vs Middle $ breakdown

8.39 bu/ac * $6.75.bu = 56.63

25lbs/ac * $0.75/unit =

$18.75/ac loss to cut 25lbs

Nitrogen trials-Lessons Learned

- Our N program is already fine-tuned
  - N up front
- Can comfortably cut 25 pounds with minimal yield drag
  - Nitrogen is a moving target
  - Weather driving factor
  - Have a backup plan ready
- Need to consider N costs and yield potential

Do’s and Don'ts of planting clover

- Seed early
  - spring seeding provides better growth in fall
- Don’t overdo it
  - 6-8 pounds will make a great stand
- Broadcast evenly
- Oats work best, limited success in rye
- Can manage broadleaf weeds with MCPA
- Mow or manage plant size

Do’s and Don'ts of planting corn into clover

- Strip-till
  - Large taproots, lots of biomass
  - Clover “makes the ground hard”
  - Will be green and growing long before planting
- Termination
  - Plan A, B, maybe C
  - Terminate early, but need active growth
  - Pay attention to weather, concentrate on corn growing conditions

The Perfect Rotation: Soybean-Oat/Clover-Corn

- 4+ crops in 3 years
  - Better with livestock
- Opportunity for multiple sales
  - Oats can be competitive with corn and soy
  - Straw adds $50-200/ac
  - Clover adds $75-150/ac
- Spread N costs over multiple years
  - 50-60 lbs on oats
  - -25 lbs on corn
  - Compare to soy-corn-corn
- Opportunity for cost-share
- Non-financial benefits
  - Soil health
  - Pollinators


Thank You!!