

Nitrogen Management & Biologicals

A Review of Products used in Wisconsin

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Nutrient Management Update Meetings

NOTICE:

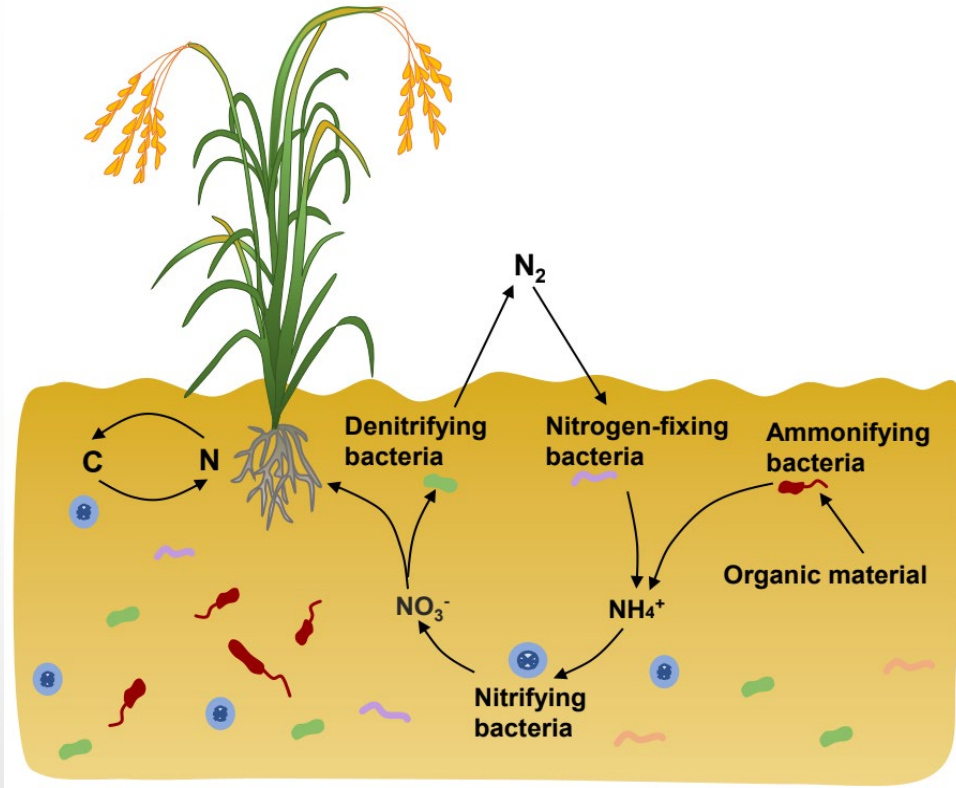
- This presentation is for educational purposes only.
- The UW does not endorse or discriminate against the use of biologicals.
- This is not an exhaustive list of biologicals used for nitrogen fixation.



Image Source: USDA NRCS

- 100 million to 1 billion bacteria in 1 teaspoon of agricultural soil
- These include: decomposers, mutualists, and pathogens
- Mutualists enhance plant growth including ability to fix N_2

Ingham, et al. (2000)



Graphic Source: Guo, et al (2023) <https://doi.org/10.1016/j.xplc.2022.100499>

- Use a nitrogenase complex to convert N_2 gas to NH_4^+
- Need a large amounts of carbon & energy to fix nitrogen (16:1)
 - Free-living N fixation: for their own use in low oxygen environments
 - Associative N fixation: live on or between cells of host plant. Use photosynthetic products as carbon sources for own use, remaining N available to host
 - Symbiotic N fixation: located in a cell, such as root nodules, and use photosynthetic products to supply N to host plant

(Guo, et al., 2023)

Free-living:

- *Klebsiella variicola* (Duran-Bedolla, et al., 2021)

Associative:

- *Kosakonia sacchari* (Jan-Roblero, et al., 2020)
- *Methylobacterium symbioticum* (Pascual, et al., 2020)
- *Gluconacetobacter diazotrophicus* (Dwivedi, 2020)

Environmental factors affecting bacteria populations establishment

pH

- *Metholybacterium symbioticum*: pH 5.5 to 8.0 with optimum pH 7 (Pascual, et al., 2020)
- *Gluconacetobacter diazotrophicus*: acid tolerant to < pH 3 to 7, optimum pH 5.5 (Dwivedi, 2020)

Soil Temperature

- *Metholybacterium symbioticum*: 50 to 86° F with optimum 82° F (Pascual, et al., 2020)

Salt tolerance

- *Metholybacterium symbioticum*: reduces growth at concentration greater than 2% and no growth greater than 3% (Pascual, et al., 2020)

Sugar tolerance

- *Gluconacetobacter diazotrophicus*: up to 30% sucrose (Van Dommelen & Vanderleyden, 2007)



Active Ingredients:
Kasakonia sacchari
Klebsiella variicola

Labeled crops:

- Grain Corn & Silage Corn

Rate:

- 12.8 ounces per acre in furrow (approx. 360 billion per acre each bacteria)
- Seed treatment is available

Application cautions:

- Must be used within 24 hours of opening container
- Preferred to add PROVEN 40 last when filling tanks
- Use within 4 hours if mixed with 10-34-0 or micronutrients
- Do not use 7-21-7, ATS, or UAN as a carrier
- Use a non-chlorinated water source

Other considerations:

- Engineered bacteria (US Patent U.S. 10,934,226), not OMRI approved
- Pivot Bio website: “Pivot Bio starts by finding the microbes with the code for nitrogen production in their DNA. Then, the nitrogen production is activated and supercharged using the microbe’s own genetics.”
- Potential health hazard: *K. variicola* may cause mastitis in dairy cows and infection in immuno-compromised individuals (uncertain this strain causes these issues) (Rodriguez-Medina, et al., 2019)

Utrisha™ N

Active Ingredient:
Methylobacterium symbioticum

Labeled crops:

- Cereals and Grain Crops: corn, soybeans, winter & spring cereals, sorghum
- Hay & Forage Crops: alfalfa & pasture
- Horticulture Crops: several vegetables, fruits, and nut crops

Rate:

5 ounces per acre foliar early vegetative stages (approx. 4 billion bacteria per acre)

Application cautions:

- Best applied in the early morning, when a greater number stomata are open
- Apply in healthy crops unaffected by poor nutrition or other biotic/abiotic stresses
- Apply with sufficient plant biomass, when the crop presents good soil coverage
- Mix with water only for best product performance
- Spray volume: between 10 and 25 GPA
- Water total chlorine content: < 2 ppm
- Water pH: between 5 and 8
- Rain fast: one hour after application
- Wheat only: to be used within current nitrogen programs

Other considerations:

OMRI approved



Active Ingredient:
Gluconacetobacter diazotrophicus

Labeled crops:

- Foliar: Corn, Soybeans, Cereals, Alfalfa, Potatoes
- In furrow: Corn, Soybeans, Potatoes

Rate:

3.2 ounces per acre foliar early vegetative stages (approx. 1 billion bacteria per acre)
3.2 ounces per acre in furrow

Application cautions:

In furrow

- Do not mix directly with UAN or undiluted liquid starter
- Mix with a minimum of 99 parts water and 1 part Envita
- 2.5 gallons of mix per acre in furrow, can be mixed with 3 gallons of starter (SI<20)
- Apply within 6 hrs of mixing

Foliar

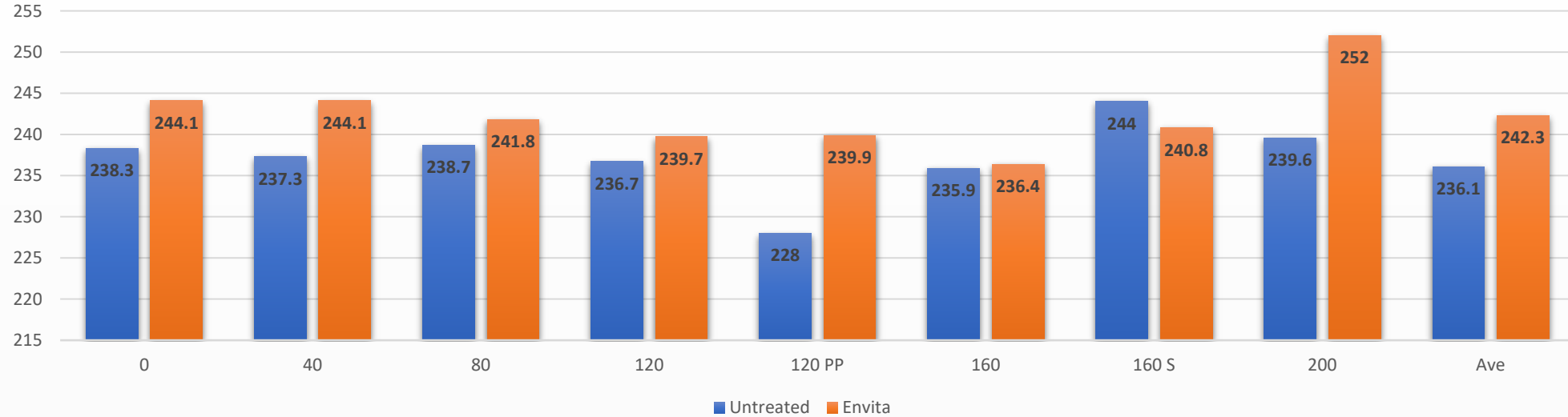
- Spray with a minimum of 10 gallons of water
- If sprayed alone needs a non-ionic surfactant at minimum 0.1% v/v
- Compatible with most pesticides, follow labeled directions
- Avoid application above 77° F or if rain is forecasted in 2 hours

Other considerations:

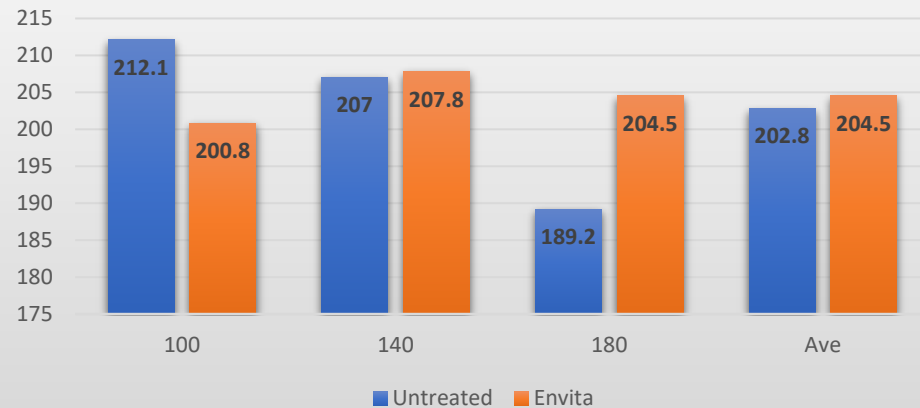
US FDA Generally Recognized as Safe (GRAS)

Current Wisconsin Research

2021 Envita Trial Abrams, Oconto County



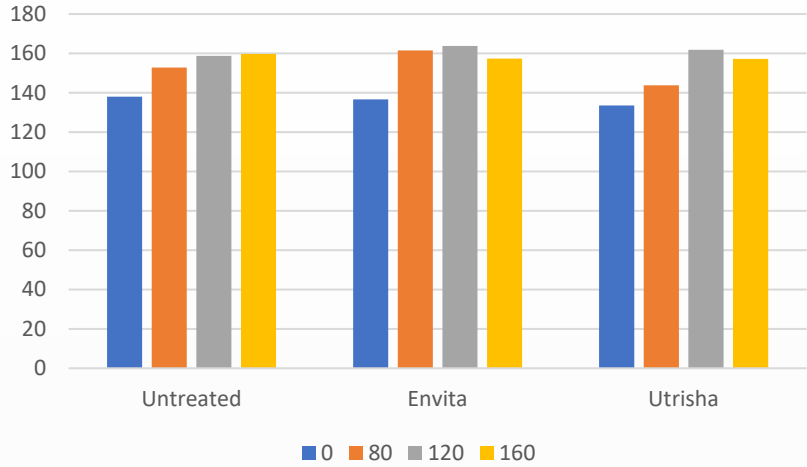
2021 Envita Trial Lena, Oconto County



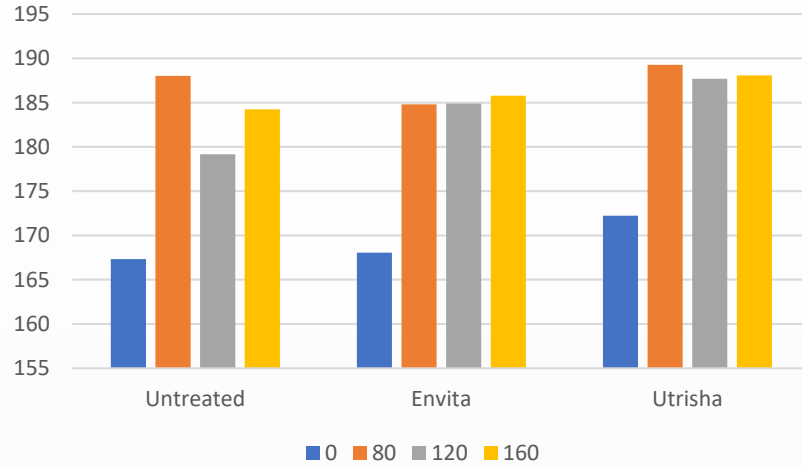
- ❖ Abrams 4 reps & Lena 3 reps
- ❖ Envita applied in furrow
- ❖ N applied at V6 growth stage
- ❖ Exceptions:
 - 160 Preplant (PP) at planting
 - 160 Split (S): 80 lbs at V6 & 80 lbs at V10
- ❖ Economic return at Abrams +6.3 bushels overall
- ❖ Compaction at Lena site

Reuss (2021) unpublished data

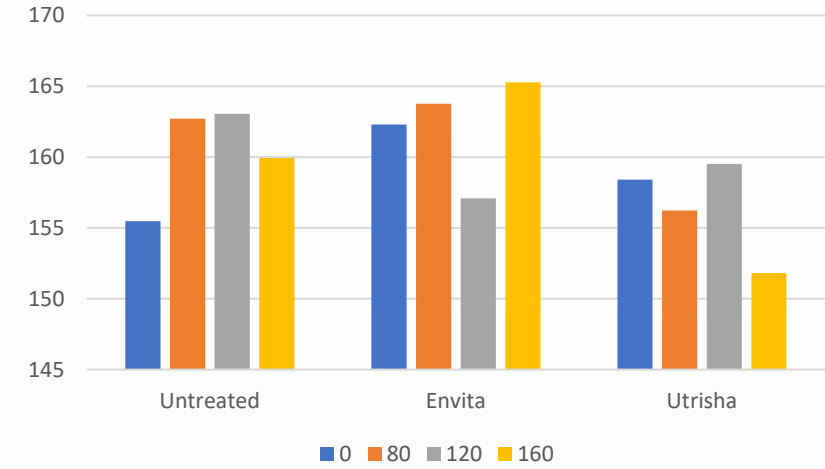
2022 Marinette County



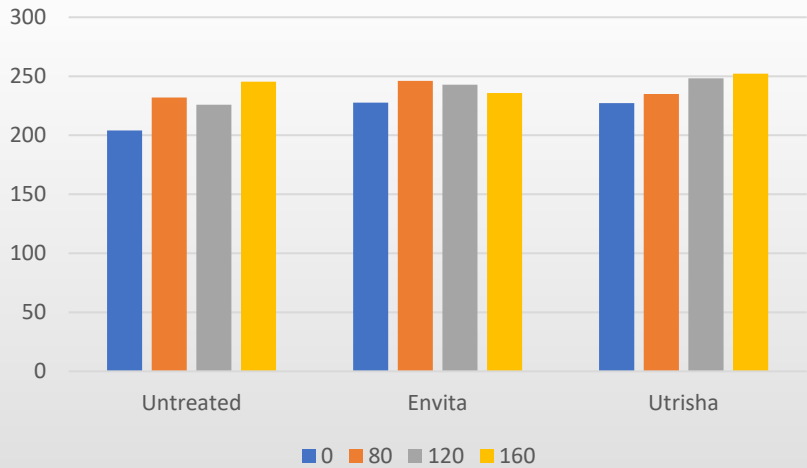
2022 Langlade County



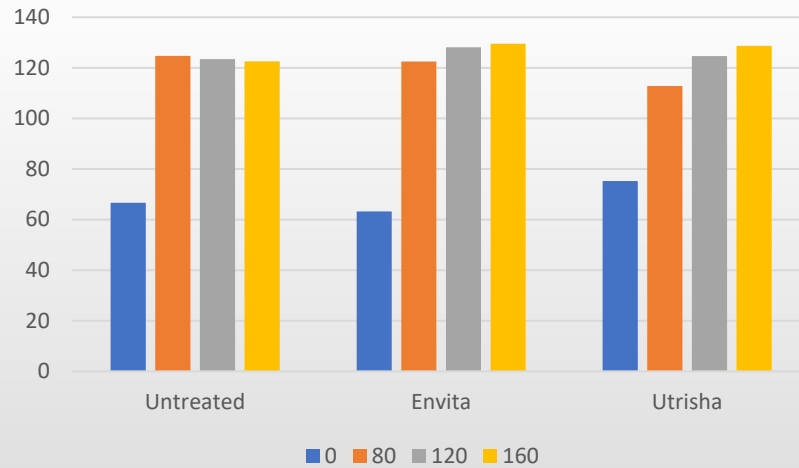
2022 Lincoln County



2022 Oconto County



2022 Shawano County

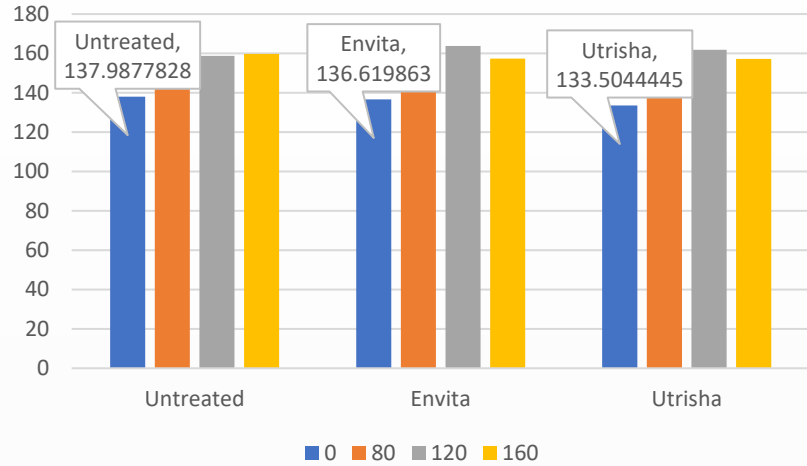


Applied foliar and sidedressed nitrogen approximately V4
Replicated 4 times per site

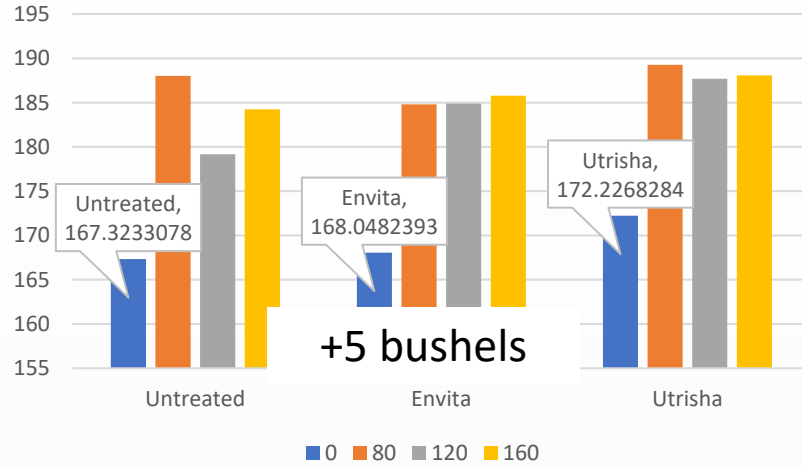
Reuss (2022) unpublished data

Possible response to nitrogen application or environmental conditions

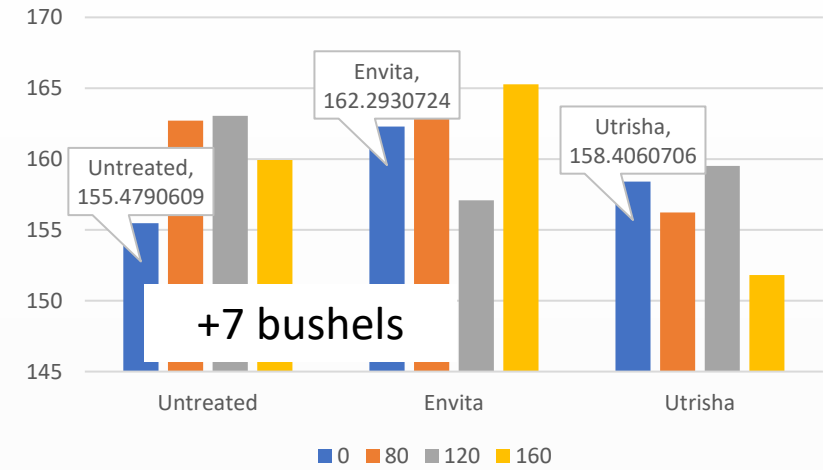
2022 Marinette County



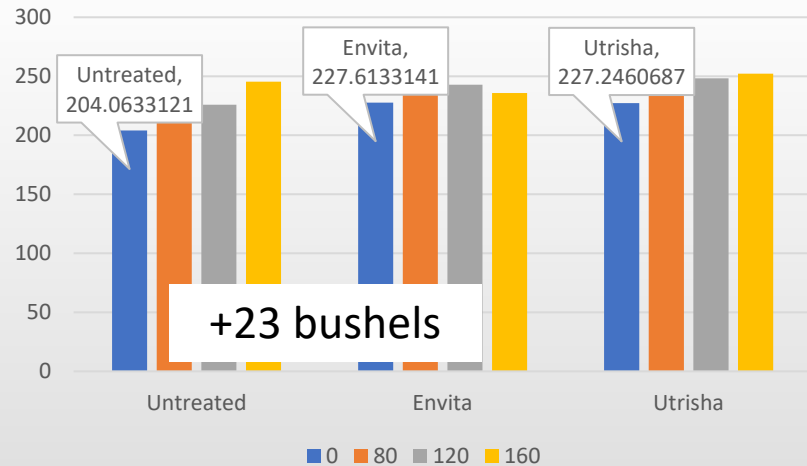
2022 Langlade County



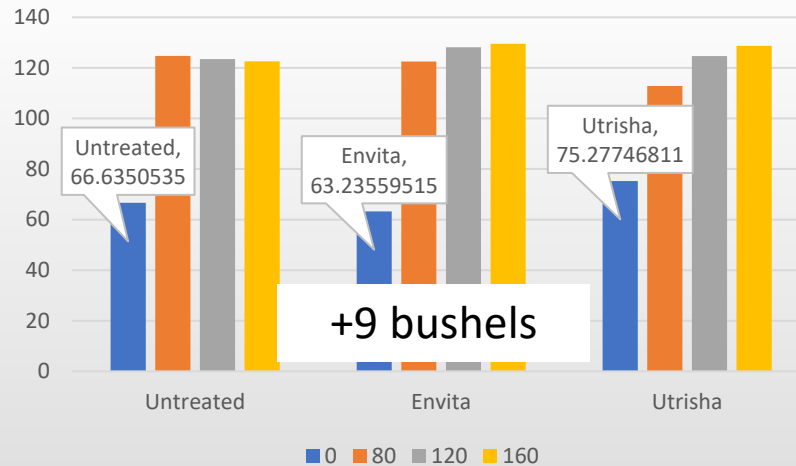
2022 Lincoln County



2022 Oconto County



2022 Shawano County



Applied foliar and sidedressed nitrogen approximately V4 Replicated 4 times

Reuss (2022) unpublished data

No statistics have been calculated and this is one year's data

Site	Control	Envita	Utrisha
Langlade	179.7	180.9	184.3
Lincoln	160.3	162.1	156.5
Marinette	152.3	154.8	149.1
Oconto	225.6	238.1	240.7
Shawano	109.3	110.8	110.4

Reuss (2022) unpublished data

- Control averaged 165.44 bu/acre
- Envita averaged 169.34 bu/acre, increase of 3.9 bu/acre over control.
- Envita greater than control at all five sites. Ranging from 1 to 12.5 bushels
- Utrisha averaged 168.2 bu/acre, increase of 2.75 bu/acre over control.
- Utrisha greater than control at three of five sites. Ranging from 1 and 15 bushels

**No statistics have been calculated and
this is one year's data**

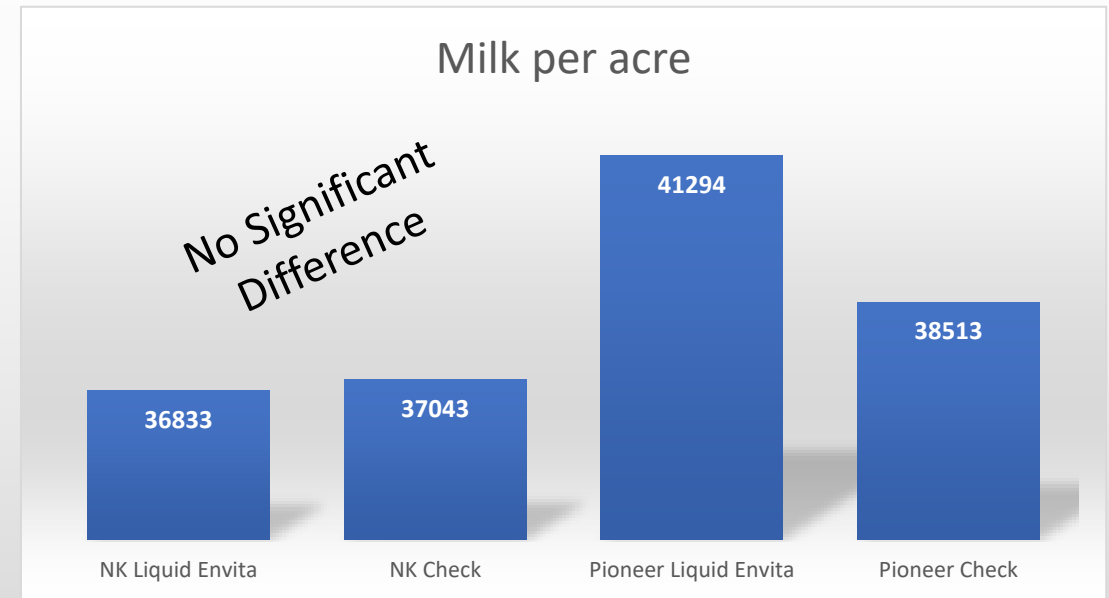
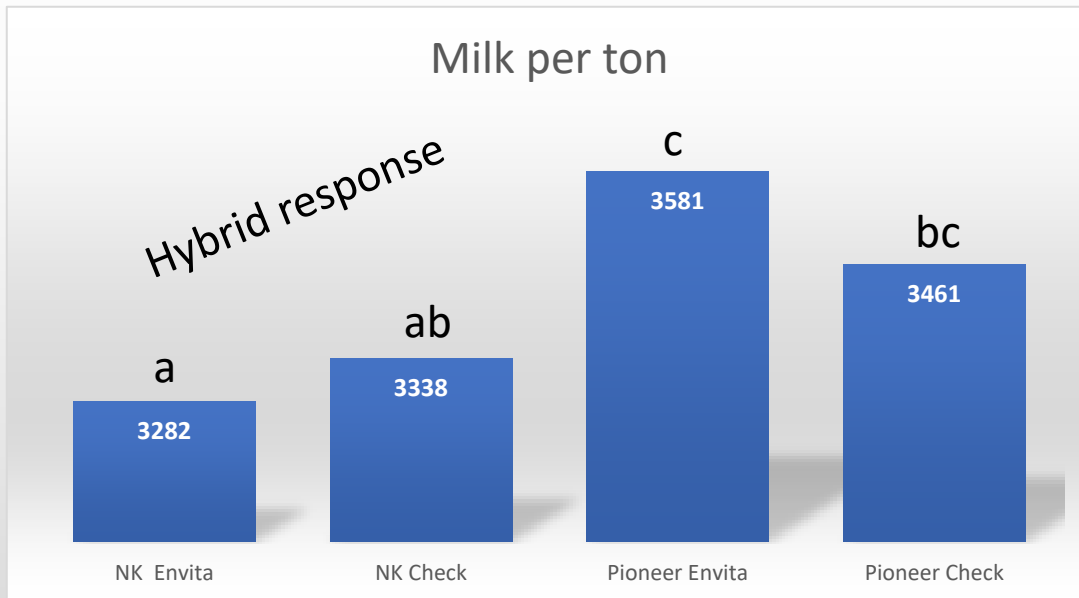
Envita Corn Silage Evaluation Study 2022

Joe Lauer, Kent Kohn, Thierno Dialio

- Arlington Research Station
- Replicated 6 times
- NK0748-5122 & P0720Q
- Envita applied foliar V2-V3

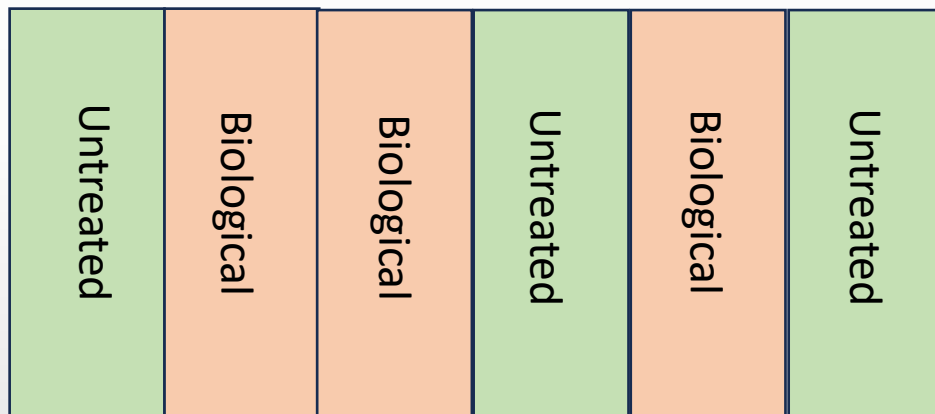
<http://corn.agronomy.wisc.edu/Research/12Fertilizer/Envita2022.pdf>

	DM Yield	Crude Protein
NK Envita	11.2	7.2
NK Check	11.1	7.2
Pioneer Envita	11.5	7.3
Pioneer Check	11.1	7.2

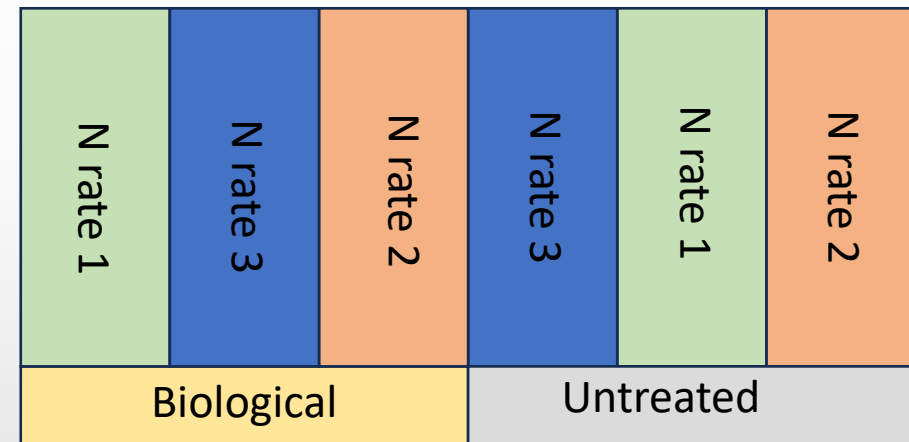


Examples of layouts for on-farm research

Paired Comparison or Block



Split Plot



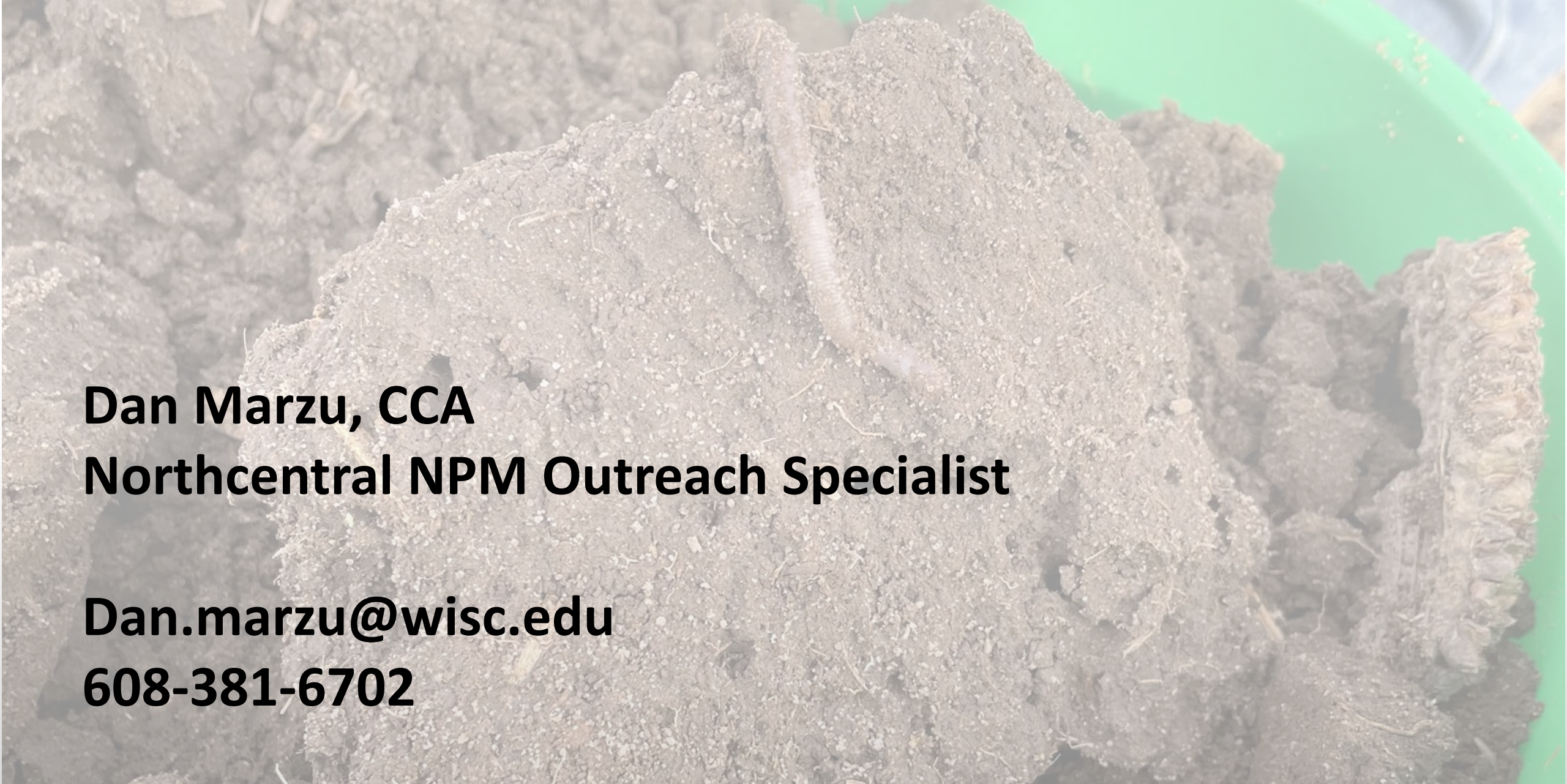
<https://www.sare.org/wp-content/uploads/how-to-conduct-research-on-your-farm-or-ranch.pdf>

What does this mean?

- Best bet is to manage N according to current recommendations
- Few soil bacteria do fix nitrogen, amount to credit is unknown
- Yield increase doesn't always equal economic return
- Wisconsin results are limited
- Results are inconsistent
- Possible environmental and/or hybrid effects
- Need to conduct more research
- Encourage farmers to develop on farm trials

Crop	Yield range per acre	Soil organic matter content (%)			
		< 2.0	2.0-9.9	10.0-20.0	> 20.0
lb N/a to apply ^a					
Grass, reed canarygrass	4-7 ton	270	250	220	100
Grass, switchgrass, seeding ^b	1-3 ton	0	0	0	0
Grass, switchgrass, established ^b	1-5 ton	120	100	75	50
Hop ^c	1,000-1,500 lb	200	180	150	120
Lettuce	15-20 ton	120	100	80	40
Lupine	40-60 bu	10	0	0	0
Melon	8-10 ton	100	80	60	30
Millet	40-60 bu	80	60	40	20
Mint, oil	35-55 lb	120	100	80	50
Oat ^c	30-120 bu	60	40	20	0
Onion	400-600 cwt	150	140	130	120
Pasture, grass ^d	0.5-5 ton		130	100	50
Pasture, ≤ 30% legume-grass, seeding				0	0





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- Utrisha N Nutrient Efficiency Optimizer Resources (2023) <https://www.corteva.us/products-and-solutions/crop-protection/utrisha-n.html>