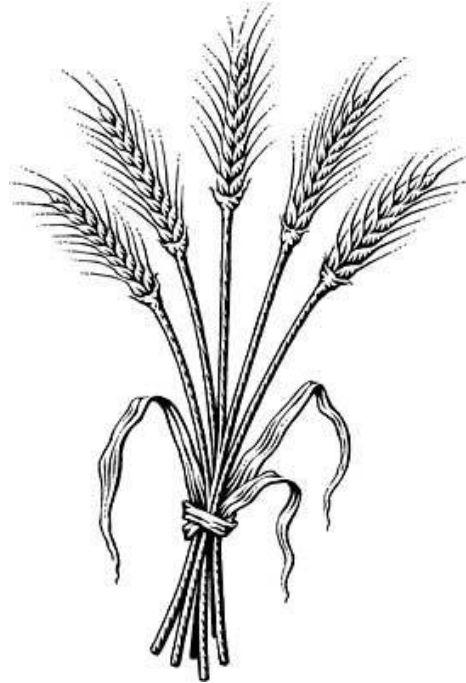


Northeast Ag Expo Small Grains Field Day 2019 Test Results



Cooperator: Jamie Stallings and Sons
Farms
Chowan County



CAMDEN • CURRITUCK • CHOWAN • GATES
PASQUOTANK • PERQUIMANS

Acknowledgements

Any effective on-farm-test requires a great deal of assistance from a number of different individuals. The Northeast Expo Team would like to officially recognize these people for their contribution to the 2019 Northeast Expo Small Grains Field Day. Collaboration with a willing and effective landowner/cooperator is a key component to all successful field research. The cooperator for these tests was Jamie Stallings and Son's Farms of Chowan County. We would like to thank Jamie Stallings and his family for allowing this work to be conducted on their farm and for conducting many of the field operations during the growing season. Several NCSU Extension specialists were also vital to this process. Dr. Ron Heiniger, Dr. Angela Post, Ryan Heiniger, and their support staff assisted in planning, planting, applying treatments, harvesting plots, and data analysis. Additionally, these specialists, Dr. Christina Cowger, and Dr. Wes Everman were presenters for the Northeast Expo Small Grains Field Day held on February 20, 2019. Financial support from the North Carolina Small Grain Growers Association was instrumental and we extend a very special thank you to the association. The various seed and agribusiness companies represented in our data donated seed and treatment materials used in the trials. Thanks to everyone who contributed in the generation of this data. In addition, we appreciate the support of the agriculture community and all that attended the field day.

Northeast Ag Expo Team

The Northeast Ag Expo Team, listed below, consists of a six-county North Carolina Cooperative Extension group located in northeastern North Carolina. This six-county team serves Camden, Chowan, Currituck, Gates, Pasquotank, and Perquimans Counties. This team conducts on-farm research, field days, and crop variety trials annually to promote the profitability and sustainability of area farming operations.

Nettie Baugher-Chowan/Gates/Perquimans Commercial Horticulture Agent

Austin Brown- Camden County Agriculture Agent

Erin Eure-Commercial Fruits & Vegetables Area Specialized Agent

Adam Formella- Currituck County Agriculture Agent

Jared Harrell- Chowan/Gates/Perquimans Livestock Agent

Matthew Leary-Chowan County Agriculture Agent

Dylan Lilley- Perquimans County Agriculture Agent

Paul Smith- Gates County Agriculture Agent

Al Wood- Pasquotank County Agriculture Agent

Site Characteristics

Trials were conducted at Jamie Stallings and Son's Farms of Chowan, North Carolina (36.266513, -76.533879). Pre plant fertilizer consisted of 2 tons of chicken litter per acre. Preplant fertilizer was applied only on the *Variety Trial, Foliar Yield Enhancement Trials, and Fungicide Trial*. The soil types found in the test plots were Augusta Fine Sandy Loam, Munden Loamy Fine Sand, and Tomotley Fine Sandy Loam. The *Large-scale Examination of Variety-specific Responses to Multiple Nitrogen Treatment Levels trial* included all three soil types. The soil type for the *Variety Trial* was Tomotley Fine Sandy Loam and Munden Loamy Fine Sand. The soil type for the *Company and Agent led Foliar Yield Enhancement trial* was Munden Loamy Fine Sand and Augusta Fine Sandy Loam. The soil type for the *Fungicide Trial* was Tomotley Fine Sandy Loam. The Soil Type for the *Identifying Management Practices that Increase Kernel Number in Wheat trial* was Munden Loamy Fine Sand.

All tests except the *Large-scale Examination of Variety-specific Responses to Multiple Nitrogen Treatment Levels trial* and the *Identifying Management Practices that Increase Kernel Number in Wheat trial* received additional fertilization consisting of 130 pounds of nitrogen per acre applied on 3/7/19. 30% UAN was the Nitrogen source. Herbicide was applied 2/7/19: 1.5oz/A Zidua, 16 oz/A Axial and 0.75 oz/A Quelex for pre and post emergent weed control and no fungicides were applied. Trials were planted on 11/8/18 and harvested on 6/4/19. Plot combines utilized for harvest recorded plot weight, test weight, and moisture for each plot. Yields were standardized to 13.5% moisture. Statistical analysis was performed using Statistical Analysis Software (SAS). Significance is reported at the 95% confidence level, unless otherwise noted.

The NE Ag Expo Small Grains Field Day site experienced wet weather conditions in Fall 2018, which delayed planting past the optimal window. Cool, wet conditions persisted following planting and delayed emergence and stand establishment. At spring green-up, disease pressure was apparent. Both Pythium and Fusarium root rotting organisms were isolated from wheat roots. The *Foliar Yield Enhancement Trials* weren't affected. The *Variety Trial* remained in good condition overall following topdress and the decision was made to take the trials to harvest. Yields suffered due to the consistent disease pressure across the site, but still provided good data for producers in the region to rely on particularly in a cool, wet fall situation which is not ideal for soft red winter wheat. All other Trials experienced deteriorating conditions and the decision was made to abandon the *Large-scale Examination of Variety-specific Responses to Multiple Nitrogen Treatment Levels Trial, Identifying Management Practices that Increase Kernel Number in Wheat Trial, and Fungicide Trial*. Results for the *Large-scale Examination of Variety-specific Responses to Multiple Nitrogen Treatment Levels Trial* and *Identifying Management Practices that Increase Kernel Number in Wheat Trial* are available because both trials were replicated across multiple locations and across multiple years. The *Fungicide Trial* was not replicated at any other locations, therefore there is no data for it.

Wheat Variety Trial

Study Design

The performance of twenty-six wheat varieties was evaluated. Varieties were randomized within four replicated blocks, in a randomized complete block design.

Results

Yield and test weight results, averaged over the four replications, from the variety trial can be found in Table 1. The varieties that are in bold in the top yield group produced a statistically equivalent yield to the top yielding variety.

Table 1: Wheat Variety Test Results

Company	Variety	Yield (bu/A)	Test Weight (lb/bu)
UniSouth Genetics	3118	85.4	60.8
Progeny	#Berkeley	83.0	59.4
Southern Harvest	7510	75.3	59.7
Progeny	#Bullet	74.6	59.6
Croplan	8550	74.3	59.8
Syngenta	SY Richie	74.2	60.0
AgriMaxx	415	73.3	60.6
Southern Harvest	7200	71.4	61.3
AgriMaxx	473	69.0	59.3
Local Seed	2848	67.1	59.1
Progeny	#Warrior	65.7	59.1
AgriMaxx	486	60.5	60.1
Croplan	8800	60.0	59.0
Southern Harvest	4400	58.5	58.9
Local Seed	2867	58.4	60.8
Croplan	9606	56.1	59.9
Syngenta	SY Viper	55.7	60.8
Syngenta	SY 547	55.1	59.9
Dyna-Gro	9811	53.9	59.8
Dyna-Gro	9701	50.3	58.9
Pioneer	26R59	47.4	58.9
UniSouth Genetics	3329	45.2	59.2
UniSouth Genetics	3458	44.3	59.1
Pioneer	26R10	42.1	58.7
Dyna-Gro	9932	40.3	59.6
Pioneer	26R45	35.8	59.4
Mean		60.6	59.7
Pr > F		<.0001	<.0001
CV		12.5	1.1
Avg LSD (p=0.05)		11.3	0.93
Yield values in bold represent the top yield group at this location with no significant difference from the top yielding variety.			

Foliar Enhancement- Product Trial

Study Design

Treatments were established in a randomized complete block design. Plots measured 5 feet wide and 25 feet long. Based on an informal survey of growers in the region of northeast North Carolina (NC), a \$20 per acre cap for treatment product costs and two application timings for the season was posed to all participants in these trials. Table 2 contains a full list of treatments.

Table 2: Foliar Enhancement-Product Test Treatment List

Treatment Name (Company)	Product Name	Application Rate/Acre	Timing
Check	N/A	N/A	N/A
Brandt	N-Boost	2qt	Top Dress
Delta Ag	Perc Plus Crop Karb Boron Plus	20floz 1qt 4floz	Top Dress Flag Leaf Top Dress
Helena	HM 1354 HM 0715	1qt 1pt	Top Dress Flag Leaf
Meherrin	MicroAmp System Advance	12.8floz 1pt	Top Dress +Flag Leaf Top Dress + Flag Leaf
Monty's	Microhance	1qt	Top Dress+Flag Leaf
Triangle	Peg Power CarboRater	1qt 1.5qt	Top Dress Flag Leaf

Results

Plots were harvested with a small plot combine. Table 3 contains yield and test weight results. The 2018-2019 wheat growing season presented challenges to producers in northeast NC. The treatments from Helena, Delta Ag, and Triangle all yielded statistically the same and were in the top yielding group. However, more data is needed to further explore the use of these products in wheat production in this region.

Table 3: Foliar Enhancement-Product Test Yield Results

Company	Yield (bu/A)	Test Weight (lb/bu)
Helena	62.3	59.4
Delta Ag	60.0	58.9
Triangle	58.0	59.2
Monty's	54.3	58.9
Meherrin	53.8	58.9
Check	50.1	58.7
Brandt	49.1	58.2
Mean	55.4	58.9
LSD 0.1	7.9	N/S

Numbers in bold indicate yield is not significantly different from the top-yielding treatment.

Foliar Enhancement-Nutrient Trial

Study Design

This year, the Ag Expo decided to test five, foliar applied, nutrients and three different timings. Boron, Copper, Magnesium, Manganese, and Zinc were applied at Top Dress, Heading, and Flowering to analyze their impact on yield and test weight. The Top Dress application was applied on 3/14/19, the Flag Leaf application was applied on 4/17/19, and the Heading application was applied on 4/30/19. The treatment list can be found in table 4. The plots were replicated four times and measured 5 feet wide and 25 feet long.

Table 4: Foliar Enhancement- Nutrient Test Treatment List

Nutrient	Application Rate (lb of actual nutrient/acre)
Check	N/A
Copper	1
Zinc	1
Manganese	0.5
Magnesium	0.65
Boron	0.5

Results

Table 5 contains yield and test weight based on each nutrient and table 6 contains yield and test weight based on timing of each nutrient. These results exhibit no nutrient application nor treatment timing statistically impacted yield and test weight. While the Magnesium treatment yielded the highest test weight, and the check treatment yielded the highest yield, more data is needed to further explore the use of these products in wheat production in this region.

Table 5: Foliar Yield Enhancement- Nutrient Test Yield and Test Weight by Nutrient

Increasing Test Weight with foliar fertilizers: Nutrient		
Nutrient	Yield (bu/A)	Test Weight (lb/bu)
Check	68.2*	58.6
Mg	66.8	59.3*
Mn	65.3	59.1
B	62.1	59.0
Cu	62.0	59.1
Zn	61.9	58.9
All Nutrients	61.0	59.1
Mean	63.9	59
LSD 0.1	N/S	N/S
*indicates highest numerical yield or test weight		

Table 6: Foliar Yield Enhancement- Nutrient Test Yield and Test Weight by Application Timing

Increasing Test Weight with foliar fertilizers: Timing		
Application Timing	Yield (bu/A)	Test Weight (lb/bu)
Check	68.2*	58.6
Flowering	63.7	59.1
Heading	63.2	59.1
Topdress	62.6	59.1
Mean	64.4	59.0
LSD 0.1	N/S	N/S
*indicates highest numerical yield and test weight		

Identifying Management Practices that Increase Kernel Number in Wheat

Objectives

The key objective of this study is to identify key management practices that lead to increases in kernel number in soft winter wheat. Specific objectives are: 1) to determine if combining pre-jointing applications of N with essential micronutrients such as B and Mg can improve kernel number and weight, and 2) to identify management systems (combinations of variety selection, planting date, and nutrients) that would promote more kernels being developed.

Study Design

Three varieties of soft red winter wheat (Dyna-Gro Shirley, VA Hillard, and USG 3404) were planted on 8 Nov. The experimental design was a split-split plot with wheat variety as the main plot, N management as the sub-plot, and micronutrient application as the sub subplot. N management consisted of two factors – N rate (either 120 or 180 lbs of N per acre) and N application timing (early split at GS23 and GS30, single application at GS30 and a late split at GS30 and GS36. Micronutrient application consisted of one of three approaches – B, Zn, and Mg applied at planting, B, Zn, and Mg applied at GS36, or no B, Zn, or Mg applied. The early split N application was made on 11 Feb, the GS30 applications were made on 11 Mar and the GS36 applications were made on 15 April. Measurements of total above ground biomass and tissue concentrations of nutrients were taken at GS 30, GS36 and boot stage at both locations. Prior to harvest, head samples were taken to measure the number of kernels per spike and grain weight. At harvest, grain yield, moisture, and test weight were recorded.

Results

As we noted in the results from the 2017-2018 research there was a strong relationship between kernel number per spike and grain yield within each of the three varieties tested (Figure 1). Differences in kernel number accounted for 57 to 74% of the variability in grain yield. In contrast tiller number only varied from 39 to 60 tillers per square foot across these three varieties and there were no significant relationships between tiller number and grain yield (data not shown). This research clearly shows that kernel number is the key yield component in determining final yield.

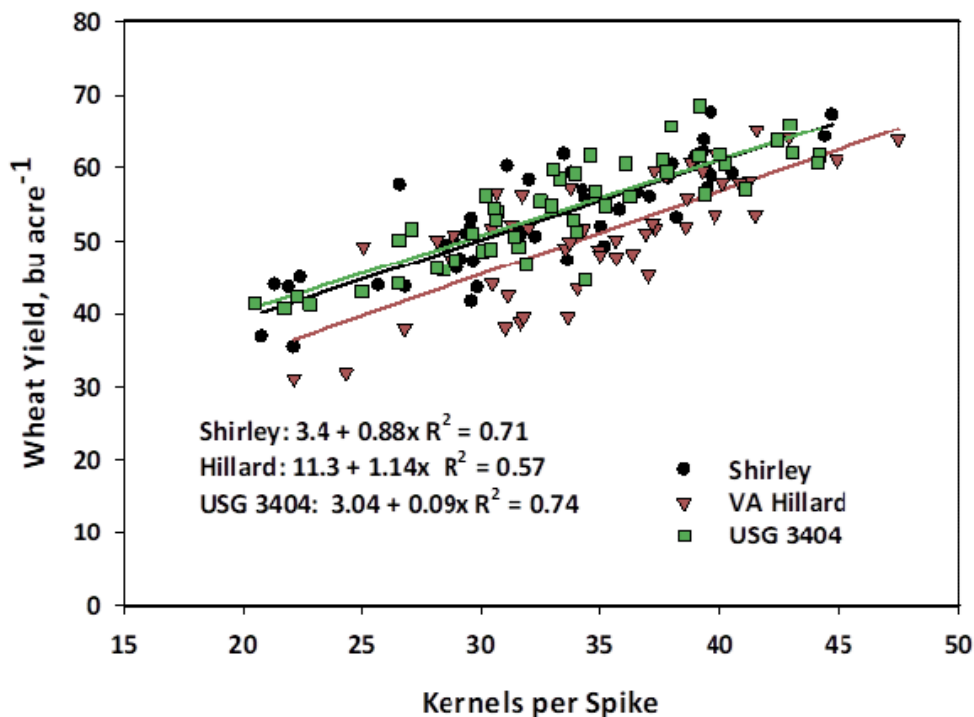


Figure 1. Relationships between kernel number per spike and grain yield for three wheat varieties.

Influence of N Timing and Rate and Micronutrients on Kernel Number and Yield

The application of the higher N rate (180 lbs N per acre) at planting resulted in the best yield (57.8 bu acre⁻¹) (Figure 2). This site experienced continuous rainfall in late Feb and early March and showed signs of some Pythium damage. Split applications of N either with a lower rate of 120 lbs N acre⁻¹ in Feb and March or a higher rate of 180 lbs N acre⁻¹ in March and early April resulted in grain yields that were slightly lower. The lowest yield was produced by the lower rate of N applied in a single application at jointing (44.1 bu acre⁻¹). Differences in kernel number per spike were similar to the differences found in grain yield. The highest rate of N or the use of split N applications using either 120 or 180 lbs N acre⁻¹ resulted in statistically similar kernel numbers. However, 120 lbs of N applied at jointing had significantly fewer kernels per spike than the other N treatments.

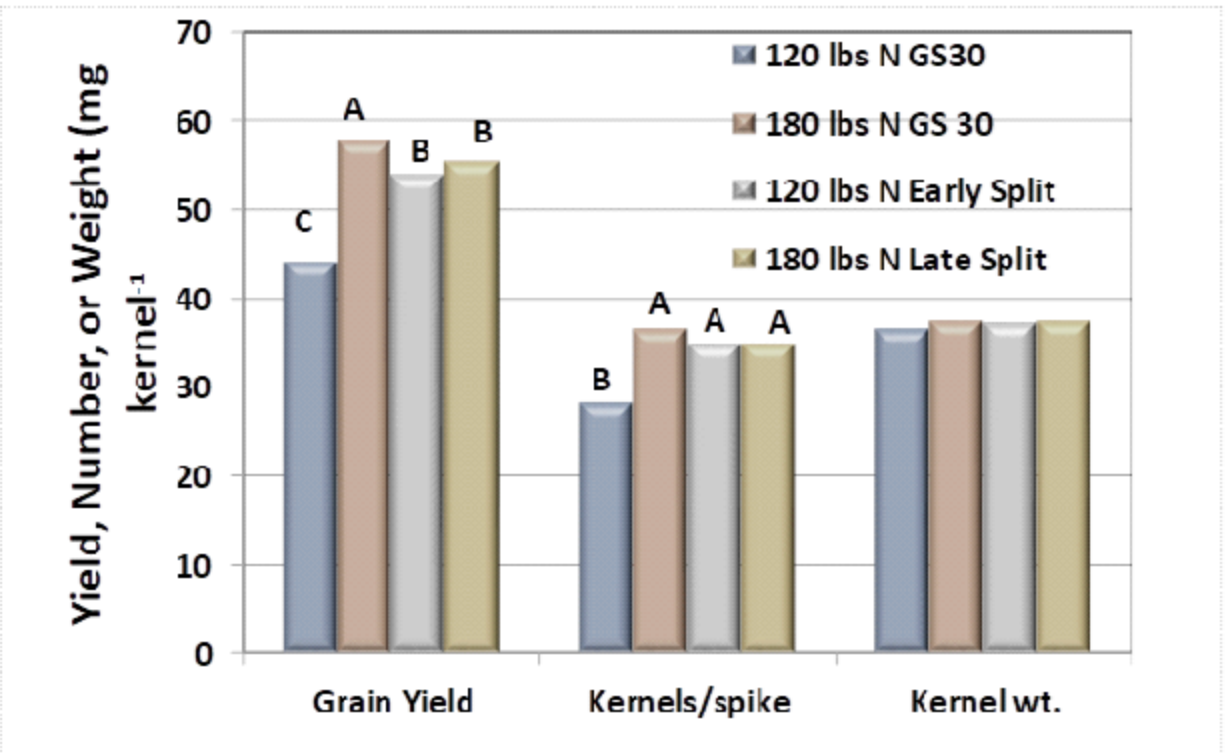


Figure 2. Impact of N treatments consisting of different rates and timing on grain yield, kernels per spike, and kernel weight.

Applications of B, Mg, and Zn at planting or GS36 resulted in significantly higher yield compared to no micronutrients applied (Figure 3). The application of B, Mg, and Zn at planting resulted in significantly greater kernel number per spike compared with application at GS36 or no micronutrients applied

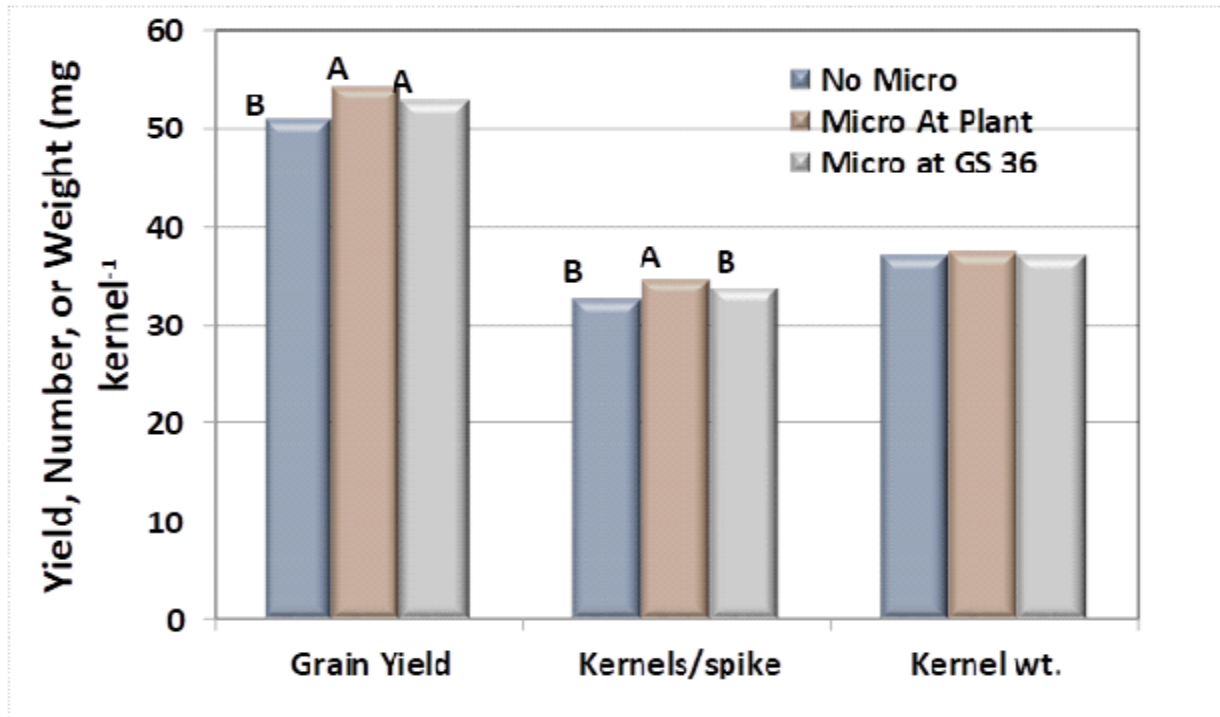


Figure 3. Impact of the applications of micronutrients consisting of a mix of B, Mg, and Zn on grain yield, kernel number, and kernel weight.

Influence of N Timing and Rate and Micronutrients on N Concentration

Similar to the results found in 2017-2018 the early split application of N had the highest N concentration in the plant at GS30. By GS36 the single application of 180 lbs N acre⁻¹ at GS30 produced the highest N concentration in the plant tissue with split applications of either 120 or 180 lbs N acre⁻¹ producing similar N concentrations in the tissue and the single application of 120 lbs N acre⁻¹ showing the lowest N concentration. By anthesis the split application of 180 lbs of N acre⁻¹ at both GS30 and GS336 resulted in the highest N concentration in the flag leaf with the single application of 180 lbs of N at GS30 close behind followed by the split application of 120 lbs of N acre⁻¹. Again, the worst treatment was the use of a single application of 120 lbs of N acre⁻¹ at GS30. These data show the importance of either large amounts of N or split applications of N in maintaining N concentration in the flag leaf at anthesis. Although the use of micronutrients did not influence N concentration in the plant at either GS30 or GS36 the application of micronutrients at planting did result in a higher N concentration in the flag leaf at anthesis (Data not shown).

Influence of N Timing and Rate and Micronutrients on Growth Rate

As we found with N concentration the early split application of N had the highest growth rate during the period from GS30 to GS36. During the period from GS36 to anthesis both the single application of 180 lbs N acre⁻¹ at GS30 and the split application of 120 lbs of N acre⁻¹ resulted in the highest rate of growth. Over the entire period from GS30 to anthesis these two treatments resulted in the highest rates of growth. For the micronutrient treatments the use of micronutrients at planting resulted in more rapid growth from GS36 to anthesis. This treatment also had the highest N concentration in the flag leaf.

Conclusions

The second year of this study has resulted in research support for the initial trends we found in 2017-2018. The significant findings of this research are:

1. Kernel number per spike is the key determining factor in setting yield in soft red wheat.
2. Both N concentration in the flag leaf of the plant and the rate of growth from boot stage through anthesis are critical to determining how many kernels a wheat plant will set on a spike.
3. Nitrogen must be managed carefully to support both the amount of N in the plant at anthesis and the rate of growth of the wheat plant. In 2018-19 a single large application of N resulted plants with more kernels per spike and greater grain yield. This was the result of a balance between more rapid growth from GS36 to anthesis and the second highest N concentration of any of the treatments tested. While the early split of 120 lbs of N acre⁻¹ also had one of the highest growth rates it did not have sufficient N in the flag leaf at anthesis to support higher kernel number. In 2017-18, the split applications of N resulted in higher kernel number and greater yield. In that season the environment allowed for better N uptake at anthesis. That combined with the advantage the split N treatments have in producing more rapid growth helped make split N treatments superior to single N applications. The worst treatment in both years has been the single N treatment of 120 lbs N acre⁻¹. This treatment does not provide enough support for rapid growth and results in less N available during anthesis.

4. While the use of micronutrients (B, Mg, Zn) in 2018-18 did not significantly improve yield they did show some advantages in increasing kernel number. This research trial supports the observation that micronutrients are important in helping increase rate of growth during the period from boot stage to anthesis and help improve N uptake. This trial showed clear advantages to using micronutrients at planting to increase kernel number and grain yield. More work needs to be done to help identify which micronutrient is most important or if other micronutrients are needed.

Large-scale Examination of Variety-specific Responses to Multiple Nitrogen Treatment Levels

Report:

Objectives were to:

- 1. Identify variety-specific responses of high performing wheat lines in the North Carolina OVT to different Nitrogen treatment levels.**
- 2. Compare variety responses to blanket applications of Nitrogen versus the N-rich strip decision making tool.**

Fifteen varieties were included in replicated trials at three locations in NC for 2017-18: Lenoir, Rowan and Union Counties. Of the Fifteen varieties used in 2017-18, only thirteen were available for use in 2018-19. AgriMAXX 474 and Harvey's AP 1882 were replaced with SY Viper and Dyna-Gro 9811. These fifteen varieties were included in replicated trials at three locations in North Carolina for 2018-19: Chowan, Moore (Sandhills) and Union Counties. The Sandhills location replaced Lenoir from 2017-18 to provide a location where nitrogen would be limiting across all treatments. Nitrogen rates across all varieties included 90, 120, and 150 units applied as 30 units at planting and the remainder prior to jointing in one spring application. The Nitrogen rates were planned to remain the same over both years except for the addition of a zero nitrogen rate but due to application error the chosen nitrogen rates in 2019 increased by 30 lb/ac overall. A zero nitrogen rate was added to the nitrogen treatment list to provide a baseline yield response for each variety. The final nitrogen treatment for each variety was a sensor-based rate utilizing the GreenSeeker crop sensor used in conjunction with the Nitrogen-rich strip at each location. The N-rich strips were initiated at planting with a single application of 120 units of N followed by an additional 120 units in the spring if needed.

Normalized Difference Vegetative Index (NDVI) was measured just prior to topdressing for all plots and was used to determine the sensor-based nitrogen rate treatment for individual varieties. Tissue samples were taken at Union and Moore county sites prior to topdress to determine N concentrations in the wheat tissue. Plots were tissue sampled and NDVI was measured a second time after topdress at the Moore county site to determine the change in tissue concentration of nitrogen across all varieties. The Chowan site was abandoned soon after topdress due to severe *Fusarium* root and crown rot at that location confirmed by samples submitted to the NC State University Plant Disease and Insect Clinic.

RESULTS

Variety yield response to nitrogen application is significant and positive across Union County for both growing seasons. The level of this response varies by variety, with some varieties having a stronger correlation of yield response to increasing nitrogen rate. For example, two varieties yielded highest at the sensor-based N rate: Gerard 557 and Southern Harvest 7200 in 2018 and Southern Harvest 4300 and 7200 in 2019. The 150 lb N/A rate resulted in the highest yield in ten varieties in 2018 and six in 2019. In 2018, three of 15 varieties yielded highest at a nitrogen rate of 120 lbs N/A. In 2019, 180 lb N/A resulted in a higher yield in seven varieties.

Nitrogen Use Efficiency (NUE) was examined in 2019 with the addition of a zero N rate. The NUE by nitrogen rate interaction was significant at Union County in 2019 but not in Moore County. In Union County, ten of the sensor-based N rates resulted in the highest NUE, five at the 120 lbs. N, three at the 150 lbs. N, and one at the 180 lbs. N. Dyna-Gro 9701 resulted in the same NUE at 120 lbs. N and the sensor based rate, Pioneer 26R59 resulted in the same NUE at 120 lbs. N, 150 lbs. N, and the sensor based rate, and Hilliard resulted in the same NUE at 120 lbs. N and the sensor based rate. In Moore County the sensor-based N rate resulted in the highest NUE in seven of the variety and N rate combinations, 120 lbs. N resulted in four, and 150 lbs. N resulted in six. Featherstone VA had the same NUE at 120 lbs. and 150 lbs. N while Southern Harvest 7200 had the same NUE at 120 lbs. N and the sensor-based N rate.

Evaluating the Nitrogen Use Efficiency by the Delta Yield from the plots that received N to the check the varieties separate out into categories. These categories are; low yield and low NUE, low yield and high NUE, high yield and low NUE, high yield and high NUE (Figure 1). Varieties Gerard 557 and Southern Harvest 4300 both perform similarly in that they all perform at a similar yield regardless of the N rate (Table 1). Varieties such as these would be result in a lower yield and low NUE. Dyna-Gro 9811, Pioneer 26R59 and 26R41, AgriMAXX 473, VA Tech Hilliard, AG South Genetics 2024, and Syngenta Viper all continue to increase in yield as more N is applied. Growers in higher yielding environments where the more N that is applied the more the yield potential increases would prefer varieties such as these where a high yield and high NUE are achieved. The high response to N category is for growers in those regions who have management practices that support supplying the wheat with additional N to increase yield. Dyna-Gro

9701, CROPLAN 8550, and Southern Harvest 7200 all perform moderately well but not as well as the varieties in the high nitrogen response category. Varieties in the moderate category are for growers who may not have the management practices to support supplying a higher than normal rate of N but still wish to achieve a higher yield. Uni-South Genetics 3536 and 3895 and Featherstone VA 258 are varieties that do not have similar characteristics at all nitrogen rates or locations and are considered varieties that can be chosen based on location and management practices. As an example, Featherstone VA 258 performs similarly at three locations where yield increases as additional N is applied and at two other locations, the amount of N applied does not drastically change the yield.

Figure 1. Change in yield by nitrogen use efficiency by variety in Union County in 2019.

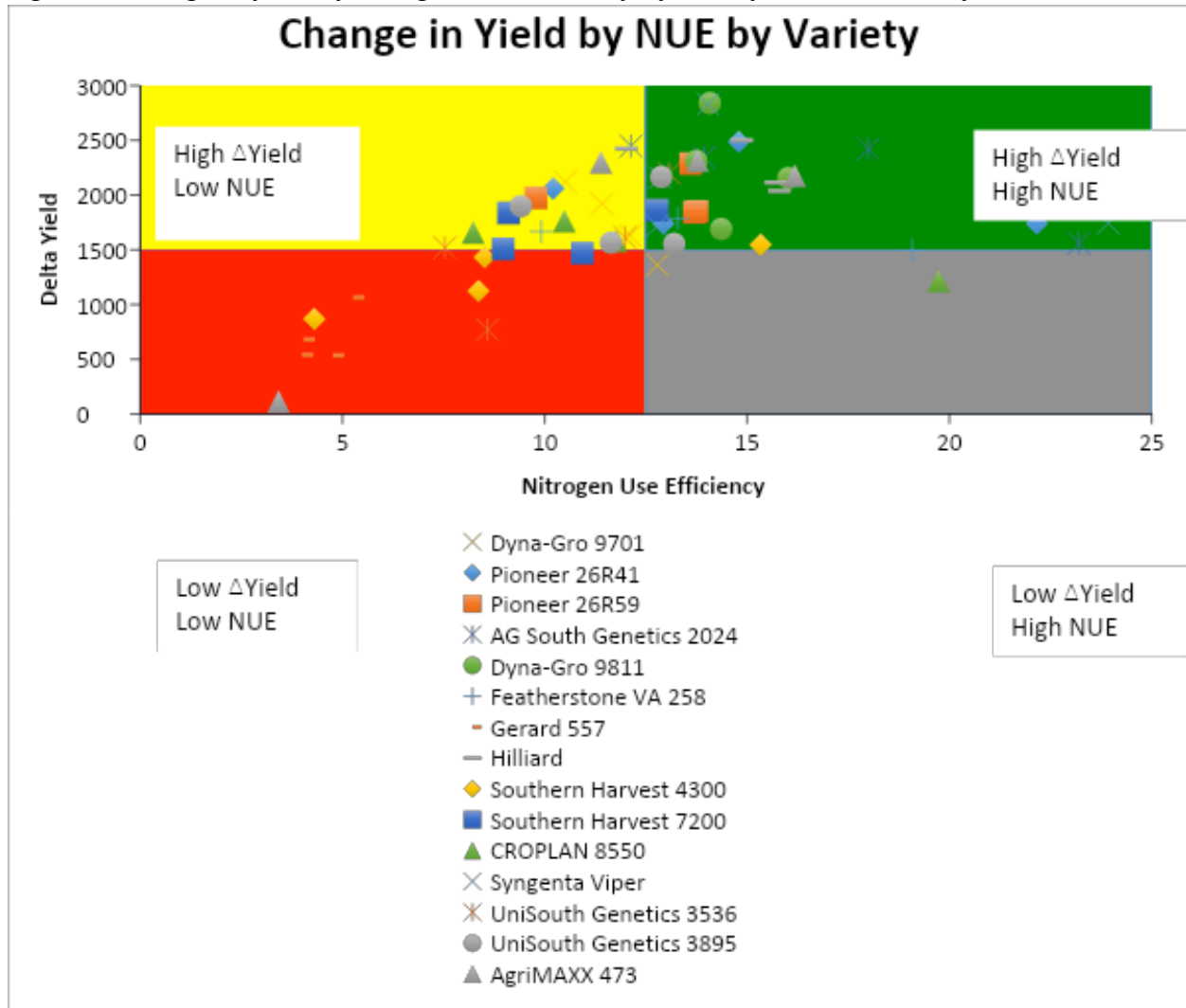


Figure 2. Yield response to nitrogen for low nitrogen response

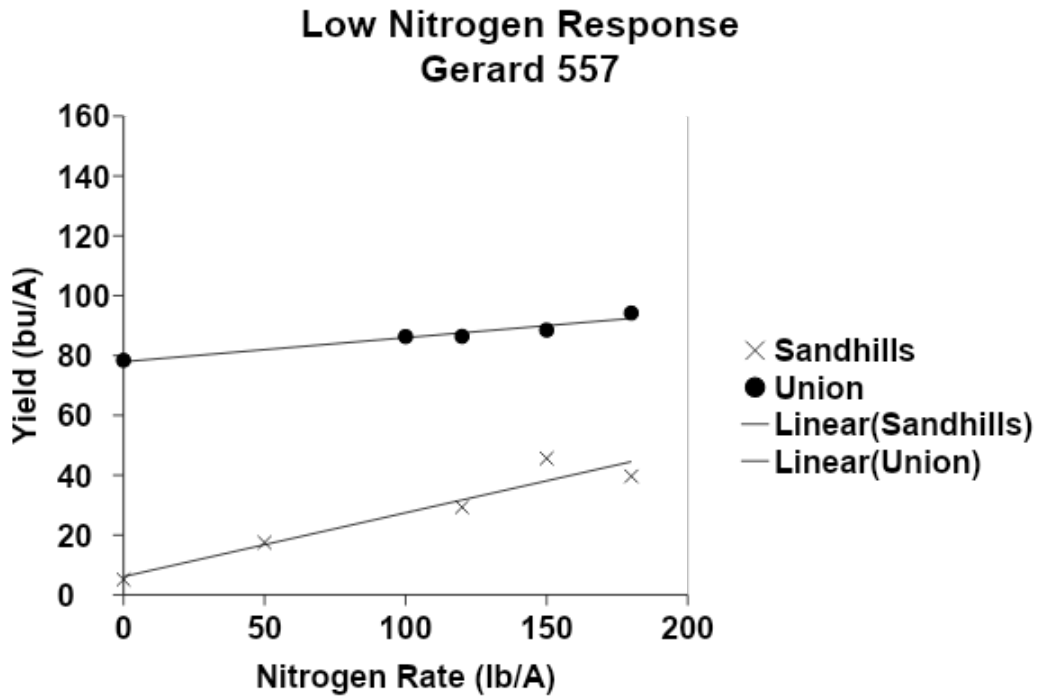


Figure 3. Yield response to nitrogen for high nitrogen response

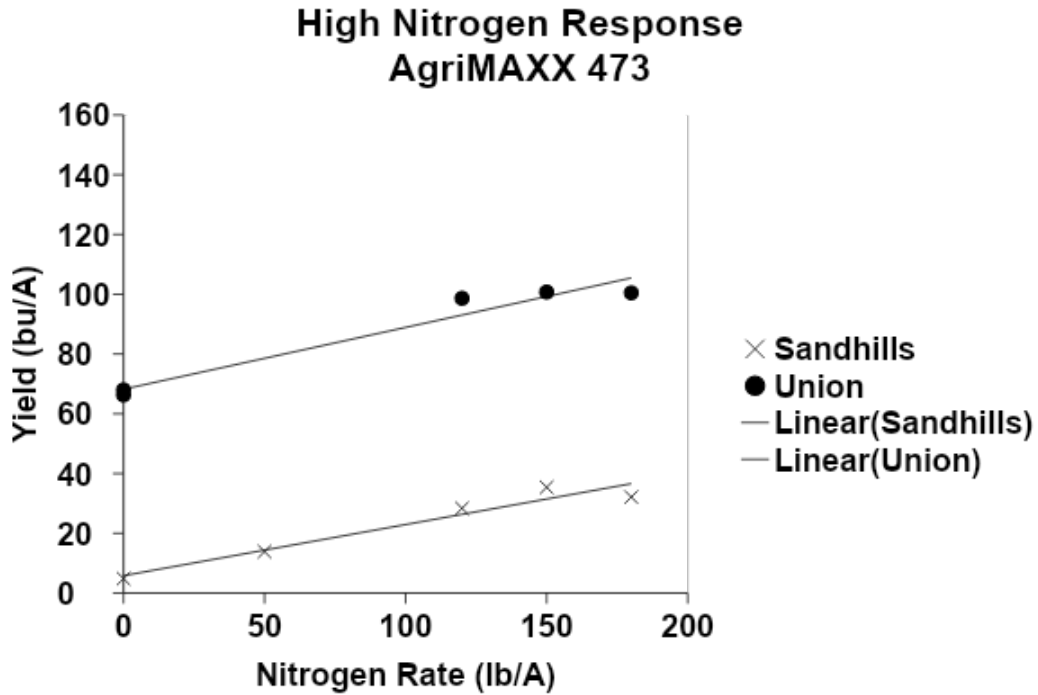


Table 1. Varieties separated into categories high, moderate, low, and nitrogen rate dependent in response to additional nitrogen from Union County in 2019.

Variety	High Response	Moderate Response	Low Response	Rate/Environment Dependent
USG 3536				✓
DG 9701		✓		
AGS 2024	✓			
AgriMAXX 473	✓			
FSVA258				✓
CROPLAN 8550		✓		
VA Tech Hilliard	✓			
Pioneer 26R41	✓			
Pioneer 26R59	✓			
SH 7200		✓		
USG 3895				✓
SH 4300			✓	
Gerard 557			✓	
Syngenta Viper	✓			
DG 9811	✓			

IMPACT STATEMENT

This project was a part of the Master's thesis work of Kaitlyn Moody in combination with the demonstration nitrogen-rich strip work we have been conducting. Each of these locations were demonstrated to farmers and agents at the small grain field days and whistle stop tours in 2019. Preliminary results were communicated to growers during grain production meetings in 2018 and 2019. Growers showed a lot of interest in the potential of this project to identify best management practices of nitrogen applications based on variety and environment. Formal nitrogen recommendations by variety for the 15 varieties tested will be made available to growers in time for topdress applications for the 2019-20 growing season.