# Results from the 2020 Season

## Presentation to NRCS 3.16.2021

This On-Farm Trials project is funded through a Conservation Innovation Grant to Brookside Labs, Inc. (www.blinc.com). Brookside Labs affiliated crop consultants are conducting the trials as part of the Amplify Network (https://www.amplifytogether.com/about-us).

Brookside Labs also owns NutrientStar, a program to share information about nutrient use efficiency tools and technologies. This presentation as well as data and updates about the project will be posted at www.nutrientstar.org for the benefit of all farmers and agricultural consultants.

# CIG On-Farm Trials

## On-Farm Evaluation Partnership to implement enhanced efficiency fertilizer trials using new scientific protocol and an adaptive management approach

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NutrientStar

# Results from the 2020 Season

## Presentation to NRCS 3.16.2021

# Agenda

- ★ Review project goals & objectives
- ★ Team member roles
- ★ Social science pre-project summary
- ★ Getting trials on the ground
- ★ Trial layout & protocol
- ★ Aggregate Data Presentation
- ★ Discuss individual trial examples
- ★ What are we learning?
- ★ Q&A

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# Project Goal

- Design, implement and demonstrate a systematic method for public and private partners to conduct scientifically robust on-farm evaluations using an adaptive management approach that can lead to greater farmer adoption of EEF technologies.

# Project Objectives

- 1) Establish a locally-driven, expert-supported On-Farm Evaluation Partnership combined with an adaptive nutrient management approach by carrying out a total of 150 on-farm trials testing EEFs over three planting seasons with 20 crop advisors and 50 farmers across 4 states;
- 2) Document and evaluate the environmental, economic, social and production impacts from the adaptive management process used by the On-Farm Evaluation Partnership;
- 3) Document the environmental and economic impacts of EEFs for farmers with a variety of soils, climate, farm operations and practices;
- 4) Work with NRCS and other partners to develop and disseminate trainings, field days and educational materials to facilitate transfer of the On-Farm Evaluation Partnership model to other areas.

# Our Team

John McGuire – Project Lead

Karen Chapman - Project coordinator

Tom Morris - Science and analysis

Geoffrey Ecker - Participant as well as science and analysis

Rob McGuire - Network coordinator

Emily Usher - Purdue - Social Science Data Analyst

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2020 Trial locations
Thunder Bay
Superior National Forest
Grand Forks
NORTH DAKOTA
Bismarck
Fargo
Duluth
Sudbury
Algonquin Provincial Park
Ottawa
MINNESOTA
St Cloud
Minneapolis
SOUTH DAKOTA
WISCONSIN
Green Bay
Oshkosh
Rochester
Sioux Falls
Madison
Milwaukee
Grand Rapids
Toronto
Mississauga
London
Buffalo
Kingston
Rochester
NEW YORK
Sioux City
Rockford
Detroit
Chicago
IOWA
Des Moines
Cedar Rapids
Naperville
Cleveland
NEBRASKA
Omaha
Lincoln
Peoria
PENNSYLVANIA
Pittsburgh
ILLINOIS
Springfield
INDIANA
OHIO
Columbus
Indianapolis
Cincinnati
Kansas City
Columbia
St. Louis
Washington
KANSAS
MISSOURI
Louisville
WEST VIRGINIA
Wichita
Springfield
Mark Twain National Forest
Evansville
Lexington
KENTUCKY
Richmond
VIRGINIA
Roanoke
Norfolk
CHEROKEE NATION
Nashville
OKLAHOMA
Oklahoma City
Knoxville
Greensboro
Durham
TENNESSEE
Memphis
Chattanooga
Charlotte
CHICKASAW NATION
CHOCTAW NATION
Atlanta
Wilmington
SOUTH CAROLINA
MISSISSIPPI
Birmingham
Tuscaloosa
Dallas
Fort Worth
Abilene
Shreveport
ALABAMA
Montgomery
GEORGIA
Charleston
Jackson
Columbus
Savannah

# Pre-Project CCA Interviews

- ★ CCAs believe conservation = efficiency
- ★ Most use and understand potential EEF benefits
- ★ Challenge is knowing where and when to use them
- ★ Products need proof of concept in own fields
- ★ CCAs like data-driven approach
- ★ Trials strengthen relationships, bring new data & information, potentially bring economic benefits

# Process for Establishing Trials

- Recruit CCAs/farmers
- Set up databases
- Provide protocol, answer questions
- Buy & ship product
- Map field trial boundaries (shape files)
- Shepherd trial implementation @ season kickoff
- Collect stalk sampling, imagery, field data

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# Trial data collection & analysis

- CCAs input management data into online database
- Rob does QA/QC (check/clean)
- Geoffrey collects rainfall data
- Harvest data (monitor) collected
- John sends individual data sheets back to CCAs
- Tom & Geoffrey aggregate and analyze data
- Aggregate & example individual data presented

# N stabilizers evaluated

| Product and Cost | Type of Stabilizer | Stabilizer mixed with | Fertilizer components |
|---|---|---|---|
| Anvol (Koch) ($0.069/lb) | Urease inhibitor | Urea and UAN | Urea = 100% urea<br>UAN = 50% urea + 25% ammonium + 25% nitrate<br>Anhydrous ammonia = 100% ammonia gas<br>Liq. Manure = mix of ammonium and organic N |
| Centuro (Koch) ($0.014/lb) | Nitrification inhibitor | UAN and AA | |
| Instinct II (Corteva) ($13.12/acre) | Nitrification inhibitor | UAN, AA and Liquid manure | |
| N-Serve (Corteva) ($11.95/acre) | Nitrification inhibitor | AA | |

BD-Ntrust (Biodyne) ($7.50/acre) is a proprietary blend of Biodyne's best-in-class beneficial microbial consortium, organic acid complexes, and chelated micronutrient technologies – use with UAN

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# Trial requirements

- Minimum 600’ strip length
- Each strip = 2 combine widths
- 4 replications of each treatment
- Input field history data into online database
- Collect yield data from calibrated monitor
- Stalk nitrate sampling from each strip
- Must participate in Purdue interviews
- Must attend review meetings for both CCA/grower

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# Treatments used to evaluate stabilizers

T1 = Farmer Normal rate of N (FN)

T2 = Farmer Normal rate of N plus product (FN+Prod)

T3 = 75% of Farmer Normal rate plus product: (FN75+Prod)

T4 (new for 2021 season) = 75% Farmer Normal rate

BUFFER AREA


BUFFER AREA

# Consultants/farmers have many questions about N stabilizers

The 2 BIG questions:

1. What conditions increase the odds of a profit from stabilizers? (Project can provide this information.)

2. What are the odds I can make money from the stabilizers? (You will have to create this information.)

# Drainage Classes of Fields in Trials

| Soil Drainage Class | Number of Fields | Percent of Fields |
|---|---|---|
| Excessive | 2 | 4 |
| Well | 11 | 22 |
| Moderately Well | 3 | 6 |
| Somewhat Poorly | 10 | 19 |
| Poorly | 13 | 24 |
| Very Poorly | 14 | 26 |

Green = Fields have higher probability of loss of nitrate by leaching = 26%

Red = Fields have higher probably of loss of nitrate by denitrification = 69%

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# Definition of economically beneficial product used for these data

1. FN+Prod treatment: Product provides an economic benefit **>$5.00** over the Farmer Normal rate given the extra cost of the product

2. FN75+Prod treatment: Product provides an economic benefit **>$5.00** given the reduced cost of N fertilizer, yield compared with Farmer Normal rate, and cost of the product

You may have reasons other than economic to use a N stabilizer:

1. Environmental
2. Regulatory
3. NRCS subsidy
4. Carbon credits – reduced $N_2O$ emissions

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# Yield Results by Product

| | | | Treatment | | | |
|---|---|---|---|---|---|---|
| **Product** | **Mode of action** | **# Trials** | **FN rate** | **FN+Prod** | **FN75%+Prod** | **Number and % trials with economic benefit[1]** |
| | | | ---------- bushels per acre ---------- | | | |
| **BD-Ntrust** | Biological | 19 | 184.1 | 183.8 | 181.9 | 8/19; 42% |
| **Anvol** | Urease Inhibitor | 8 | 191.0 | 191.1 | 187.7 | 1/8; 7% |
| **Centuro** | Nitrification inhibitor | 13 | 178.5 | 178.1 | 174.8 | 1/13; 8% |
| **Instinct II** | Nitrification inhibitor | 10 | 190.6 | 190.3 | 185.7 | 2/10; 20% |
| **N Serve** | Nitrification inhibitor | 3 | 188.8 | 188.6 | 183.5 | 0/3; 0% |
| **Overall mean** | | (53) | **185.3** | **185.0** | **181.8** **(-3.5 bu/a)** | 12/53; 23% |

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[1] Economic benefit = >$5.00 increase from product compared with FN with no product

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# Economic Results by Product

| Product | Avg $ return FN All trials | Avg $ return FN+Prod (FN+ minus FN) All trials | Avg $ return FN75%+Prod (FN75%+ minus FN) All trials | Avg return; only econ benefit trials (difference FN+Prod minus FN) | Avg return; only econ benefit trials (difference FN75%+Prod minus FN) | Avg yield FN; Econ benefit trials only | Avg yield FN; Trials with NO economic benefit |
|---|---|---|---|---|---|---|---|
| | ---------- $ per acre ---------- | | | ---------- $ per acre ---------- | | -------- bushels per acre -------- | |
| **BDNTrust (8/19)** | 584 | 576 (-8) | 579 (-5) | 555-553 (+2) | 563-553 (+10) | 174.2 | 190.5 (+16.3) |
| **Anvol (1/10)** | 603 | 595 (-8) | 596 (-7) | 367-378 (-11) | 406-378 (+28) | 126.3 | 200.2 (+73.9) |
| **Centuro (1/13)** | 553 | 532 (-21) | 537 (-16) | 400-402 (-2) | 415-402 (+13) | 138.5 | 181.8 (+43.3) |
| **Instinct II (2/8)** | 598 | 583 (-15) | 581 (-17) | 390-388 (+2) | 399-388 (+11) | 132.7 | 205.1 (+72.4) |
| **N Serve (0/3)** | 581 | 566 (-15) | 564 (-17) | ---- | ----- | ---- | 188.8 |
| **Overall mean (12/53) (23%)** | 576 | 564 (-12) | 564 (-12) | 499-498 (+1) | 498-510 (+12) | 160.3 | 192.3 (+32) |

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# Stalk Nitrate Results

## Average for all trials

| FN | FN+Prod | FN75+Prod |
|---|---|---|
| ----------parts per million nitrate-N (ppm) ---------- | | |
| 814 | 760 | 552 |

| Stalk Categories | | FN treatment – All trials | |
|---|---|---|---|
| | ppm nitrate-N | Number of Fields | % of Fields |
| Deficient | 0-250 | 27 | 54 |
| Marginal | 250-700 | 7 | 14 |
| Optimum | 700-2000 | 9 | 18 |
| Excess | >3000 | 4 | 8 |

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# Stalk Values and Nutrient Management Plans (NMPs)/regulation

Summaries of stalk values like shown on previous slide can be valuable to show regulators/environmental groups how farmers are managing nitrogen well

Stalk values are used in Connecticut and New York to verify nitrogen management practices for NMPs

# Strengths and Limitations of the Results from 2020

## Strengths:

1. 53 well-run trials with complete field and management data
2. Trials across many different environments and geographies

## Limitations:

1. Only one year of data
2. All trials sidedress N; could use trials with N applied earlier in the season (weed and feed practice maybe?)
3. Many trials with low rainfall in 2020

# Centuro trial with response

Hail

CIG2020_04CB003

| Replication | FN | FN+Prod | FN75+Prod | Mean |
|---|---|---|---|---|
| | ---------- bushels per acre ---------- | | | |
| 1 | 137.0 | 142.5 | 145.1 | 141.5 |
| 2 | 141.0 | 148.4 | 125.7 | 138.4 |
| 3 | 122.9 | 150.5 | 156.7 | 143.4 |
| 4 | 152.9 | 143.2 | 145.5 | 147.2 |
| **Mean** | **138.5** | **146.2** | **143.3** | |

Rainfall (Days after sidedress on June 9)
Day 1 = 1.78 inches
Day 10 = 1.24 inches
Days 1 to 30 = 6.0 inches (118% of normal)
Normal Rainfall Days 1 to 30 = 5.08 inches

Oran loam
Somewhat poorly drained

**Form of N: UAN**
**Total N:**
FN = 236 lbs/a
75% of FN = 186 lbs/a

**Sidedress:**
FN = 200 lbs/a
75% of FN = 150 lbs/a

7.7 bushel yield increase from use of Centuro at Farmer Rate

4.8 bushel yield increase from use of Centuro at 75% of Farmer Rate

At 200 lb N rate need 8.2 bu/a yield increase to pay for Centuro

## Economics in terms of Return to N and Return to N plus Centuro ($/acre)

| | |
|---|---|
| FN at 200 lbs N/a as UAN | 401.98 |
| FN+Prod at 200 lbs N/a | 400.21 (-1.77) |
| FN+Prod (150 lbs/a) | 414.74 (+12.76) |

N = $0.35/lb
Corn = $3.50/bu
Centuro:
200 lb N rate = $28.71
150 lb N rate = $21.54

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# BD-Ntrust trial with response

CIG2020_26DAL001

| REP | FN | FN+Prod | FN75+Prod | **Mean** |
|---|---|---|---|---|
| | ----------bushels per acre ---------- | | | |
| 1 | 176.3 | 196.0 | 189.3 | 187.2 |
| 2 | 181.2 | 180.3 | 191.5 | 184.3 |
| 3 | 189.3 | 174.0 | 189.0 | 184.1 |
| 4 | 174.9 | 168.9 | 178.8 | 174.2 |
| **Mean** | **180.4** | **179.8** | **187.2** | |

Rainfall (Days after sidedress on June 8)
Days 14 and 15 = 0.55 inches
Day 20 = 0.71 inches
Days 1 to 30 = 4.3 inches (98% of normal)
Normal Rainfall Days 1 to 30 = 4.41 inches

**Form of N: UAN**
**Total N:**
FN = 240 lbs/a
75% of FN = 195 lbs/a
**Sidedress:**
FN = 180 lbs/a
75% of FN = 135 lbs/a

Eldean silt loam
Well drained

0.6 bushel yield decrease from use of BD-Ntrust at Farmer Rate

6.8 bushel yield increase from use of BD-Ntrust at 75% of Farmer Rate

Need 2.1 bu/a yield increase to pay for BD-Ntrust

Economics in terms of Return to N and Return to N plus BD-Ntrust ($/acre)

| | |
|---|---|
| FN at 180 lbs/a N as UAN | 547.49 |
| FN+Prod at 180 lbs/a | 537.80 (-9.69) |
| FN75+Prod (135 lbs/a) | 579.28 (+31.79) |

N = $0.35/lb
Corn = $3.50/bu
BD-Ntrust: $7.50/acre

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# BD-Ntrust trial with response

| CIG2020_15MAX001 | | | | |
|---|---|---|---|---|
| REP | FN | FN+Prod | FN75+Prod | Mean |
| 1 | 160.1 | 175.3 | 158.8 | 164.7 |
| 2 | 146.0 | 153.2 | 141.6 | 146.9 |
| 3 | 187.5 | 187.9 | 179.1 | 184.8 |
| 4 | 162.3 | 175.4 | 154.6 | 164.1 |
| **Mean** | **164.0** | **173.0** | **158.5** | |

Rainfall (Days after sidedress on July 9)
Days 2-3 = 0.4 inches
Day 11 = 1.0 inches
Days 1 to 30 = 3.8 inches (136% of normal)
Normal Rainfall Days 1 to 30 = 2.8 inches

**Form of N: UAN**
**Total N:**
FN = 136 lbs/a
FN75+Prod = 118 lbs/a
**Sidedress:**
FN = 75 lbs/a
FN75+Prod = 57 lbs/a

Tappan loam
Poorly drained

9.0 bushel yield increase from use of BD-Ntrust at Farmer Rate

5.5 bushel yield decrease from use of BD-Ntrust at 75% of Farmer Rate

Need 2.1 bu/a yield increase to pay for BD-Ntrust

## Economics in terms of Return to N and Return to N plus BD-Ntrust ($/acre)

| | |
|---|---|
| FN at 75 lbs/a N as UAN | 526.31 |
| FN+Prod at 75 lbs/a | 550.23 (+23.92) |
| FN75+Prod at 57 lbs/a | 506.04 (-31.79) |

N = $0.35/lb
Corn = $3.50/bu
BD-Ntrust: $7.50/acre

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# Instinct II trial NO response

| CIG2020_10GR001 | | | | |
|---|---|---|---|---|
| REP | FN | FN+Prod | FN75+Prod | Mean |
| 1 | 255.1 | 260.4 | 243.1 | 252.9 |
| 2 | 254.3 | 251.1 | 244.4 | 249.9 |
| 3 | 246.6 | 252.8 | 230.9 | 243.4 |
| 4 | 253.3 | 244.0 | 234.7 | 244.0 |
| **Mean** | **252.3** | **252.1** | **238.3** | |

Rainfall (Days after sidedress on June 1)
Day 22 = 0.8 inches
Days 1 to 30 = 3.1 inches (74% of normal)
Normal Rainfall Days 1 to 30 = 4.2 inches

Treaty silty clay loam
Poorly drained
Field patterned drained

**Form of N: UAN**
**Total N:**
FN = 202 lbs/a
FN75+Prod = 155 lbs/a
**Sidedress:**
FN = 190 lbs/a
FN75+Prod = 143 lbs/a

0.2 bushel yield decrease from use of Instinct II at Farmer Rate

14.0 bushel yield decrease from use of Instinct II at 75% of Farmer Rate

Need 3.75 bu/a yield increase to pay for Instinct

Economics in terms of Return to N and Return to N plus Instinct II ($/acre)

| | |
|---|---|
| FN at 190 lbs/a N as UAN | 812.44 |
| FN+Prod at 190 lbs/a | 798.45 (-13.99) |
| FN75+Prod (143 lbs/a) | 766.60 (- 45.84) |

N = $0.35/lb
Corn = $3.50/bu
Instinct: $13.12/acre

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# Centuro trial NO response

| CIG2020_20OTE001 | | | | |
|---|---|---|---|---|
| REP | FN | FN+Prod | FN75+Prod | Mean |
| 1 | 197.1 | 190.4 | 179.6 | 189.0 |
| 2 | 209.0 | 208.7 | 190.3 | 202.7 |
| 3 | 203.6 | 202.1 | 189.4 | 198.4 |
| 4 | 202.5 | 212.1 | 188.9 | 201.2 |
| **Mean** | **203.1** | **203.3** | **187.1** | |

Rainfall (Days after sidedress on June 17)
Days 5 and 6 = 1.26 inches
Day 14 = 1.0 inch
Days 1 to 30 = 4.7 inches (115% of normal)
Normal Rainfall Days 1 to 30 = 4.1 inches

**Form of N: UAN**
**Total N:**
FN = 198 lbs/a
75% of FN = 161 lbs/a
**Sidedress:**
FN = 150 lbs/a
FN75+Prod = 113 lbs/a

Pewamo silty clay loam
Very Poorly Drained

0.2 bushel yield increase from use of Centuro at Farmer Rate

16.0 bushel yield decrease from use of Centuro at 75% of Farmer Rate

At 150 lb N rate need 6.2 bu/a yield increase to pay for Centuro

## Economics in terms of Return to N and Return to N plus Centuro ($/acre)

| | |
|---|---|
| FN at 150 lbs/a N as UAN | 641.38 |
| FN+Prod at 150 lbs/a | 620.80 (-21.38) |
| FN75+Prod (113 lbs/a) | 582.11 (-59.27) |

N = $0.35/lb
Corn = $3.50/bu
Centuro at 150 lb rate = $21.54/acre

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# Summary: what have we learned?

1. Dry year in ~70% of the fields
   a. Pay close attention to 5-day forecast for rain when deciding to use a urease inhibitor
   b. Consider soil drainage when choosing to use a nitrification inhibitor
   c. Nitrification inhibitors most likely to provide economic benefit on well drained light soils and poorly drained heavy soils
2. BD-Ntrust looks interesting – needs more evaluation
3. Farmers and consultants are interested in and are paying attention to these results

# What are we doing next year?

- Same stabilizer products as this year
- Interested in trials with stabilizers applied early in season – weed and feed time or earlier
- Need to add a 75% total N untreated strip
- Need to have a post-harvest wrap-up to understand hail etc.
- Plan to capture drone images for all trials next year

# Q&A - thank you!

- ★ Contact us if you would like more detail on any of these slides
- ★ Keep us in mind for venues to present results or field days in your area
- ★ Questions? Comments?

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