Perkins County Rainfed
2019 Winter Wheat Variety Trial

Name	Source/ Brand	Yield (bu/ac)[a]	Protein (%)	Height (in)	1000 Kernel Weight (grams)
WB4595 (XB4520)	WestBred	119.4	11.4	31.6	45.0
SY Monument	AgriPro	116.3	11.2	31.6	43.6
NW15443	UNL-Experimental	113.3	11.3	33.8	49.4
Winterhawk	WestBred	112.8	11.6	31.8	46.6
CPCPX79-10	CROPLAN	111.8	11.3	31.0	43.1
Tatanka	KSU	111.2	11.2	29.0	42.6
SY AP 18AX	AgriPro	111.1	11.1	29.8	47.2
SY Wolverine (Exp 40-1)	AgriPro	110.5	11.6	30.0	46.5
NE12561 (Siege)	UNL-Experimental	110.4	12.0	33.0	43.6
SY Legend CL2	AgriPro	110.2	11.8	30.8	46.6
Long Branch	Dyna-Gro	109.6	11.7	30.6	45.1
SY Rugged	AgriPro	108.5	11.6	27.8	46.1
Breck	PlainsGold	107.7	11.5	32.4	43.4
NE14434	UNL-Experimental	107.3	11.5	32.8	45.8
SY Wolf	AgriPro	107.3	12.0	32.2	43.4
SY Sunrise	AgriPro	106.7	11.7	30.8	46.3
Robidoux	Husker Genetics	104.7	11.2	31.6	42.8
Whistler	PlainsGold	104.5	10.6	30.6	44.4
WB4462	WestBred	104.3	11.4	32.0	49.3
LCS Valiant	Limagrain Cereal Seeds	103.4	12.1	31.0	46.4
CP7869	CROPLAN	103.2	11.5	29.8	47.9
Freeman	Husker Genetics	103.2	11.3	29.6	45.0
WB4792	WestBred	102.9	10.8	32.0	44.5
Settler CL	Husker Genetics	102.5	11.4	31.4	45.7
NE15624	UNL-Experimental	102.0	11.8	29.4	43.2
Overland	Husker Genetics	101.4	11.6	33.8	45.0
WB4269	WestBred	101.0	11.9	30.0	41.9
LCS Avenger	Limagrain Cereal Seeds	100.6	12.0	30.4	46.7
AM Eastwood	AgriMAXX	100.1	11.5	29.2	42.6
LCS Link	Limagrain Cereal Seeds	99.6	11.8	31.6	46.2
WB-Grainfield	WestBred	98.8	11.4	30.2	43.1
CP7909	CROPLAN	98.4	11.7	26.4	42.6
LCS Chrome	Limagrain Cereal Seeds	96.7	12.3	32.0	41.9
Ruth	Husker Genetics	95.5	11.8	34.0	42.5
Langin	PlainsGold	95.4	11.2	28.2	42.8
NHH144913-3	UNL-Experimental	95.1	11.8	30.8	42.6

		Means			
Name	**Source/ Brand**	**Yield (bu/ac)[a]**	**Protein (%)**	**Height (in)**	**1000 Kernel Weight (grams)**
Crescent AX	PlainsGold	94.8	11.2	30.4	45.9
Canvas	PlainsGold	94.7	11.3	29.8	41.4
WB4418	WestBred	92.1	11.8	31.0	40.0
NW13493	UNL-Experimental	91.6	11.9	29.6	43.5
NE14691	UNL-Experimental	91.6	12.7	33.4	45.6
LCS Revere	Limagrain Cereal Seeds	87.6	11.6	30.8	45.1
Scout 66	Check	86.7	12.0	28.4	45.7
Turkey	Check	81.9	13.1	29.8	42.7
	Standard Error	5.1	0.2	0.7	0.9
	LSD[b]	12.4	0.5	2.1	2.2
	Mean[c]	102.6	11.6	30.8	44.5
	CV[d]	11.8	5.1	7.2	5.6

[a]Wheat yields were adjusted to 12% moisture.
[b]For differences between varieties that are equal to or greater than the LSD value, the chance that the difference is significant is 95%.
[c]Mean value of all plots in the trial
[d]Coefficent of Variation (CV) indicates the quality of a trial; a number lower than 15 indicates a high quality trial.

SITE INFORMATION

Collaborator: UNL Stumpf Wheat Center, Grant
Planting Date: 9/24/18
Harvest Date: 7/19/19
Fertilization: —
Herbicide/Fungicide: —
Soil Type: Mace silt loam
GPS Coordinates: 40.845137, -101.705653
Trial Notes: Disked following fallow (corn in 2017)

Do not reprint without permission. Contacts: Amanda Easterly or Cody Creech

UNIVERSITY of NEBRASKA
LINCOLN

West Central 3-Year Average
Winter Wheat Variety Tests 2016-2019

Name	Source/ Brand	Yield (bu/ac)[a]	Test Weight (lbs/bu)	Height (in)	Protein (%)
SY Monument	AgriPro	82.3	56.5	32.4	13.1
Langin	PlainsGold	80.9	56.1	31.5	12.7
WB4462	WestBred	80.8	57.4	33.7	12.9
LCS Valiant	Limagrain Cereal Seeds	80.4	57.4	31.6	13.4
AM Eastwood	AgriMAXX	79.5	58.0	29.9	13.1
SY Wolf	AgriPro	79.3	56.1	32.1	14.0
LCS Link	Limagrain Cereal Seeds	79.1	58.1	33.6	13.2
Ruth	Husker Genetics	78.7	56.6	34.2	13.4
WB-Grainfield	WestBred	78.6	57.0	33.1	12.9
Tatanka	Kansas Wheat Alliance	78.6	57.3	31.3	12.9
LCS Chrome	Limagrain Cereal Seeds	77.8	57.5	32.9	14.0
Siege	NuPride	76.7	58.4	32.9	13.4
Freeman	Husker Genetics	76.0	55.5	33.1	13.1
NW13493	UNL-Experimental	75.8	57.3	32.5	13.3
Robidoux	Husker Genetics	75.4	55.9	32.8	13.4
SY Sunrise	AgriPro	75.4	57.2	30.9	13.5
Long Branch	Dyna-Gro	74.5	56.4	32.7	13.3
Winterhawk	WestBred	74.4	57.4	33.3	13.2
Overland	Husker Genetics	73.5	56.8	35.3	13.1
Settler CL	Husker Genetics	73.3	56.3	32.4	12.5
Scout 66	---	56.3	56.0	36.6	13.7
Turkey	---	55.7	56.5	37.2	14.0
[a] Wheat yields were adjusted to 12% moisture.					

SITE INFORMATION

The West Central Region includes sites in Red Willow, Harlan/Furnas, Keith, Lincoln, and Perkins counties.

Wheat behind Field Peas, Chickpeas and Soybeans vs Fallow – Rotation Demo Plot near Grant, NE

Strahinja Stepanović, Ognjen Zivković, Jovan Radojičić, Milica Bogdanović

Figure 1. Field peas vs chickpeas in 2018 (left picture); Wheat planted behind soybean vs fallow (right picture)

Why are fewer farmers using fallow?

Over the past 30 years, many dryland farmers throughout western Nebraska have replaced conventional tillage fallow with no-till chem-fallow to improve water conservation practices under wheat-corn-fallow or wheat-fallow rotations. However, sustainability of fallow is becoming a major challenge due to:

1. Weeds evolving resistance to herbicides and forcing farmers to use summer tillage for weed control.
2. Inefficient water use, soil degradation, and reduction in soil organic carbon (Blanco-Canqui et al., 2010)
3. Decline in wheat market prices and expenses to maintain fallow weed-free
4. Increase in expenses associated with state property taxes and cash rental rates for dryland cropland

What are the alternatives?

Switching to continuous corn or replacing fallow with shorter season crops such as soybean, field peas, chickpeas, or proso millet eliminates the expenses associated with the fallow period. Unlike fallow, each year crops are harvested for grain with hopes of generating economic return. However, intensification of crop rotations often leads to less water being available to the subsequent crop in the rotation, often causing lower crop yield and reduced profit (Nelson et al., 2016).

The objective of this project was to compare fallow to field peas, chickpeas, and soybeans in terms of water balance, impact on next year's wheat crop and profitability.

Trial summary

The demonstration plot was conducted at the Henry J. Stumpf International Wheat Research Center at Grant. The predominant soil type in the study was Kuma silt loam and the previous crop in rotation was corn. The demonstration plot included side-by-side comparison of field peas, chickpeas, soybeans, and fallow planted in 40-by-400 foot strips. Seeding dates for field peas, chickpeas and soybeans were March 14, March 24 and May 17, respectively. Harvest was conducted on July 16, August 17, and October 23 for field peas, chickpeas and soybeans, respectively. Other cultural and agronomic practices were completed following university-based recommendations. The winter wheat crop was planted on October 23 across all four strips following soybean harvest and was harvested on July 20 the following year.

Water Balance

Soil water balance (DSW), the difference in soil water profile (inches per 4.5-foot depth) at the beginning and end of the growing season. Water losses in fallow due to runoff (0.6 inches), deep percolation (11.5 inches), and evaporation (8.0 inches) were much greater compared to fallow replacements, resulting in total of 20.1 inches of total water loss (Table 1). However, fallow was also the only rotation that increased soil water profile by 1.9 inches over the course of the season (Table 1).

Deep percolation (DP). Substantial DP losses were observed in all evaluated cropping systems due to above-average spring precipitation (6.5 inches higher than the 30-year average; Table 1). Among cropping systems, the largest DP was observed in fallow (11 inches) followed by chickpeas, soybeans and field peas which had 6.7, 6.0, and 5.0 inches of DP, respectively. Growing field peas led to better utilization of spring precipitation and consequently, reduced water losses due to DP.

Soil evaporative losses (ET). Fallow periods varied between the cropping systems causing different patterns in soil evaporative losses. While field peas were able to efficiently use early season precipitation, hot and dry post-harvest period (July 16 to October 23) led to 5.7 inches of evaporative losses. One month shorter post-harvest periods of chickpeas (August 17 to October 23) cut evaporative losses in the chickpea-wheat cropping system to 1.4 inches. Finally, the cooler pre-season fallow period of soybeans and no post-season fallow period resulted in no soil evaporative losses in soybeans.

Runoff (RO). All cropping systems had very little runoff, due to good ground cover and relatively flat topography.

Crop Water Use Efficiency (CWUE). Among the fallow replacements, field peas were the most water-use efficient crop, producing 30 bu/ac yield with 11.9 inches of water (2.5 bu/ac-inch). Next were chickpeas with a CWUE of 1.9 bu/ac-inch, followed by soybeans, which produced only 18 bu/ac using 18.6 inches of water (CWUE of ~1.0 bu/ac-inch).

Table 1. Yield (bu/ac), Crop Water Use Efficiency (CWUE), precipitation (P), runoff (RO), deep percolation (DP), evapotranspiration/soil evaporation (ET), and soil water change (ΔSW) from Mar 14 to Oct 23 for field peas, chickpeas, soybeans and fallow cropping systems from Mar 14 to Oct 23.

Cropping system	Periods of crop growth/fallow	2018 Date	P (in)	RO (in)	DP (in)	ET (in)	ΔSW (in)	Yield (bu/ac)	CWUE (bu/ac-inch)
Field peas - Wheat	Crop growth	03/14 to 7/16	15.7	0.0	3.3	11.9			
	Fallow	7/16 to 10/23	7.1	0.2	1.7	5.7	-1.4	30.0	2.5
	Total	3/24 to 10/23	22.7	0.2	5.0	17.5			
Chickpeas - Wheat	Crop growth	03/24 to 8/17	19.8	0.0	4.9	15.5			
	Fallow	8/17 to 10/23	2.9	0.0	1.8	1.4	-1.6	30.0	1.9
	Total	3/24 to 10/23	22.7	0.0	6.7	16.9			
Soybeans - Wheat	Crop growth	5/18 to 10/23	18.3	0.0	4.7	18.6			
	Fallow	3/14 to 5/18	4.4	0.0	1.3	0.0	-0.4	18.0	1.0
	Total	3/24 to 10/23	22.7	0.0	6.0	18.6			
Fallow - Wheat	Total	3/24 to 10/23	22.7	0.6	11.5	8.0	+1.9		

Patterns in soil water extractions.

Although field peas, chickpeas and soybeans had similar amount of total available soil water at wheat planting (10.2-10.7 inches), the soil water extraction patterns were quite different between fallow replacements. Field peas utilized water from soil depths below 3 feet during the grain fill period in the months of June and July, but allowed for greater precipitation storage in the top 3 feet during the three-month long post-harvest period. Conversely, chickpeas and soybeans used most of the available water in the top 3 feet of the soil profile finishing off the crop during the summer months, thereby not reaching for water at depths greater than 3 feet and not allowing enough time for precipitation storage in top soil. Soil water storage in fallow was greater than any fallow replacements, except in top 6 inches of the soil where water retention was reduced due to lack of residue cover.

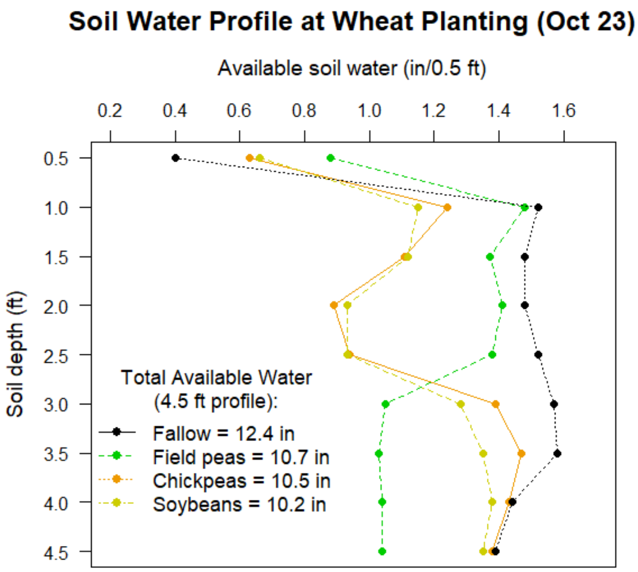

Figure 2. Plant available soil water and soil water profile at wheat planting (Oct 23, 2018) as affected by fallow, field peas, chickpeas and soybeans during the 2019 demo plot at Grant, NE.

Effects on next year's wheat crop

Compared to fallow, field peas, chickpeas and soybeans had 1.7, 1.9 and 2.2 inches of soil water deficit causing yield penalties of 6, 16, and 36 bu to the subsequent wheat crop, respectively (Figure 2).”The Figure 1. shows that average yield penalty of 11.76 bu/ac per inch of water less at wheat planting (slope of the regression line), which is much higher yield penalty than 5.94 bu/ac per inch reported in cover crop termination timing study near Akron, CO (Nielsen and Vigil, 2005). Nielsen and Vigil (2005) found that delaying cover crop termination from June 12 to July 13 (32 days) caused an additional 12 bu/ac wheat yield reduction. In our study, similar trend occurred as time between harvest of field peas (July 20; 99 days), chickpeas (Aug 17; 67 days) and soybeans (Oct 23; 0 days) and planting of wheat (Oct 23) was narrowed, causing severe yield reduction in wheat planted after soybean.

The slope of the water use versus yield relationship at Grant, NE (10.19 bu/ac per inch) was higher than previously published relationship in the Akron, Colorado research (4.72 bu/ac per inch). Majority of research conducted in the High Plans region shows that wheat is not as efficient water user, suggesting that factors other than available water influenced subsequent wheat yield (Nielsen et al., 2016; Stone and Schlegel, 2006). Yield vs water use relationship derived in this demo plot may, therefore, be exaggerated by low yielding wheat planted behind soybean (point below the trend line). We suspect that one factor to cause that was lower levels of soil phosphorus behind soybean. We found no differences between rotations in any other soil nutrient, soil health assessment, and tissue analysis.

Which rotation is the most profitable?

Field peas – wheat was the most profitable rotation in this two-year demo project. There are several factors that influenced such outcome including growing season conditions, ability of farmer to grow good crops, production cost, etc. However, we find grain marketing and market price to be the most significant factor influencing short-term profitability. For example, we did not market chickpeas, thus low market price reported in table 2 was influenced by market crash and low seed quality at the time grain was delivered to the elevator. In addition, increase in wheat price makes a more compelling case for fallow.

One clear message is that replacing fallow with soybean will most likely result in economic loss. Soybean yield potential depends much on rains we get in normally dry month of August and large penalty on subsequent wheat yield cannot be ignored. At current soybean prices, soybean yield would have to be 31-38 bu/ac in the first year of rotation to be as profitable as fallow-wheat, field peas-wheat or chickpeas-wheat rotation.

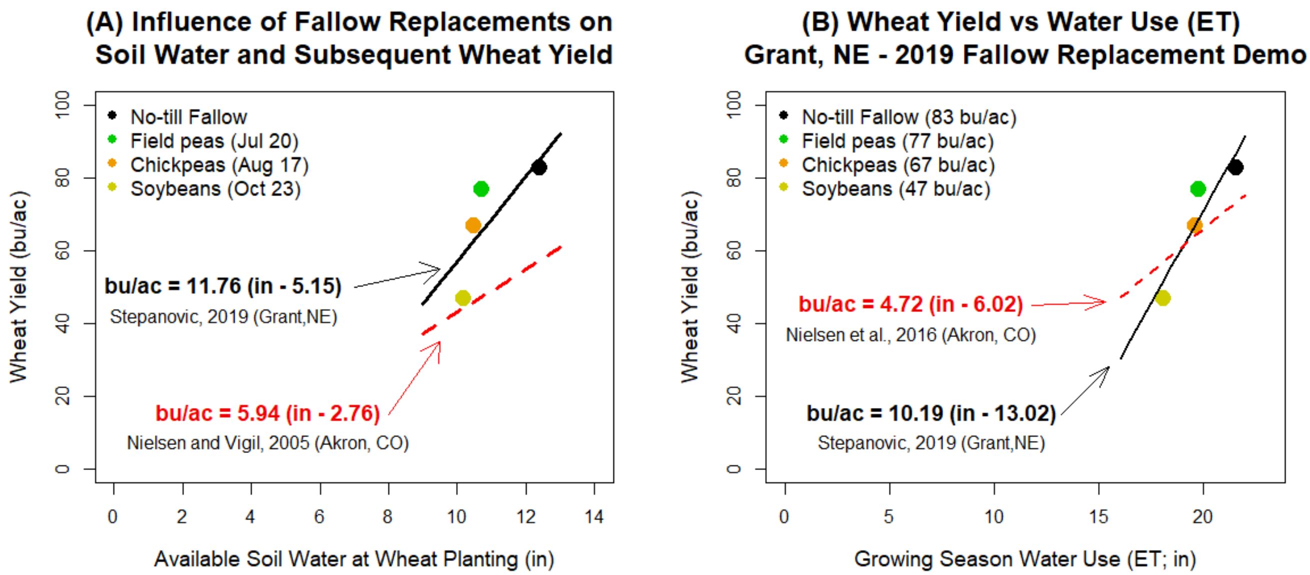

Figure 3. (A) Influence of fallow, field peas, chickpeas and soybeans on the available soil water at wheat planting and subsequent wheat yield; (B) Water use (ET) and yield of wheat planted behind fallow, field peas, chickpeas, and soybeans; Black line is data from 2018/19 demo plot near Grant, NE, red line is a published relationship from studies conducted at Akron, CO (Nielsen and Vigil, 2016; Nielsen et al., 2016).

Table 2. Comparison of fallow, field peas, chickpeas, and soybeans production cost, effects on subsequent wheat yield, and overall profitability. Reported production cost and grain prices are based on actual spending in 2018 and 2019 growing season. Average Production History (APH) for dryland corn in 3rd year is 115 bu/ac for this farm.

Rotation	2018 - Year 1 (prior to 10/23/2018)			2019 - Year 2 (10/23/18 to 07/20/2019)		
	Production* cost ($/ac)	Yield (bu/ac)	Grain prices ($/bu)	What Yield (bu/ac)	Wheat grain protein (%)	Profitability ($/ac) †
Fallow - Wheat	67	0	0.0	83	11.4	27
Field peas - Wheat	192	30	6.5	77	10.5	66
Chickpeas - Wheat	227	30	6.8	67	9.7	2
Soybeans - Wheat	232	18	9.2	47	9.7	-118

* Production cost includes expenses for seed, inoculant, herbicides, fungicides, planting, and spraying, harvest, trucking and land charge. Production cost may differ from year to year and from producer to producer.
† Wheat production cost of $232/ac and wheat grain price of $3.8/bu were included in profitability calculation

References

Blanco-Canqui, H., L.R. Stone, and P.W. Stahlman. 2010. Soil response to long-term cropping systems on an Argiustoll in the central Great Plains. Soil Sci. Soc. Am. J. 74:602–611. doi:10.2136/sssaj2009.0214

Nielsen, D.C., and M.F. Vigil. 2005. Legume green fallow effect on soil water content at wheat planting and wheat yield. Agron. J. 97:684-689. doi:10.2134/agronj2004.0071

Nielsen, D.C., D.J. Lyon, R.K. Higgins, G.W. Hergert, J.D. Holman, and M.F. Vigil. 2016. Cover crop effect on subsequent wheat yield in the Central Great Plains. Agron. J. 108:243–256. doi:10.2134/agronj2015.0372

Stone, L.R., Schlegel, A.J. 2006. Yield-water supply relationships of grain sorghum and winter wheat. Agron. J. 98: 1359-1366

Crop budgets, link: https://cropwatch.unl.edu/budgets

Hard Red Winter Wheat Yield Components and Quality As Influenced By Planting Date and Seeding Rate

Dr. Cody Creech and Dr. Amanda Easterly

This experiment evaluated winter wheat planting date, row spacing, and population on yield to provide recommendations to Nebraska growers. Three years of data have been collected from locations near McCook, Grant, Sidney, Hemingford, and Kimball. Wheat was seeded on 7.5 and 10 inch rows using seeding rates of 14, 16, 18, and 20 seeds per foot of row. The varieties chosen were Goodstreak, Robidoux, and Wesley. Seeding dates were approximately two weeks prior to the current recommended date, on-time, and two weeks late and varied depending on the recommendation for each location.

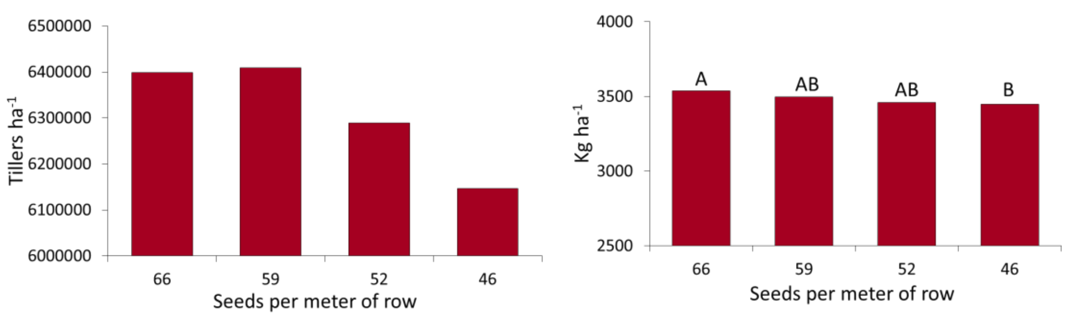

Figure 1. Increasing the number of seeds per row (seeding rate) to 20 seeds per foot (66 seeds/m) of row increased the number of heads/tillers per acre and yield compared to 14 seeds per foot of row (46 seeds/m).

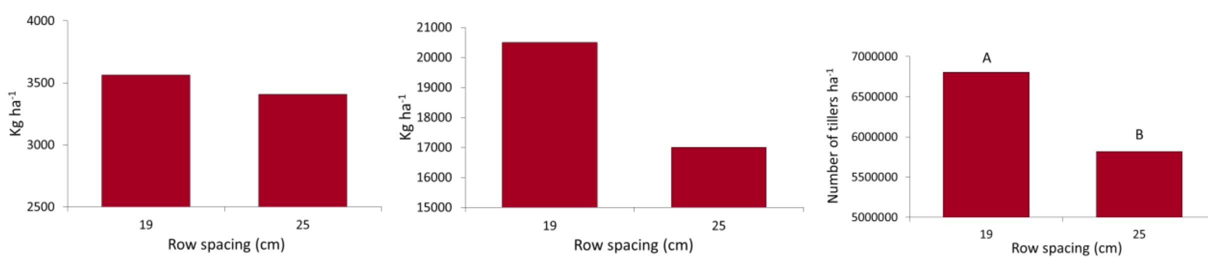

Figure 2. Figures left to right report yield, biomass, and head count. Decreasing row spacing to 7.5 inches (19 cm) compared to 10 inches (25 cm) increased yield, biomass, number of tillers/heads per acre.

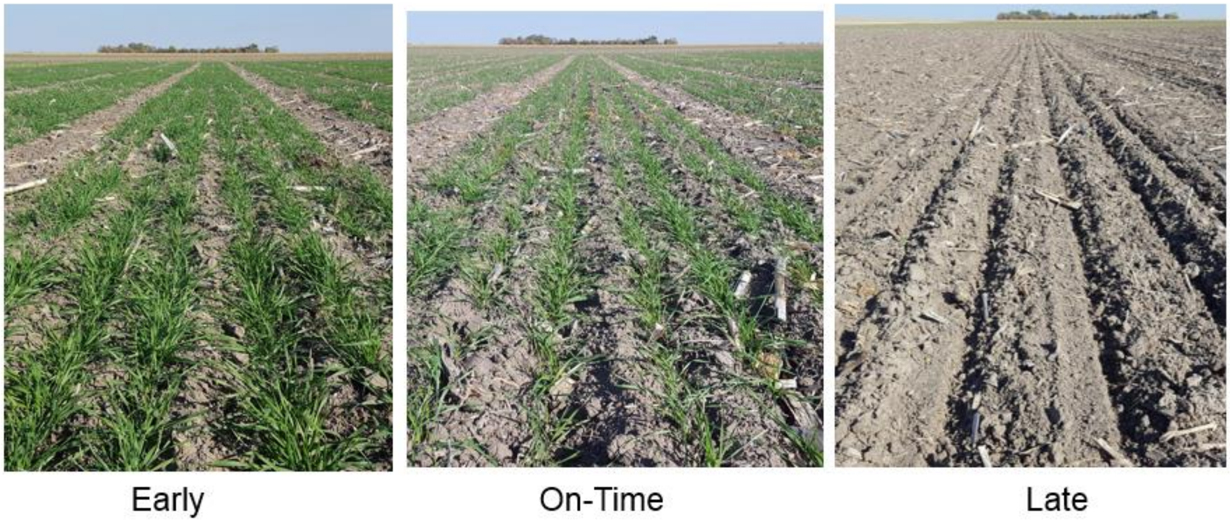

Figure 3. Picture taken at Hemingford in October illustrates the difference in growth observed due to planting date.

Conclusions:

Planting date and seeding rate did not impact grain protein or seed weight. Narrow row spacing and high seeding rates achieved the greatest yields. Narrow row spacing and high seeding rates had the greatest number of heads per acre. We do believe that opportunity exists to refine Nebraska's recommendations for seeding rate and date. This will be accomplished once data analysis is complete and will be available for wheat producers prior to the next wheat planting season.

Project Title: Improving Nitrogen Management in Dryland Winter Wheat Production

Bijesh Maharjan, Deepak Ghimire, Cody Creech, Devin Rose, Nathan Mueller, Yeyin Shi, Dipak Santra, Amanda Easterly, Laila Puntel, and Teshome Regassa

Background:

Low protein levels caused an estimated $2.3 million to $9.6 million loss in income for producers in 2016 despite high grain yields. Similar low protein issues persisted in 2017. Wheat producers lose income as a discount kicks in at protein levels below 10%-11%, depending on the elevator. Among many potential factors, soil nitrogen (N) is probably the most central factor that affect protein.

A two-year study was initiated at Henry J. Stumpf International Wheat Center, Grant along with other three locations across Nebraska (Mead, Sidney and Scottsbluff) in the fall of 2018. The specific objectives of the field study are:

- To evaluate effects of the combination of different rates and application timing of N on grain yield and quality.
- To evaluate the effect of sulfur rates and timings on yield and acrylamide accumulation.
- To explore use of crop sensors for in-season N management in winter wheat.

Study design:

Two hard red winter wheat varieties (Ruth and Freeman) were used as the main plot factor. The sub plot factor was combination of: Three fertilizer N application timing - 100% in fall, 100% in spring and Split (30% in fall and 70% in spring) and six N rate (0, 25%, 50%, 75%, 100% and 125% of recommended N rate). Recommended N rate is estimated based on soil test and yield goal using current UNL algorithm. Hand-held sensor (RapidScan CS-45) and UAV (mounted with MicaSense sensor) were used to collect Normalized Difference Vegetation Index (NDVI) at Feeks 10.5.2 (flowering) stage.

Results and Discussion:

At Grant, precipitation was above average from May through July, when the crop goes through tillering, booting, heading and flowering, increasing daily crop water use. This resulted in considerably high yield across all N treatments. This first-year results indicate that the grain yield and protein content of winter wheat may be improved by optimizing N rates (Fig. 1 and 2). Nitrogen application timing had significant effect ($p<0.05$) on grain yield with split and spring application yielding higher than fall application (Fig. 3). No significant difference in yield and protein was observed by variety.

Data from this study also is suggesting that crop sensors can be effective in letting producers know whether additional inputs are needed during the growing season. Nitrogen rate had significant effect on NDVI readings ($p<0.05$, Fig. 5). However, the NDVI values did not differ by N application timing (Fig. 6). Wheat grains from Nitrogen-Sulfur study plots is yet to be analyzed for amino acids. The field trial will continue in 2019/20. Over years, the team will develop and share with producers optimized N management strategy to improve wheat grain yield and protein.

Acknowledgment: This research is funded by IANR ARD and Nebraska Wheat Board.

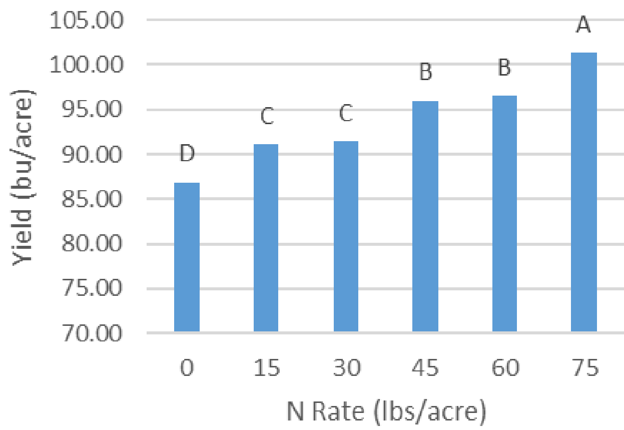

Fig. 1: Grain yield as affected by N rates.

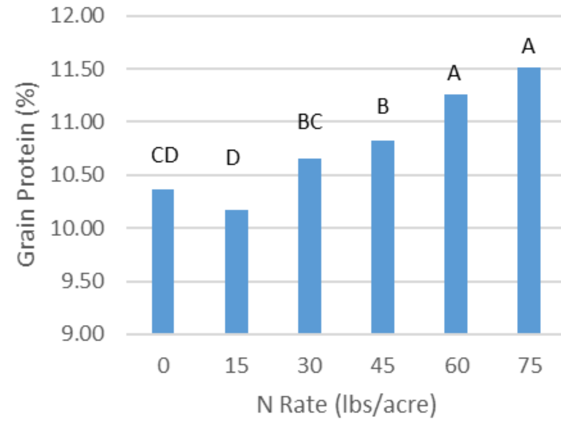

Fig. 2: Grain protein as affected by N rates.

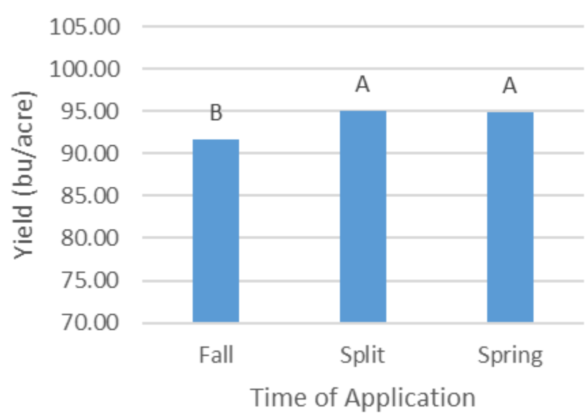

Fig. 3: Grain yield as affected by N application timing.

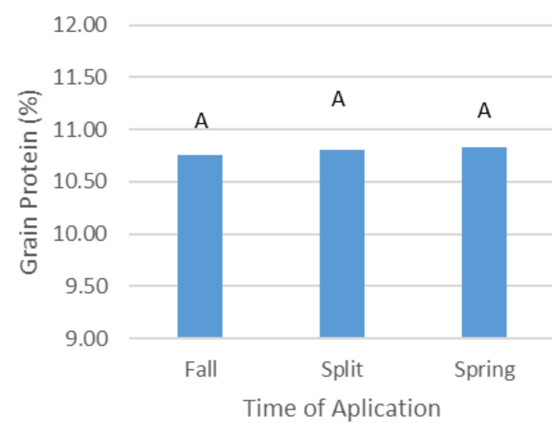

Fig. 4: Grain protein as affected by N application timing.

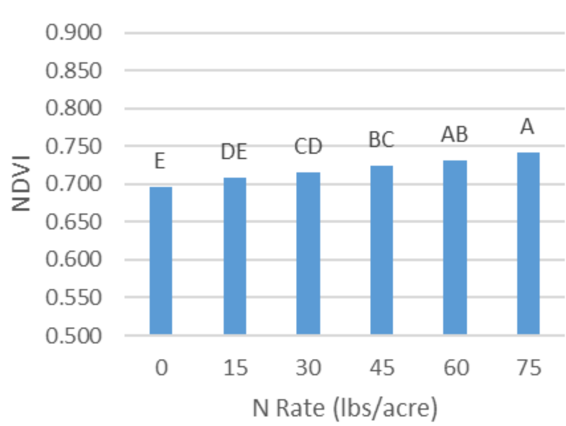

Fig. 5: NDVI values as affected by N rates.

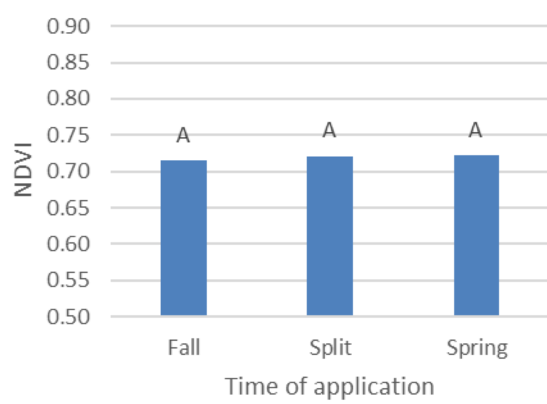

Fig. 6: NDVI values as affected by N application timing.

2019 Grant Wheat Plot Results

Variety	Yield	Protein	Test Weight	Moisture
Sunshine	**79.6**	**13.2**	**57.4**	**11.2**
Breck	92.2	14.6	61.9	11
Aspen	**104.0**	**14.1**	**62.6**	**11.2**
Snowmass	86.6	13.9	62.3	11.2
WB 623CLP	**83.2**	**13.7**	**62.2**	**11.6**
WB 4418	107.5	12.9	63.1	11.7
WB Keldin	**99.7**	**12.9**	**59.9**	**11.5**
WB 4462	100.4	13.2	62	11.7
WB Grainfield	**120.5**	**12.7**	**64.8**	**11.7**

Summer and Fall of 2018

The field was chemfallow. It had Amber @ .56 oz/acre applied in the fall.
The field had the Veris machine across to gather EC, pH and soil color.
The field was grid sampled on 2.5 acre size.
Variable Rate 40 Rock at 120-128# on the harvest results area.
Variable Rate 34.2-0-0-11.3s at 106-110# on the results area.
Pelletized lime applied at 330 lbs per acre.
Planted 9/28/2018 at 1.1 million seeds per acre.

Spring 2019

FVC Protein Builder @ 20 GPA + Alto @ 4 oz/acre applied right after green-up.
32% UAN @ 30 GPA streamed on after 1st joint.
KQ XRN @ 2 GPA + Quilt Xcel @ 10.5 oz applied at flag leaf.

Total fertility

169-48-0-49s-1.2zn