CERTIFIED BIOSTIMULANT

SECTION 1. INTRODUCTION & VERIFICATION

1.1 Introduction Product Claim

Identify the following:
Physiological effect on crop as indicated by the label claim (i.e. root growth, yield increase).
This must match the response variable.
Yield Increase, Nutrient Use Efficiency

Target crop(s) for product use

All Crops/Crop Groups

Target geographic location(s) to use this product (please identify by geographic boundaries, i.e. states, countries, continents)

United States of America

If product is for a target environment or stressor, please identify climatic or soil conditions for this product (check all that apply):

- ☐ Flooded conditions
- ☐ Drought conditions
- ☐ Heat stress
- ☐ Chilling Stress
- ☐ Salt Stress
- ☐ General abiotic stress
- ☐ Other ___________________

1.2 Verification Method

Please check which verification method was used to show this product's efficacy:
Must present research on the product for this application

☑ Original Research

☑ Independent research with a credible institution (USDA-ARS, Land Grant University, or other).

Please list institution(s) North Carolina State University, Mid-Michigan Agronomy (CRO), & Ag Metrics Group (CRO)

☐ Internal/In-house Research

CONTINUE TO SECTION 2.

☐ Published Research

☐ Product used in published Literature is the product for this application

FILL OUT TABLE PAGE 3

FOR PUBLISHED RESEARCH VERIFICATION ONLY:

Purpose: Validate the product in this application is equivalent to the products tested in the literature accompanying this application. If there are variations, please specify how products differ. Provide information on product composition/formulation, amount or concentration of the active ingredient or the guaranteed analysis, and the application rate corresponding to the product used in the literature (for the product/area and the active ingredient/area).

If this is a microbial product with strain not specified, please provide an additional written explanation to support your product.

Table 1. Compare and contrast of product for approval and product used in research literature provided. Add columns as necessary for each additional research article.

	Product on this application	Product from literature	
		Article 1	Article 2
Composition or Statement of Formulation [a]	Duo Maxx		
Guaranteed Analysis or Active Ingredient Concentration	Organic Carbon (13.4%)** Sources on COA		
Application Rates corresponding to the supporting literature [b]	8-32 oz/A -OR- 64 oz/ton of fertilizer (labeled product use rate per area)		

[a] If product composition or formulation is proprietary, please provide a statement of Formulation to describe the product and tie its similarity to the corresponding product in the literature
[b] Specify either the product rate per area or ingredient rate per area.

Attach peer-reviewed article(s) using the product from Table 1 to this packet labeled Supporting Literature 1, Supporting Literature 2, etc.

END OF APPLICATION

FOR ORIGINAL RESEARCH VERIFICATION ONLY

SECTION 2. MATERIALS & METHODS

2.1 Description of the Study Areas

2.1.1 Trials and Locations

a) Trial type (i.e. greenhouse, small plot field trial) Small plot field trials

b) Number of site-years/trials[a] Two Trials, three years each, six site-years

FIELD TRIALS ONLY:

c) States where field trials were conducted North Carolina & Michigan

[a] *Site-years is the total number of trials in considering both years and locations. I.e., If your study was conducted for 4 years at 4 locations, there was a total of 16 site-years.*

2.1.2 Climatic Information

a) Table number(s) and page number(s) for climatic information

Page 1

Table Number(s) 2 & 3

Section 2.1.3 Soils Information

a) Table number(s) and page number(s) for soils information

Page 2

Table Number(s) N/A

2.1.4 Cropping System

a) Which crop(s) were evaluated in this research:

Corn (*Zea Mays*), Potato (*Solanum tuberosum*)

FOR FIELD TRIALS ONLY:

b) Tillage System

☐ No Tillage ☐ Strip Till ☒ Plow ☐ Chisel or Disk

☐ Other

c) Irrigation .... ☒ YES for potato ☒ NO for corn

2.2 Experimental Design

CERTIFIED BIOSTIMULANT

a) Experimental Design type (i.e. Randomized Block) Randomized Block

b) Number of Replications for each trial Corn - 4, Potato - 6

c) Treatment list (include controls)

Please see "Original Research Written Report"

d) Response variable measured (i.e. yield, root mass, etc.):

Yield

The response variable measured MUST support the claims stated on the label

2.2.1 Controls

a) Was a Control Used ☐ YES ☐ NO

Lack of control will result in an incomplete application

b) Negative Control Used ☒ YES ☐ NO

*A negative control is an untreated control comprised of an area without the material for which the claim is being tested. *__*Required for all products.__*

c) Positive Control Used ☐ YES ☐ NO

A positive control that provides a comparative standard product, which exhibits known effects like those being claimed.

If applicable

d) Control Using Plant Nutrients ☐ YES ☐ NO

Control containing plant nutrient composition for products combining a beneficial substance with plant nutrients to demonstrate efficacy of the beneficial substance component alone.

Required for products with fertilizer.

e) Control For Challenge Condition ☐ YES ☐ NO

For experimental designs where a challenge condition is used, control data should be generated in the absence of the challenge condition (e.g., drought, heat, reduction of input).

Required for products with challenge conditions.

f) Other Control ______________________________

g) Are the controls listed above in the treatment list (2.2 c)? ☐ YES ☐ NO

2.3 Statistical Analysis

a) Descriptive statistics and measures of variation reported for response variable (check all that apply):
□ Histogram(s) □ Mean □ Median □ Quartiles □ Standard Deviation
□ Variance □ Standard Error □ Percentiles □ Range
□ Other Confidence Intervals

b) Statistical Test employed to show significance (check all that apply):
□ ANOVA □ T-test □ Regression □ HSD or LSD Tests
□ Linear Mixed Models □ Bayesian Statistics □ Multivariate Model
□ Correlations [a]
□ Other ______
If other, briefly explain

[a] Correlations are not to be used in place of an analysis that provides significant value for explanation of variation. Correlations may only be used to show relationships.

c) ***If Regression,***
Is the model being used for prediction? □ YES □ NO
Was the model cross validated? [a] □ YES □ NO

[a] Was a subset of your data withheld in the model building if cross-validated with a test and training dataset?

SECTION 3. RESULTS & DISCUSSION

3.1 Description of the Dataset

a) Report the Tables & Figures in your report that include descriptive statistics and measures of variation

Tables 4, 5, 6, 7, 8, & 9

3.2 Statistical Testing Results

a) Identify statistical metrics that were used to show significance (i.e. p-value):

Corn p=0.05 (2020, 2021)/p=0.10 (2022), Potato p=0.1

b) Identify the Tables & Figures in your report that include statistical results

Tables 4, 5, 6, 7, 8, & 9

CERTIFIED BIOSTIMULANT

2.1.1 Trials and Locations

a) Trial type (i.e. greenhouse, small plot field trial) Small plot field trial

b) Number of site-years/trials[a] 1

FIELD TRIALS ONLY:

c) States where field trials were conducted Florida

[a] Site-years is the total number of trials in considering both years and locations. I.e., If your study was conducted for 4 years at 4 locations, there was a total of 16 site-years.

2.1.2 Climatic Information

a) Table number(s) and page number(s) for climatic information

Page 2

Table Number(s) 3

Section 2.1.3 Soils Information

a) Table number(s) and page number(s) for soils information

Page 2

Table Number(s) N/A

2.1.4 Cropping System

a) Which crop(s) were evaluated in this research:

Tomato

FOR FIELD TRIALS ONLY:

b) Tillage System

☐ No Tillage ☐ Strip Till ☒ Plow ☐ Chisel or Disk

☐ Other ____

c) Irrigation .... ☒ YES ☐ NO

2.2 Experimental Design

CERTIFIED BIOSTIMULANT

a) Experimental Design type (i.e. Randomized Block) Randomized Block

b) Number of Replications for each trial 7

c) Treatment list (include controls)

Please see "Original Research Written Report"

d) Response variable measured (i.e. yield, root mass, etc.):
Yield

The response variable measured MUST support the claims stated on the label

2.2.1 Controls

a) Was a Control Used ◻ YES ◻ NO
Lack of control will result in an incomplete application

b) Negative Control Used ☒ YES ◻ NO
A negative control is an untreated control comprised of an area without the material for which the claim is being tested. ***Required for all products.***

c) Positive Control Used ◻ YES ◻ NO
A positive control that provides a comparative standard product, which exhibits known effects like those being claimed.

If applicable

d) Control Using Plant Nutrients ◻ YES ◻ NO
Control containing plant nutrient composition for products combining a beneficial substance with plant nutrients to demonstrate efficacy of the beneficial substance component alone.
Required for products with fertilizer.

e) Control For Challenge Condition ◻ YES ◻ NO
For experimental designs where a challenge condition is used, control data should be generated in the absence of the challenge condition (e.g., drought, heat, reduction of input).
Required for products with challenge conditions.

f) Other Control ____________________

g) Are the controls listed above in the treatment list (2.2 c)? ◻ YES ◻ NO

2.3 Statistical Analysis

a) Descriptive statistics and measures of variation reported for response variable (check all that apply):
□ Histogram(s) □ Mean □ Median □ Quartiles □ Standard Deviation
□ Variance □ Standard Error □ Percentiles □ Range
□ Other Confidence Intervals

b) Statistical Test employed to show significance (check all that apply):
□ ANOVA □ T-test □ Regression □ HSD or LSD Tests
□ Linear Mixed Models □ Bayesian Statistics □ Multivariate Model
□ Correlations [a]
□ Other ___
If other, briefly explain

[a] Correlations are not to be used in place of an analysis that provides significant value for explanation of variation. Correlations may only be used to show relationships.

c) ***If Regression,***
Is the model being used for prediction? □ YES □ NO
Was the model cross validated? [a] □ YES □ NO

[a] Was a subset of your data withheld in the model building if cross-validated with a test and training dataset?

SECTION 3. RESULTS & DISCUSSION

3.1 Description of the Dataset

a) Report the Tables & Figures in your report that include descriptive statistics and measures of variation

Table 10

3.2 Statistical Testing Results

a) Identify statistical metrics that were used to show significance (i.e. p-value):

p=0.05

b) Identify the Tables & Figures in your report that include statistical results

Table 10

SECTION 1. INTRODUCTION & VERIFICATION

1.1 Product Claim

Duo Maxx improves nutrient uptake via natural complexing agents and optimizes nutrient use efficiency.

Duo Maxx is a fertilizer additive that combines three technologies patented by the Roullier Group; Macro-Molecular Poly Phenolic Acid (MPPA) (Roullier Patent – [redacted]), XCK-1750 extracted from micro algae (Roullier Patent - [redacted]), and the Rhizovit complex (Roullier International Patent - [redacted]). The product can be applied directly to dry fertilizers or added to liquid fertilizers.

SECTION 2. MATERIALS & METHODS

2.1 Description of the Study Areas

2.1. 1 Trials and Locations

A. Broadacre

1. Corn- This study was conducted in the years 2020, 2021, and 2022 by Dr. Ron Heiniger of North Carolina State University. The plots were located at the Tidewater Research Station outside of Plymouth, North Carolina

2. Potato- This study was conducted in the years 2020, 2021 and 2023 by Rob Schafer with Mid-Michigan Agronomy. The plots were located at the Marshall Research Site outside of Marshall, Michigan.

B. Vegetable

1. Tomato- This study was conducted in 2020 by Brandon McCauley with Florida Ag Research/Ag Metrics Group. The plots were located at the Florida Ag Research Farm located in Thonotosassa, Florida.

2.1.2 Climatic Information

A. Broadacre

1. Corn- Plymouth, NC has a humid subtropical climate (Köppen Cfa). The growing months are hot and humid, with an average rainfall of 55.68 inches per year. The weather patterns during the trial site years were consistent with the 15-year climate normals (Table 1).

2. Potato- Marshall, MI has a humid continental climate (Köppen Dfa). The growing months are moderately hot and humid, with an average rainfall of 35.24 inches per year. The weather patterns during the trial site years were consistent with the 15-year climate normals (Table 2).

B. Vegetable

1. Tomato- Thonotosassa, FL has a humid subtropical climate (Köppen Cfa). The growing months are hot and humid, with an average rainfall of 52.51 inches per year. While precipitation for the growing year was higher than the 15 year climate average, patterns during the trial time period were mostly consistent with the 15-year climate normals with an upward trend for temperature minimum and maximum observed during the calendar year (Table 3).

2.1.3 Soils Information

A. Broadacre

1. Corn- Cape fear silt loam. The Cape Fear series consists of very poorly drained, nearly level soils on stream terraces. These soils formed in alluvial sediment. A seasonal high-water table is at or near the surface. In a typical profile, the surface layer is black and very dark gray loam about 14 inches thick. The subsoil, about 26 inches thick is dominantly gray, firm clay mottled with yellowish brown. Below the subsoil and extending to a depth of about 60 inches is light-gray coarse sand mottled with gray. Natural fertility, the content of organic matter, and available water capacity are all medium. Permeability is slow, and shrink-swell potential is high. In areas that have not received lime, reaction is very strongly acid. (USDA Official soil series description)

2. Potato- St. Joseph Oshtemo sandy loam. The Oshtemo series consists of very deep, well drained soils formed in stratified loamy and sandy deposits on outwash plains, valley trains, moraines, and beach ridges. The potential for surface runoff is negligible to medium. Saturated hydraulic conductivity is moderately high or high in the upper loamy materials and high or very high in the lower sandy materials. Permeability is moderately rapid in the upper loamy materials and very rapid in the lower sandy materials. (USDA Official soil series description)

B. Vegetable

1. Tomato- Lake fine sand. The Lake series consists of excessively drained, rapidly to very rapidly permeable soils formed in thick beds of sand. They are on nearly level to steep slopes in central Florida. Slopes range from 0 to 30 percent. Silt plus clay content ranges from 5 to 10 percent, and moisture equivalent is 2 percent or more within the 10- to 40-inch control section. Textures of sand or fine sand occur uniformly to depths more than 80 inches. Soil reaction is strongly or very strongly acid except in the A horizon when limed. (USDA Official soil series description)

2.1.4 Cropping System

A. Broadacre

1. Corn- The Tidewater Research center uses a corn/soybean rotation and conventional tillage. Irrigation was not used.

2. Potato- The Marshall Research site uses a small grain/cover crop/potato rotation with conventional tillage and bedding practices typical of commercial potato production. Irrigation was used.

B. Vegetable

1. Tomato-The Florida Ag Research Farm (Thonotosassa) uses a multiple vegetable/cover crop rotation system with conventional tillage and bedding practices (plastic mulch) typical of commercial vegetable production. Drip irrigation was used.

2.2 Experimental Design

2.2.1 Study Design

A. Broadacre

1. Corn- The experimental design was a randomized complete block with four replications. Pioneer '1464 YHR' (2020), DynaGro '58VC65' (2021), and Dekalb 'DKC 64-35' (2022), were seeded using conventional tillage practices in four 30-inch rows in plots that were 40 ft long by 10 ft wide at a seeding rate of 34,000 (2020, 2021) and 33,000 seeds/acre (2022) on May 7th (2020), May 9th (2021), and May 3rd (2022). A starter fertilizer, 10-27-0 + micro pack, was applied at planting in a 3 x 2 x 2 bands at a rate of 20 gal/acre. The remaining Nitrogen was applied using the treatments outlined below on June 17th (2020), June 15th (2021), and June 9th (2022). Each treatment was applied at V5 using a ground wand that dribbled the Side-dress N beside each row. This wand was attached to a backpack sprayer and used the appropriate orifice to deliver the desired rate of UAN at the given speed. The center two rows of each plot were harvested using a Kincaid 8XP combine with a HarvestMaster™ H2 high-capacity grain gauge that recorded grain weight, moisture, and test weight. These were used to calculate yield.

The Treatments were as follows:

2020:

1. Check – No additional N applied
2.30% UAN at 37.5 gal/acre (control)
3.30% UAN at 50 gal/acre (control)
4.30% UAN at 66.6 gal/acre
5.30% UAN at 37.5 gal/acre + Duo Maxx at 12 fl. oz/acre (2 qt ton)
6.30% UAN at 50 gal/acre + Duo Maxx at 16 fl. oz/acre (2 qt ton)

2021:

1.Check – No Side-dress N applied
2.30% UAN at 42.19 gal/acre
3.30% UAN at 56.25 gal/acre (control)
4.30% UAN at 75 gal/acre (control)
5.30% UAN at 56.25 gal/acre + Duo Maxx at 18 fl. oz/acre (2 qt/ton)
6.30% UAN at 75 gal/acre + Duo Maxx at 24 fl. oz/acre (2 qt/ton)

2022:

1. 30% UAN at 54.7 gal/acre (control)
2. 30% UAN at 40.6 gal/acre (control)
4. 30% UAN at 40.6 gal/acre + Duo Maxx at 24 fl. oz/acre
6. 30% UAN at 26.6 gal/acre + Duo Maxx at 24 fl. oz/acre
7. 30% UAN at 26.6 gal/acre (control)

2. Potato- The experimental design was a split-plot by variety with randomized complete block (RCB) design with six replications per treatment. The varieties "Manistee" and "Russet Norkotah" were planted at 2000 lb/a in 34-inch rows. Planting dates for the trial years were as follows: April 19 (2020), April 25 (2021), and April 22 (2023). The plots were twelve feet wide by forty feet long. All plots received a standard fertilization program of 135 lb/a DAP, 387 lb/a Urea, and 300 lb/a SOP preplant. 44 lb/a of Urea was applied at TI, then at 4 and 6 weeks after planting. 265 lb/a of Muriate of Potash 4 weeks after planting. Applications of ammonium polyphosphate liquid fertilizer were dribbled in the furrow by a calibrated liquid applicator prior to closure, with and without Duo Maxx treatment, to simulate a liquid planter attachment metering 10 gallon per acre of liquid fertilizer material in a seed furrow. Harvest was conducted on August 19 (2020), September 9 (2021), and September 13 (2023). The center two rows of each plot for both "Manistee" and "Russet Norkotah" were harvested using a modified, self-propelled Lenco Twin-Row Potato Plot Harvester. Tubers were weighed and graded on-site to ensure minimum shrink, and total plot weights and counts were converted to an acre basis (yield given in hundred weight/cwt per acre). Design and methods were consistent for all years of the study (2020, 2021, 2023).

Treatments were as follows:

2020:

1. Manistee, 10 gal/a Ammonium Polyphosphate (control)
2. Manistee, 10 gal/a Ammonium Polyphosphate + 8 fl oz/a Duo Maxx
3. Manistee, 10 gal/a Ammonium Polyphosphate + 16 fl oz/a Duo Maxx
4. Manistee, 10 gal/a Ammonium Polyphosphate + 32 fl oz/a Duo Maxx
5. Russet Norkotah, 10 gal/a Ammonium Polyphosphate (control)
6. Russet Norkotah, 10 gal/a Ammonium Polyphosphate + 8 fl oz/a Duo Maxx
7. Russet Norkotah, 10 gal/a Ammonium Polyphosphate + 16 fl oz/a Duo Maxx

8. Russet Norkotah, 10 gal/a Ammonium Polyphosphate + 32 fl oz/a Duo Maxx

2021:

1. Manistee, 10 gal/a Ammonium Polyphosphate (control)
2. Manistee, 10 gal/a Ammonium Polyphosphate 16 fl oz/a Duo Maxx
3. Manistee, 10 gal/a Ammonium Polyphosphate 32 fl oz/a Duo Maxx
4. Russet Norkotah, 10 gal/a Ammonium Polyphosphate (control)
5. Russet Norkotah, 10 gal/a Ammonium Polyphosphate + 16 fl oz/a Duo Maxx
6. Russet Norkotah, 10 gal/a Ammonium Polyphosphate + 32 fl oz/a Duo Maxx

2023:

1. Manistee, 10 gal/a Ammonium Polyphosphate (control)
2. Manistee, 10 gal/a Ammonium Polyphosphate + 16 fl oz/a Duo Maxx
3. Manistee, 10 gal/a Ammonium Polyphosphate + 32 fl oz/a Duo Maxx
4. Russet Norkotah, 10 gal/a Ammonium Polyphosphate (control)
5. Russet Norkotah, 10 gal/a Ammonium Polyphosphate + 16 fl oz/a Duo Maxx
6. Russet Norkotah, 10 gal/a Ammonium Polyphosphate + 32 fl oz/a Duo Maxx

B. Vegetable

1. Tomato- The experimental design was a randomized complete block (RCB) with seven replications per treatment. “Charger” variety tomatoes were transplanted into plastic covered beds with drip irrigation on September 11, 2020 at a plant population of 4585 per acre, spaced on 6’ centers with 19” between plants. Residual fertility was considered on soil test analysis to be sufficient for base levels of phosphorus, potassium and other nutrients. Grower standard practice of a banded 21-0-21 (95 lbs/acre) placed on top of the bed was used to provide initial soluble nitrogen and potassium prior to standard fertigation practice of 4-2-9 liquid fertilizer blend that was injected twice weekly for the duration of the trial at levels based on plant development. Treatment of Duo Maxx on banded 21-0-21 was coated on the granular material to simulate commercial fertilizer blending equipment at a labeled rate (2 quarts/dry ton) and treatment of liquid 4-2-9 fertilizer was applied based on the weekly volume to account for the labeled rate (2 quarts/liquid ton). Full plots were hand harvested on November 18, November 24, and December 8. Fruit was weighed on-site and plot weight was averaged and converted to lbs per acre.

The treatments were as follows:

1. 21-0-21 95 lb/a at planting + 4-2-9 Weekly drip (control)
2. 21-0-21 95 lb/a at planting with Duo Maxx (2 qt/dry ton) + 4-2-9 Weekly drip
3. 21-0-21 95 lb/a at planting + 4-2-9 Weekly drip with Duo Maxx (2 qt/liquid ton)
4. 21-0-21 95 lb/a and Duo Maxx (2 qt/dry ton) at planting + 4-2-9 Weekly drip with Duo Maxx (2 qt/liquid ton)

2.2.2 Controls

A. Broadacre

1. Corn- Negative controls were used in the form of UAN applied on its own, without anything added, at various rates at standard side-dress timing (V5-V7).

2. Potato- Negative controls were used in the form of ammonium polyphosphate applied on its own, without anything added, at planting with a standard in-furrow placement.

B. Vegetable

1. Tomato- Negative controls were used in the form of 21-0-21 homogenous granular banded on the top of the row at planting with a liquid 4-2-9 blend applied on its own, without anything added, throughout the growing season at a frequency and volume determined by crop nutrient demand.

2.3 Statistical Analysis

A. Broadacre

1. Corn- Data were analyzed based on a randomized complete block (RCB) design using PROC MIXED (SAS Institute, Cary, NC 2009) where block and treatment effects were evaluated to minimize degree of error and improve confidence intervals among experimental units. When significant differences were found Fischer's protected LSD was used to separate treatment means. Means were separated using the Least Significant Difference (LSD) test at $P\alpha=0.05$ for 2020-2021 and $P\alpha=0.10$ for 2022. Other than $P\alpha$ values, all statistical analyses were equal for 2020-2022.

2. Potato- Trial design used was a split-plot by variety with a randomized complete block (RCB) design with six replications. Yield data were analyzed via Analysis of Variance (ANOVA) for a RCB design (ARM 8 Statistical Software, Gylling Data Management, Brookings, SD) where block and treatment effects were evaluated to minimize degree of error and improve confidence intervals among experimental units. Means were separated using the Least Significant Difference (LSD) test at $P\alpha=0.10$. All statistical analyses were equal for 2020, 2021, and 2023.

B. Vegetable

1. Tomato- Trial design used was a randomized complete block (RCB) design with six replications. Yield data were analyzed via Analysis of Variance (ANOVA) for a RCB design (ARM 8 Statistical Software, Gylling Data Management, Brookings, SD) where block and

treatment effects were evaluated to minimize degree of error and improve confidence intervals among experimental units. Means were separated using the Least Significant Difference (LSD) test at Pα=0.5.

SECTION 3. RESULTS

3.1 Description of the Dataset

A. Broadacre

1. Corn- Duo Maxx treatment improved yield across comparison untreated UAN in all three years at both rates (higher and lower N). This would include averaging 17.63 bushel per acre higher in the lower N rate untreated comparisons and 12.31 bushel per acre higher in the higher N rate untreated comparisons. When surplus untreated N rates were included in the trial (125-133% N), the 100% N Duo Maxx treated comparison improved average yield by 5.29 bushel per acre over the surplus N rate. Furthermore, the lower N rate (66-75%) Duo Maxx treated UAN outperformed the 100% N untreated comparison by an average of 9.96 bushel per acre. This trend was consistent in all three years of the trial, despite variances in yield range between the years. This consistent increase in grain yield between lower Duo Maxx treated N rates over higher untreated N rates indicates improved nitrogen use efficiency, indicating its utility as an enhanced efficiency fertilizer additive. Despite yield ranges varying between seasons, a "No side-dress N" check/treatment used in 2020/2021 did reveal strong nitrogen response from side-dress UAN applications indicating that residual soil fertility was not sufficient to meet yield goals based on prescriptive University/Extension recommended N rates. The total average yield benefit from adding Duo Maxx to side-dress UAN across the six comparison N rates over 3 years was 14.97 bushel per acre (Table 4, 5, 6).

2. Potato- With only one exception over the 3 trial years, all treatments that included Duo Maxx had a higher average yield (cwt/acre) than their respective untreated controls. This totaled 14 Duo Maxx treatments combined over both varieties, Manistee and Russet Norkotah. Duo Maxx treatments (n=14) reported an average yield advantage of 43.0 cwt/acre (+8.43%). For 2 out of the 3 years (2020, 2021) Russet Norkotah variety reported higher yields between the untreated and the Duo Maxx treatments averaged across all rates compared to the Manistee variety. Trial year of 2020 reported the highest overall yields between both varieties with yields ranging from 553.6 cwt to 672.1 cwt, with the highest yielding single treatment being the 32 oz rate of Duo Maxx on Russet Norkotah variety. The trial year of 2021 reported the lowest overall yields between both varieties with yields ranging from 392.0 cwt to 531.7 cwt, with the highest yielding single treatment being the 16 oz rate of Duo Maxx on Russet Norkotah variety. The 2023 trial yield also featured high yields and strong treatment response, with yields ranging from 507.6 cwt to 572.8 cwt. The highest yielding 2023 was 16 oz rate of Duo Maxx on Manistee variety, with 2023 being the only year with average yields across the Manistee variety being higher than the Russet Norkotah variety. Average yields across Duo Maxx treatment rates for 8 oz, 16 oz, and 32 oz per acre for both

varieties were as follows: 42.9 cwt (n=2), 23.7 cwt (n=6), and 42.7 cwt (n=6), respectively (Table 7, 8, 9).

B. Vegetable

1. Tomato- Total marketable yield for "Charger" variety tomato averaged between 31141.25 lbs/acre and 34719.4 lbs/acre. Banded granular 21-0-21 fertilizer treated with Duo Maxx improved marketable tomato yield over the same rate of banded fertilizer without the Duo Maxx treatment by 293.3 lbs/acre. Injected 4-2-9 liquid fertilizer treated with Duo Maxx improved marketable tomato yield over the same rate of liquid fertilizer without the Duo Maxx treatment by 1910.8 lbs/acre. Banded granular 21-0-21 fertilizer and injected 4-2-9 liquid fertilizer treated with Duo Maxx improved marketable tomato yield over the same rate of grower standard fertilizer without the Duo Maxx treatment by 3569.0 lbs/acre. This upward yield trend based on the frequency of use for treatment of Duo Maxx within grower standard fertility program suggest the broad benefit for different fertilizer application. Return on investment was calculated at retail cost of Duo Maxx of $100/gallon and marketable tomato boxes of 25-lbs at $14/box. Treatments of Duo Maxx for banded granular, injected liquid, and the combination of both treated with Duo Maxx resulted in the following return on investments: $160.69/acre, $1046.88/acre, and $1971.90/acre, respectively (Table 10).

3.2 Statistical Testing Results

A. Broadacre

1. Corn- 2020 Season: Duo Maxx treatment of 30% UAN did result in a statistically significant average yield at the 50 gallon per acre rate. The Duo Maxx treated 50 gallon per acre rate of UAN did perform at a statistically similar average yield to the much higher rate of untreated 66 gallon per acre of UAN. Though the treatment of Duo Maxx with UAN at 37.5 gallon per acre was not significantly different from it's untreated control, it was statistically similar to the much higher rate of untreated UAN at 66 gallon per acre. Statistical significance was analyzed at a 95% confidence level (Table 4).

2021 Season: While all untreated control and Duo Maxx treatments for both higher rates of UAN (56.25 gallon per acre and 75 gallon per acre) were statistically similar in regards to average yield, the 56.25 gallon per acre Duo Maxx treated UAN had an average yield that was statistically the same as the 75 gallon per acre untreated control rate of UAN. The higher rate of untreatedUAN (75 gallon per acre) was statistically the same as the matching rate of Duo Maxx treated UAN. Both of the lower "check" untreated UAN side-dress volumes (42.19 gallon per acre and 0 gallon per acre) were significantly lower than agronomically recommended UAN rates of 56.25 gallons per acre and higher (untreated and Duo Maxx treated). Statistical significance was analyzed at a 95% confidence level (Table 5).

2022 Season: Both matching rates of UAN with Duo Maxx treatment had an average yield that was significantly higher than similar rates of untreated UAN (40.6 gallons per acre and 26.6 gallons per acre). Both treatments including Duo Maxx were also statistically similar to the highest rate of untreated UAN at 54.7 gallon per acre, with the lowest rate of UAN treated with Duo Maxx having less than half of the volume of the highest rate, at a 90% confidence level (Table 6).

2. Potato- 2020 Season: For Manistee variety, all rates of Duo Maxx treatment of ammonium polyphosphate increased average yields but were statistically similar to the control untreated ammonium polyphosphate. For Russet Norkotah variety, both the 8 oz rate and 32 oz rate of Duo Maxx treated ammonium polyphosphate provided statistically significant higher average yields than the untreated control ammonium polyphosphate. The 16 oz rate of Duo Maxx treated ammonium polyphosphate was statistically similar to the untreated ammonium polyphosphate but did numerically increase yield. Statistical significance was analyzed at a 90% confidence level (Table 7).

2021 Season: There were no statistically significant differences within the data set for average yield between varieties for treatments and controls. Variances in the data set analyzed by ANOVA equated to a higher least significant difference value of 106.08 – which was much higher than both 2020 and 2023 growing seasons. Statistical significance was analyzed at a 90% confidence level (Table 8).

2023 Season: For Manistee variety, the 16 oz rate of Duo Maxx treated ammonium polyphosphate provided statistically significant higher average yields than the untreated control polyphosphate. The 32 oz rate of Duo Maxx treated ammonium polyphosphate was statistically similar to the untreated control and the 16 oz rate of Duo Maxx treated ammonium polyphosphate but numerically higher than the untreated control. Both rates of Duo Maxx treated ammonium polyphosphate (16 oz and 32 oz) were numerically higher than untreated control ammonium polyphosphate but were statistically similar. Statistical significance was analyzed at a 90% confidence level (Table 9).

B. Vegetable

1. Tomato- There were no statistically significant differences between treatments, but as Duo Maxx treatment did increase numerical average yields in the trial. Statistical significance was analyzed at a 95% confidence level (Table 10).

SECTION 4. CONCLUSIONS

Within the body of original research submitted, Duo Maxx makes a compelling case for the use of biostimulants as enhanced efficiency fertilizer tools that can enhance nutrient use efficiency. The validation for this claim of "increased nutrient use efficiency" is based on Duo Maxx treatment of grower standard fertilizer materials increasing yield when compared to untreated fertilizer materials of the same rate, and many times – as validated by the North Carolina State University UAN Side-dress study - improving average yield over untreated higher rates of nitrogen. This evidence of 20-30% nitrogen reduction without sacrificing crop productivity is a critical strategy for farm profitability. This is an important element of reducing greenhouse gas (GHG) emissions through enhanced nitrogen use efficiency (Gao & Cabrera Serrenho, 2023).

It is also important to note the impacts of different fertilizers used with Duo Maxx treatment presented in the original research. Within the Mid-Michigan Agronomy potato research, Duo Maxx treated ammonium polyphosphate used at different rates improved average yield in 92.8% of the comparisons against the untreated ammonium polyphosphate over the 14 total data points. The evidence of this yield response would suggest that Duo Maxx helps chelate and protect phosphate from soil retrogradation and other limiting factors for phosphorus use efficiency. Early phosphorus uptake and soil P availability is critical to maintain peak production in potato cultivation because of the essential roles the nutrient plays in early development, tuber formation and plant maturation (Thornton et al., 2014).

In conclusion, the original research presented around Duo Maxx embodies the long-term vision for biostimulant product validation across years and multiple cropping systems. We are confident that we have presented strong evidence on Duo Maxx around the claims of optimizing nutrient use efficiency and improves nutrient uptake via natural complexing agents. Beyond the data presented in this original research to meet the crop group requirements of an "all crop" certification label designation, Timac Agro USA has over one hundred replicated data points on fertilizer with and without Duo Maxx. As of December 2023, Duo Maxx treated fertilizer improved average yield over untreated comparison fertilizer by 5.94% with a win-rate of 93.27% across 102 replicated trials in a myriad of cropping systems and applications.

Sources

Gao, Y., Cabrera Serrenho, A. Greenhouse gas emissions from nitrogen fertilizers could be reduced by up to one-fifth of current levels by 2050 with combined interventions. Nat Food 4, 170–178 (2023). https://doi.org/10.1038/s43016-023-00698-w

Thornton, M. K., R. G., Novy, and J. C. Stark. 2014. "Improving Phosphorus Use Efficiency in the Future." American Journal of Potato Research 91(2): 175–179. https://doi.org/10.1007/s12230-014-9369-9.

SECTION 5. TABLES & FIGURES

Table 1	Min Temp	Max Temp	Precipitation	Growing Degree Days
Plymouth, NC	-°F-	-°F-	-In-	-GDD-
2006-2020	52.1	73	55.68	5440
2020-2022	52.62	73.3	55.63	5441

Table 2	Min Temp	Max Temp	Precipitation	Growing Degree Days
Marshall, MI	-°F-	-°F-	-In-	-GDD-
2006-2020	39.5	59.8	35.24	3071
2020-2022	41.5	59.9	33.10	3295

Table 3	Min Temp	Max Temp	Precipitation	Growing Degree Days
Thonotosassa, FL	-°F-	-°F-	-In-	-GDD-
2006-2020	63.9	83.4	52.51	8716
2020	65.9	87.2	56.85	9811

Table 4 (2020 NCSU – Side-dress UAN Corn Trial)	Yield (bushel/acre)
30% UAN at 66.6 gal/acre	168.3 abc
30% UAN at 50 gal/acre (control)	161.0 c
30% UAN at 50 gal/acre + Duo Maxx at 16 fl. oz/acre (2 qt ton)	178.8 a
30% UAN at 37.5 gal/acre (control)	164.0 bc
30% UAN at 37.5 gal/acre + Duo Maxx at 12 fl. oz/acre (2 qt ton)	177.2 ab
Check – No additional N applied	121.0 d
LSD ($p < 0.05$)	**14.65**

Table 5 (2021 NCSU - Side-dress UAN Corn Trial)	Yield (bushel/acre)
30% UAN at 75 gal/acre (control)	197.2 abc
30% UAN at 75 gal/acre + Duo Maxx at 24 fl. oz/acre (2 qt/ton)	202.0 abc
30% UAN at 56.25 gal/acre (control)	193.3 bc
30% UAN at 56.25 gal/acre + Duo Maxx at 18 fl. oz/acre (2 qt/ton)	197.2 abc
30% UAN at 42.19 gal/acre	173.5 d
Check – No Side-dress N applied	77.5 e
LSD ($p < 0.05$)	**17.5**

Table 6 (2022 NCSU - Side-dress UAN Corn Trial)	Yield (bushel/acre)
30% UAN at 54.7 gal/acre (control)	143.42 a
30% UAN at 40.6 gal/acre (control)	133.46 cd
30% UAN at 40.6 gal/acre + Duo Maxx at 24 fl. oz/acre	143.09 ab
30% UAN at 26.6 gal/acre (control)	127.73 d
30% UAN at 26.6 gal/acre + Duo Maxx at 24 fl. oz/acre	143.26 ab
LSD ($p < 0.1$)	**9.10**

Table 7 (2020 Mid-Michigan Agronomy – Potato Trial)	Yield (cwt/acre)
Manistee, 10 gal/a Ammonium Polyphosphate (control)	553.6 c
. Manistee, 10 gal/a Ammonium Polyphosphate + 8 fl oz/a Duo	579.3 bc
Manistee, 10 gal/a Ammonium Polyphosphate + 16 fl oz/a Duo Maxx	555.0 c
Manistee, 10 gal/a Ammonium Polyphosphate + 32 fl oz/a Duo Maxx	579.7 bc
Russet Norkotah, 10 gal/a Ammonium Polyphosphate (control)	584.1 bc
Russet Norkotah, 10 gal/a Ammonium Polyphosphate + 8 fl oz/a Duo Maxx	644.3 a
Russet Norkotah, 10 gal/a Ammonium Polyphosphate + 16 fl oz/a Duo Maxx	602.7 b
Russet Norkotah, 10 gal/a Ammonium Polyphosphate + 32 fl oz/a Duo Maxx	672.1 a
LSD ($p = 0.1$)	**30.36**

Table 8 (2021 Mid-Michigan Agronomy – Potato Trial)	Yield (cwt/acre)
Manistee, 10 gal/a Ammonium Polyphosphate (control)	426.4 -
Manistee, 10 gal/a Ammonium Polyphosphate + 16 fl oz/a Duo Maxx	392.0 -
Manistee, 10 gal/a Ammonium Polyphosphate + 32 fl oz/a Duo Maxx	445.1 -
Russet Norkotah, 10 gal/a Ammonium Polyphosphate (control)	471.3 -
Russet Norkotah, 10 gal/a Ammonium Polyphosphate + 16 fl oz/a Duo Maxx	531.7 -
Russet Norkotah, 10 gal/a Ammonium Polyphosphate + 32 fl oz/a Duo Maxx	528.1 -
LSD (p = 0.1)	**106.08**

Table 9 (2023 Mid-Michigan Agronomy – Potato Trial)	Yield (cwt/acre)
Manistee, 10 gal/a Ammonium Polyphosphate (control)	518.2 efg
Manistee, 10 gal/a Ammonium Polyphosphate + 16 fl oz/a Duo Maxx	572.8 abcd
Manistee, 10 gal/a Ammonium Polyphosphate + 32 fl oz/a Duo Maxx	563.2 bcdef
Russet Norkotah, 10 gal/a Ammonium Polyphosphate (control)	507.6 g
Russet Norkotah, 10 gal/a Ammonium Polyphosphate + 16 fl oz/a Duo Maxx	549.4 bcdefg
Russet Norkotah, 10 gal/a Ammonium Polyphosphate + 32 fl oz/a Duo Maxx	529.3 defg
LSD (p = 0.1)	**48.65**

Table 10 (2020 Florida Ag Research – Tomato Trial)	Yield (lbs/acre)
21-0-21, 95 lb/a at planting + 4-2-9 Weekly drip (control)	31141.25 a
21-0-21, 95 lb/a at planting with Duo Maxx (2 qt/dry ton) + 4-2-9 Weekly drip	31459.86 a
21-0-21, 95 lb/a at planting + 4-2-9 Weekly drip with Duo Maxx (2 qt/liquid ton)	33049.6 a
21-0-21, 95 lb/a and Duo Maxx (2 qt/dry ton) at planting + 4-2-9 Weekly drip with Duo Maxx (2 qt/liquid ton)	34719.4 a
LSD (p = 0.05)	**3633.826**

Title 6 Addendum

Introduction

Duo Maxx is a fertilizer additive that has been successfully applied to many cropping systems throughout the United States. Common use cases for Duo Maxx fertilizer treatment include, but are not limited to: granular commodity fertilizer blends, liquid fertilizer sources used in starters such as orthophosphate and polyphosphate, side-dress nitrogen liquids including urea-ammonium nitrate (UAN), and treating manure sources prior to soil application/incorporation. Target crops for Duo Maxx fertilizer treatment include, but are not limited to: corn, wheat, rice, cotton, potato, onions, pasture, turfgrass, horticultural crops, fruits and vegetables. Duo Maxx is compatible with most standard liquid application and dry handling systems.

Section 1. Soil Characteristics

1.1 Soil Test Results

A. Potato- The soil test results from 2021 and 2023 were very similar, with a very low standard deviation between the different years for each nutrient and property. Soil results for 2020 were unavailable. (Table A. 1)

B. Corn- Soil test results for 2020, 2021, and 2022 all had similar nutrient levels. While the chemical properties varied slightly year to year, there was still a low standard deviation between all three years. (Table A. 2)

Section 2. Partial Factor Productivity

2.1 Nitrogen Partial Factor Productivity

A. Corn- Duo Maxx showed a higher PFP (partial factor productivity= yield/ Lbs. applied nutrient) over untreated for every nitrogen rate it was included in during the three-year study. As nitrogen rates increased the PFP was smaller, as to be expected, but was still higher when compared to untreated. A single tailed T-test shows a statistical significance at the p=.05 level (Table A. 3).

B. Potato- Across all three study years, all rates of Duo Maxx, and both varieties Duo Maxx only had a lower PFP for nitrogen than the untreated in one instance. Both 8 oz and 16 oz treatments of Duo Maxx had a similar PFP compared to each other. A single tailed T-test shows significance at the p=.10 level (Table A. 4).

2.2 Phosphorus Partial Factor Productivity

A. Potato- Duo Maxx had a higher PFP than untreated on phosphorus for all treatment levels save for the same instance in the nitrogen PFP. The rate of Duo Maxx did not seem to influence the PFP. A single tailed t-test shows significance at the $p=.10$ level (Table A. 5).

Section 3. Descriptive Statistics

3.1 Yield Data Analysis

A. Potato- The mean, standard deviation, and standard error are reported for all treatment levels and variety all three years of the study (tables A. 6 - A. 11). Duo Maxx treatments had a higher average yield than all untreated, except for Manistee 2021 at 16 oz of Duo Maxx. The 16 oz treatment of Duo Maxx tended to have a lower standard deviation than the 32 oz treatment, however untreated was generally lower. An analysis of variance test (ANOVA) was conducted on all data at alpha levels of .05 and .10; however all data sets were found to not be statistically significant at $p=.05$ or $p=.10$.

B. Corn- The mean, standard deviation, and standard error are reported for the trial years of 2020, 2021, and 2022 (Tables A. 12-14). Duo Maxx treatments showed a higher average yield, a mostly lower standard deviation, and a lower standard error than untreated plots. Both ANOVA and a single tailed t-test found this data to be significant at the alpha level of $p=.10$ (Table A. 12) for 2020. A t-test also showed the higher rate of UAN with Duo in 2022 to be significant at the alpha level of $p=.10$ (Table A. 14).

Summary

The research data provided here has demonstrated that treatments including Duo Maxx Increase nutrient use efficiency (NUE), as defined by a greater partial factor productivity (PFP= yield/ lbs. nutrient applied) over untreated, on nitrogen in corn ($p<.05$ table A. 3), as well as potatoes where Duo Maxx showed a greater PFP on nitrogen and phosphorus ($p<.10$ tables A. 4-5) .

Table A. 1

MMA In-Furrow Potato Trial Soil Data

Year	OM	pH	CEC	P	K	Mg	Ca
2021	1.7	6.6	4.2	73	133	105	600
2023	1.5	7.1	5.2	126	114	105	800
Mean	1.6	6.85	4.7	99.5	123.5	105	700
Std Dev	0.1	0.25	0.5	26.5	9.5	0	100

Table A. 2

NCSU Corn Trial Soil Data

Year	OM	pH	CEC	P	K	Mg	Ca
2020	1.9	6.3	8.2	72.0	88.0	21.0	63.0
2021	6.3	5.8	3.0	67.0	106.0	22.0	49.0
2022	1.8	6.3	9.1	79.0	89.0	20.0	62.0
Mean	3.3	6.1	6.8	72.7	94.3	21.0	58.0
Std Dev	2.1	0.2	2.7	4.9	8.3	0.8	6.4

Table A. 3

NCSU side-dress UAN Corn Trial 2020-2022

Nitrogen PFP

N Rate (lb/A)	Untreated	w/ Duo Maxx	PFP untreated	PFP Duo
85	127.43	143.26	1.50	1.69
120	164	177.2	1.37	1.48
130	133.46	143.09	1.03	1.10
135	173.5		1.29	
160	161	178.8	1.01	1.12
180	143.42		0.80	
185	193.3	197.2	1.04	1.07
215	168.3		0.78	
245	197.2	202	0.80	0.82
		Mean PFP	1.07	1.21
		Std Dev	0.25	0.28
		Std Error	0.08	0.12
			p=.009 < .05	

Table A. 4
MMA In-Furrow Potato Trial 2020-2021, 2023
Nitrogen PFP

Year	Variety	N rate (lb/a)	DM Rate	Total Yield	PFP Untreated	PFP Duo
2020	Manistee	11	0	553.6	50.33	
2020	Manistee	11	8	579.3		52.66
2020	Manistee	11	16	555		50.45
2020	Manistee	11	32	579.7		52.70
2020	Russet Norkotah	11	0	584.1	53.10	
2020	Russet Norkotah	11	8	644.3		58.57
2020	Russet Norkotah	11	16	602.7		54.79
2020	Russet Norkotah	11	32	672.1		61.10
2021	Manistee	11	0	426.4	38.76	
2021	Manistee	11	16	392		35.64
2021	Manistee	11	32	445.1		40.46
2021	Russet Norkotah	11	0	471.3	42.85	
2021	Russet Norkotah	11	16	531.7		48.34
2021	Russet Norkotah	11	32	528.1		48.01
2023	Manistee	11	0	518.2	47.11	
2023	Manistee	11	16	572.8		52.07
2023	Manistee	11	32	563.2		51.20
2023	Russet Norkotah	11	0	507.6	46.15	
2023	Russet Norkotah	11	16	549.4		49.95
2023	Russet Norkotah	11	32	529.3		48.12
				Mean PFP N	46.38	50.29
				Std Dev	5.13	6.25
				Std Error	2.10	1.67
					p=.08 < .10	

Table A. 5
MMA In-Furrow Potato Trial 2020-2021, 2023
Phosphorus PFP

Year	Variety	P rate (lb/a)	DM Rate	Total Yield	PFP Untreated	PFP Duo
2020	Manistee	37	0	553.6	14.96	
2020	Manistee	37	8	579.3		15.66
2020	Manistee	37	16	555		15
2020	Manistee	37	32	579.7		15.67
2020	Russet Norkotah	37	0	584.1	15.79	
2020	Russet Norkotah	37	8	644.3		17.41
2020	Russet Norkotah	37	16	602.7		16.29
2020	Russet Norkotah	37	32	672.1		18.16
2021	Manistee	37	0	426.4	11.52	
2021	Manistee	37	16	392		10.59
2021	Manistee	37	32	445.1		12.03
2021	Russet Norkotah	37	0	471.3	12.74	
2021	Russet Norkotah	37	16	531.7		14.37
2021	Russet Norkotah	37	32	528.1		14.27
2023	Manistee	37	0	518.2	14.01	
2023	Manistee	37	16	572.8		15.48
2023	Manistee	37	32	563.2		15.22
2023	Russet Norkotah	37	0	507.6	13.72	
2023	Russet Norkotah	37	16	549.4		14.85
2023	Russet Norkotah	37	32	529.3		14.31
				Mean PFP P	13.79	14.95
				Std Dev	1.39	1.86
				Std Error	0.57	0.50
					p=.08 < .10	

Table A. 6

2020 Manistee

	Untreated	8 oz Duo	16 oz Duo	32 oz Duo
yield	517.80	539.90	576.80	554.70
	500.60	558.40	583.00	558.40
	569.50	589.10	530.10	591.60
	589.10	580.50	557.20	575.60
	511.70	640.80	487.10	669.10
	488.30	506.70	612.50	517.80
Mean	529.50	569.23	557.78	577.87
Std Dev	36.83	41.90	40.32	46.62
Std Error	15.04	17.10	16.46	19.03

Table A.7

2020 Norkotah

	Untreated	8 oz Duo	16 oz Duo	32 oz Duo
Yield	546.10	632.20	619.90	645.70
	552.20	659.20	597.70	639.60
	560.80	662.90	591.60	691.20
	592.80	662.90	591.60	694.90
	570.70	589.10	617.40	677.70
	512.90	562.10	600.20	658.00
Mean	555.92	628.07	603.07	667.85
Std Dev	24.37	39.33	11.47	21.45
Std Error	9.95	16.06	4.68	8.76

Table A. 8

2021 Manistee

	Untreated	16 oz Duo	32 oz Duo
yield	348.50	356.00	396.10
	492.50	324.70	507.00
	314.20	307.80	539.60
	455.90	471.60	355.40
	506.50	498.30	530.90
	440.80	393.80	341.50
Mean	426.40	392.03	445.08
Std Dev	71.32	71.36	82.97
Std Error	29.12	29.13	33.87

Table A. 9

2021 Norkotah

	Untreated	16 oz Duo	32 oz Duo
yield	316.50	594.70	577.90
	348.50	532.00	631.90
	389.10	575.00	335.70
	569.20	324.10	627.80
	663.90	608.10	530.90
	540.70	556.40	464.60
Mean	471.32	531.72	528.13
Std Dev	127.34	96.08	103.48
Std Error	51.99	39.22	42.25

Table A. 10

2023 Manistee

	Untreated	16 oz Duo	32 oz Duo
yield	527.60	581.80	549.20
	496.90	613.70	563.90
	502.40	592.80	512.30
	517.80	536.90	621.70
	523.90	588.50	588.50
	540.60	523.30	543.60
Mean	518.20	572.83	563.20
Std Dev	14.87	31.99	34.72
Std Error	6.07	13.06	14.18

Table A. 11

2023 Norkotah

	Untreated	16 oz Duo	32 oz Duo
yield	504.90	539.90	461.20
	462.50	598.40	516.00
	494.40	477.80	474.80
	553.50	553.50	559.60
	560.80	624.20	610.70
	469.20	502.40	553.50
Mean	507.55	549.37	529.30
Std Dev	37.92	50.73	51.50
Std Error	15.48	20.71	21.03

Table A. 12

NCSU Side-Dress UAN 2020

	30% UAN 37.5 gal/A	30% UAN 50 gal/A	30% UAN 37.5 gal/A + Duo	30% UAN 50 gal/A + Duo
Yield	138.25	144.24	172.59	182.50
	173.29	150.77	175.33	175.35
	152.04	151.58	175.44	180.48
	168.97	169.04	174.45	178.79
	187.23	189.24	188.22	177.10
Mean	163.96	160.97	177.21	178.84
Std Dev	17.07	16.35	5.60	2.50
Std Error	7.63	7.31	2.50	1.12
			p=.058 < .10	*p*=.056 < .10

Table A. 13

NCSU Side-Dress UAN 2021

	30% UAN 56.25 gal/A	30% UAN 75 gal/A	30% UAN 56.25 gal/A + Duo	30% UAN 75 gal/A + Duo
Yield	196.72	208.95	196.85	200.26
	194.40	171.86	187.94	208.77
	194.29	204.49	203.95	194.71
	187.80	203.66	200.06	207.50
Mean	193.30	197.24	197.20	202.81
Std Dev	3.32	14.79	5.91	5.69
Std Error	1.66	7.40	2.96	2.85
			p= .18 > .10	*p*=.28 > .10

Table A . 14

NCSU Side-Dress UAN 2022

	30% UAN 26.6 gal/A	30% UAN 40.6 gal/A	30% UAN 26.6 gal/A + Duo	30% UAN 40.6 gal/A + Duo
Yield	129.81	144.20	144.15	157.56
	135.59	132.52	150.89	138.61
	114.40	122.15	155.53	143.17
	131.14	134.96	122.48	133.03
Mean	127.73	133.46	143.26	143.09
Std Dev	7.99	7.85	12.66	9.09
Std Error	4.00	3.92	6.33	4.55
			p= .11 > .10	*p*= .07 < .10