Carrington Research Extension Center

NDSU NORTH DAKOTA AGRICULTURAL EXPERIMENT STATION

A Report of Agricultural Research and Extension in Central North Dakota

Volume 60
December 2019

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Research Highlights from 2018

Crop Variety Comparison Data

The Carrington Research Extension Center conducts research and educational programs to enhance the productivity, competitiveness, and diversity of agriculture in central North Dakota. Research activities at the CREC include scientists and support staff trained and implementing programs in Agronomy, Plant Pathology, Soil Science, Precision Agriculture and Animal Science. These program teams are able to address a broad scope of factors that impact North Dakota agriculture. The crop diversity of the state is addressed in all program areas and is further supported by the ability to conduct research under both dryland and irrigated conditions. Projects addressing organic crop production and a fruit and berry program broaden the constituency being served. The foundation seed program of the center represents an important part of the overall NDSU Foundation Seed program. The CREC is the base of operation for four Extension specialists. This report highlights a portion of the department's contributions to research and extension. Following are a few examples of highlights from our past season and significant impacts and contributions to the region's agriculture.

Expanded bunk management and distillers grains research that will aide in understanding the links between feedlot management, distiller's grains inclusion, and incidence of Polioencephalomalacia (PEM) in feedlot cattle.

Conducted a study that used remote sensors to measure corn canopy spectral reflectance, and used the results, which differentiated the impact of N rates on corn vigor and plant height, to determine the mid-season N requirements and amount to variably top-dress.

Ongoing research evaluating the impacts of pre-weaning and post-weaning mineral programs are designed to determine the lasting impacts of trace mineral nutrition on livestock performance and health.

Intercropping studies were conducted for pea/canola, flax/chickpea, and corn silage companions as a way to increase net productivity per acre. In each case, treatment combinations were discovered that result in total yields higher than a single crop.

Increased the educational efforts in the livestock program through the addition of two graduate students conducting research, including collaborations with main station faculty and other REC scientists.

The fruit and berry project continues to serve a broadened constituency as rural and urban homeowners alike contact the Center's project leader for information on fruit production and related horticultural issues.

Completed multi-year, multi-location field studies rigorously demonstrating that the efficacy of fungicides against white mold in soybeans is sharply improved by delaying fungicide applications from the R1 growth stage (previously the standard recommendation) to the R2 growth stage.

Tested 130 biological seed treatments in wheat, soybeans, and corn to test for the ability of the microorganisms to mitigate abiotic stresses like salt, excess water, and reduced nutrients. The CREC was the main screening site in North Dakota to determine if any of the products would be suitable for commercialization in our region.

A study was conducted to determine the impacts of mid-winter pen cleaning on feedlot performance and carcass characteristics of steers. Pen cleaning treatments did not impact animal performance within the conditions of this study. However, marbling score and quality grade of carcasses tended to be greater with increasing extent of pen cleaning.

Fertility studies confirmed that planting date is more important to soybean yields than phosphorus fertilization in North Dakota, with the highest probability of producing greater yields from early planting (first two weeks in May) than the following two weeks (when majority farmers are able to plant), or in June, when yields are the lowest. There was not convincing evidence of yield improvement from phosphorus application when planting was in early spring than later.

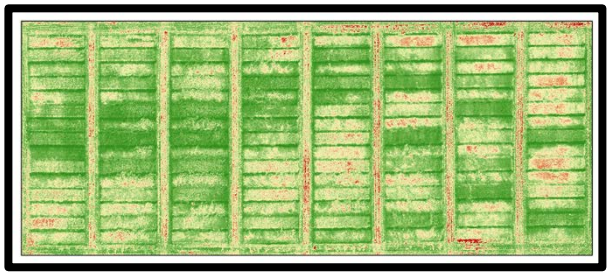
A new winter rye variety, ND Gardner, was released by the NDSU Agricultural Experiment Station in 2019. This variety was developed at the CREC and is intended to be used mainly for the rapidly growing cover crop market. Releasing a variety with traits desirable for cover crop applications will insure that farmers use good quality seed of known origin to obtain the desired benefits of the cover crop. ND Gardner is a very early, tall variety with very good winter hardiness and good early-season vigor. ND Gardner is named to honor the memory and contributions of Dr. John Gardner, former director at the NDSU Carrington Research Extension Center.

Multi-year, multi-location field studies conducted with over 30 soybean varieties across the 00 and 0 maturity groups exhibiting upright and bushy architectures demonstrated that soybean yields are maximized under white mold pressure when soybeans are planted to narrow (14- or 15-inch) or intermediate (21 - or 22.5-inch) rows versus wide rows (28- or 30-inch) when white mold incidence is below 50% at the end of the season.

An NDSU Extension circular was written in 2019 that provides a summary of black and navy bean response to row spacing and plant population from trials conducted from 2014 through 2018. The circular 'Black and navy bean response to row spacing and plant population in eastern North Dakota' (A1921) indicates navy bean grown in narrow rows (14 inches) with plant populations greater than 115,000 plants per acre increases seed yield compared to the traditional recommendation of 90,000 plants per acre in wide rows.

Provided farmers and the agri-industry with variety and hybrid performance trial results from 68 different trials representing 26 different crops annually.

UAV imagery was collected to determine whether aerial sensors could be effective tools to determine plant disease symptoms in small grain crops and thereby define differences in disease pressure. Multiple spectral indices were highly correlated to ground-based assessments, suggesting that UAV imagery may have practical applications for disease management in the future.



Is There Antagonism between Glyphosate and Glufosinate?

Mike Ostlie, Joe Ikley, Brian Jenks, and Greg Endres

In North Dakota we now have three crops where both glyphosate (ex. RoundUp Powermax) and glufosinate (ex. Liberty) can be applied in the same season. These crops are corn, soybeans, and canola. Since glyphosate is highly mobile in plants and glufosinate is a contact product, there is potential for antagonism on the plant surface. In 2018, an investigation of the impact of adding glyphosate to glufosinate began. In 2019, combinations were tested in three locations of North Dakota with a variety of weed species. In each of these experiments the application was optimized for glufosinate (ex. >15 GPA spray volume), based on the recommendation. In 2019, combinations of glyphosate and glufosinate with Enlist One and Enlist Duo were also tested.

The weed species response varied. Shepard's purse, common ragweed and redroot pigweed were controlled by all treatment combinations. Green foxtail control was initially good with all treatment combinations, however, by 21 days after application the presence of glufosinate caused a mild reduction in control compared to glyphosate alone. Yellow foxtail control was not affected by the combination of products, it was simply less in treatments without glyphosate. Kochia control was negatively impacted by the combination of products (Table 1). This is the one case where both products applied alone performed better than the combination. In fact, when adding Enlist products, Enlist Duo was better without glufosinate than with. In all other cases Enlist Duo was a neutral or positive addition.

Table 1. Weed species of interest while testing combinations of glyphosate, glufosinate, and Enlist in 2019.

Treatment	Rate		W. buckwheat 7 DAT	W. buckwheat 21 DAT	G. foxtail 21 DAT	Kochia 48 DAT
Check			0.0	0.0	0.0	0
Liberty	32	FL OZ/A	80.0	60.0	60.0	41.7
RoundUp Powermax	28	FL OZ/A	31.3	83.8	93.8	45.0
Liberty + R. Powermax	32 + 28	FL OZ/A	85.0	86.3	75.0	32.7
Liberty + R. Powermax	32 + 21	FL OZ/A	82.5	85.0	87.5	30.0
Liberty + R. Powermax	43 + 21	FL OZ/A	87.5	88.8	72.5	30.0
Liberty + Enlist Duo	32 + 64	FL OZ/A	91.3	91.3	95.0	38.3
Liberty + Enlist One	32 + 32	FL OZ/A	90.0	90.0	37.5	38.3
Enlist Duo	4	PT/A	32.5	75.0	93.8	50.0
Enlist One	2	PT/A	25.0	27.5	0.0	10.0
LSD (0.05)			6.1	6.2	3.5	9.4

Common lambsquarters had a variable response. In 2019, at both locations all treatment combinations were equally effective, achieving high levels of control. In 2018 there was notable antagonism (Table 2). RoundUp Powermax (28 oz) and Liberty (32 oz) alone provided similar levels of control. When combined, control dropped by 10%. Lowering the RoundUp Powermax rate (21 oz) and increasing the Liberty rate (43 oz) overcame this antagonism, but was less economical than either product alone. However, if trying to control glyphosate-resistant weeds, this may have been acceptable.

Table 2. RoundUp and Liberty combinations for controlling common ND weeds in 2018.

2018 Herbicide	Rate	Adjuvant	Y. Foxtail	Co. Lambqtrs	Redroot Pigweed
	oz/a		14 DAT	14 DAT	14 DAT
Check			0.0	0.0	0.0
Liberty	32	AMS	41.7	81.7	86.7
RoundUp Powermax	28	Class Act NG	63.3	81.7	93.3
Liberty + R. Powermax	32 + 28	Class Act NG	56.7	71.7	85.0
Liberty + R. Powermax	43 + 21	Class Act NG	68.3	88.3	88.3
LSD (0.05)			8.3	7.9	4.6

Wild buckwheat control was enhanced by the combination of the two products. When glufosinate was applied alone, it quickly burned the leaves of wild buckwheat, by the end of the trial the buckwheat had recovered. Glyphosate alone was very slow to control buckwheat, but by the end finished better than glufosinate. When they were added together it was the best of both worlds. The buckwheat was quickly burned back and by the end of the trial the combination performed better than either product alone. Glufosinate with Enlist Duo or Enlist One provided an even larger benefit to buckwheat control at 7 days after application, but was similar to glyphosate plus glufosinate by 21 days.

In short, there was less antagonism than expected when using these combinations, however, each weed species may have a unique response to the products. In fact, this may be a case where every application of this combination may respond in a unique way. When antagonism existed, it was often a reduction of 10 to 20% compared to glyphosate alone. These combinations may be highly effective when used to manage herbicide resistance, but scouting for escapes will be necessary. Generally these escapes were not detectable until two weeks following application.

To avoid potential antagonism and escapes, sequential applications will be most effective. Rarely did combining the products add to herbicide effectiveness (except with buckwheat). In our studies, the added cost of mixing the products rarely would give an advantage. If using a sequential program, glufosinate would be a good early POST product to target the weeds when they are small. A late POST application of glyphosate, with the lower water volume, would maximize the effectiveness of each product that is applied.

Corn Yield Response to N Fertilization

Jasper M. Teboh, Szilvia Yuja, Kelly Cooper, Heidi Eslinger, and Blaine G. Schatz

Objectives:

- Assess the impact of N rates on corn yields
- Estimate maximum return to N fertilizer (MRTN)

Methods

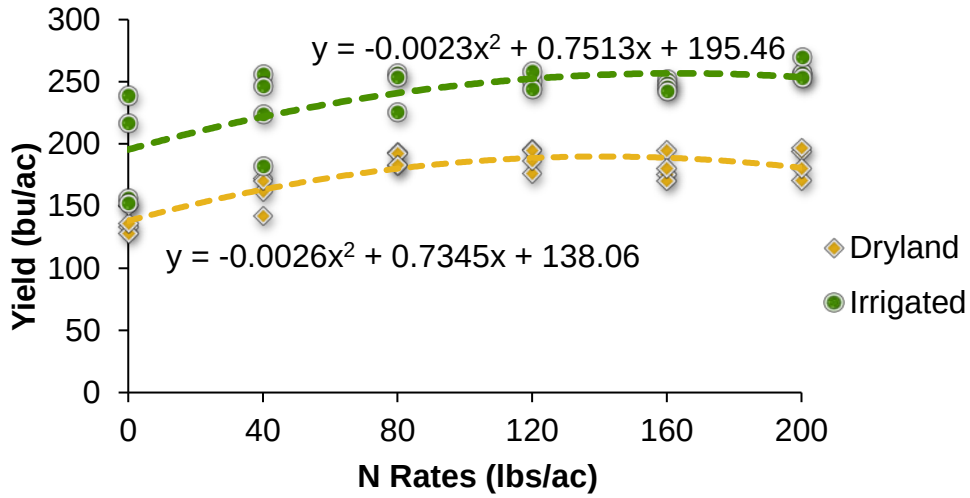
Two N response trials were conducted on corn at Oakes under dryland and irrigated conditions, and one at Carrington under dryland (non-irrigated). The N fertilizer treatments were 0 (control), 40, 80, 120, 160, and 200 lbs N at Oakes, and 0, 55, 110, 138 lbs N at Carrington. The two sites at Oakes were strip-till; therefore, urea, the source of N, was applied and left on the surface followed by seeding. Urea was incorporated after broadcasting on the surface at the conventional till site at Carrington before seeding. Soil N tests at the dryland and irrigated Oakes sites were 24 and 38 lbs/ac, respectively, and 14 lbs/ac at Carrington. Soybean was the previous crop at Oakes; meanwhile, corn followed corn at Carrington. Grain yield, test weight, and grain protein data were collected. Maximum return to N

fertilizer (MRTN) was calculated for each treatment that received N fertilizer at the Oakes sites, using price of N fertilizer estimated at $0.30/lb, and the price of corn grain at $3.70/bu. Farm gate cost of $6.25/ac was subtracted from the total cost of application of urea. MRTN was calculated by subtracting the cost of application (N rate X price of N - $6.25) from total return (grain price X yield differences between fertilized plots and unfertilized plot) and grain price.

Results

At Carrington, N application resulted in significant yield improvement. Yields increased linearly with increasing N rates (Figure 1), suggesting that even at the highest N rate applied at 138 lbs/ac, maximum yield was not attained. Very low initial soil N of 14 lbs/ac and microbial immobilization (tie-down) of N applied would explain why available N was low and insufficient. Microbial immobilization would happen because relatively high carbon content in relation to amount of N (C/N ratio) in the previous corn residue causes soil microorganisms to use up available N to break up and use carbon in the residues, thus reducing the amount of N available to the crop. Nutrient analysis of the ear leaves showed that application of N resulted in significant increases of all elements measured (N, P, K, S, Ca, K, Zn, Mn, Fe, and Cu) except boron (B). Test weight (TWT) was low on average (49.7 lb/bu), compared to averages for the site, usually between 54 to 56 lbs/bu. As a result of a prolonged growing season with low fall temperatures and an unusually wet September, grains did not attain full maturity, and because grain moisture at harvest was relatively high (21.5%), TWTs were low. According to researchers from Iowa State University, TWT should increase by about 0.2 lb/bu for each percent moisture reduced, and if the TWT increase is less than 0.2 lbs/bu it is indicative of immature grains.

Fig 1. Effect of N rates on grain yield of corn under dryland and irrigation (Oakes, 2019)



At Oakes, yields responded significantly to N rates with average yields at the irrigated site greater than the dryland site (Figure 2). Under dryland, the average yield was 173 bushels, compared to 236 bushels under irrigation. Maximum yield of 188 bushels was produced from 80 and 120 lbs N under dryland. This yield was significantly greater than yields at 0 and 40 lbs N, but not different from yields at higher N rates. Despite high numerical yield differences between treatments under irrigation, yields were not statistically different between 0, 40, and 80 lbs N, nor between 40 lbs and higher N rates. This was probably because of high variability within the data. However, average yield at 0 lbs N was significantly less than the yields produced at rates greater than 80 lbs (Table 1).

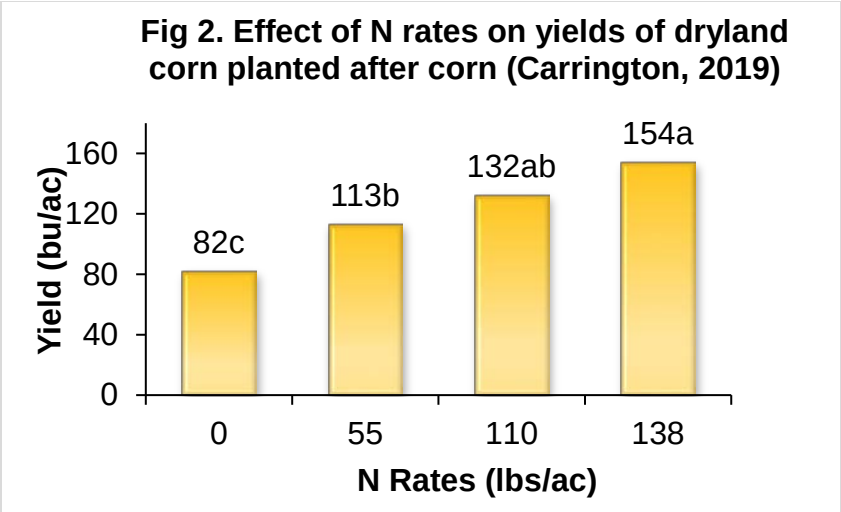


Table 1. N rate effects on corn grain yields, and maximum return to N (MRTN) under dryland and irrigated conditions at Oakes in 2019.

---------- Dryland ----------				---------- Irrigated ----------		
N Rates	Grain Yield	MRTN		N Rates	Grain Yield	MRTN
lb/ac	bu/ac	$/acre		lb/ac	bu/ac	$/acre
0	137c	-		0	191b	-
40	162b	72		40	225ab	108
80	188a	157*		80	244ab	166
120	188a	147		120	249a	172
160	180ab	105		160	248a	156
200	186a	113		200	262a	196

[ab] Means with different letters indicate significanct difference (95% probability)
Grain price = $3.7/bu; N Cost = $0.30/lb; N applicator rate of = $6.25/ac
* [(188-137)bu/ac x $3.70/bu] - [(80-0)lb N x $0.30/lb N] - $6.25/ac = $158/ac

Under dryland, MRTN was greatest at 80 lbs N with a return of $158/ac. Under irrigation, MRTN was $196/ac at 200 lbs N (Table 1). Even though yield differences were not significant between N rates at 40 lbs and above, the economic return suggested that higher profits were obtained when N fertilizer was applied at 80 lbs or above. The lack of significant yield differences between N rates at 40 and 200 lbs may be attributed to high variability within the data, and contribution of N from soil organic matter and soybean N credit. The MRTN results demonstrate that, MRTN can easily vary by the year and site as a result of changing climatic factors that affect N mineralization, and efficiency of crop N use. This explains why predicting optimal rates of N is difficult to accomplish.

Conclusion

Nitrogen fertilizer significantly improved yields. Obviously, some N contribution from preceding soybean crop or soil organic matter accounted for weak differences in yields between lower N rates and higher N rates. The highest rate of N (138 lb) applied at Carrington was not enough to satisfy the high demands of corn following corn, compared to corn following soybeans, because some of the N applied was likely tied up (immobilized) by soil microorganisms. Even though the estimated MRTN was for a single year and site (understanding that multiple years' data are required to make informed economic N rate decisions), this study showed that MRTN under irrigation was attained at higher N rates than under dryland, probably due to higher yields obtained under irrigation.

Distillers Grain Byproducts as a Phosphorus Source in Wheat

Szilvia Yuja and Jasper Teboh

At the Carrington Research Extension Center (CREC), we have been conducting studies using corn distillers byproducts in corn and wheat. Farmers that cultivate land close to ethanol plants have expressed interest in using these byproducts as fertilizer sources. Condensed distillers solubles (CDS) is a liquid that can be injected into the ground, and wet distillers grains (WDG) can be applied using a manure spreader. As with any fertilizer material, effectiveness needs to be assessed and rates need to be established. Both CDS and WDG provide multiple nutrients.

In our study we wanted to look at the applicability of these by-products as phosphorus sources, by controlling for other nutrients based on soil test levels.

At the CREC there was a trial conducted in wheat for four years between 2016 and 2019. There were two phosphorus (P) rates: 40 and 80 lbs P_2O_5 per acre plus a check with no P. There were three products applied at these rates: triple super phosphate (TSP), which does not supply any other macro nutrients, CDS, and WDG. Nitrogen levels were brought up to the level of the highest amount of nitrogen supplied by one of the by-products or to the recommended level, whichever was higher. Other nutrients were applied based on soil test levels. The sites were all on a Heimdal loam soils. Three sites tested low for phosphorus: 2016 at 5ppm, 2018 at 6ppm and 2019 at 5ppm. The site in 2017 had 13 ppm phosphorus.

Results

Protein and test weight did not have a significant response to treatments. The yield results are shown in Figure 1. There were significant yield differences in 2016 and 2018. In 2016, CDS at 80 lbs had the highest yield (56.54 bu/ac) and the check had the lowest (42.33 bu/ac). In 2018, only the check was significantly different from the rest, but there was a consistent yield increase by phosphorus rates for all three products. Yields from the WDG plots were consistently higher than those from the TSP-treated plots in every year, even though the differences were not significant. CDS had higher yields than TSP in three out of the four years, but these differences were not statistically significant either.

Application of wet distiller's grains.

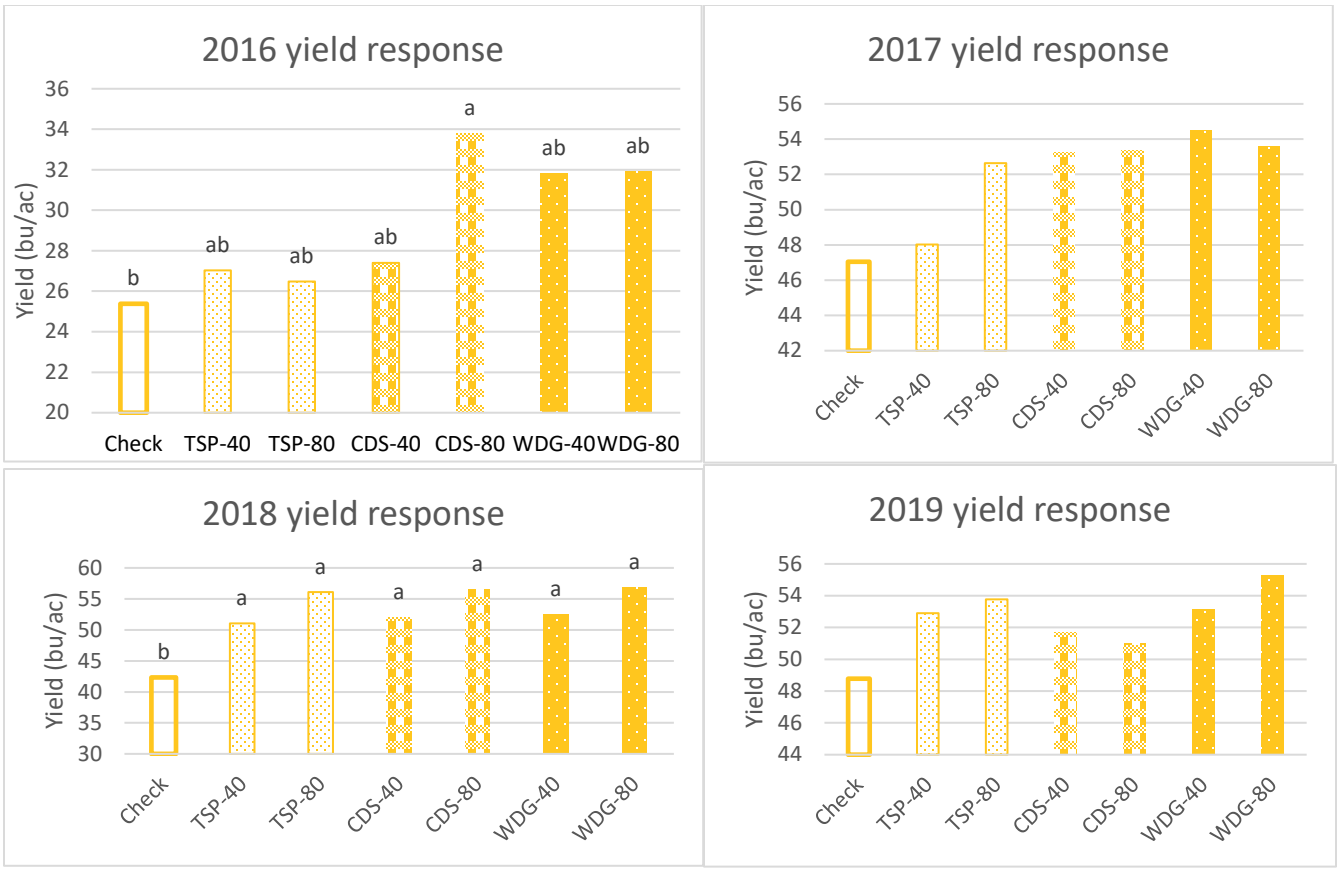


Figure 1. Yield response to phosphorus treatments by rates and products broken down by year.
Letters depict mean separations using Tukey, alpha<0.05.

Conclusion

The results of this study show that corn distillers by-product when applied at the same phosphorus rate, serve just as well, or in some years better, as phosphorus sources for spring wheat than triple super phosphate. An added benefit is that they supply other macro and micro nutrients as well, which lowers the need for synthetic fertilizer inputs. Given that the nutrient content of CDS and WDG varies batch to batch, it is helpful to send a sample for nutrient analysis before application. For those thinking of using these products on their field, it is also important to take into consideration the cost of hauling and applying, as well as the price of the products.

Effect of Phosphorus Fertilization of Soybeans at Three Planting Dates

Jasper M. Teboh, Szilvia Yuja, Kelly Cooper, Heidi Eslinger, and Mike Ostlie

Objective

- Evaluate soybean P fertility management based on planting date in different environments

Materials and methods

Two soybean planting date trials were conducted in 2019 at the NDSU Carrington Research Extension Center under irrigation and dryland conditions, and a third trial was conducted at Oakes, under irrigation. Yields were evaluated in response to soybeans planted on three dates that received three phosphorus (P) fertilizer rate treatments at 0, 20, and 40 lbs P_2O_5. Composite soil samples were taken at the top 6 inches and analyzed for P and reported with the planting dates for each site as described in Table 1. Normal planting date, as referenced in these studies, reflects an approximate period between mid-May to May 25, when the majority of farmers start and conclude their soybean planting in eastern

North Dakota. However, the majority of the farmers would typically start planting within the first two weeks of May if conditions were adequate, and after their early-season crops would have been planted.

Table 1. Soil analysis and soybean planting date by site.

	Carrington		Oakes
	Dryland	Irrigated	Irrigated
	Soil test P		
	7 ppm	9 ppm	18 ppm
Planting Date	Dates planted		
Early	7-May	7-May	7-May
Normal	21-May	21-May	24-May
Late	3-Jun	3-Jun	31-May

Results

At Carrington, yields at the dryland site (58 bu/ac) were about 12 bushels greater than averages for the area. P fertilization had significant impact on yields (Table 2). Application of 40 lbs P improved yields by three bushels from the control. At 20 lbs P, soybean yield (58 bushels) improved by two bushels, but was not significantly different from yields at either 0 or 40 lbs P (Table 2). Planting dates had significant effects on yields. Planting early and during the normal planting date resulted in 8 and 9-bushel increases, respectively, compared to late planting (52 bushels). Seed protein significantly improved by 0.3% from P application, but was significantly less at early planting compared to either normal or late planting. Even though grain protein tends to be relatively less when yields are greater, the lower protein from early planting could not necessarily be attributed to higher yields from early planting because the normal planting date produced similar yields; yet, the grain protein was significantly greater than for early planting. Results from a similar dryland study, conducted in 2018, showed that normal and late planted soybean yields (37 bushels each) were significantly lower than from early planting (46 bushels), but their protein content was significantly greater (36.5 and 37.5%, respectively) than for early planting (35.4%).

Mid-September maturity status of soybeans planted at three different dates, with the earliest date on the left.

Table 2. Effects of planting date and P fertilization on seed yield, protein, test weight (TWT), and oil content of dryland soybean at Carrington (2019).

P Rate (P)	Yield	Protein	TWT	Oil
lb/ac	bu/ac	%	lb/bu	%
0	56b	34.2b	57.3	17.4a
20	58ab	34.5a	57.3	17.2b
40	59a	34.5a	57.4	17.3b
Date				
Early	60a	34.0b	57.4	17.5a
Normal	61a	34.6a	57.3	17.4b
Late	52b	34.5a	57.3	17.0c
Effects	----------*p > F*----------			
P Rate	0.0624	0.0022	0.8331	0.0099
Date	0.0079	0.008	0.2926	<0.0001
P x Date	0.6851	0.1644	0.9581	0.68

[ab] Means separated by different letters within a column are significantly different (p<0.1).

At the Carrington irrigation site, yields were about average, at 62 bushels. Yields responded significantly to planting date and P fertilization (Table 3). Yields from late planting were at least 10 bushels less than from earlier planting dates. A two-bushel improvement in yield from 20 lbs P was statistically significant in comparison to the control; meanwhile, a bushel increase by 40 lbs P over the control was not statistically significant. Planting late resulted in significantly greater seed protein content than from the two earlier dates, but also produced significantly lower TWT and oil.

Fig 1. Soybean yield response to P rates and planting dates under dryland and irrigated conditions at Carrington (2019)

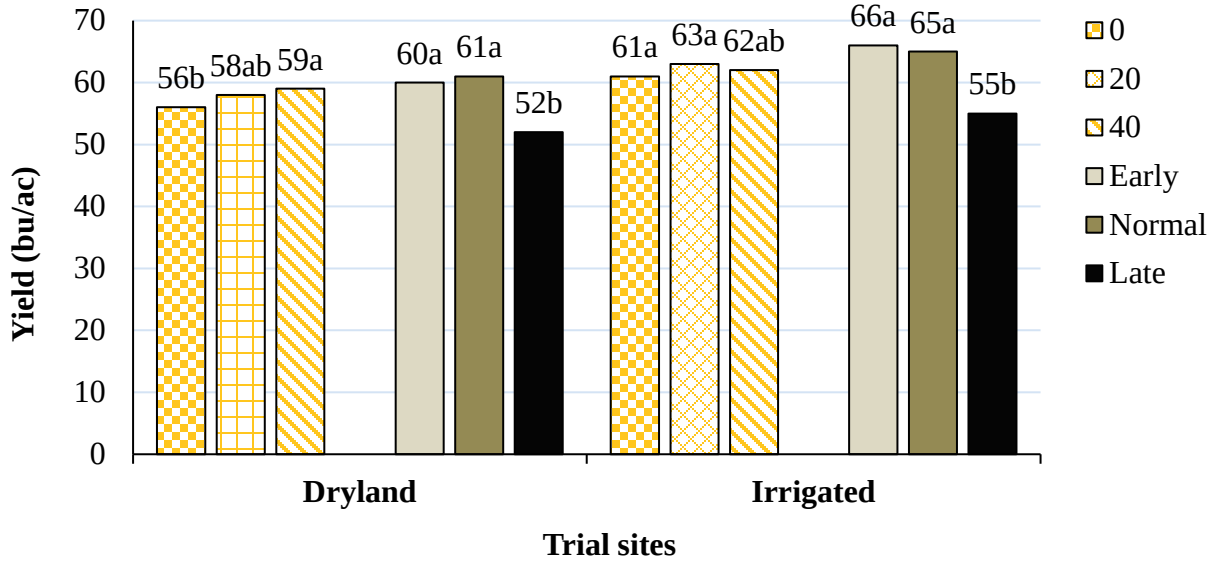


Table 3. Effects of planting date and P fertilization on seed yield, protein, test weight (TWT), and oil content of irrigated soybean at Carrington (2019).

P Rate (P)	Yield	Protein	TWT	Oil
lb/ac	bu/ac	%	lb/bu	%
0	61b	35.3	57.6	17.1
20	63a	35.3	57.6	17.1
40	62ab	35.3	57.6	17.0
Date				
Early	66a	35.2b	57.8a	17.3a
Normal	65a	35.2b	57.6a	17.1b
Late	55b	35.5a	57.3b	16.8c
Effects	----------*p > F*----------			
P Rate	0.0606	0.5061	0.9354	0.4138
Date	<.0001	0.0251	0.0053	<0.0001
P x Date	0.1322	0.1514	0.6069	0.2250

[ab] Means separated by different letters within a column are significantly different (p<0.1).

At Oakes, planting date significantly affected yields. Yields from late planting were significantly greater than from early or normal planting dates (Table 4). This was probably due to hail damage in early June to young growing plants from the two earlier planting dates. Grain protein was significantly greater from late planting. The TWT from early planting was significantly less than from the normal planting date.

Table 4. Effects of planting date and P fertilization on seed yield, protein, test weight (TWT), and oil content of irrigated soybean at Oakes (2019).

P Rate (P)	Yield	Protein	TWT	Oil
lb/ac	bu/ac	%	lb/bu	%
0	62.3	34.5	56.5	17.8
20	61.0	34.6	56.3	17.7
40	59.9	34.5	56.6	17.7
Date				
Early	59.3b	34.3b	56.2b	17.8
Normal	59.4b	34.5b	56.6a	17.7
Late	64.3a	34.9a	56.5ab	17.6
Effects	----------*p > F*----------			
P Rate	0.3456	0.6533	0.211	0.7676
Date	0.0184	0.0001	0.0564	0.3041
P x Date	0.3329	0.9895	0.3192	0.3036

[ab] Means separated by different letters within a column are significantly different (p<0.1).

Conclusion
From these studies, the effects that P fertilization had on yields were not dependent on the date of planting. Compared to the unfertilized control, P fertilization improved yields at Carrington by an average of 2.5 bushels under dryland, where soil P was low, by 1.5 bushels under irrigation where P was medium, but did not improve yields where P was very high (Oakes). Even though P improved yields, the yield gains were neither high enough, nor consistent enough to economically justify recommending that farmers fertilize soybeans with P in North Dakota. Yields from early and normal planting dates were not different, but were significantly greater than planting late. Therefore, farmers are better off planting during the early to normal planting window, when the risk of yield loss is relatively low.

Influence of Harvest Management Strategies on Flax Yield and Quality

Blaine G. Schatz, Sam Richter and Mark Halvorson

The practice of harvesting a crop of flax has evolved over the years as both equipment and technologies change. Traditionally, flax would be swathed into a windrow to promote plant dry down with threshing by the combine to follow. Now, most flax acres are direct-harvested, often after application of a desiccant to speed up dry down of both the flax plants and any weeds present. Producers initiate a flax harvest operation once the plant has reached physiological maturity (PM). At PM, the optimum flax seed yield, oil content and oil quality should be achieved. PM in flax is defined as when 75% of the seed bolls have reached a brown color. This determination of brown is often not a clear or straightforward assessment since flax bolls will express wide variations of this color as the plant matures.

The procedures a producer follows when harvesting flax are influenced by weed infestations, uneven stand, available labor and pending weather conditions. These factors, along with the challenges of assessing the 75% brown boll stage, may result in windrowing or applying a desiccant prior to actual physiological maturity. In theory, terminating flax before PM would cause reduced seed yield and oil content or quality would likely be impacted. This effect may be most significant when using a fast-acting desiccant versus one that results in slower rates of plant dry down. When slightly immature flax is swathed and laid in a windrow, we expect some degree of continued maturation as long as temperatures are moderate. Likewise, we would expect a slow acting desiccant to allow some degree of continued maturation for a limited time.

Flax processors and end-users have observed moderate variations in oil content and oil quality (i.e. ALA, alpha-linolenic acid) over the years. Minimal explanations exist as to why these variances occur. Our hypothesis was that harvest management might play a role in influencing flax oil content and quality.

Field trials were conducted at the NDSU Carrington Research Extension Center from 2017 to 2019 to determine how the different harvest approaches used by farmers may affect seed yield and oil content and quality. Objectives of the trial were to: 1) Compare windrowing and desiccation to natural plant dry down. 2) Determine if harvest at a stage prior to assessed PM influenced seed yield, oil content and quality. 3) Assess multiple herbicide desiccants to determine effective rate of plant dry down and influence on yield and oil.

Windrowing and desiccant application were initiated at 50% and 75% brown boll color representing two stages of maturity. Three herbicide desiccants were evaluated at each maturity stage including glyphosate and flumioxazin, which are both registered, and one product where a label is being pursued. A control treatment where flax dried down naturally to harvest moisture was established to allow comparison to harvest management strategies.

Trial results indicate that defining when flax is mature is very important to optimize seed yield when choosing among desiccants. However, oil content and oil quality were minimally effected by harvest timing or the desiccant used. Glyphosate and flumioxazin are slower-acting desiccants that allowed for a more gradual plant dry down resulting in similar seed yield when applied at either harvest timing and when compared to the control treatment. However, the other desiccant evaluated is a fast-acting product that reduced seed yield significantly across both harvest timings suggesting that at 75% brown boll stage, complete dry matter deposition had not occurred.

Based on this study the variations in oil and alpha-linolenic acid content in flax that are observed by end-users in the marketplace are not likely due to the timing a producer initiates harvest nor the desiccant they may have used. However, the potential for producers to use a fast-acting desiccant in the future will require greater attention to the crop stage when the product is applied to prevent reductions in seed yield. Further research to define flax boll color characteristics that correlate with optimized seed yield will be needed to effectively use a fast-acting desiccant.

Field Pea Protein Response to Mid-season Nitrogen Application

Mike Ostlie, Jasper Teboh, and Shana Forster

Field peas are growing in popularity as a protein source for both human and animal markets. Only recently has grain protein been included in the marketing process. Several field pea processors now offer tiered protein premiums for high protein peas. Unfortunately, field management for protein content has not been well studied. In 2018 (Carrington) and 2019 (Carrington and Minot) trials were conducted to evaluate potential methods for enhancing field pea protein content. The focus for this report is the treatments involving nitrogen applications at different phases of field pea reproduction. The theory behind the treatments is to add an additional nitrogen source at the time the plants have the biggest need for nitrogen, and when innate nitrogen fixation would be affected the least. This would be comparable to a post-anthesis nitrogen application that can be used to improve wheat protein content. For these studies, nitrogen was applied as UAN at a rate of 10 gal/ac mixed with an additional 10 gal/ac water, resulting in a nitrogen addition of about 30 lb/ac. In 2018, the application occurred at end-bloom, when greater than 90% of the flowers were desiccated. The variety was Admiral. In 2019, this was expanded to include three timings; early bloom, mid-bloom, and end-bloom using three field pea varieties.

In each case where mid-season nitrogen was applied, there was never any observed signs of crop injury from the nitrogen. In 2019 conditions were favorable for injury, as similarly timed applications in spring wheat caused very noticeable leaf burning. If nothing else, this practice appears to be quite safe to the field peas regardless of timing.

In 2018 the end-bloom application gave a boost of 0.74% protein compared to the check with no effect on yield or physiological response. In 2019, the results were not so straight-forward. In both locations there was once again no yield response (Table 1). In Minot, only one of the treatments provided a boost to protein content. This was at the early bloom stage on the NDSU experimental field pea variety (0.41% increase). In Carrington, the only protein response was with an end-bloom application to the variety Agassiz (0.64% increase). Other physiological effects were also evident in Carrington. Early bloom applications caused an increase in lodging to both AAC Carver and the NDSU experimental. The same application also caused Agassiz to grow taller than the check. The later application times did not seem to affect field peas in any other visible way.

Table 1. 2019 field pea variety response to nitrogen application timing.

						Minot			Carrington		
Treatment	N timing	Days to PM	Harvest Lodge	Lodge at PM	Plant Ht at PM	Yield	Test Weight	Protein	Yield	Test Weight	Protein
	10 gal UAN/ac		0 to 9	0 to 9	cm	bu/ac	lb/bu	%	bu/ac	lb/bu	%
Agassiz	Check	98.8	8.8	2.3	76.0	48.0	63.7	25.69	50.9	64.7	27.21
	Early Bloom	98.8	8.3	1.5	90.3	49.0	63.3	25.82	55.1	65.0	27.11
	Mid-Bloom	98.8	7.8	2.0	81.3	48.1	63.7	25.96	52.8	65.0	27.01
	End Bloom	98.8	8.5	1.3	77.3	47.7	63.8	25.82	55.2	65.2	27.85
NDSU Exp	Check	95.8	8.8	4.3	72.5	49.2	63.8	24.63	58.4	64.9	25.15
	Early Bloom	96.3	8.8	6.0	70.3	49.6	63.5	25.04	60.0	64.8	25.26
	Mid-Bloom	96.5	8.8	4.3	73.3	50.1	63.8	24.98	61.5	65.2	25.18
	End Bloom	96.5	9.0	5.3	68.0	49.2	63.6	24.93	61.0	65.0	25.48
AAC Carver	Check	97.3	7.0	1.8	82.8	50.8	64.2	24.43	64.9	66.0	24.65
	Early Bloom	96.8	5.8	1.8	82.8	50.6	64.8	24.16	64.0	66.2	24.06
	Mid-Bloom	97.0	7.3	2.0	91.5	51.3	65.0	24.07	67.0	66.0	24.20
	End Bloom	97.3	7.5	2.0	80.5	50.6	64.9	24.27	63.3	65.9	24.64
LSD (0.05)		0.7	0.8	1.9	14.1	2.1	0.4	0.36	7.1	0.9	0.56

It is difficult to explain the variability of protein response. The suitability for mid-season nitrogen application may be variety specific and a response appears less predictable than with a post-anthesis nitrogen application. Field pea nodulation likely complicates the issue of nitrogen availability, particularly late in the season. Due to these factors, it is likely that protein response may even be site-specific within a field, depending on nutrient availability, nodulation, soil characteristics, water status, etc. For now, we cannot recommend a mid-season nitrogen application until we have a better understanding of the conditions needed to make it successful. Even if a response is observed, only meager gains should be expected (<0.5%), likely resulting in non-economical application.

Chickpea and Flax Intercropping

Mike Ostlie and Justin Jacobs

Intercropping is the production practice of growing two crops in the same space in the same year. There has been a resurgence of interest in intercropping recently due to increased incorporation of soil health practices, spread of pesticide resistance, and tight agricultural margins. The ultimate goal of intercropping is to produce more yield per acre than with a single crop. The crops in this system are likely competitive with each other, meaning that the yield of a species within an intercrop will be less than if the species was grown on its own. However, when the yield of all crops in the intercrop are added together there would be a net gain. The focus of this research is planting the two crops together (same furrow) and harvesting together, with separation occurring after harvest.

Chickpea and flax intercrops have gained a lot of attention recently. Part of the attention is due to the difficulty in controlling Ascochyta blight in chickpeas. There are many anecdotal reports that indicate flax reduces the amount of Ascochyta when mixed with chickpeas. The mechanism for this reduction is unknown at this time. In 2018 and 2019, an intercropping study was established to evaluate chickpea and flax seeding rate ratios, and in 2019 fungicide applications were added to the protocol. The ratios were based on the percent of a normal seeding rate. For CDC Glas flax, the 100% seeding rate was 30 lb/ac and for Orion chickpeas the 100% seeding rate was 125 lb/ac. The fungicide in 2019 was two applications of Proline applied in early and late July. Ascochyta was scored based on observed severity

of infection within a plot. Land Equivalency Ratio (LER) is a productivity index used to compare monocropping with multicropping to compare total production on a unit of land. Values greater than 1 indicate combined yields were higher than with monocropping.

Chickpea emergence was poor in 2019. As a consequence, the flax compensated for the lack of plants and vigorously branched to result in very high yields, even with low populations. Due to the low chickpea population, LER values are skewed and not representative of the individual yield components. In this study, if the intention was to produce a profitable chickpea crop, it would have failed in intercrop settings. LER values in 2018 are more representative of a typical chickpea/flax intercrop. Ascochyta pressure was very high in 2018, but no other diseases were noted in the two crops. In 2018 there was no Ascochyta present in the trial.

In 2018, the chickpea/flax system was optimized by including a higher percentage of chickpeas in the ratio (Table 1). The best performing plots had at least a 66% rate of chickpeas and either 66 or 33% rate of flax. Both combinations provided a total productivity boost of 27% or greater compared to either chickpea or flax alone. The best treatment combination (66/33) resulted in 1863 lb/ac chickpeas and 26 bu/ac flax. This was compared to 3392 lb/ac chickpeas or 35.8 bu/ac flax when each was alone. In this system the flax influenced chickpea yields more than chickpeas influenced flax. Flax yields were only reduced 25% or less by having chickpeas present in any ratio. By comparison, chickpea yields were reduced by up to 75% by having high levels of flax in the mix, and reduced 44% with the lowest flax ratio. In this case, the chickpea yields were so high under monocrop production that it may not have been economically feasible to grow it as an intercrop, depending on the cash/contract price for each species. It should also be noted that white mold existed in chickpea-only plots, but was not present in intercropped plots.

Table 1. Chickpea and flax performance alone and in different seeding rate combinations in 2018.

Treatment	Rate	LER	Chickpea Yield	Flax Yield
	% of check	%	lb/ac	bu/ac
Chickpea/Flax	66/33	1.31	1863	26.9
Chickpea/Flax	50/50	1.15	1280	26.9
Chickpea/Flax	33/66	1.14	805	32.2
Chickpea	100	1.00	3392	.
Flax	100	1.00	.	35.8
Chickpea/Flax	66/66	1.27	1657	27.4
LSD (0.05)		0.18	635	5.9

In 2019, additional seeding ratios were added, along with the inclusion of fungicide as a treatment. However, the different ratios had little effect on results due to the unpredictable resulting stand of chickpeas. The biggest takeaway from 2019 was the disease observation (Table 2). Ascochyta severity in the monocrop chickpea was 60%. The use of two fungicide applications reduced the incidence to 33%. With intercropping ascochyta severity was 29% and reduced to 18% with fungicide treatments. To put it another way, fungicide application or intercropping chickpeas reduced Ascochyta by nearly 50%. Combining the two practices reduced the disease nearly by 50% again, resulting in a total reduction of 70%.

Table 2. Chickpea and flax disease incidence and yield when grown alone or in combination in 2019.

Treatment		Seeding Ratio	Rate	Ascochyta 8/6	Total LER	Flax	Chickpea
		%chickpea/flax	lb/ac	% severity		bu/ac	lb/ac
Fungicide	1	100/0	125/0	33.8	1.00	.	1182
	2	0/100	0/30	.	1.00	38.0	.
	3	66/66	84/20	18.8	1.24	42.6	170
	4	66/33	84/10	20.0	1.13	32.9	331
	5	33/66	42/20	18.0	1.28	44.5	115
	6	50/50	63/15	13.8	1.24	39.5	247
	7	100/100	125/30	15.5	1.36	44.8	210
	8	100/66	125/20	22.5	1.40	41.5	357
	9	100/50	125/15	17.5	1.40	42.1	356
No Fung	10	100/0	125/0	60.0	1.00	.	271
	11	0/100	0/30	.	1.00	44.2	.
	12	66/66	84/20	35.0	1.38	41.1	118
	13	66/33	84/10	30.0	1.42	38.4	147
	14	33/66	42/20	32.5	1.28	44.4	72
	15	50/50	63/15	23.8	1.11	38.9	62
	16	100/100	125/30	23.8	1.15	41.4	56
	17	100/66	125/20	33.8	1.34	40.3	113
	18	100/50	125/15	27.5	1.27	37.3	116
		LSD (0.05)		11.9	0.41	6.2	135.0

Compared to no management, applying a fungicide twice brought chickpea yields from 271 to 1182 lb/a (77% yield reduction with no management). With intercropping, yields declined 64% with no other disease management. In fact, when a high proportion of chickpeas were seeded and treated with fungicide, it out-yielded monocrop chickpea plots without fungicide. Once again in 2019, chickpea yields were heavily influenced by the amount of flax, but flax was only lightly affected by the amount of chickpeas. Both years indicate efficiencies when flax is seeded at less than 50% of a normal seeding rate when intercropped with chickpeas. The chickpea ratio was best at 100 or 66% of a normal seeding rate.

Intercropping Oats and Field Pea in an Organic Production System

Steve Zwinger, Steve Schaubert, and Jim Eckberg

Intercropping is the practice of growing two or more crops together at the same time in the same field. The idea is to find combinations of plants that complement each other or perform better than when planted alone. Intercropping can lead to increased yield and quality compared to mono-cropping. Agronomic benefits from this mix also include the oats providing support for the pea with the pea providing nitrogen to the production system. Important considerations for intercropping include: proper seeding rate/plant density for each component of the mix, and variety selection to match maturity dates.

A field trial to examine organic intercropping of oats and peas for grain production was conducted this past growing season at the CREC. The trials main intent was to examine pea types and several seeding rate combinations of oat pea intercrops for grain yield. The sole rates and the 100% intercrop rates were set at 1,250,000 PLS/ac for the oats and 350,000 PLS for the peas. The seeding rate for

peas remained constant across all intercrops. Rates for oats ranged from 25% to 100% seeding rate across the oat pea intercrops. Table 1 lists the rates used for all treatments in PLS per acre along with the plants per square foot for each treatment. The trial evaluated two pea types, Nette a semi-leafless pea and Protecta a leaf type field pea, which was developed for bio-farming or organic agriculture. Rockford was the oat variety used in this trial.

Table 1. Seeding rates for sole and intercropped treatments.

Treatments	Seeding Rate
Oat 100 %/pea intercrop	1,250,000 PLS/ac or 28.7 PLS sq. ft.
Pea 100% and all intercrops	350,000 PLS/ac or 8.0 PLS/ac sq. ft.
Oat 75% intercrop	937,500 PLS/ac or 21.5 PLS sq. ft.
Oat 50% intercrop	625,000 PLS/ac or 14.3 PLS sq. ft.
Oat 25% intercrop	312,000 PLS/ac or 7.2 PLS sq. ft.

The field trial was planted on May 6 on ground that was previously a cover crop of sorghum sudangrass, sudangrass, cowpea, soybean, crimson clover and turnip. Peas and oats were sown in the same row together with a row spacing of 7”. Peas were inoculated with an OMRI-listed, peat-based rhizobia inoculant prior to planting. Stand counts were taken on May 29 to determine plant densities of the seeding rates used. The trial was harvested on August 7.

Performance of each crop component are presented in tables 2 and 3. Data gathered for the two pea varieties, table 2, illustrate the differences these two pea types possess. Protecta, a leaf-type pea, had more plant lodging as compared to Nette a semi-leafless type. Lodging scores ranged from 8.5 for the sole treatment to 1.0 for the 100% oat treatment demonstrating the benefits of the oat intercrop providing support for the pea. No plant lodging occurred with any of the Nette treatments. Seed protein percent was significantly different between the pea varieties with Protecta having a higher protein content. Seed yields were also higher with Protecta as compared to Nette. Seed yields for Protecta ranged from 43.9 (sole) to 30.1 (100% oat) bu/ac. Seed yields for Nette ranged from 37.9 (sole) to 13.0 (100 % oat) bu/ac. Data gathered illustrate that as more oats is added to the mix Nette is not as competitive as Protecta. Results also demonstrate that as more oats are added to the intercrop pea yields are lowered.

Table 2. Pea performance in the oat pea intercrop.

Oat Rate	Pea Variety	Plant Stand	Days to Bloom	Plant Lodge	Plant Height	Seed Protein	Test Weight	Seed Yield	Yield % of check
		sqft		0 to 9	inch	%	lbs/bu	bu/ac	LER
NA	Protecta	8.8	53.3	8.5	14.2	26.2	62.6	43.9	1.00
25%	Protecta	7.8	53.5	6.5	17.8	26.2	62.9	42.4	0.97
50%	Protecta	8.9	53.0	2.5	24.4	26.0	63.8	36.6	0.84
75%	Protecta	8.1	53.3	1.8	23.8	26.2	63.7	31.6	0.73
100%	Protecta	7.7	53.3	1.0	24.1	25.4	64.0	30.1	0.69
NA	Nette	7.9	52.5	0.0	26.4	22.6	64.2	37.9	1.00
25%	Nette	6.4	51.8	0.0	21.2	22.3	63.8	26.7	0.70
50%	Nette	6.6	52.0	0.3	22.7	21.7	63.9	18.6	0.49
75%	Nette	6.7	52.0	0.0	19.1	21.9	63.9	14.6	0.38
100%	Nette	6.2	51.8	0.0	16.4	21.7	63.9	13.0	0.34
Mean		7.5	52.6	1.9	21.0	24.0	63.7	29.5	0.71
C.V. (%)		10.9	1.8	58.2	17.9	2.3	0.7	11.0	13.0
LSD 0.05		1.2	1.4	1.6	5.5	0.8	0.6	4.7	0.13

Table 3. Oat performance in the oat pea intercrop.

Oat Rate	Pea Variety	Plant Stand	Days to Head	Plant Lodge	Plant Height	Grain Protein	Test Weight	Grain Yield	Yield % of check
		sqft		0 to 9	inch	%	lb/bu	bu/ac	LER
25%	Protecta	6.1	60.5	6.5	37.4	11.5	34.1	28.4	0.38
50%	Protecta	12.2	60.5	2.5	39.0	11.3	36.6	49.2	0.66
75%	Protecta	16.2	60.3	1.8	38.0	10.7	37.8	58.6	0.78
100%	Protecta	23.6	59.8	1.0	38.6	11.0	38.1	62.2	0.83
25%	Nette	4.7	60.5	0.0	39.7	10.4	34.5	47.7	0.64
50%	Nette	11.0	60.3	0.3	39.0	10.2	36.2	67.4	0.91
75%	Nette	15.8	59.5	0.0	38.2	10.2	37.4	75.6	1.01
100%	Nette	21.6	58.8	0.0	38.4	10.5	37.4	79.8	1.06
100%	NA	26.3	58.8	0.0	36.3	9.7	37.7	75.5	1.00
Mean		15.3	59.9	1.9	38.3	10.6	36.6	60.5	0.81
C.V. (%)		12.2	1.6	58.2	3.6	2.5	2.2	10.7	10.1
LSD 0.05		2.7	1.4	1.6	2.0	0.4	1.2	9.4	0.12

Oat performance, table 3, was also significantly influenced by pea variety in this trial. Oat yields were lower for the Protecta intercrops as compared to the Nette intercrop treatments. Yields for oats ranged from 28.4 to 62.2 bu/ac for the Protecta intercrop treatments and 47.7 to 79.8 bu/ac with the Nette intercrops. Oats over yielded in the Nette intercrop with a LER of 1.01 and 1.06 for the 75% and 100% oat intercrop treatments. Test weight of the oats was affected by the intercrop treatments. Lower plant densities of oats in the intercrop resulted in lower test weights of the oats in all pea intercrop treatments. Test weights ranged from 34.1 to 38.1 lbs/bu with Protecta as oat rates increased from 25% to 100%. The same trend was observed with Nette pea intercrop treatments with test weights increasing from 34.5 to 37.7 lbs/bu in the 25% to 100% treatments respectively. Grain protein of the

oats was also significantly influenced by the addition of peas to the mix. All pea intercrop treatments increased the protein content of the oats. An increase up to 1.8% in oat protein was detected when peas were added to the mix compared to the sole oat treatments.

Crop component yields, total yields and Land Equivalent Ratio are presented in table 4. Results gathered show significant differences in total yield amongst the treatments. Intercropping peas and oats increased total yield compared to sole treatments of either peas or oats. Total yields were higher as more plants were added to the mix. Land Equivalent Ratio (LER) is a measure of the amount of land it would take to achieve equal yields of the intercrop as compared to growing the crops individually. If the LER is greater than 1.0, overyielding occurred and the intercrop is more productive then growing either of the crops alone. LER for all intercrop treatments ranged from 1.34 to 1.52, meaning it would take 34 to 52% more land to equal the intercrop yield if each crop was grown alone.

Table 4. Crop component yields, total yield and Land Equivalent Ratio of the oat pea intercrop.

Oat Rate	Pea Variety	Pea Yield	Oat Yield	Pea Yield	Oat Yield	Total Yield	LER
		bu/ac	bu/ac	lb/ac	lb/ac	lb/ac	%
NA	Protecta	43.9	.	2631	.	2631	1.00
25%	Protecta	42.4	28.4	2542	909	3451	1.35
50%	Protecta	36.6	49.2	2196	1575	3771	1.50
75%	Protecta	31.6	58.6	1893	1876	3769	1.50
100%	Protecta	30.1	62.2	1805	1990	3795	1.52
NA	Nette	37.9	.	2275	.	2275	1.00
25%	Nette	26.7	47.7	1600	1527	3128	1.34
50%	Nette	18.6	67.4	1117	2156	3274	1.39
75%	Nette	14.6	75.6	877	2419	3296	1.39
100%	Nette	13.0	79.8	783	2552	3335	1.40
100%	NA	.	75.5	.	2416	2416	1.00
Mean		29.5	60.5	1772	1936	3195	1.31
C.V. (%)		11.0	10.7	11.0	10.7	8.0	8.5
LSD 0.05		4.7	9.4	284	302	369	0.16

The Effects of Phosphorus Fertilization on Four Wheat Varieties with Differing Tillering Abilities - Summary of Four Years

Szilvia Yuja, Jasper Teboh, and R. Jay Goos

An adequate supply of phosphorus is essential to maximizing wheat yields. There are about 0.5-0.6 lbs of phosphorus removed by one bushel of grain. One of the effects of phosphorus deficiency is reduced tillering. Unlike winter wheat, spring wheat does not have many productive tillers. This is due to a shorter growing season, which allows for less time for tillers to mature. Almost all the grain production comes from the main stem and the T1 and T2 tillers which are initiated between two and three weeks after emergence. However the initiation of these tillers is not automatic and depends on favorable conditions early in the growing season (Goos 1995).

There was a trial conducted from 2016 to 2019, looking at the effects of phosphorus fertilization on spring wheat yield, quality and tillering. Four commonly grown spring wheat varieties were chosen based on their differing tillering abilities. Bolles, a variety with very high protein and relatively lower

yields has low tiller production. Albany, which has very high yield potential, but lower protein tends to tiller very well, and Linkert and Prosper are somewhere in between these two. All but one site-year was at the Carrington Research Extension Center. In this article only results from the sites at the CREC are included. Each year there were two sites at the CREC. The difference between the two was either based on soil P level: high and low in 2016 and 2017; or based on irrigation: irrigated and dryland in 2018 and 2019, with all sites testing low for phosphorus (Table 1). There were two phosphorus treatments that were consistent across all site-years, which were 24 lbs/A P_2O_5 and no phosphorus applied. In 2017, 2018 and 2019 there was also a 12 lb rate, and in 2018 and 2019 there was a rate of 7.2 lbs applied in-furrow which is 30% of the 24 lb P rate. All other phosphorus treatments were broadcast applied and incorporated. All the phosphorus was applied in the form of triple super phosphate which does not contain any other macro nutrients. Tillering assessment was done in 2016, 2018 and 2019.

Table 1. Soil P levels in site-years.

Site-year	Olsen-P (ppm)
2016 low P	4
2016 high P	15
2017 low P	5
2017 high P	18
2018 dryland	6
2018 irrigated	4
2019 dryland	7
2019 irrigated	9

Results

There was no significant interaction between variety and phosphorus rate for yield, protein or tillering. Which means phosphorus rates affected the different varieties similarly within each site-year. Protein content was not significantly affected by phosphorus rates. Phosphorus rate significantly increased yield in only two site-years, but there was a numerical increase with P rates in five; two of which tested high for phosphorus (Figure 1). Figure 1 also shows that yields of the 7.2 lbs in-furrow P treatments were comparable to those obtained by applying either 12 or 24 lbs P per acre. Tillering numerically increased with P levels in four of the six observed site-years, but this effect was not statistically significant. Tillering in the in-furrow treatment was not significantly different from the rest, but was numerically similar to those of the 12 lb and 24 lb broadcast P rates (Figure 2). The average number of T1+T2 tillers per plant had a very weak slight positive correlation for the variety Bolles in three site years: the low testing site in 2016 and the dryland sites of 2018 and 2019, both testing low for phosphorus (Figure 3).

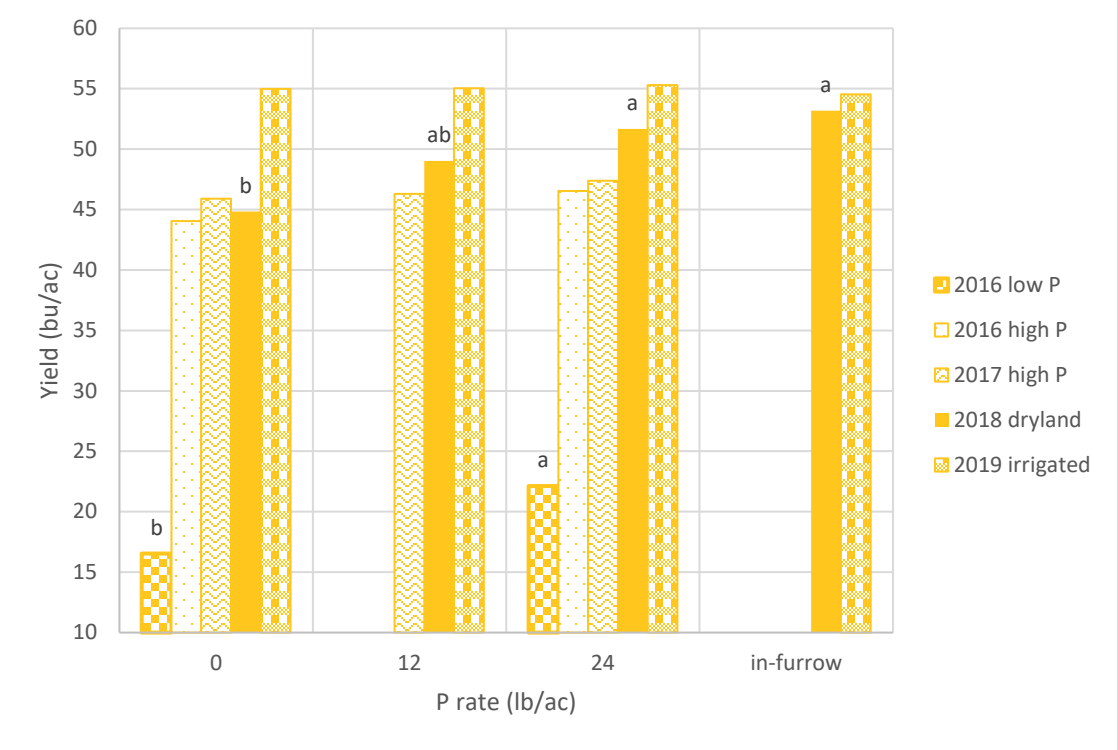


Figure 1. Yield response to phosphorus treatments in 5 site-years.
Letters depict mean separations within their respective site years using Tukey, alpha<0.05.

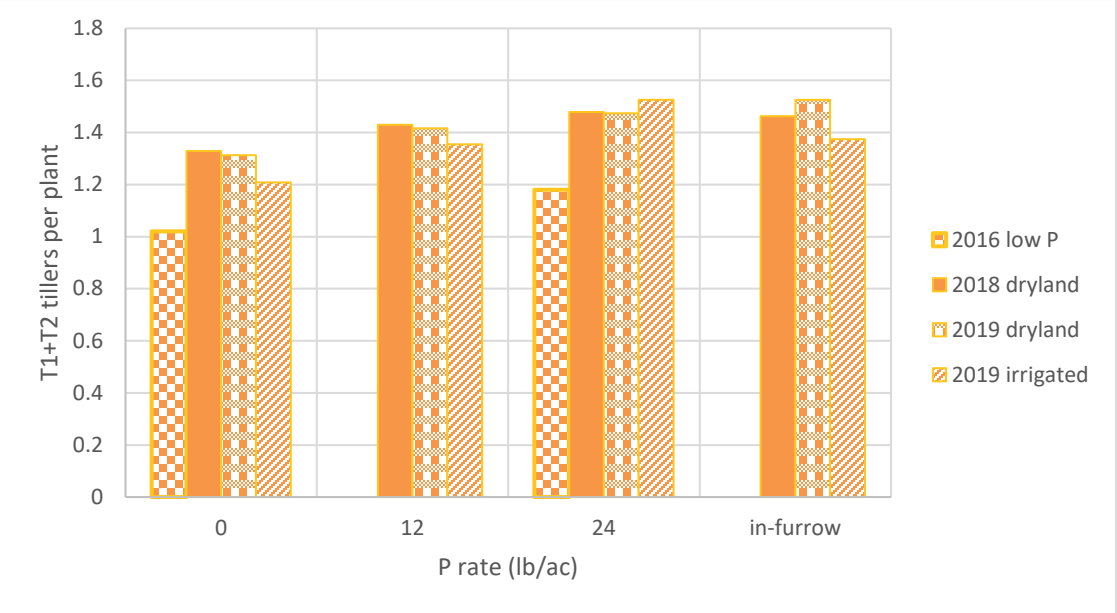


Figure 2. T1+T2 tillers per plant by phosphorus treatment and year.

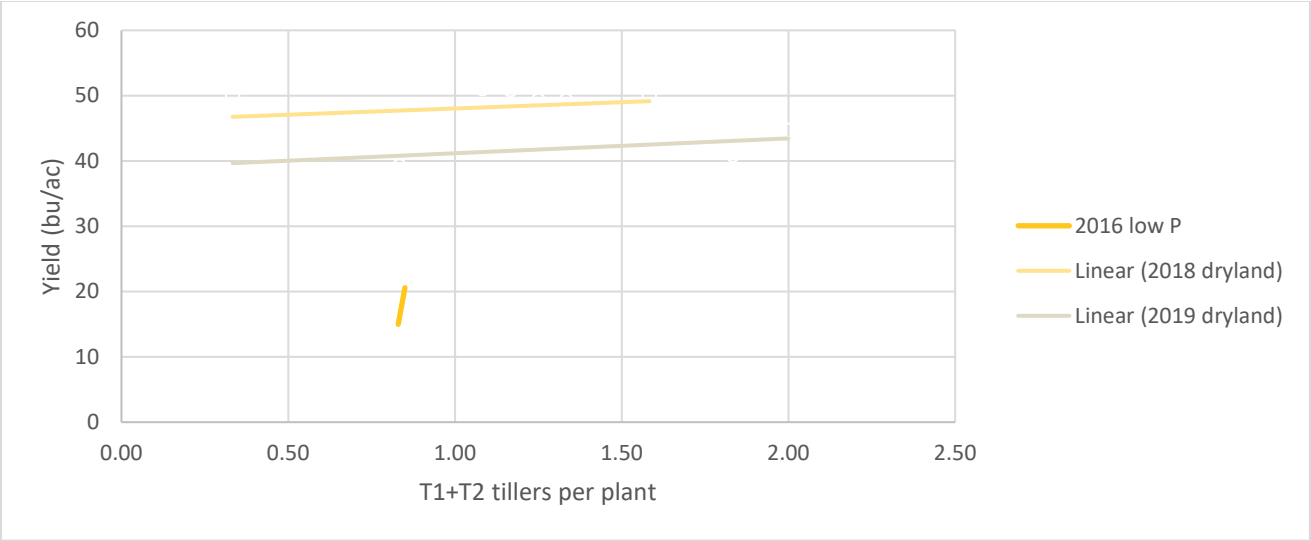


Figure 3. Yield response of the variety Bolles to T1+T2 tiller initiation.
Results are not significant.

Conclusion
Phosphorus fertilization can increase yields across varieties in responsive environments. There was no difference between the 12 and the 24 lb phosphorus treatments in our study. The 7.2 lb in-furrow treatment performed similarly to the 12 lb and 24 lb broadcast P rates. Despite the fact that tillering generally increased with phosphorus rates, tiller counts were a very poor predictor of yield in this trial. It is possible that the differences in tillering ability and yield weren't great enough to be able to pick up a more consistent correlation between the two

Sulfur and Nitrogen Effects on Yield and Protein of Barley

Jasper M. Teboh, Szilvia Yuja, Mike Ostlie, and Ezra Aberle

Objective

- Assessment of sulfur fertilization influences yield and grain protein of malting barley

Materials and methods
Two trials were conducted at Carrington and New Rockford (and on a farmer's field) to assess the effects of four sulfur (S) rates across three levels of N on performance of two malting varieties, ND Genesis (two-row) and Tradition (six-row). The four S rates were 0, 10, 20, and 30 lbs S/ac, applied as ammonium sulfate. The S treatments were applied in all combinations with N at 0, 30, and 60 lbs at CREC, and 30, 60, and 90 lbs/ac at New Rockford to each variety. Treatments were replicated four times.

Results
Yields were relatively lower than in some years. High grasshopper infestation in 2019, especially at New Rockford, probably had serious impacts on yields. The main highlights of these results are that no significant interaction effects were observed between any of the treatment combinations at Carrington (Table 1) or at New Rockford (Table 2). Sulfur did not have an effect on yields or any variable measured. Nitrogen enhanced yield significantly at Carrington, but not at New Rockford. Grain protein differed between varieties. Tradition produced significantly greater grain protein than ND Genesis at either location. The fact that N had no significant effect on grain protein suggests that soil residual N contributed N in amounts that were adequate to produce similar yields as the fertilized plots.

Table 1. Performance of two barley varieties in response to S and N at Carrington, 2019.

Treatments	Yield	Protein	TWT	Plump
	bu/ac	lb/bu	---------- % ------	
Variety				
ND Genesis	56.1	10.99b	44.1	93.90
Tradition	60.4	13.52a	44.6	993.9
N Rates (lb/ac)				
0	52.1b	12.10	43.8b	94.0
30	58.6ab	12.18	44.4ab	93.9
60	64.1a	12.50	44.8a	93.8
S Rates (lb/ac)				
0	57.20	12.19	44.3	0.938
10	58.20	12.31	44.4	0.940
20	58.40	12.30	44.3	0.940
30	59.20	12.26	44.3	0.938
Effect	----------*Pr > F*----------			
Variety (Var)	0.427	0.0075	0.4096	0.9307
N rates (N)	0.007	0.2399	0.0342	0.4958
Var x N	0.2148	0.0931	0.0515	0.7500
S Rates (S)	0.7443	0.9149	0.9746	0.6835
Var x S	0.2188	0.8114	0.219	0.7928
N x S	0.9881	0.9391	0.9868	0.1532
Var x N x S	0.7784	0.3216	0.5779	0.0069

[ab] Means followed by the same letter within a column are not signifcantly different.

Trial site at the CREC, established to assess the effects of sulfur and nitrogen on two varieties of malting barley.

Table 2. Performance of two barley varieties in response to S and N at New Rockford, 2019.

Treatments	Yield	Protein	TWT	Plump	Thin	Grain N	Grain S	N:S Grain	N_Rmval	S_Rmval
	bu/ac	%	lb/bu	---------%----------		----------%----------			----------lb/ac---------	
Variety										
ND Genesis	53.2	10.96b	42.41	93.9	2.23	1.61b	0.105b	15.44b	51.6b	8.6
Tradition	53.0	12.82a	41.79	90.9	3.59	1.81a	0.112a	16.26a	57.7a	9.0
N Rates (lb/ac)										
60	52.5	11.93	42.23	92.2	2.85	1.71	0.109	15.76	54.0	8.9
90	52.7	11.66	42.19	92.8	2.74	1.68	0.106	15.88	53.5	8.6
120	54.2	12.63	41.88	92.1	3.15	1.74	0.109	15.91	56.4	9.0
S Rates (lb/ac)										
0	54.8	11.80	42.00	93.3	2.58	1.71	1.060	16.1042	56.4	8.60
10	52.9	11.89	42.24	91.8	3.18	1.71	1.090	15.6542	54.2	8.90
20	52.9	11.93	42.17	92.2	3.02	1.72	1.080	15.9958	54.7	8.80
30	51.9	11.93	41.99	92.3	2.87	1.70	1.090	15.6535	53.3	8.90
Effect	----------*Pr > F*----------									
Variety (Var)	0.9144	0.0031	0.1943	0.2816	0.2870	<.0001	0.0488	0.0114	0.0095	0.3651
N rates (N)	0.6530	0.1068	0.5555	0.8223	0.7745	0.3381	0.1309	0.9051	0.4727	0.4330
Var x N	0.3517	0.3944	0.2914	0.8718	0.8467	0.7947	0.1568	0.7068	0.5696	0.3320
S Rates (S)	0.2171	0.8560	0.3777	0.2271	0.2912	0.8449	0.3263	0.188	0.3003	0.5070
Var x S	0.9852	0.4150	0.4170	0.1767	0.3212	0.8131	0.6115	0.2607	0.9798	0.6956
N x S	0.5334	0.1490	0.1966	0.7178	0.8071	0.0845	0.4046	0.1458	0.7850	0.5403
Var x N x S	0.4897	0.1767	0.3605	0.2334	0.5359	0.4140	0.1225	0.1259	0.8619	0.8147

[ab] Means followed by the same letter within a column are not signifcantly different.

Conclusion

Sulfur did not have a significant impact on grain yields and protein. Consistent with previous reports, Tradition was a higher yielding variety than ND Genesis.

Corn Silage Intercropping Summary

Mike Ostlie and Bryan Neville

Much of the intercropping research at the CREC has recently focused on growing two grain crops at the same time. However with innovations in silage harvest equipment, and the increase in custom harvest acres, more options are possible for corn silage. A trial was initiated in 2018 to begin screening possible companions to pair with corn. The focus of the pairing was legume crops. The goal of the research was to find combinations that could increase the potential silage tonnage and quality. In total, 11 combinations were tested. Plots were planted to corn and the companion on the same day. The companion crops were planted in paired rows 7” on either side of the corn rows and at 66% of a full seeding rate. The corn was planted on 30” centers at 32,000 plants/ac. Due to extremely dry conditions in 2018, the overall yield with corn was quite low.

Based on the results from 2018, a larger more focused study was conducted in 2019. Field peas and soybeans were evaluated as corn silage companions in the same configuration as 2018. Plant populations of each legume were tested in an attempt to optimize the production practices of

intercropped silage. Legume seeding rates were 100, 66, and 50% of a full seeding rate for each legume. Grain soybeans (Proseed 30-20 RR2Y) were used along with a dual-purpose field pea variety (Flex). The trial was fertilized as if it was a silage field, using 150 lb/ac N. The concept was to add crops that would have mature or nearly mature grain at silage harvest so that the grain would boost the protein content of the silage. A one-row corn chopper was refurbished and fitted with load cells and a hopper to weigh the resulting chopped forage. In both years, a productivity index called Land Equivalency Ratio (LER) was used to compare the production of corn silage alone, with intercrop combinations. Values greater than one indicate a net yield gain.

In 2018 every intercrop combination resulted in a reduction in corn silage yield (Table 1). Some of the companion crops produced enough biomass to overcome this reduction. Field peas, soybeans, and scarlet runner bean produced a high amount of biomass as an understory crop. Scarlet runner bean was too vigorous and competitive with the corn crop resulting in a net negative yield. Faba bean and cowpea also produced net negative yields, however this could be attributed to poor performance of the crops late in the season, coupled with early-season competitiveness. Field pea and grain soybeans produced enough biomass to overcome and surpass the tonnage of corn silage alone so they were the only companions to produce a positive LER. The comparison of grain vs. forage soybeans was interesting to study. The forage soybean never reached reproduction, so the plants were quite large and grew better than grain soybeans in the corn understory, however the lack of kernel production put them at a biomass yield disadvantage compared to grain soybeans. Field pea and grain soybeans also added to the silage quality, increasing protein content by 1.88 and 0.51% respectively. This potentially offsets substantial off-farm input investment into protein supplements.

Table 1. intercropping performance of corn with and without companion legumes in 2018.

Treatment	Corn Dry Matter	Broadleaf Dry Matter	Total Dry Matter	Corn DM Reduction	Total LER	Crude Protein	Protein Change
	ton/ac	ton/ac	ton/ac	%	%	%	%
Corn only	4.66	.	4.66	0.0	1.00	8.39	.
Forage Soybean + Corn	4.06	0.41	4.47	LER	0.96	7.55	-0.84
Forage Field Pea + Corn	3.67	1.74	5.41	32.1	1.16	10.27	1.88
Faba Bean + Corn	4.16	0.24	4.41	5.5	0.95	6.93	-1.46
Sunflower + Forage Soybean + Corn	3.39	1.16	4.55	25.5	0.98	9.22	0.83
Cowpea + Corn	4.14	0.14	4.28	3.2	0.92	8.34	-0.05
Scarlet Runner Bean + Corn	2.68	1.74	4.42	39.4	0.95	7.84	-0.55
Grain Soybean + Corn	3.48	2.23	5.71	39.1	1.23	8.9	0.51

In 2019, the corn production was much better. It was believed that this would also lead to better intercropping performance. Yet, field peas had a large impact on corn biomass production (Table 2). The corn plants were shorter for much of the year which had a cascade of effects. First, the stunted corn did not yield as well, but it also created more lanes for sunlight which in turn created a more robust field pea crop. Normally this would be an advantage, but the conditions this year were favorable for lodging, and the majority of the field peas were not harvestable with silage equipment. It is estimated that only 25% of the field pea biomass was harvested. It is possible that enough field pea biomass remained in the field to offset the corn yield reductions. In 2018 the corn yields were reduced 32% with field peas, but in 2019 the reduction was only 23%. Capturing this lodged biomass likely would have created a positive LER. Reducing the nitrogen rate in the future would likely counter lodging potential but it could also negatively impact corn silage. Soybean production had minimal impact on corn yields, however the corn was too robust in this mix. This created a poor environment for soybeans to contribute much seed production. The best advantage with soybeans was 5% more tons/ac compared to corn alone, achieved with the middle soybean population of 145K seeds/ac. For both soybeans and field peas, it appears that the lower populations were generally more favorable for the system.

Table 2. Corn silage paired with field peas or soybeans planted at different populations in 2019.

Treatment	Legume Population target pl/ac	Corn Stand pl/ac	Legume Stand pl/ac	Corn Ear Height cm	Corn Plant Height cm	Legume Height cm	Fresh Yield ton/ac	Total LER
Corn only	0	30,855	0	89.5	261.0	0	25.4	1.00
Field Pea	330,000	28,738	353,925	91.5	238.0	134.0	19.5	0.77
Field Pea	217,800	30,704	205,549	89.3	245.0	122.5	20.6	0.82
Field Pea	165,000	31,309	194,659	95.3	270.0	122.3	23.2	0.92
Soybean	220,000	29,494	157,905	94.5	274.0	96.0	25.2	1.00
Soybean	145,200	29,645	127,958	93.3	276.0	110.3	26.4	1.05
Soybean	110,000	29,645	81,675	96.8	265.0	95.5	26.3	1.04

Overall, these results were very meager or negative compared to 2018. This system still holds promise with further optimization. One of the assumptions was that the field peas would cling or climb on the corn plants. This did not happen. Choosing a different variety or using different management strategies could enhance the field pea production substantially. Field peas could also be planted after corn emergence to reduce the competition with corn. Using wider rows or lower corn plant populations, or planting the legume in the center between rows could all be options for creating more growth opportunity for the companion crops.

Northern-Hardy Fruit Evaluation Project: SWD Thrives in Warm, Moist Conditions

Kathy Wiederholt

In 2019, the Northern Hardy Fruit Evaluation Project at the Carrington Research Extension Center brought fruit-growing information to over 950 people. People accessed information through tours, meetings, video-conference programs and personal phone calls. In 14 years, we have reached approximately 13,300 constituents. This year, we responded to calls from North Dakota, Minnesota, Montana, South Dakota, Illinois and Idaho.

Fall 2018 was very dry and warm with temperatures in the 70s and 80s through mid-September. Plants were drip-irrigated to prepare them for winter. The first week of October saw a day of rain followed by 2-inches of snow and temperatures as low as 22ºF. It snowed again the following week with eastern areas of the state receiving nearly 20 inches. This was finally a 'test' winter with high temperatures averaging almost seven degrees below normal. At the end of January 2019, CREC recorded -35 and -40ºF. One pear cultivar and one black currant variety were injured by winter conditions and were removed from the project. Spring was cool and deficient in moisture. In summer, rainfall began to increase and by late October, the orchard precipitation was 6.2 inches ahead of average.

After a slow-warming spring, the growing season was 4.0ºF cooler than normal. Bloom and fruit development were slowed, however, spotted wing Drosophila (SWD) arrival was right on time. Warm, moist conditions in the middle part of the U.S. and North Dakota likely contributed to the onset of intense SWD fruit fly infestations. The three types of haskap and honeyberry we grow usually escape damage but this year, even the mid-season harvests were ruined. Most of the juneberry and all the cherry crops were lost despite pesticide applications. Early currant crops were damaged although later varieties were less bothered; there were fewer crops to inhabit, making hand-sprayed applications of pesticides more effective.

Notable events in the fruit orchard:

- Again, there was less bird depredation of early fruit but the reason was finally determined not to be drought, as surmised in 2018, but due to nesting Cooper's hawks.
- Older Canadian cherry shrubs were removed to decrease host fruit, but SWD was terrible this year. 'Juliet' cherry was ripe earlier than our previous early crop of 'Carmine Jewel' but was ruined before it was fully ripe.
- Mid- and late-season haskap harvest was hurried by SWD. Much of the later crop was picked in 'rescue' mode and was frozen but not weighed.
- Juneberry fruit was not ready for harvest until July 14. The crop was essentially lost by July 16 due to SWD. CREC students picked 56 pounds of a 400 to 500-pound crop. Volunteers and Field Day visitors probably brought the estimated harvest up to 250 pounds before the remainder was picked and destroyed.
- No irrigation was needed in 2019. The growing season was ended with plants in full leaf and apples not fully ripe when we received approximately 20-inches of snow October 10-12. Temperatures rebounded and melted the snow before freeze-up.

Northern Hardy Fruit Project - Yearly Production Records										
		No. of	**2016**		**2017**		**2018**		**2019**	
		plants	Date	pounds	Date	pounds	Date	pounds	Date	pounds
Aronia	Nero	4	9/3-6	54.5	9/12-13	12.6	9/10-11	105.8	17-Sep	19.4
	Raintree Seedling	4	2-Sep	52.1	x	x	12-Sep	70.3	18-Sep	11.8
	Raintree Select	4	6-Sep	60.0	9/13-19	7.4	8/31-9/5	94.2	13-Sep	23.0
	Viking	4	9/2-7	63.2	12-Sep	4.5	8/22-9/5	105.7	16-Sep	27.8
	McKenzie	4	7-Sep	42.0	11-Sep	5.1	8/28-30	78.0	16-Sep	37.0
	Galicjanka	4	6-Sep	3.6	5-Sep	1.0	27-Aug	29.0	13-Sep	23.9
				275.4		**30.6**		**483.0**		**142.9**
					Crop aborted		*Overcropped, fruit poor*		*Hail, SWD loss*	
Hardy Cherries	SK Carmine Jewel	12	13-Jul	93.1	19-Jul	306.4	12-Jul	loss	*Removed*	x
	SK Crimson Passion	12	13-Jul	32.2	20-Jul	129.3	13-Jul	loss	*Removed*	x
				125.3		**435.7**		**x**		**x**
			hail, SWD 70% loss				*All lost to SWD*		*CP: gummosis in all*	
	SK Romeo	3							31-Jul	11.5
	SK Not Romeo	1							19-Jul	8.2
	SK Juliet	5							17-Jul	46.2
										65.9
									All lost to SWD	
	Evans / Bali	2	19-Jul	**17.3**	8/1-2	loss	7/20	loss	30-Jul	**53.5**
			hail, SWD 70% loss		*SWD infested (all)*		*SWD infested (all)*		*Heavy pruning + SWD loss*	
Black Currant	*Black Down*	16	7/22-28	36.7	x	x	x	x	*Removed*	x
Old	*Titania*	15	25-Jul	20.1	x	x	18-Jul	2.6	*Removed*	x
Variety Trial	*Whistler*	3	7/27-28	53.0	x	x	7/31	6.3	19-Aug	18.1
				127.3		**0.0**		**8.9**		**18.1**
			hail, SWD ≥50% loss		*Pruned out bearing canes*		*Recovery year*			
Black Currant	*Blackcomb*	15	1-Aug	6.3	31-Jul	67.2	7-Aug	60.9	14-Aug	61.7
New	*Cheakamus*	15	28-Jul	6.7	28-Jul	79.7	31-Jul	79.8	7-Aug	63.9
Variety Trial	*Stikine*	15	1-Aug	0.1	26-Jul	115.4	7/18-24	52.2	7/31-8/5	58.1
	Tahsis	15	28-Jul	2.8	26-Jul	77.6	26-Jul	83.5	7/31-8/6	76.9
	Tiben	15	1-Aug	3.8	8-Aug	88.0	6-Aug	82.2	16-Aug	79.2
	Tofino	14	10-Aug	3.0	8/1-4	45.9	8-Aug	14.3	Removed	x
	Nechako - 2 ft space	7	15-Aug	2.5	11-Aug	21.5	9-Aug	12.7	20-Aug	14.4
	Nechako - 3 ft space	7	15-Aug	3.5	11-Aug	26.6	9-Aug	18.6	20-Aug	25.4
				28.7		**521.9**		**404.2**		**379.6**

Northern Hardy Fruit Project - Yearly Production Records										
		No. of plants	2016		2017		2018		2019	
			Date	pounds	Date	pounds	Date	pounds	Date	pounds
Black Currant	Ben Lomand	4	26-Jul	8.3	x	x	25-Jul	4.9	30-Jul	7.2
	Blackcomb	4	26-Jul	21.4	x	x	1-Aug	17.6	15-Aug	38.3
	Champion	4	26-Jul	6.7	x	x	25-Jul	11.5	30-Jul	9.6
	Minaj Smyriou	4	26-Jul	3.2	x	x	18-Jul	5.5	x	*SWD loss*
				39.6		**0.0**		**39.5**		**55.1**
			hail, SWD ≥50% loss		*Pruned out bearing canes*		*Recovery year*		*SWD losses*	
Red Currant	Jhonkheer Van Tets	4	21-Jul	42.9	21-Jul	46.1	25-Jul	3.2	24-Jul	39.5
	Red Lake	4	x	x	21-Jul	18.4	removed	removed		
	Redstart	4	x	x	x	x	*SWD*	x	*Removed*	x
	Rosetta	4	26-Jul	20.9	3-Aug	70.5	*SWD*	x	2-Aug	37.8
	Rovada	4	27-Jul	52.3	31-Jul	83.6	7/25-8/1	12.4	1-Aug	56.3
				116.1		**218.6**		**15.6**		**133.4**
			SWD loss				*Pruned for Borer 2018*		*SWD losses*	
White Currant	Blanka	4	22-Jul	15.0	x	x	x	x	x	x
	Swedish White	4	21-Jul	20.5	x	x	x	x	x	x
				35.5		**0.0**		**0.0**		**0.0**
			SWD loss		*Removed plants 2017*		*Removed plants 2017*		*Removed plants 2017*	
Ore. Honeyberry	22-37	2	1-Jul	5.8	*did not pick*	x	6/26-28	5.9	12-Jul	NA
	41-100	1	30-Jun	3.0	*did not pick*	x	7-Jul	x	12-Jul	NA
	43-87	2	30-Jun	1.2	*did not pick*	x	6/22-28	7.9	12-Jul	NA
	43-97	2	5-Jul	3.6	*did not pick*	x	28-Jun	x	12-Jul	NA
	45-57	1	5-Jul	1.2	*did not pick*	x	28-Jun	4.1	12-Jul	NA
	85-26	2	5-Jul	8.8	*did not pick*	x	7/2-5	3.2	12-Jul	NA
	20-04	3	30-Jun	3.8	7-Jul	12.8	26-Jun	3.2	*Fruit fell early*	x
	21-20	3	6-Jul	1.9	12-Jul	4.3	2-Jul	5.9	12-Jul	NA
	22-14	3	6-Jul	2.8	7-Jul	8.2	28-Jun	6.5	10-Jul	4.8
	22-26	3	6-Jul	3.4	7-Jul	12.0	26-Jun	8.9	12-Jul	NA
	41-75	3	6-Jul	3.7	7/4-6	15.7	6/27-7/2	15.8	8-Jul	10.3
	44-19	3	6-Jul	2.2	12-Jul	9.4	2-Jul	7.1	12-Jul	NA
	57-49	3	6-Jul	4.6	11-Jul	13.0	2-Jul	10.1	10-Jul	21.8
	88-92	3	30-Jun	2.0	4-Jul	6.3	27-Jun	6.2	8-Jul	5.8
	88-102	2	30-Jun	0.9	4-Jul	5.8	26-Jun	4.7	5-Jul	12.9
	108-23	3	30-Jun	4.8	7/6-7	17.0	26-Jun	8.9	5-Jul	18.0
	131-08	3	6-Jul	2.8	12-Jul	10.8	5-Jul	8.7	12-Jul	NA
	142-30	3	6-Jul	1.9	10-Jul	6.8	28-Jun	5.7	10-Jul	9.5
	78-89	2			7-Jul	0.8	5-Jul	3.5	10-Jul	4.7
				58.4		**122.9**		**116.3**		**87.8**
					Excellent Bbee popl.				*NA: quick pick, SWD*	
Rus. Honeyberry	Berry Blue	4	21-Jun	12.4	28-Jun	23.6	*did not pick*	x	*did not pick*	x
	Blue Belle	4	13-Jun	10.1	19-Jun	21.8	*did not pick*	x	*did not pick*	x
	Kamchatka	4	15-Jun	9.2	*did not pick*	x	*did not pick*	x	*did not pick*	x
				39.5		**45.4**		**0.0**		**0.0**
					Excellent Bbee popl.				*Left for birds*	
Haskaps	Borealis	2	30-Jun	0.7	26-Jun	9.6	22-Jun	0.2	*did not pick*	x
- Canadian	Tundra	3	27-Jun	2.8	27-Jun	17.7	21-Jun	4.8	*did not pick*	x
	Indigo Gem (9-15)	5	22-Jun	12.4	27-Jun	20.9	21-Jun	3.6	*did not pick*	x
	Indigo Treat (9-91)	2	27-Jun	0.5	29-Jun	6.9	21-Jun	3.7	*did not pick*	x
	Aurora	1					2-Jul	0.3	*did not pick*	x
				16.4		**55.1**		**12.6**		**0.0**
			Reduced plant numbers		*Excellent Bbee popl.*				*Left for birds*	
Juneberry	Honeywood	20	7/9-12	144.6	7/10-11	166.2	7/10	68.3	15-Jul	*apx.* 14.0
Variety Trial	JB30	20	7/6-7	174.3	7/5-7	133.4	7/5-9	60.8	15-Jul	*apx.* 14.0
	Martin	20	7/5-7	131.4	7/5-6	101.0	7/5-9	68.6	15-Jul	*apx.* 14.0
	Smoky	20	7/8-12	147.3	7/13-14	154.1	7/11-12	115.9	x	
	Thiessen	20	7/5-8	164.9	7/5-6	142.2	7/6-9	60.0	15-Jul	*apx.* 14.0
				762.5		**696.9**		**373.6**		***Est 4-500 lbs***
			Some SWD after 7/8				*Only 2 of 4 rows picked*		*SWD b4 Field Day. Lost*	
The Project was planted in 2007, except Juneberries 2006.										

Effects of Pen Cleaning on Feedlot Performance and Carcass Characteristics of Beef Steers Fed during the Winter in the Northern Great Plains

Bryan W. Neville and Rebecca L. Moore

The objective of this study was to determine the effects of winter pen cleaning methods on feedlot performance and carcass characteristics of steers. Pen cleaning treatments did not influence animal performance within the conditions of this study. However, marbling score and quality grade of carcasses tended to be greater with increasing amounts of pen cleaning. The relationship between pen space and pen cleaning requires further research to determine their combined influences on animal performance.

Summary

Our hypothesis was that pen cleaning during the winter would improve animal performance and carcass characteristics of steers fed in the northern Great Plains. This study utilized 156 steer calves. Calves were assigned randomly to one of 12 pens, with pen randomly assigned to treatment. Treatments consisted of 1) Control - no cleaning, 2) Full - entirety of the pen cleaned twice throughout the study and 3) Apron - bunk aprons (approximately 10 feet) behind the bunk cleaned twice throughout the study. Calf weights were collected twice, prior to the start of study and prior to slaughter. Calves were fed for 195 days prior to reaching market readiness. Following slaughter, carcass data were collected. Our results are contrary to our hypothesis because pen cleaning resulted in no differences ($P \geq 0.48$) in body weight, average daily gain (ADG), dry-matter intake (DMI) or feed efficiency in the current study. Hot carcass weight, ribeye area, back fat and yield grade of carcass also were not affected ($P \geq 0.44$; Table 2) by pen cleaning treatment. We observed a tendency ($P = 0.09$) for greater marbling score and quality grade in carcasses resulting from steers managed with more thorough pen cleaning strategies. That pen cleaning did not improve animal performance was unexpected. It is possible that the light stocking density of pens or the ample bedding supplied negated the anticipated differences.

Introduction

The purpose of this study was to evaluate the efficacy of pen cleaning as a method to improve livestock performance of beef cattle fed to finish during the winter months in the northern Great Plains. Previous research with bedding frequency (Anderson et al., 2007) has demonstrated factors related to environment can improve animal performance.

Observing greater performance with pen cleaning as a result of reduced energy expenditure to maintain body temperature or by decreasing the energy expenditure associated with movement is logical. Secondary benefits to removing manure, mud and snow across the entirety of a drylot pen would be captured through decreased maintenance of pen surfaces.

The removal of manure buildup directly behind the bunk line, allowing cattle easier access to feed, is a less labor-intensive cleaning method. Both pen cleaning methods have positive attributes, but no research has directly compared the extent of pen cleaning (cleaning bunk apron only vs. cleaning full pens) on animal performance. The objective of this project was to evaluate pen cleaning method on feedlot performance and carcass characteristics of steers fed in a drylot during the winter in the northern Great Plains.

Experimental Procedures

This study was approved by the North Dakota State University Institutional Animal Care and Use Committee prior to initiation of study procedures. To accomplish our research objective, 156 beef steers (626.2 ± 30.28 pounds) were assigned to one of 12 pens (n = four per treatment).

Thirteen steers initially were placed into each pen. Pens were stocked at a similar density with approximately 290 square feet of pen space per animal. Treatment was assigned randomly to pen and

consisted of: 1) Control - no cleaning, 2) Full - entirety of the pen cleaned twice throughout the study and 3) Apron - bunk aprons (approximately 10 feet) behind the bunk cleaned twice throughout the study.

Pens or aprons were cleaned on approximately 56-day intervals from the start of the study. Throughout the study, cattle were provided fresh bedding weekly, with an estimated 5.5 pounds/head/day of straw used during the course of the study.

Upon arrival, cattle were acclimated to pens. Weights were collected on two consecutive days and calves were sorted into pens. All calves received a growth promotant implant (Synovex S, Zoetis Inc., Parsippany-Troy Hills, N.J.) at the initiation of the study and were re-implanted 56 days later with Synovex Plus (Zoetis Inc., Parsippany-Troy Hills, N.J.).

Rations were developed to adapt cattle from a moderate-roughage diet to a high-concentrate diet. The final finishing ration consisted of 57.7% corn, 23.5% modified distillers grains with solubles (mDGS), 5% straw, 11% silage, 1.3% calcium carbonate and 1.5% supplement (dry-matter basis). Steers were fed for a total of 195 days. Feed was provided to target clean bunks the following morning prior to feeding.

At the conclusion of the feeding period, cattle were weighed on two consecutive days and shipped to a commercial abattoir for slaughter and subsequent carcass data collection. Data were analyzed with the mixed procedures of SAS (SAS Ins. Inc., Cary, N.C.). All data were analyzed, with pen serving as the experimental unit. Significance was declared at $P \leq 0.05$.

Results and Discussion

We found no influence ($P \geq 0.48$; Table 1) of pen cleaning on initial body weight (BW), final BW or ADG. Likewise, dry-matter intake and feed efficiency were similar ($P \geq 0.55$) across treatment. Hot carcass weight, ribeye area, back fat and yield grade of carcass also were not affected ($P \geq 0.44$; Table 2) by pen cleaning treatment. We observed a tendency ($P = 0.09$) for greater marbling score and quality grade in carcasses resulting from steers managed with more thorough pen cleaning strategies.

Table 1. Impacts of pen cleaning on feedlot performance of steers fed during the winter in the northern Great Plains.

	Treatment[1]				
	Control	Apron	Full	SEM	P-value
Initial BW, lb.	627.8	625.2	625.6	30.28	0.99
Final BW, lb.	1,392.7	1,370.7	1,391.7	26.59	0.81
ADG, lb/day	3.93	3.83	3.93	0.065	0.48
DMI, lb/day	23.2	23.4	23.3	0.53	0.94
G:F	0.170	0.163	0.169	0.004	0.55

[1] Treatments: Control = Pens that were not cleaned, Apron = bunk aprons cleaned twice throughout the study, Full = entire pen cleaned twice throughout the study.

Table 2. Impacts of pen cleaning on carcass characteristics of steers fed during the winter in the northern Great Plains.

	Treatment[1]				
	Control	Apron	Full	SEM	P-value
HCW, lb.	838.4	830.2	844.7	15.48	0.81
Ribeye area, inch^2	13.2	13.1	13.1	0.28	0.97
Back fat, inch	0.50	0.46	0.50	0.025	0.44
Marbling score[2]	444	463	484	11.1	0.09
Quality grade[3]	9.9	10.2	10.4	0.13	0.09
Yield grade	3.1	3.0	3.1	0.10	0.46

[1] Treatments: Control = Pens that were not cleaned, Apron = bunk aprons cleaned twice throughout the study, Full = entire pen cleaned twice throughout the study.
[2] Marbling score based on 400 = Small^{00}.
[3] Quality grade based on Low Choice (Ch$^-$) = 10, High Prime (Pr$^+$) = 15.

The data presented in the current study are largely contrary to our hypothesis. The reason for the lack of feedlot performance differences in steers could be attributed to lack of separation of pen conditions, to the relatively light stocking density of pens, or to the adequate bedding provided to all pens. Any of these factors could have resulted in pen conditions that negated the possible impacts of the treatments imposed.

Previous research at the Carrington Research Extension Center has demonstrated that pen management can influence animal performance. Average daily gains of steers were improved by 0.86 pound/day by providing bedding, when compared with cattle not provided bedding (Anderson et al., 2007). This improvement is likely due to reduced energy expenditure to maintain body temperature. Previous research evaluating mud depth, bedding and temperature has demonstrated significant effects to livestock performance and economic returns (Mader, 2011). Cleaning frequency has been evaluated (Wilson et al., 2004); unfortunately this research was not able to determine effects on animal performance. Pen maintenance, especially pen cleaning, may decrease the energy expenditures associated with movement, reduce environmental stress, and subsequently improve overall gain and performance.

Future research evaluating stocking density of pens and cleaning regimens may lead to better understanding of the benefits of pen cleaning. Specifically, research evaluating at what point animal space dictates that producers place greater attention on pen cleaning to avoid decreases in performance would be helpful for livestock producers. Additionally, continued research through time would prove beneficial because the differences in weather within a given year can influence cattle performance strongly.

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Impacts of Inclusion of either 25 or 50% Modified Distillers Grains (DM Basis) in Feedlot Rations on Ruminal Hydrogen Sulfide Concentration and Blood Oxygen Concentration in Steers

Bryan Neville, Rebecca Moore, Cierrah Kassetas, and Leslie Lekatz

Introduction

Sulfur induced polioencephalomalacia (PEM) has been an ongoing issue with the use of greater concentrations of distillers grains in feedlot rations. Research, for the most part, has been unable to understand the correlation between sulfur in distiller's grains and the incidence rate of PEM in feedlots. Research on hydrogen sulfide outside of ruminant nutrition has also led to a better understanding of hydrogen sulfide at a molecular level. Hydrogen sulfide has been reported to interfere with oxygen transport in blood (Guidotti, 2010). This leads us to the research question of what impact does hydrogen sulfide resulting from feeding rations containing distiller's grains have on oxygen transport in the ruminant animal. One way to measure this type of response is through blood gas profiles. The evaluation of blood gas profiles in beef cattle fed high sulfur diets has not previously been evaluated.

The hypothesis of this project was that bunk management will impact hydrogen sulfide gas concentrations and blood gas profiles in steers, with steers fed greater concentration of distiller's grains having a more pronounced effect. Our secondary hypothesis was that feeding greater concentrations of distillers grains will have minimal impacts on animal performance while bunk management strategy will alter feed efficiency. Our objectives were: 1) to evaluate the impacts of feeding either 25 or 50% distillers grains under two bunk management methods on animal performance and carcass characteristics, and 2) evaluate the impacts of feeding either 25 of 50% distillers grains under two bunk management methods on hydrogen sulfide gas concentrations in the rumen.

Materials and Methods

Steers originating from the North Dakota Angus University and Central Grasslands REC were utilized to evaluate the objectives of this study. Beef steers (32 hd) were stratified by weight, assigned to pen with pens randomly assigned to treatment. Treatments were arranged in a 2 x 2 factorial and included either 25% or 50% distillers grains and managed under one of two bunk management systems: 1) Control: bunks managed to be devoid of feed one hour prior to feeding, and 2) Long: bunks managed to still have approximately 1" of feed remaining at the time of new feed delivery. Adaptation was accomplished by making a series of five transition diets changed weekly until reaching the final finishing ration on day 28. All diets were supplemented with 100 mg of thiamin per head per day to assist in the prevention of polioencephalomalacia.

Ruminal hydrogen sulfide gas concentrations were collected on two steers from each of four pens per treatment, with the average score of the pen used for data analysis. Ruminal hydrogen sulfide was collected on days: 0, 7, 14, 21, 28, and 35 with collections occurring four hours after feeding. Procedures for sampling rumen hydrogen sulfide were previously outlined by Gould et al. (1997) and modified by Neville et al. (2010, 2012). Arterial blood samples were used for evaluation of blood gas profile including but not limited to pH, oxygen pressure, carbon dioxide pressure, and bicarbonate levels using an I-STAT machine and appropriate cartridges.

Results and Discussion

The bunk management strategies imposed in this study did not impact hydrogen sulfide concentrations or blood oxygen saturation ($P = 0.82$). Therefore, bunk management was removed from statistical models and only the effects associated with mDGS inclusion are being presented. As anticipated, the concentration of ruminal hydrogen sulfide increased throughout adaptation ($P < 0.001$, Figure 1). Further, including 50% mDGS increased ruminal hydrogen sulfide compared to those fed 25% mDGS. Previous research has shown that level of roughage and source of sulfur in the diet can impact the concentration of hydrogen sulfide in the rumen (Drewnoski et al., 2014). Previous research has also demonstrated that hydrogen sulfide concentrations can be influenced by bunk management during

adaptation (Lekatz and Neville, 2019). However, the inclusion rate of mDGS in the diets utilized by Lekatz and Neville (2019), were relatively low (25% mDGS, DM basis). In the present study, there is not a definite reason why bunk management did not impact ruminal hydrogen sulfide; however, initial evaluations of dry matter intake seem to indicate that the same degree of separation in intake were not achieved when comparing the current project and the data of Lekatz and Neville, 2019. Research in lambs (Neville et al., 2011) and steers (Neville et al., 2012) has utilized greater percentages of distillers grains in feedlot rations, which resulted in increasing concentration of dietary sulfur and hydrogen sulfide.

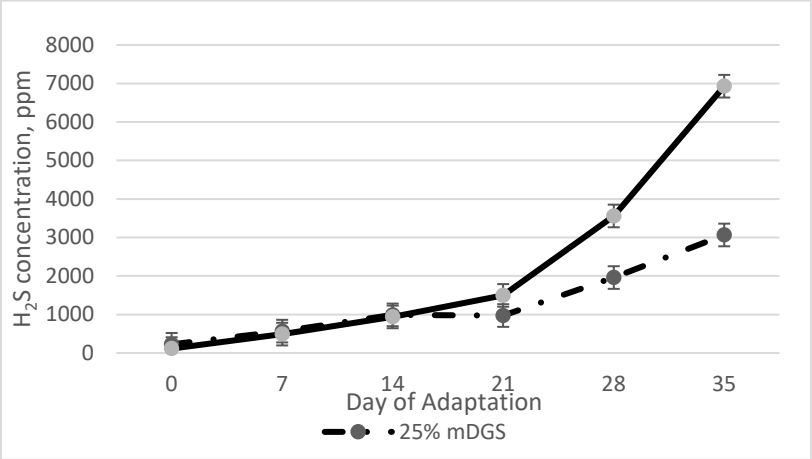

Figure 1. Concentration of ruminal hydrogen sulfide gas in steers fed either 25% or 50% mDGS (DM basis) during adaptation to finishing rations. P-values: Day (P < 0.001), mDGS inclusion (P < 0.001), Day x mDGS (P < 0.001).

Blood oxygen saturation was influenced by day of sampling (P = 0.01, Figure 2). The blood oxygen saturation of steers fed 50% mDGS tended to be greater than that of steers fed 25% mDGS. This is opposite of our hypothesis and is interesting given that hydrogen sulfide exposure has been shown to decrease blood oxygen binding (Guidotti, 2010). Certainly, this fact leads to some questioning the role of hydrogen sulfide in toxicity in ruminants fed high-sulfur diets. However, before any final determinations are made other research needs to be conducted to validate results observed in this study.

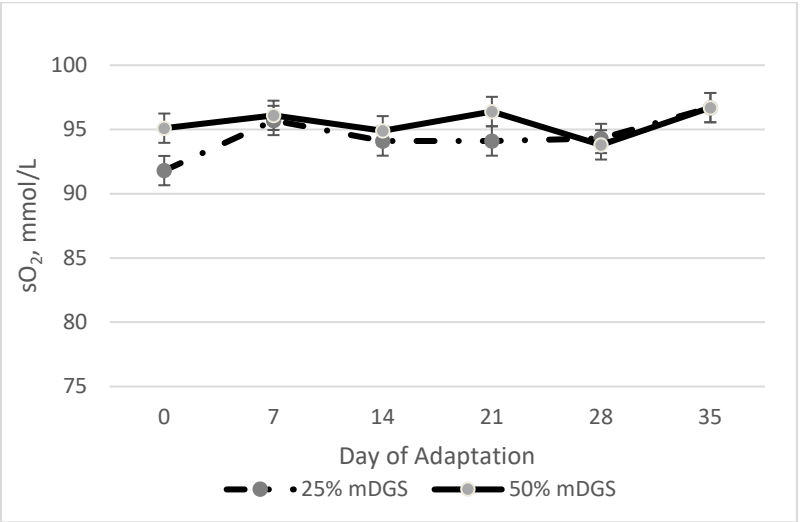

Figure 2. Blood oxygen saturation in steers fed either 25% or 50% mDGS (DM basis) during adaptation to finishing rations. P-values: Day (P = 0.01), mDGS inclusion (P = 0.07), Day x mDGS (P = 0.034).

Conclusions

It is probable that insufficient separation in dry matter intake occurred between the two bunk management systems to result in a difference in rumen fermentation and thus ruminal hydrogen sulfide. The increased ruminal hydrogen sulfide concentrations observed in steers fed 50% mDGS was expected. There appears to be no relationship between ruminal hydrogen sulfide concentration and arterial blood oxygen saturation. Further research evaluating the impacts of hydrogen sulfide concentration, and the mechanism by which ruminal hydrogen sulfide enters the blood are needed. This additional information may allow for more definitive answers which define the relationship between dietary sulfur, ruminal hydrogen sulfide, changes in oxygen saturation, and polioencephalomalacia.

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This research was partially funded by the North Dakota Corn Utilization Council and the North Dakota State Board of Agriculture Research and Education (SBARE).

Dakota Feeder Calf Show 2018-2019 - Discovering Value in North Dakota Calves

Karl Hoppe

Superior growth and carcass characteristics of North Dakota calves are identified with producers participating in the Dakota Feeder Calf Show. The difference in profitability between consignments from the top five herds and the bottom five herds was $169.47 per head for the 2018-2019 feeding period.

The Dakota Feeder Calf Show was developed for cattle producers willing to consign steer calves to a show and feedout project. By determining calf value in a feedout program, cow-calf producers can identify superior genetics when fed with common feedlot management.

The calves were received in groups of three or four on Oct. 20, 2018, at the Turtle Lake Weighing Station, Turtle Lake, N.D., for weighing, tagging, veterinary processing and showing. The calves were evaluated for conformation and uniformity, with the judges providing a discussion to the owners at the beginning of the feedout. The number of cattle consigned was 129, of which 110 competed in the pen-of-three contest.

The calves were shipped to the Carrington Research Extension Center, Carrington, N.D., for feeding. Prior to shipment, calves were vaccinated, implanted with Synovex-S, dewormed and injected with a prophylactic long-acting antibiotic.

Calves were sorted and placed on corn-based receiving diets. After an eight-week backgrounding period, the calves were transitioned to a 0.62 megacalorie of net energy for gain (Mcal NEg) per pound

finishing diet. Cattle were weighed every 28 days, and updated performance reports were provided to the owners. Cattle were re-implanted with Synovex-Plus.
An open house was held on Feb. 1, 2019, at the Carrington Research Extension Center Livestock Unit, where the owners reviewed the calves and discussed marketing conditions.

The cattle were harvested on May 22, 2019 (125 head). The cattle were sold to Tyson Fresh Meats, Dakota City, Neb., on a grid basis, with premiums and discounts based on carcass quality. Carcass data were collected after harvest.

Cattle consigned to the Dakota Feeder Calf Show feedout project averaged 604.88 pounds upon delivery to the Carrington Research Extension Center Livestock Unit on Oct. 20, 2018. After an average 212-day feeding period, cattle averaged 1,325.4 pounds (at plant, shrunk weight). Death loss was 2.33 percent (three head) during the feeding period.

Average daily feed intake per head was 36.2 pounds on an as-fed basis and 23.9 pounds on a dry-matter basis. Pounds of feed required per pound of gain were 11.1 on an as-fed basis and 7.35 pounds on a dry-matter basis.

The overall feed cost per pound of gain was $0.487. The overall yardage cost per pound of gain was $0.106. The combined cost per pound of gain, including feed, yardage, veterinary, trucking and other expenses except interest, was $0.746.

Calves were priced by weight upon delivery to the feedlot. The pricing equation ($ per 100 pounds = (-0.058517799* initial calf weight, pounds) + 198.6623157) was determined by regression analysis on local livestock auction prices reported for the weeks before and after delivery.

Overall, the carcasses contained U.S. Department of Agriculture Quality Grades at 2.4 percent Prime, 67.2 percent Choice (including 13.6 percent Certified Angus Beef), 28.0 percent Select, 0.8 percent Standard and 1.6 percent other, and USDA Yield Grades at 9.6 percent YG1, 44.0 percent YG2, 41.6 percent YG3, 4.8 percent YG4 and 0 percent YG5.

Carcass value per 100 pounds (cwt) was calculated using the actual base carcass price plus premiums and discounts for each carcass. The grid price received for May 22, 2019, was $189.05 Choice YG3 base with premiums: Prime $15, CAB $6, YG1 $6.50 and YG2 $3, and discounts: Select minus $13, Standard (no roll) minus $15, YG4 minus $6, and defect carcasses (blood splash or dark cutter) minus $55.

Results from the calves selected for the pen-of-three competition are listed in Table 1.

Overall, the pen-of-three calves averaged 409 days of age and 1,333.3 pounds per head at harvest. The overall pen-of-three feedlot average daily gain was 3.42 pounds, while weight gain per day of age was 3.27 pounds. The overall pen-of-three marbling score was 459.3 (low choice, small marbling).

The top-profit pen-of-three calves with superior genetics returned $167.46 per head, while the bottom pen-of-three calves returned $-199.23 per head. The average of the five top-scoring pens of steers averaged $142.46 per head, while the average of the bottom five scoring pens of steers averaged $-27.01 per head.

For the pen-of-three competition, average profit was $69.45 per head. The spread in profitability between the top and bottom five herds was $169.47 per head.

Calf value is improved with superior carcass and feedlot performance. Exceptional average daily gains, weight per day of age, harvest weight and marbling score can be found in North Dakota beef herds.

Feedout projects provide a source of information for cattle producers to learn about feedlot performance and individual animal differences, and discover cattle value.

Table 1. Feeding performance - 2018-2019 Dakota Feeder Calf Show Feedout.

	Average Birth Date	Average Weight per Day of Age, lbs.	Average Harvest Weight, lbs.	Average Daily Gain, lbs.	Average Marbling Score (1)	Ave Calculated Yield Grade	Ave Feeding Profit or Loss / Head
	21-Apr-18	3.347	1323.6	3.663	514.3	2.522	$ 137.82
	7-Apr-18	3.520	1436.0	3.784	539.7	3.192	$ 165.46
	31-Mar-18	3.337	1385.8	3.564	606.0	3.443	$ 139.21
	25-Mar-18	3.210	1354.7	3.645	458.0	2.648	$ 139.98
	15-Mar-18	3.400	1465.5	3.954	475.7	3.108	$ 129.82
Average Top 5 herds	1-Apr-18	3.363	1393.106	3.722	518.733	2.983	$ 142.46
	19-Apr-18	3.546	1406.5	3.622	422.0	2.380	$ 107.27
	4-Mar-18	3.141	1391.4	3.645	486.7	3.068	$ 142.02
	6-Apr-18	3.374	1379.4	3.730	452.0	2.959	$ 148.65
	16-Apr-18	3.297	1316.4	3.418	524.0	2.978	$ 101.59
	25-Apr-18	3.567	1391.4	3.856	491.7	3.534	$ 158.64
	7-Apr-18	3.269	1334.0	3.125	549.3	3.019	$ 105.44
	27-Mar-18	3.348	1404.9	3.575	531.7	3.763	$ 166.13
	26-Mar-18	3.328	1400.1	3.475	493.3	3.429	$ 153.29
	2-Mar-18	3.147	1392.9	3.558	480.0	3.593	$ 110.73
	13-Apr-18	3.469	1396.1	3.550	437.7	3.179	$ 86.15
	21-Mar-18	3.080	1307.7	3.432	536.0	3.872	$ 102.41
	6-Apr-18	3.489	1425.6	3.634	378.0	2.796	$ 59.42
	6-Apr-18	3.102	1271.8	3.296	387.3	2.095	$ (24.77)
	21-Apr-18	3.310	1303.7	3.116	592.3	3.986	$ 81.53
	8-Apr-18	2.735	1115.6	3.031	358.3	1.943	$ 15.12
	16-Mar-18	3.052	1313.3	3.176	444.7	2.766	$ 10.53
	25-Mar-18	3.277	1379.4	3.479	404.7	3.153	$ 63.55
	27-Apr-18	3.289	1279.8	3.074	507.3	3.432	$ 44.06
	8-Apr-18	3.097	1261.5	2.965	476.3	2.949	$ 10.29
	6-Jun-18	3.362	1173.0	3.128	332.7	2.019	$ (29.75)
	17-Apr-18	3.508	1398.5	3.373	413.0	2.794	$ (36.46)
	24-Apr-18	3.480	1361.9	3.600	381.7	2.799	$ (48.32)
	30-Apr-18	3.182	1227.2	3.242	473.0	3.795	$ 52.69
	20-Mar-18	2.899	1236.0	3.103	337.7	2.745	$ (21.97)
	20-Apr-18	3.028	1197.4	3.079	360.0	2.262	$ (199.23)
	1-Apr-18	3.150	1304.1	3.188	393.5	3.489	$ 81.78
Average bottom 5 herds	13-Apr-18	3.148	1265.3	3.242	389.2	3.018	$ (27.01)
Overall average - pens of three	7-Apr-18	3.269	1333.4	3.422	459.3	3.023	69.45
Standard deviation	18.9	0.2	82.8	0.3	72.8	0.5	82.8
number	31	31	31	31	31	31	31

(1) Marbling score 300-399 = select, 400-499 = low choice, 500-599 = average choice, 600-699 = high choice, 700-799 = low prime

Weed Arboretum – A Popular Weed Identification Tool in 2019

Greg Endres

The CREC's weed arboretum, a living exhibit of North Dakota weeds, was utilized throughout the 2019 crop season to assist crop advisers and farmers with identifying weeds. The exhibit was a major attraction and tool this past year as it contained most North Dakota pigweed species including Palmer amaranth and waterhemp. For most visitors, this was the first time they were able to view a live Palmer amaranth plant.

The weed arboretum was used for seven training sessions during 2019 that reached a total of 200 people:

1. ND Weed Control Association sprayer clinic (May 28)
2. CREC Advisory Board meeting (June 11)
3. NDSU Extension Crop Management Field School (June 19)
4. Pioneer staff training (June 26)
5. CREC Field Day (July 16)
6. Bismarck State College and ND School of Science ag student field lab (July 18)
7. NDSU Extension sunflower field survey training (August 29)

Participants in the various events were able to view about 60 weeds in the weed arboretum and receive tips on plant identification as well as information on biology and management. NDSU Extension specialists providing the training included Greg Endres, CREC agronomist; Joe Ikley, weed specialist; and Leslie Lubenow, Langdon REC agronomist.

Joe Ikley discussing Palmer amaranth during Field Day.

Crop Production Field Training for Crop Advisers

Greg Endres

The Carrington Research Extension Center (CREC) has a long history of devoting resources to provide agronomy training to crop advisers as part of its educational mission. During the 2019 crop season, two major programs were conducted at the CREC to provide 'hands-on' training using field demonstration exhibits and research trials.

Crop management field school

The field school was conducted on June 19 with over 50 participants, primarily crop advisers from industry and extension agents. There were five educational sessions: weed identification, herbicide site-of-action, herbicide-tolerant soybean traits, late-season small grain disease management, improving soil productivity and weed management. Instructors were NDSU Extension crop specialists and a research agronomist. Plant exhibits and field trials were used for 'hands-on' training. Participants received information that could be immediately used during the balance of this crop season and future seasons. Over 90 percent of participants completing a written evaluation indicated good to excellent usefulness of sessions.

Small grain disease management session conducted by Andrew Friskop, Extension plant pathologist.

Crop field labs for college ag students

Field labs were conducted on July 18 for 35 agricultural students from Bismarck State College and ND State College of Science (Wahpeton). Subjects included alternative crops and crop diversification, weed identification, crop staging and management (alfalfa, corn, soybean, sunflower and wheat), and cropping systems (crop sequences, tillage, N management and cover crops). Instructors were CREC Extension and research agronomists. The field training was used to enhance the students' classroom learning experiences. Seventy-seven to 93 percent of students completing a written evaluation indicated good to excellent usefulness of sessions.

Ag student crop staging and management sessions.

Weather Summary

Monthly Temperatures (°F) and Normals

	Max Temp				Min Temp				Monthly Avg. Temp			
Month	2019	Norm*	2018	2017	2019	Norm*	2018	2017	2019	Norm*	2018	2017
Apr	51	55	44	54	31	31	23	31	41	37	33	43
May	63	68	75	69	38	43	46	41	50	54	61	55
June	77	76	79	77	53	53	57	52	65	63	68	65
July	80	82	81	83	58	58	56	58	69	65	68	71
Aug	75	81	81	77	53	55	52	52	64	65	67	64
Sept	68	71	67	70	48	45	42	46	58	58	55	58
Avgs:	69	72	71	72	47	47	48	47	58	57	59	59

*Normals = 1981-2010 averages

Monthly Precipitation (in) and Normals

	2019 Monthly Precipitation*				
Month	NDAWN	NOAA	Normal[1]	2018	2017
Apr	0.92	1.35	1.17	0.06	1.43
May	1.46	1.67	2.76	1.28	0.94
June	3.00	2.41	3.77	4.63	3.62
July	3.64	5.11	3.39	2.65	1.13
Aug	3.08	3.54	2.31	0.24	3.45
Sept	8.26	9.25	1.91	0.75	2.68
Totals:	20.36	23.33	15.31	9.61	13.26

[1] Normals = 1981-2010 averages * NDAWN and NOAA are two different weather stations at the CREC.

Monthly Growing Degree Days and Normals

	Wheat GDD				Sunflower GDD				Corn GDD			
Month	2019	Norm*	2018	2017	2019	Norm*	2018	2017	2019	Norm*	2018	2017
Apr	308	357	225	341	---	---	---	---	---	---	---	---
May	593	736	872	718	303	386	575	395	202	282	431	290
June	986	982	1085	976	630	626	725	619	458	448	544	447
July	1141	1182	1130	1198	769	810	758	826	585	624	573	625
Aug	980	1119	1070	1004	610	747	704	632	444	561	515	456
Sept	788	775	685	785	441	437	383	442	298	320	273	314
Totals	4796	5155	5026	5022	2753	3006	3145	2914	1987	2235	2336	2132

*Normals = 1981-2010 averages

Growing season GDD Totals, Normals, and Killing Frost Dates

Year	Frost Date	Corn Temp (°F)	Total GDD	Frost Date	Sunflower Temp (°F)	Total GDD
2017	Sept 29	31	2121	Oct 9	27	2740
2018	Sept 28	27	2336	Sept 28	27	3142
2019	*Oct 2	32	1987	**Oct 10	29	2637
*Normal Corn GDD for date =		2249		**Normal Sunflower GDD for date =		2876
Total corn GDD = May 1 to frost date				Total sunflower GDD = May 20 to frost date		

Normals=1981-2010 averages Source: NDAWN

Agronomic Research Trials

The following information is a listing of agronomic research conducted at the Carrington Research Extension Center. CREC and other NDSU research staff provide this list to illustrate specific research issues that are being addressed. The listing briefly describes the trial and indicates project collaborators who are working in cooperation with CREC agronomy team leaders. Results of this work may be made available at a later date by contacting the CREC.

Cover Crop

Corn: Corn silage intercropping - soybeans; *Ag Products Utilization Commission*
Corn: Corn silage intercropping replicated trial; *Ag Products Utilization Commission*
Cover crop demonstration, Dazey; *North Dakota Soybean Council*
Dry bean: Pinto bean with rye cover/companion; *Northarvest Bean Growers Assoc.*
Soybean: Rye seeding rate x date; *North Dakota Soybean Council*
Soybean: Soybean and winter rye water use; *North Dakota Soybean Council*
Soybean: Winter rye cover crop, Wishek; *North Dakota Soybean Council*
Wheat: Organic cover crop timimg - year 2; *General Mills*
Wheat: Organic legume interseeding - year 2; *General Mills*
Wheat: Wheat cover crop grazing experiment; *USDA NIFA Sustainable Agriculture Research and Education*
Wheat: Cover crop timing - year 2 test crop
Wheat: Legume interseeding year 1
Wheat: Legume interseeding year 2 test crop

Crop Fertility

Barley: Sulfur and nitrogen fertilization effects on barley yield and quality; *North Dakota Barley Council*
Barley: Sulfur and nitrogen fertilization effects on barley yield and quality, New Rockford; *North Dakota Barley Council*
Corn: Corn performance evaluation after intercropping
Corn: Effect of zinc application timing on corn yield; *Advansix*
Corn: Fertilizer evaluation trial; *North Dakota Corn Utilization Council*
Corn: In-season estimation of N requirment for corn using remote sensors; *Hellevang/Ewumbua (Ag and Biosystems Engineering)*
Corn: Phosphorus and zinc interaction effects on corn, Oakes; *North Dakota Corn Utilization Council*
Corn: Sulfur and nitrogen fertilization effect on dryland corn, Carrington; *North Dakota Corn Utilization Council*
Corn: Sulfur and nitrogen fertilization effect on dryland corn, Oakes; *North Dakota Corn Utilization Council*
Corn: Sulfur and nitrogen fertilization effect on irrigated corn, Carrington; *North Dakota Corn Utilization Council*
Corn: Sulfur and nitrogen fertilization effect on irrigated corn,Oakes; *North Dakota Corn Utilization Council*
Corn: Yield response of dryland corn to split N application at V8 and tasseling, Oakes; *North Dakota Corn Utilization Council*
Corn: Yield response of irrigated corn to split N application at V8 and tasseling; *North Dakota Corn Utilization Council*
Corn: Yield response of irrigated corn to split N application at V8 and tasseling, Oakes; *North Dakota Corn Utilization Council*
Dry bean: Evaluation of starter fertilizer sources and rates in pinto bean; *Northarvest Bean Growers Assoc.*
Soybean: Phosphorus fertilization of soybean at different planting dates, dryland
Soybean: Phosphorus fertilization of soybean at different planting dates, irrigated
Soybean: Phosphorus fertilization of soybean at different planting dates, Oakes
Soybean: Response to plant nutrition input, Wishek; *North Dakota Soybean Council*

Wheat: Predicting protein content of irrigated wheat using remote sensors
Wheat: Predicting protein content of wheat using sensors - dryland
Wheat: Phosphorus fertilization effect on four wheat varieties on dryland
Wheat: Phosphorus fertilization effect on four wheat varieties under irrigation
Wheat: Distiller's grain by-products as phosphorus sources for wheat

Crop Management
Alfalfa: Organic alfalfa establishment with oats as nurse crop/genetics and harvest timing; *General Mills*
Barley: Cropping systems experiment – rotation, tillage, and fertility
Barley: Optimizing barley quality across a pH and organic matter gradient; *SBARE/North Dakota Barley Council*
Corn: Cropping systems experiment – rotation, tillage, and fertility
Dry Bean: Dry bean performance adjacent to native pollinator habitat; *USDA Specialty Crop Block Grant*
Dry bean: Evaluation of row spacing and plant population in pinto bean; *Northarvest Bean Growers Assoc.*
Dry Bean: SHARE farm - tillage and soil health with pinto bean; *Wick (Soil Science)*
Field Pea: Cropping systems experiment – rotation, tillage, and fertility
Field Pea: Enhancing field pea protein through management factors; *USDA Specialty Crop Block Grant*
Field Pea: Organic seeding rate trial
Field Pea: Timing of POST nitrogen application for protein; *USDA Specialty Crop Block Grant*
Flax: Impact of harvest management on flax performance; *Ameriflax*
Misc: Chickpea and flax intercropping seeding rate x fungicide; *Jacobs (Williston REC)*
Misc: Effects of mycorrhizal depletion on corn after non-mycorrhizal crops (canola, beets and soybean)
Misc: Field pea and canola intercropping seeding rate x N; *Jacobs (Williston REC)*
Misc: Field pea and lentil tolerance to water logging - dryland; *Zhang (Plant Sciences)/SBARE*
Misc: Field pea and lentil tolerance to water logging - irrigated; *Zhang (Plant Sciences)/SBARE*
Oats: Organic intercropping with faba bean; *General Mills*
Oats: Organic intercropping with pea types and rates; *General Mills*
Soybean: Cropping systems experiment – rotation, tillage, and fertility
Soybean: Early planting date demonstration; *BASF*
Soybean: Evaluation of drying and storage methods of soybean grain; *North Dakota Soybean Council/Hellevang (Ag and Biosystems Engineering)*
Soybean: Response to defoliaton and foliar fungicide; *Berg (Towner County Extension)/North Dakota Soybean Council*
Soybean: Soybean and winter rye water use; *North Dakota Soybean Council*
Sunflower: Cropping systems experiment – rotation, tillage, and fertility
Sunflower: Row x planting rate demonstration; *Beutow (Dickinson REC)/National Sunflower Assoc.*
Wheat: Cropping systems experiment – rotation, tillage, and fertility
Wheat: Influence of seeding rate on lodging potential of wheat varieties
Winter Wheat: Cropping systems experiment – rotation, tillage, and fertility

Crop Quality
Misc: Hail insurance demo; *NAU Insurance*

Crop Rotation
Corn: Corn cover crop grazing experiment; *USDA NIFA Sustainable Agriculture Research and Education*

Entomology
Flax: Influence of pollinators on flax performance; *Knodel (Plant Pathology)*

Forage Production
Forages: Cool-season cereal forage variety trial; *McMullen (Plant Sciences)/Industry*

Forages: Corn silage intercropping with field peas
Forages: Cereal/pea forage variety trial; *Industry*
Forages: Forage/cover crop pea variety rial; *Industry*
Forages: Forage sorghum evaluation
Forages: Sorghum planting date study
Forages: Winter rye forage variety trial
Forages: Winter triticale forage trial; *Husker Genetics/Northern Seed*

Inoculants and Plant Health
Field Pea: Evaluation of granular inoculant with nodulation promoters; *Loveland*
Lentil: Lentil inoculant evaluation; *Loveland*
Lentil: Lentil special input trial; *Miller (Montana State Univ.)/Specialty Crop Research Initiative*

Product Evaluation
Barley: Foliar Badge for early season use in barley; *Gowan*
Canola: Evaluation of SymTRX as a multinutrient fertilizer in canola; *Anuvia*
Corn: Biological in-furrow products in corn; *Ag Concepts*
Corn: Formulation screening for biologicals; *Ag Concepts*
Corn: Inoculants in corn; *AgriTec*
Corn: Effect of zinc sources on corn yield; *Advansix*
Corn: Evaluation of Nanophos and Nanogro as P sources for corn; *Aqua-yield*
Corn: Italpollina foliar biologicals in corn; *Italpollina*
Corn: Italpollina in-furrow biologicals in corn; *Italpollina*
Lentil: Lentil seed treatment evaluation; *Miller (Montana State Univ.)/Speciality Crop Research Initiative*
Misc: Assessment of eNhance as a slow N release multinutrient fertilizer; *Agroliquid*
Soybean: Inoculants for soybeans; *AgriTec*
Soybean: Evaluation of biostimulants for enhanced soybean performance; *Afrikelp-USA*
Soybean: Evaluation of biostimulants for enhanced soybean performance (later planting); *Afrikelp-USA*
Soybean: Evaluation of Nanophos and Nanogro as P sources for soybean; *Aqua-yield*
Soybean: Italpollina foliar biologicals in soybeans; *Italpollina*
Sunflower: Evaluation of seed coating on stand establishment and yield in sunflower; *Germains*
Wheat: Effects of N extenders on wheat performance; *Koch Agronomic Services*
Wheat: Evaluation of N stabilizer sources on wheat; *Plant Response Biotech*
Wheat: Evaluation of SymTRX as a multinutrient fertilizer in wheat; *Anuvia*
Wheat: Foliar Badge for early season use in wheat; *Gowan*
Wheat: Indigo Ag biologicals - high fertility; *Indigo Ag*
Wheat: Indigo Ag biologicals - low fertitlity; *Indigo Ag*
Wheat: Indigo Ag biologicals - wet non-treated; *Indigo Ag*
Wheat: Indigo Ag biologicals - wet treated; *Indigo Ag*
Wheat: Special input broadcast treatments; *Loveland Products*
Wheat: NanoPro spray additive comparison; *Aqua-yield*
Wheat: Special input broadcast treatments; *West Central*
Wheat: Special input in-furrow treatments; *West Central*
Wheat: Evaluation of experimental fertility products on wheat; *Plant Response Biotech*
Winter Wheat: Evaluating seed treatments to reduce salt stress; *Indigo Ag*

Plant Pathology
Barley: Fungicide applications for disease control in barley
Barley: Fusarium head blight as influenced by variety and fungicide
Canola: Breeder's nursery for white mold resistance
Canola: Evaluation of seed treatment for Rhizoctonia; *BASF*
Canola: Evaluation of seed treatments for Pythium; *Syngenta*
Canola: Fungicide efficacy for white mold; *Gowan*
Chickpea: Alternatives to conventional fungicides for Aschochyta

Chickpea: Optimizing the deployment of tank mixes with chlorothalonil for management of Ascochyta blight in chickpeas; *North Dakota Crop Protection Product Harmonization Board/BASF/Syngenta*
Chickpea: Ascochyta - Impact of fungicide droplet size, teeJet nozzles; *Northern Pulse Growers/ North Dakota Crop Protection Product Harmonization Board*
Chickpea: Ascochyta - Impact of fungicide droplet size, Wilger nozzles; *Northern Pulse Growers/ North Dakota Crop Protection Product Harmonization Board*
Chickpea: Ascochyta - Impact of fungicide spray volume; *Northern Pulse Growers/ North Dakota Crop Protection Product Harmonization Board*
Chickpea: Ascochyta resistance screening nursery; *McPhee (Montana State Univ.)*
Chickpea: Efficacy of tank mixes with chlorothalonil for Ascochyta blight in chickpea; *Northern Pulse Growers/ North Dakota Crop Protection Product Harmonization Board*
Chickpea: Fungicide efficacy for Ascochyta blight in chickpea - Mountrail County; *Northern Pulse Growers/ North Dakota Crop Protection Product Harmonization Board*
Chickpea: Impact of spray droplet size; *Northern Pulse Growers/ North Dakota Crop Protection Product Harmonization Board*
Dry bean: Foliar fungicide evaluation for white mold; *BASF*
Dry bean: Fungicide efficacy for white mold; *BASF/Syngenta*
Dry bean: Fungicide efficacy for white mold; *Bayer CropSciences*
Dry bean: Fungicide efficacy for white mold; *Gowan*
Dry bean: Impact of adjuvants with Topsin for white mold control; *Northarvest Bean Growers Assoc./North Dakota Crop Protection Product Harmonization Board*
Dry bean: Impact of fungicide droplet size, TeeJet nozzles; *Northarvest Bean Growers Assoc. /North Dakota Crop Protection Product Harmonization Board*
Dry bean: Impact of fungicide droplet size, Wilger nozzles; *Northarvest Bean Growers Assoc. /North Dakota Crop Protection Product Harmonization Board*
Dry bean: Optimizing row spacing for improved agronomic performance under white mold pressure - Black Tail black beans; *USDA Specialty Crop Block Grant*
Dry bean: Optimizing row spacing for improved agronomic performance under white mold pressure - Eclipse black beans; *USDA Specialty Crop Block Grant*
Dry bean: Optimizing row spacing for improved agronomic performance under white mold pressure - kidney beans; *USDA Specialty Crop Block Grant*
Dry bean: Optimizing row spacing for improved agronomic performance under white mold pressure - Palomino pinto beans; *USDA Specialty Crop Block Grant*
Dry bean: Optimizing row spacing for improved agronomic performance under white mold pressure - Viberance pinto beans; *USDA Specialty Crop Block Grant*
Dry Bean: Optimizing row spacing for improved agronomic performance under white mold pressure - Oakes; *USDA Specialty Crop Block Grant*
Dry bean: Impact of rye cover crop on white mold - Carrington; *USDA Specialty Crop Block Grant*
Dry Bean: Impact of rye cover crop on white mold - Oakes; *USDA Specialty Crop Block Grant*
Dry bean: Seed treatment for root rot complex; *Albaugh*
Dry bean: Seed treatment with biostimulants for root rot complex; *McGregor & Co.*
Dry bean: Seed treatment with fungicides for root rot complex; *McGregor & Co.*
Dry bean: White mold variety screening - Nebraska; *USDA National Sclerotinia Initiative*
Dry bean: White mold variety screening; *Osorno/Romero (Plant Sciences)*
Dry bean: Seed treatment for Rhizoctonia root rot; *McGregor & Co.*
Dry bean: Seed treatment for Rhizoctonia root rot; *Albaugh*
Durum: Variety x fungicide; *US Wheat & Barley Scab Initiative*
Durum: USWBSI Uniform Fungicide Efficacy Trial; *USWBSI/Friskop (Plant Pathology)*
Faba bean: Impact of spray droplet size on Botrytis and Aschochyta
Field pea: Breeder's nursery for Ascochyta screening
Field pea: Foliar fungicide evaluation for Ascochyta; *BASF*
Field pea: Foliar fungicide evaluation for Ascochyta; *Syngenta*
Field pea: Impact of crop residues on Fusarium; *USDA Specialty Crop Block Grant*
Field pea: Impact of crop residues on Aphanomyces; *USDA Specialty Crop Block Grant*

Field pea: Impact of crop residues on Fusarium, Williston; *USDA Specialty Crop Block Grant*
Field pea: Impact of fungicide droplet size on Ascochyta, TeeJet nozzles; *North Dakota Crop Protection Product Harmonization Board*
Field pea: Impact of fungicide droplet size on Aschochyta, Wilger nozzles; *North Dakota Crop Protection Product Harmonization Board*
Field pea: Impact of herbicides on Fusarium; *USDA Specialty Crop Block Grant*
Field pea: Impact of herbicides on Aphanomyces; *USDA Specialty Crop Block Grant*
Field pea: Impact of herbicides on Fusarium, Williston; *USDA Specialty Crop Block Grant*
Field pea: Impact of planting date with conventional tillage on Aphanomyces; *North Dakota Crop Protection Product Harmonization Board*
Field pea: Impact of planting date with direct seeding on Aphanomyces; *USDA Specialty Crop Block Grant/ North Dakota Crop Protection Product Harmonization Board*
Field pea: Impact of planting date on root rot, McClean County; *Northern Pulse Growers/North Dakota Crop Protection Product Harmonization Board*
Field pea: Impact of planting date on root rot, Mountrail County; *Northern Pulse Growers/North Dakota Crop Protection Product Harmonization Board*
Field pea: Impact of planting date with no-till on Aphanomyces; *USDA Specialty Crop Block Grant/North Dakota Crop Protection Product Harmonization Board*
Field pea: Impact of planting date on Fusarium, Williston; *USDA Specialty Crop Block Grant*
Field pea: Seed treatment evaluations for Aphanomyces (2); *Valent USA*
Field pea: Seed treatment evaluation, Fusarium (Albaugh); *Albaugh*
Field pea: Seed treatment evaluation for Fusarium; *Syngenta*
Field pea: Seed treatment evaluation for Fusarium; *Valent USA*
Field pea: Susceptibility of breeding lines to Fusarium; *Bandillo (Plant Sciences)*
Field pea: Seed treatment evaluation for Rhizoctonia; *Bayer CropScience*
Lentil: Anthracnose resistance screening nursery
Lentil: Foliar fungicide evaluation for anthracnose; *BASF*
Lentil: Impact of planting date with conventional tillage on Aphanomyces; *USDA Specialty Crop Block Grant/ North Dakota Crop Protection Product Harmonization Board*
Lentil: Impact of planting date with conventional tillage on Fusarium; *USDA Specialty Crop Block Grant/ North Dakota Crop Protection Product Harmonization Board*
Lentil: Impact of planting date with direct seeding on Fusarium; *USDA Specialty Crop Block Grant/ North Dakota Crop Protection Product Harmonization Board*
Lentil: Impact of planting date on root rot, McClean County; *Northern Pulse Growers/ North Dakota Crop Protection Product Harmonization Board*
Lentil: Impact of planting date on root rot, Mountrail County; *Northern Pulse Growers/ North Dakota Crop Protection Product Harmonization Board*
Lentil: Impact of planting date with no-till on Aphanomyces; *USDA Specialty Crop Block Grant/ North Dakota Crop Protection Product Harmonization Board*
Lentil: Impact of planting date on Fusarium, Oakes; *USDA Specialty Crop Block Grant*
Lentil: Impact of spray droplet size on Anthracnose; *North Dakota Crop Protection Product Harmonization Board*
Lentil: Seed treatment evaluation for Fusarium; *North Dakota Crop Protection Product Harmonization Board*
Lentil: Seed treatment evaluation for Fusarium; *Valent USA*
Lentil: Seed treatment evaluation for Rhizoctonia; *North Dakota Crop Protection Product Harmonization Board*
Lentil: Seed treatment evaluation for Rhizoctonia; *Syngenta*
Lentil: Seed treatment evaluation for Rhizoctonia; *Valent USA*
Safflower: Foliar fungicide evaluation for Alternaria; *BASF*
Soybean: Droplet size of TeeJet nozzles for white mold control; *North Dakota Soybean Council*
Soybean: Droplet size of Wilger nozzles for white mold control; *North Dakota Soybean Council*
Soybean: Fungicide efficacy x application method for white mold control; *North Dakota Soybean Council*
Soybean: Fungicide efficacy for white mold; *ADAMA*
Soybean: Fungicide efficacy for white mold; *AMVAC Corp.*

Soybean: Fungicide efficacy for white mold; *Syngenta*
Soybean: Fungicide efficacy x application method for white mold control; *North Dakota Soybean Council*
Soybean: Impact of adjuvants on fungicide efficacy; *North Dakota Soybean Council*
Soybean: Impact of adjuvants with Topsin for white mold; *North Dakota Soybean Council*
Soybean: Impact of droplet size of TeeJet nozzles for white mold control; *North Dakota Soybean Council*
Soybean: Impact of droplet size of Wilger nozzles for white mold control; *North Dakota Soybean Council*
Soybean: Infection timing of white mold; *North Dakota Soybean Council*
Soybean: Row spacing x application method for white molde control; *North Dakota Soybean Council*
Soybean: Varieties for white mold control; *North Dakota Soybean Council*
Soybean: Varieties for white mold control, Oakes; *North Dakota Soybean Council*
Sunflower: Bee vectoring for Sclerotinia head rot; *Bee Vectoring Technologies, Inc.*
Sunflower: Commercial hybrids for Sclerotinia head rot; *USDA Specialty Crop Block Grant Program*
Sunflower: Foliar/stem fungicide evaluation; *Markell (Plant Pathology)*
Sunflower: Phomopsis/Phoma fungicide evaluations (2); *Markell (Plant Pathology)*
Sunflower: Rust fungicide evaluation; *Markell (Plant Pathology)*
Sunflower: USDA germplasm evaluation for Sclerotinia head rot; *Underwood (USDA Sunflower Research Unit)*
Sunflower: USDA Stalkrot Nursery; *Misar (USDA)*
Sunflower: Varieties for white mold control, Oakes; *USDA Specialty Crop Block Grant*
Wheat: Evaluation of fungicide compounds in spring wheat; *Arystra*
Wheat: Evaluation of wheat fungicides at herbicide timing; *BASF*
Wheat: Management of bacterial leaf streak in wheat; *Bayer CropScience*
Wheat: Management of FHB and leaf diseases in wheat (2); *Bayer CropScience*
Wheat: Management of leaf and head diseases with fungicides; *Bayer CropScience*
Wheat: Seed treatment evaluations; *Bayer CropScience*
Wheat: USWBSI Integrated Scab Fungicide Management Trial; *USWBSI/Friskop (Plant Pathology)*

Seed Increase
Buckwheat: Increase of Devyatka, a determinate variety; *Northern Plains Sustainable Agriculture Society FBC*
Emmer: Increase of F4 free thrashing crosses; *Northern Plains Sustainable Agriculture Society FBC*
Field Pea: Increase of CREC small seeded selection

Germplasm Evaluation/Cultivar Development
Barley: Barley breeder nurseries (3); *Horsley (Plant Sciences)*
Barley: Barnes County (Dazey) variety trial
Barley: Drill strip demonstration plots
Barley: Dryland variety trial
Barley: Irrigated variety trial
Barley: Organic variety trial
Barley: Tri-County (Wishek) variety trial
Buckwheat: Organic variety trial
Canola: Canola breeder's nursery; *Rahman (Plant Sciences)*
Canola: Clearfield and SU performance test; *Industry*
Canola: Conventional canola performance test
Canola: Roundup Ready performance test; *Industry*
Chickpea: Western Regional Nursery and variety trial; *Bandillo (Plant Sciences)/Worral (North Central REC)*
Corn: Dryland hybrid performance test; *Industry*
Corn: Dryland hybrid performance test - conventional lines; *Industry*
Corn: Fingal hybrid performance test; *Industry*
Corn: Irrigated hybrid performance test; *Industry*

Corn: Oakes dryland hybrid performance test; *Industry*
Corn: Oakes irrigated hybrid performance test; *Industry*
Dry Bean: Breeder's nursery; *Osorno (Plant Sciences)*
Dry Bean: Dryland variety trial; *Industry*
Dry Bean: Irrigated variety trial; *Industry*
Dry Bean: Wishek variety trial
Durum: Drill strip demonstration plots
Durum: Dryland variety trial
Durum: Organic variety trial
Durum: Uniform Region Durum Nursery - dryland; *Elias (Plant Sciences)*
Durum: Uniform Region Durum Nursery - irrigated; *Elias (Plant Sciences)*
Einkorn: Organic variety trial
Emmer: Organic variety trial
Fababean: Dryland variety trial; *Industry*
Fababean: Organic variety trial; *Industry*
Field Pea: Breeder nursery - advanced pea yield trial; *Bandillo (Plant Sciences)/Worral (North Central REC)*
Field Pea: Field pea evaluation; *Legume Logic*
Field Pea: No-Till field pea variety evaluation
Field Pea: Organic variety trial and nursery; *Industry/Worral (North Central REC)*
Field Pea: Field pea nursery; *Pulse USA*
Field Pea: Variety trial - primary evaluation; *Stefaniak (North Central REC)/Worral (North Central REC)*
Field Pea: Western Regional Nursery; *Bandillo (Plant Sciences)/Worral (North Central REC)*
Flax: Variety trial
Flax: Flax breeder's nursery; *Rahman (Plant Sciences)*
Flax: Organic flax fariety trial; *Ameriflax/Eriksmoen (North Central REC)*
Hemp: Dryland variety trial; *Hanson (Langdon REC)*
Lentil: Breeders Nursery - advanced yield trial; *Bandillo (Plant Sciences)/Worral (North Central REC)*
Lentil: Western Regional Nursery and variety trial; *Bandillo (Plant Sciences)/Worral (North Central REC)*
Lentil: Lentil germplasm screening; *Miller (Montana State Univ.)/Specialty Crop Research Initiative*
Lupin: Multi species variety evaluation; *Industry*
Oats: Breeder's nursery; *McMullen (Plant Sciences)*
Oats: Drill strip demonstration plots
Oats: Dryland variety trial
Oats: Midseason Oat Nursery; *McMullen (Plant Sciences)*
Oats: Organic Breeders Nursery; *Fetch (Agri Food Canada)*
Oats: Organic hexaploid yield trial; *Richter (General Mills)*
Oats: Organic rust sentinel evaluation; *Richter (General Mills)*
Oats: Organic variety trial
Rye: Organic winter rye variety trial
Rye: Winter rye variety trial
Safflower: Variety trial
Soybean: Barnes County – Dazey Roundup Ready variety performance test; *Industry*
Soybean: Dryland soybean agronomic performance trial - Carrington; *BASF*
Soybean: Irrigated soybean agronomic performance trial - Carrington; *BASF*
Soybean: Soybean agronomic performance trial - Dazey; *BASF*
Soybean: Soybean agronomic performance trial - Fingal; *BASF*
Soybean: Dryland soybean agronomic performance trial - Oakes; *BASF*
Soybean: Irrigated soybean agronomic performance trial - Oakes; *BASF*
Soybean: Soybean agronomic performance trial - Wishek; *BASF*
Soybean: Breeders Nursery: Expt. 19C16 Glyphosate Tolerant; *Helms (Plant Sciences)*
Soybean: Breeders Nursery: Expt. 19C17 Glyphosate Tolerant; *Helms (Plant Sciences)*
Soybean: Breeders Nursery: Expt. 19C18 Glyphosate Tolerant; *Helms (Plant Sciences)*
Soybean: Breeders Nursery: Expt. 19C19 Advanced Glyphosate - Dryland; *Helms (Plant Sciences)*
Soybean: Breeders Nursery: Expt. 19C20 Advanced Conventional; *Helms (Plant Sciences)*

Soybean: Breeders Nursery: Expt. 19C21 Tofu Conventional; *Helms (Plant Sciences)*
Soybean: Breeders Nursery: Expt. 19C22 Natto Conventional; *Helms (Plant Sciences)*
Soybean: Breeders Nursery: Expt. 19D19 Glyphosate Tolerant - Dazey; *Helms (Plant Sciences)*
Soybean: Breeders Nursery: Expt. 19I19 Advanced Glyphosate - Irrigated; *Helms (Plant Sciences)*
Soybean: Dryland conventional and Liberty Link variety performance test; *Industry*
Soybean: Dryland Roundup Ready variety performance test; *Industry*
Soybean: Evaluation of soybean genetics: early versus modern varieties
Soybean: Irrigated conventional variety performance test; *Industry*
Soybean: Irrigated Roundup Ready variety performance test; *Industry*
Soybean: LaMoure Roundup Ready variety performance test; *Industry/Helms (Plant Sciences)*
Soybean: No-till RoundUp Ready variety performance
Soybean: Oakes conventional variety performance test; *Industry*
Soybean: Oakes irrigated Roundup Ready variety performance test; *Industry*
Soybean: Tri-County - Wishek Roundup Ready variety performance test; *Industry*
Soybean: Barnes County - Dazey conventional variety performance test; *Industry*
Soybean: LaMoure conventional variety performance test; *Industry/Helms (Plant Sciences)*
Soybean: Tri-County – Wishek conventional variety performance test; *Industry*
Squash: Nutritional quality analysis in storage grown with organic management; *Row 7/Sarkar (Plant Sciences)*
Sunflower: Non-Oil sunflower hybrid performance test; *Industry*
Sunflower: Oil sunflower hybrid performance test; *Industry*
Sunflower: Sunflower hybrid nursery - confection type; *SunOpta*
Sunflower: Sunflower hybrid nursery - oil type; *SunOpta*
Triticale: Winter triticale variety trial - grain
Wheat: Barnes County (Dazey) variety trial
Wheat: Drill strip demonstration plots
Wheat: Dryland variety trial
Wheat: Irrigated variety trial
Wheat: Organic variety trial
Wheat: Saline wheat variety trial
Wheat: Spring wheat breeder's nursery; *Green (Plant Sciences)*
Wheat: Tri-County (Wishek) variety trial
Wheat: Uniform Regional Spring Wheat Nursery; *Garvin (USDA)*
Wheat: Breeder's leaf rust nursery; *Green (Plant Sciences)*
Winter Wheat: Elite breeder's nursery; *Marais (Plant Sciences)*
Winter Wheat: Winter wheat variety trial

Weed Science

Canola: Canola weed management systems with Warrant; *Bayer/Monsanto*
Canola: Evaluating canola tolerance to sulfentrazone; *Northern Canola Growers/Jenks (North Central REC)*
Corn: Corn herbicide adjuvant screening; *Winfield*
Dry Bean: Gramoxone Magnum for dry beans; *Syngenta*
Durum: Destiny HC use with Slam'R; *Winfield*
Durum: Enforcer M use with Slam'R; *Winfield*
Flax: Flax tolerance to POST herbicides; *Ameriflax/Jenks (North Central REC)*
Flax: Flax tolerance to PRE herbicides; *Ameriflax/Jenks (North Central REC)*
Hemp: Hemp herbicide tolerance evaluation; *Gowan*
Misc: Burndown options with Vida; *Gowan*
Misc: Glyphosate resistant kochia burndown options; *Monsanto*
Misc: Herbicide site of action demonstration
Misc: Kochia burndown with Gramoxone plus MTZ; *Ikley*
Rye: Effective rye burndown treatments
Soybean: Effect of solution pH on dicamba; *Ikley*

Soybean: Glyphosate, glufosinate and Enlist combinations for soybeans
Soybean: Gramoxone Maxium for soybeans; *Syngenta*
Soybean: Identifying consequences of poor performing nozzles for weed management; *Intelligent Ag*
Soybean: Residual herbicide impact on cover crops; *North Dakota Soybean Council/Howatt (Plant Sciences)*
Soybean: Soybean herbicide adjuvant screening; *Winfield*
Soybean: Soybean simulated herbicide drift; *Sun (Ag and Biosystems Engineering)*
Soybean: Spray nozzle techonolgy evaluation for weed management; *Intelligent Ag*
Soybean: Tavium herbicide system for soybeans; *Syngenta*
Soybean: UAV weed resistance screening; *Zhang (Ag and Biosystems Engineering)*
Wheat: Kochia management in wheat; *Bayer*
Wheat: Weed control with Luxxur herbicide; *Bayer*
Wheat: Wheat and durum desiccation; *North Dakota Wheat Commission/Howatt (Plant Sciences)*

Herbicide site of action demonstration plots.

Variety	Days to Head	Plant Lodge	Plant Height	Grain Protein 2019	Grain Protein 3-yr. Avg.	1000 KWT	Test Weight	Grain Yield 2019	Grain Yield 2-yr. Avg.	Grain Yield 3-yr. Avg.
		0 to 9	inch	%		gram	lb/bu	bu/ac		
SY Ingmar	57.3	0.5	26.4	15.4	15.6	29.2	59.9	46.2	60.2	59.2
SY Valda	56.0	0.8	26.1	14.7	14.2	31.6	59.6	54.0	62.9	64.3
SY Soren	56.5	0.0	26.5	16.1	15.7	29.0	60.1	50.4	58.0	58.6
Barlow	56.3	1.0	27.7	15.5	14.9	29.6	60.3	45.4	55.9	56.3
Bolles	59.8	0.8	26.4	17.4	16.5	30.8	59.4	54.0	56.3	57.5
Faller	58.5	1.0	28.5	14.5	13.9	35.1	60.1	51.4	63.6	61.9
Linkert	57.0	0.5	24.5	16.4	16.0	33.6	59.7	50.1	56.8	56.9
Elgin-ND	56.3	0.5	27.6	15.6	14.8	29.5	59.0	49.6	56.1	56.6
Glenn	55.5	0.8	27.7	15.8	15.0	28.8	62.5	43.8	51.7	53.3
Boost	59.0	0.3	29.0	15.4	15.0	31.7	58.9	47.6	57.0	58.2
CP3504	58.5	0.5	26.8	14.7	14.2	30.0	58.5	55.1	65.0	63.7
CP3530	58.5	1.3	27.6	15.0	14.5	32.0	58.8	52.9	62.5	61.0
CP3616	57.5	0.0	26.0	16.5	15.7	32.4	59.6	50.3	58.2	59.1
CP3888	57.3	0.3	27.6	15.5	--	31.4	58.2	48.7	61.6	--
CP3910	55.5	1.5	26.3	15.9	--	27.7	58.8	44.2	--	--
CP3915	56.8	0.5	25.7	14.5	--	27.0	58.3	42.9	--	--
CP3939	56.5	0.5	27.5	16.0	--	29.7	59.9	44.2	--	--
Ambush	55.3	1.3	27.6	15.4	14.8	30.9	60.8	45.7	59.1	59.3
Commander	55.0	1.3	25.3	14.7	--	30.7	59.6	50.8	--	--
Lang-MN	57.3	0.3	26.8	15.0	14.8	28.2	60.8	46.9	59.0	58.9
LCS Breakaway	55.5	0.0	24.4	15.5	15.8	32.6	60.7	41.6	57.8	55.3
LCS Cannon	54.8	1.0	24.4	14.8	--	28.1	60.0	37.7	55.4	--
LCS Rebel	55.3	2.0	27.1	15.4	15.1	30.8	60.4	42.0	56.8	56.9
LCS Trigger	61.5	0.5	28.3	13.0	12.8	29.0	58.7	50.0	63.9	63.8
MN Washburn	57.3	0.3	25.9	14.3	--	27.6	57.7	40.2	51.0	--
Mott	57.3	0.3	29.7	16.2	--	28.0	59.5	44.2	--	--
MS Barracuda	54.3	0.8	24.5	15.8	--	32.3	59.5	40.4	53.7	--
MS Camaro	56.8	0.0	25.8	15.3	15.4	28.9	59.7	43.3	52.5	52.7
MS Chevelle	56.3	2.8	26.6	14.0	13.9	28.1	59.2	51.3	64.2	63.0
ND VitPro	56.0	1.0	27.5	15.7	15.5	29.7	61.2	50.1	52.8	54.0
Shelly	57.0	0.8	25.3	14.2	14.1	28.3	59.0	41.1	57.6	60.5
Surpass	55.5	0.8	25.1	15.0	14.7	28.4	58.9	42.5	58.0	--
SY Longmire	56.5	1.3	27.4	15.7	--	29.8	59.9	47.8	56.5	--
SY McCloud	55.3	0.8	26.8	15.6	--	33.1	61.1	41.9	52.2	--
SY Rockford	58.0	0.5	29.2	15.2	--	29.4	57.4	53.7	59.4	--
SY 611CL2	56.5	0.8	25.1	15.5	--	30.0	60.4	49.9	55.5	--
TCG-Climax	61.3	0.0	28.1	16.6	16.0	27.9	61.0	43.5	55.2	57.8
TCG-Heartland	55.5	2.0	26.0	15.7	--	30.0	60.8	47.7	--	--
TCG-Spitfire	58.3	0.3	26.8	14.4	14.3	31.7	57.9	50.4	60.4	62.4
TCG-Stalwart	56.3	0.8	25.8	16.4	--	28.0	55.7	38.2	--	--
MEAN	56.8	0.8	26.8	15.3	--	30.2	59.6	47.4	--	--
C.V. (%)	1.6	72.3	7.5	2.2	--	4.7	1.4	10.4	--	--
LSD 0.10	1.1	0.7	2.3	0.4	--	1.7	0.9	5.8	--	--
LSD 0.05	1.3	0.8	2.8	0.5	--	2.0	1.1	6.9	--	--

Planting Date = May 3 ; Harvest Date = August 20 ; Previous Crop = Flax

Variety	Days to Head	Plant Lodge	Plant Height	----- Grain Protein ----- 2019	3-yr. Avg.	1000 KWT	Test Weight	---------- Grain Yield ---------- 2019	2-yr. Avg.	3-yr. Avg.
		0 to 9	inch	---------- % ----------		gram	lb/bu	---------- bu/ac ----------		
Prosper	57.8	0.8	26.4	14.2	14.0	31.6	59.9	52.6	63.5	63.4
Rollag	56.8	1.8	24.8	15.7	15.5	28.3	59.7	40.6	50.8	53.4
Ballistic	57.3	1.0	28.8	14.5	--	29.6	58.5	53.6	--	--
AAC Brandon	57.3	1.3	26.4	15.0	--	29.8	57.8	41.7	51.6	--
AAC Goodwin	56.0	1.3	27.1	15.0	--	31.0	59.7	50.5	60.9	--
AAC Penhold	56.5	0.8	24.9	14.7	--	35.0	60.1	46.9	59.4	--
MEAN	56.8	0.8	26.8	15.3	--	30.2	59.6	47.4	--	--
C.V. (%)	1.6	72.3	7.5	2.2	--	4.7	1.4	10.4	--	--
LSD 0.10	1.1	0.7	2.3	0.4	--	1.7	0.9	5.8	--	--
LSD 0.05	1.3	0.8	2.8	0.5	--	2.0	1.1	6.9	--	--

Planting Date = May 3 ; Harvest Date = August 20 ; Previous Crop = Flax

* Spring wheat seeding rate used in this trial was 1,400,000 pure live seeds acre^{-1}.

Lodging Score: 0 = no lodging; 9 = plants lying flat.

Barley drill strip demonstration.

Variety	Days to Head	Plant Lodge	Plant Height	----- Grain Protein ----- 2019	2-yr. Avg.[1]	1000 KWT	Test Weight	----- Grain Yield ----- 2019	2-yr. Avg.[1]
		0 to 9	inch	---------- % ----------		gram	lb/bu	--------- bu/ac ---------	
SY Ingmar	59.3	5.0	33.2	15.5	15.4	31.1	57.9	63.8	66.0
SY Valda	58.5	3.8	31.5	13.8	14.1	33.0	58.0	66.0	76.8
SY Soren	58.8	4.5	31.1	15.1	15.4	29.7	57.8	59.1	61.7
Barlow	56.3	4.8	35.2	14.4	15.2	30.6	57.8	61.4	64.7
Bolles	62.0	4.3	32.3	15.5	15.9	32.7	57.3	59.0	64.8
Faller	60.8	6.8	34.2	14.4	14.4	34.6	57.6	69.3	76.4
Linkert	60.8	2.3	31.0	15.9	15.6	32.2	56.3	52.7	64.7
Elgin-ND	59.0	5.3	35.8	15.7	15.5	29.8	56.1	54.5	62.4
Glenn	57.0	6.8	37.5	15.5	15.8	32.2	59.8	58.9	67.2
Boost	61.5	6.0	32.3	15.4	15.4	32.8	56.5	55.5	63.8
CP3504	61.3	3.8	30.7	14.0	14.0	32.2	56.5	66.1	73.0
CP3530	61.5	4.0	37.4	15.4	15.3	31.7	57.2	64.3	77.6
CP3616	59.8	5.0	34.0	16.1	16.0	33.0	55.8	54.0	62.3
CP3888	59.8	5.0	32.7	16.1	--	27.4	55.9	54.7	--
CP3910	55.8	4.8	30.6	14.2	--	29.9	58.2	58.0	--
CP3915	58.8	4.3	33.3	14.8	--	30.4	58.2	63.4	--
CP3939	58.5	3.8	32.1	15.9	--	30.8	56.9	56.2	--
Ambush	57.3	5.0	33.1	15.8	15.6	30.9	57.4	57.5	64.2
Commander	56.8	6.3	34.7	14.9	--	31.6	57.4	60.4	--
Lang-MN	61.0	6.5	34.4	15.3	15.6	28.3	58.1	58.6	70.9
LCS Breakaway	57.0	4.8	30.6	15.9	15.5	31.5	58.6	51.3	64.5
LCS Cannon	55.0	6.3	32.8	14.8	--	29.5	59.0	74.9	--
LCS Rebel	56.0	6.8	34.1	15.3	15.6	33.3	58.2	59.6	67.6
LCS Trigger	63.0	3.0	34.9	12.5	12.8	31.1	58.2	73.0	75.2
MN Washburn	60.3	2.0	31.2	15.2	--	32.2	56.8	57.2	--
Mott	59.5	5.0	37.7	14.3	--	30.0	56.3	53.6	--
MS Barracuda	55.5	3.3	30.9	15.0	--	32.2	57.7	68.8	--
MS Camaro	58.0	5.8	30.8	15.1	15.4	28.7	56.7	51.8	62.2
MS Chevelle	57.3	5.3	33.8	14.1	14.4	29.6	57.1	60.2	65.8
ND VitPro	58.0	3.5	33.6	14.7	15.2	32.4	59.5	60.6	67.5
Shelly	61.5	4.0	30.9	13.8	14.3	32.6	57.2	56.4	67.7
Surpass	55.5	7.0	34.5	14.6	14.8	31.5	56.9	59.9	66.4
SY Longmire	58.5	3.8	31.7	14.8	--	27.9	56.4	57.4	--
SY McCloud	57.3	5.3	33.5	15.5	--	32.6	58.1	66.4	--
SY Rockford	60.5	6.8	33.9	14.3	--	29.6	54.6	53.2	--
SY 611CL2	57.5	5.0	31.5	15.0	--	29.6	58.2	68.0	--
TCG-Climax	61.8	2.3	34.4	16.2	16.2	27.7	58.7	50.2	64.7
TCG-Heartland	57.8	4.0	30.9	15.8	--	32.5	58.0	56.8	--
MEAN	58.7	4.9	33.3	15.1	--	31.4	57.4	59.6	--
C.V. (%)	1.5	33.1	4.4	6.3	--	5.9	1.0	9.7	--
LSD 0.10	1.0	1.9	1.7	1.1	--	2.2	0.7	6.7	--
LSD 0.05	1.2	2.2	2.0	1.3	--	2.6	0.8	8.0	--
					--				

Planting Date = May 7 ; Harvest Date = September 6 ; Previous Crop = Soybean

Variety	Days to Head	Plant Lodge	Plant Height	----- Grain Protein ----- 2019	2-yr. Avg.[1]	1000 KWT	Test Weight	----- Grain Yield ----- 2019	2-yr. Avg.[1]
		0 to 9	inch	---------- % ----------		gram	lb/bu	--------- bu/ac ---------	
TCG-Spitfire	61.0	4.3	32.0	14.8	14.6	33.4	55.5	62.1	65.2
TCG-Stalwart	58.3	6.0	32.1	17.0	--	27.8	52.4	42.4	--
Prosper	60.5	7.0	33.8	13.8	14.2	34.1	57.0	61.3	71.7
Rollag	58.5	5.0	31.8	15.9	15.7	34.3	58.5	61.1	65.0
Ballistic	59.0	6.8	33.8	15.1	--	29.8	56.6	64.9	--
AAC Brandon	58.8	3.0	33.0	16.5	--	35.8	57.7	56.2	--
AAC Goodwin	59.3	5.3	33.8	15.2	--	35.1	57.8	62.9	--
AAC Penhold	58.3	4.0	31.1	14.3	--	36.9	57.7	64.5	--
MEAN	58.7	4.9	33.3	15.1	--	31.4	57.4	59.6	--
C.V. (%)	1.5	33.1	4.4	6.3	--	5.9	1.0	9.7	--
LSD 0.10	1.0	1.9	1.7	1.1	--	2.2	0.7	6.7	--
LSD 0.05	1.2	2.2	2.0	1.3	--	2.6	0.8	8.0	--

Planting Date = May 7 ; Harvest Date = September 6 ; Previous Crop = Soybean

* Spring wheat seeding rate used in this trial was 1,400,000 pure live seeds acre^{-1}.

[1] Two-year average is for 2017 and 2019.

Barley variety trial at Wishek.

Variety	Plant Height	Plant Lodge	Bacterial Leaf Streak[1]	Scab Incidence[2]	--- Grain Protein --- 2019	3-yr. Avg.	1000 KWT	Test Weight	------ Grain Yield ----- 2019	2-yr. Avg.	3-yr. Avg.
	inch	0 to 9	%	0 to 10	--------- % ---------		gram	lb/bu	---------- bu/ac ---------		
SY Ingmar	29.5	1.3	5.8	2.8	15.5	15.2	27.0	56.2	65.3	68.8	72.8
SY Valda	28.3	3.0	2.5	3.3	14.7	14.2	29.3	55.8	65.0	69.9	77.3
SY Soren	29.3	1.8	3.8	2.8	15.2	15.0	27.1	57.1	64.4	66.5	73.5
Barlow	29.9	1.5	5.8	3.0	14.9	15.1	28.1	56.6	60.0	64.0	70.8
Bolles	29.9	2.8	25.0	2.8	16.7	16.8	27.6	54.8	56.4	58.7	67.0
Faller	29.3	3.0	16.3	1.5	14.5	14.1	31.4	56.2	64.3	69.9	77.0
Linkert	29.9	1.8	3.0	4.0	15.5	15.3	31.1	55.5	57.8	62.0	68.4
Elgin-ND	30.8	3.8	6.5	3.0	15.6	15.2	27.2	55.2	58.9	62.9	72.1
Glenn	30.5	2.5	2.8	2.3	15.4	15.5	29.2	59.3	55.6	59.8	67.7
Boost	31.1	3.5	4.3	1.0	14.5	14.5	30.7	56.3	63.0	67.9	74.0
CP3530	32.1	3.5	10.0	2.8	15.8	15.4	28.5	55.9	62.7	69.3	77.6
CP3888	29.9	1.5	4.8	3.8	14.8	--	28.1	54.9	60.0	66.6	--
CP3939	29.7	2.3	8.8	1.8	15.6	--	28.7	55.7	59.2	--	--
Ambush	29.1	2.8	13.3	3.0	15.4	--	29.0	56.8	62.0	--	--
Commander	28.7	3.5	2.5	2.3	14.5	--	29.6	57.6	67.9	--	--
Lang-MN	30.7	3.3	3.3	1.3	15.0	15.3	28.6	58.9	69.5	70.3	75.7
LCS Cannon	27.0	3.3	4.5	1.3	14.2	--	26.8	57.8	67.2	--	--
LCS Rebel	29.9	3.5	10.0	2.5	15.3	15.1	29.3	57.8	60.9	67.2	74.2
LCS Trigger	30.1	3.5	4.0	1.3	11.9	12.0	29.2	57.6	74.7	76.9	82.6
MN Washburn	29.9	2.3	18.8	4.0	14.3	--	27.3	55.6	49.2	--	--
MS Barracuda	26.4	4.5	17.8	1.3	15.4	--	26.8	54.9	54.4	66.8	--
MS Chevelle	28.9	5.3	10.0	2.3	14.3	--	25.4	54.2	54.7	--	--
ND VitPro	30.1	3.8	4.5	1.0	15.4	15.5	30.0	58.6	58.6	62.4	69.4
Shelly	28.5	2.8	5.0	1.3	13.9	13.8	27.0	56.2	63.1	69.9	78.8
SY McCloud	30.5	2.8	3.0	2.8	15.2	--	32.7	58.1	66.9	--	--
TCG-Climax	30.9	1.5	18.8	1.3	16.1	--	26.4	58.8	60.3	64.1	--
TCG-Heartland	30.5	2.3	6.8	3.5	16.0	--	30.5	57.0	59.9	--	--
TCG-Spitfire	31.7	2.8	9.5	2.5	14.1	--	30.6	55.9	67.0	70.6	--
TCG-Stalwart	28.9	4.0	53.8	1.5	17.7	--	22.9	47.8	27.4	--	--
Ballistic	30.3	2.3	8.8	3.3	14.8	--	27.1	54.8	68.0	--	--
MEAN	29.7	2.9	9.4	2.4	15.1	--	28.5	56.3	60.9	--	--
C.V. (%)	5.3	47.5	95.6	58.5	1.9	--	4.6	1.5	7.9	--	--
LSD 0.10	1.9	1.6	10.5	1.6	0.3	--	1.5	1.0	5.7	--	--
LSD 0.05	2.2	1.9	12.6	1.9	0.4	--	1.8	1.2	6.8	--	--

Planting Date = May 10 ; Harvest Date = September 6 ; Previous Crop = Soybean

* Wheat seeding rate used in this trial was 1,400,000 pure live seeds acre^{-1}.

[1] Bacterial Leaf Streak: Ratings recorded on July 23 to capture relative differences in BLS plot severity among varieties.

[2] Scab Incidence: Scored on July 23 to capture relative differences in the incidence of head scab. 0 = none, 10 = high.

Variety	Plant Height	Plant Lodge	Grain Protein 2019	Grain Protein 3-yr. Avg.	1000 KWT	Test Weight	Grain Yield 2019	Grain Yield 2-yr. Avg.	Grain Yield 3-yr. Avg.
	inch	0 to 9	%	%	gram	lb/bu	bu/ac	bu/ac	bu/ac
SY Ingmar	28.3	0.8	16.7	16.2	24.2	55.7	48.8	56.3	51.5
SY Valda	28.7	0.8	15.9	15.4	27.9	56.1	54.2	59.0	54.5
SY Soren	26.7	0.8	16.7	16.3	25.7	56.3	48.3	56.6	52.0
Barlow	30.8	1.8	16.7	16.1	27.3	57.0	49.6	56.0	49.5
Bolles	30.5	1.3	18.3	18.2	28.5	55.9	47.9	54.2	48.5
Faller	30.3	3.5	14.9	14.9	28.5	56.1	51.1	58.8	49.2
Linkert	27.7	1.5	16.9	16.5	27.1	54.4	41.5	47.7	44.0
Elgin-ND	32.6	2.0	16.2	15.9	25.9	56.1	49.6	58.7	50.0
Glenn	31.8	3.5	16.4	16.1	27.1	59.2	45.0	52.5	44.7
Boost	32.8	2.8	15.7	15.9	25.7	55.1	44.0	50.9	45.7
CP3530	31.6	3.3	16.5	--	29.8	56.1	56.5	--	--
CP3888	29.0	1.8	16.1	--	26.1	54.3	46.5	--	--
CP3939	29.8	2.5	16.7	--	27.2	55.5	47.9	--	--
Ambush	27.8	0.8	16.7	--	30.3	57.3	47.1	--	--
Commander	28.7	1.3	16.4	--	27.8	55.6	49.9	--	--
Lang-MN	30.6	2.3	16.7	16.3	23.7	55.5	45.1	53.6	48.8
LCS Cannon	27.1	1.5	16.4	--	27.1	57.5	43.9	--	--
LCS Rebel	29.7	1.5	17.0	16.4	32.8	58.0	47.3	53.8	48.9
LCS Trigger	31.9	5.8	13.7	14.0	24.3	55.0	44.1	54.5	50.1
MN Washburn	28.7	1.3	16.0	--	25.0	53.7	44.1	--	--
MS Barracuda	27.0	1.3	17.4	--	30.5	55.9	43.1	46.8	--
MS Chevelle	28.0	3.3	15.6	--	24.3	55.1	45.0	--	--
ND VitPro	28.6	2.5	16.4	16.4	26.0	57.9	46.2	50.4	45.3
Shelly	27.5	2.8	16.0	15.3	23.6	53.9	44.3	55.4	51.0
SY McCloud	30.2	2.8	16.2	--	27.6	56.0	43.6	--	--
SY Rockford	29.5	5.5	16.3	--	22.2	49.6	37.3	47.6	--
TCG-Climax	29.6	3.0	17.5	--	22.9	56.8	42.6	49.7	--
TCG-Heartland	26.8	3.3	17.1	--	25.2	54.9	38.4	--	--
TCG-Spitfire	29.1	2.3	15.3	--	24.6	52.4	49.8	54.6	--
TCG-Stalwart	28.7	1.5	18.1	--	22.2	48.9	29.2	--	--
Ballistic	32.3	3.0	15.8	--	27.9	54.8	50.8	--	--
MEAN	29.4	2.3	16.4	--	26.5	55.5	46.3	--	--
C.V. (%)	5.1	42.1	1.7	--	4.7	1.5	7.7	--	--
LSD 0.10	1.7	1.1	0.3	--	1.5	1.0	4.2	--	--
LSD 0.05	2.1	1.4	0.4	--	1.7	1.1	5.0	--	--

Planting Date = May 30 ; Harvest Date = September 18 ; Previous Crop = Soybean

* Spring wheat seeding rate used in this trial was 1,400,000 pure live seeds acre^{-1}.

Hard Red Spring Wheat - Organic **Carrington**

Variety	Days to Heading	Plant Lodge	Plant Height	1000 KWT	--- Grain Protein --- 2019	3-yr. Avg.	Test Weight	--- Grain Yield --- 2019	3-yr. Avg.
		0 to 9	inch	gram	------- % -------		lb/bu	------- bu/ac -------	
Glenn	55.3	3.3	34.2	29.1	14.4	12.0	60.5	50.1	33.1
Faller	57.8	3.0	34.0	33.4	13.0	11.0	57.4	66.4	43.9
Barlow	55.0	3.0	35.1	28.1	14.1	12.2	58.6	56.4	37.2
Elgin-ND	56.3	1.8	36.0	29.3	13.9	11.8	57.9	59.6	38.5
Linkert	57.0	2.3	28.1	32.5	15.0	12.7	57.3	51.9	32.5
Bolles	58.8	2.3	31.6	30.8	15.5	12.9	56.9	58.1	36.9
Shelly	58.3	5.3	28.8	26.1	12.9	10.9	56.2	49.4	34.1
Boost	59.3	4.3	32.2	28.3	13.9	12.3	55.9	50.1	33.6
Surpass	54.3	4.3	32.2	26.7	13.6	10.7	55.9	51.8	35.0
ND Vitpro	56.0	4.8	31.6	28.6	14.4	--	59.7	48.8	--
SY Soren	56.5	2.0	28.6	27.9	14.4	12.8	57.7	49.5	32.0
SY Ingmar	57.5	4.3	29.5	25.4	15.1	12.5	56.2	45.7	30.8
SY Valda	57.0	5.0	29.7	29.3	13.0	--	56.8	53.2	--
LCS Rebel	56.3	4.3	32.0	28.0	14.4	--	58.0	50.0	--
TCG Spitfire	59.8	3.5	30.2	29.3	13.7	--	55.4	51.3	--
Dapps	57.0	1.3	39.3	31.6	15.7	12.8	56.1	47.6	32.0
Mida	58.0	6.8	38.9	35.1	15.7	12.8	55.0	33.6	25.8
Ceres	57.3	6.3	42.2	28.6	14.3	11.9	56.7	41.3	28.1
FBC Dylan	56.5	5.5	32.5	31.3	13.8	11.1	56.3	49.2	34.1
Howard	56.5	4.8	35.3	28.1	13.9	11.6	56.3	49.9	33.7
Red Fife	61.0	5.0	46.2	30.7	13.7	11.1	54.8	39.8	31.1
Lang-MN	58.8	3.0	32.0	26.7	14.1	--	57.8	50.9	--
Mean	57.3	3.9	33.7	29.4	14.2	--	57.0	50.4	--
C.V. (%)	1.1	22.8	3.6	3.7	3.2	--	1.3	--	--
LSD 0.10	0.7	1.0	1.4	1.3	0.5	--	0.9	--	--
LSD 0.05	0.9	1.2	1.7	1.6	0.7	--	1.0	--	--

Planting Date = May 3; Harvest Date = August 22; Previous Crop = Buckwheat Cover Crop

Hard Red Winter Wheat - Direct Seeded **Carrington**

Treatment	Heading Date	Plant Lodge[1]	Plant Height	-- Grain Protein -- 2019	3-yr. Avg.	1000 KWT	Test Weight	--------- Grain Yield --------- 2019	2-yr. Avg.	3-yr. Avg.
		0 to 9	in.	--------- % ---------		gram	lb/bu	---------- bu/ac ----------		
Jerry	6/20	1.5	33.9	13.55	14.2	31.8	59.0	44.1	56.1	52.7
Decade-Fhb1 (MT	6/19	0.3	29.6	14.93	15.2	28.6	57.1	37.8	51.6	44.9
Northern	6/20	0.3	28.9	14.18	14.3	25.8	56.2	38.4	51.0	49.8
Loma	6/21	0.8	27.3	15.28	15.2	22.2	55.0	29.7	40.7	39.5
Ideal	6/20	0.8	28.3	13.48	14.1	28.0	58.8	40.6	52.7	45.5
Oahe	6/18	1.0	28.0	13.13	14.2	34.4	59.6	45.7	57.7	50.3
Thompson	6/19	0.5	30.1	13.60	--	25.6	57.5	34.8	52.0	--
Overland-Fhb1	6/19	0.8	30.1	13.58	14.7	27.4	57.8	29.2	45.4	41.2
Peregrine	6/20	1.5	34.4	12.65	13.1	27.7	59.2	44.9	59.7	54.1
AC Emerson	6/21	0.0	33.5	14.23	15.2	27.5	59.8	43.4	54.7	49.1
WB4462	6/15	1.5	28.2	13.23	--	31.5	57.9	37.8	54.5	--
Keldin	6/19	1.0	29.1	13.63	13.4	35.2	59.2	45.4	58.0	58.8
SY Wolf	6/16	0.5	26.0	13.48	14.3	31.0	59.4	39.1	51.7	51.2
SY Monument	6/18	0.3	26.9	13.40	13.6	30.3	57.3	37.6	51.2	44.4
SY Sunrise	6/15	1.0	25.4	13.90	14.7	25.4	55.7	29.9	48.9	45.1
SY Wolverine	6/13	0.5	26.6	13.70	--	32.5	59.0	41.2	--	--
TCG-Boomlock	6/18	1.8	29.4	14.10	--	28.6	59.7	36.4	--	--
Mean	6/18	0.8	29.2	13.74	--	29.3	58.2	38.5	--	--
C.V. (%)	0.1	62.7	8.0	2.5	--	6.6	1.4	8.2	--	--
LSD (0.10)	1.6	0.6	2.8	0.41	--	2.3	0.90	3.7	--	--
LSD (0.05)	1.9	0.7	3.3	0.49	--	2.7	1.10	4.5	--	--

Planting Date = September 12, 2018; Harvest Date = August 6; Previous Crop = Spring Wheat

[1]Lodging score: 0 = no lodging; 9 = plants lying flat

Durum - Dryland **Carrington**

Variety	Days to Head	Plant Lodge	Plant Height	-- Grain Protein -- 2019	3-yr. Avg.	1000 KWT	Test Weight	--------- Grain Yield --------- 2019	2-yr. Avg.	3-yr. Avg.
		0 to 9	inch	--------- % ---------		gram	lb/bu	---------- bu/ac ----------		
Rugby	55.0	2.0	41.5	15.2	14.9	29.5	52.0	39.4	46.8	47.3
Ben	54.8	1.3	37.2	16.0	15.1	29.5	50.3	33.5	41.5	45.3
Maier	55.8	2.5	34.4	16.4	15.0	30.7	51.8	36.0	41.2	47.9
Mountrail	55.8	1.8	38.6	15.8	15.0	28.3	49.4	36.0	45.5	47.5
Lebsock	54.8	2.5	36.5	15.8	15.2	30.1	52.4	40.7	43.5	48.9
Pierce	55.0	2.0	35.1	15.2	14.6	28.7	52.4	39.4	45.7	48.8
Alkabo	55.5	2.0	37.0	15.1	14.5	28.6	51.3	37.1	45.1	45.9
Grenora	55.0	1.5	36.2	15.8	15.0	33.3	51.5	38.6	47.7	50.9
Divide	57.0	2.8	39.5	15.6	14.6	32.2	53.6	45.7	49.9	52.3
Tioga	56.0	4.0	40.1	14.6	14.5	33.9	52.1	44.2	49.3	53.0
Carpio	57.5	4.0	39.9	14.8	14.4	33.4	53.7	50.5	52.9	51.4
Joppa	56.5	3.0	37.0	15.0	14.2	34.1	52.7	45.5	51.5	53.2
ND Grano	57.5	4.0	37.5	15.4	14.7	29.9	51.8	39.8	49.2	53.6
ND Riveland	55.8	4.0	39.2	14.8	14.9	35.9	54.7	53.2	56.5	55.0
VT Peak	55.0	1.8	35.9	15.7	14.8	32.1	54.0	48.0	49.5	52.1
Alzada	53.5	5.3	31.1	16.0	15.7	27.0	48.3	22.3	34.2	38.4
Strongfield	56.0	2.8	38.0	17.3	15.9	32.9	50.5	42.6	48.4	49.1
AC Commander	54.0	4.0	38.4	16.2	15.1	28.8	49.4	34.7	41.4	45.1
CDC Verona	54.8	2.8	36.2	16.1	15.3	33.8	53.9	43.8	48.5	50.0
TCG-Webster	53.3	5.5	32.0	14.9	--	28.5	50.8	24.8	37.1	--
TCG-Bright	56.0	2.3	36.3	16.0	--	29.4	50.9	36.5	--	--
MEAN	56.3	2.9	38.3	15.5	--	32.4	52.4	42.9	--	--
C.V. (%)	2.1	26.7	5.5	3.0	--	9.1	1.9	8.1	--	--
LSD 0.10	1.4	0.9	2.5	0.5	--	3.4	1.2	4.0	--	--
LSD 0.05	1.7	1.1	2.9	0.7	--	4.1	1.4	4.8	--	--

Planting Date = May 13 ; Harvest Date = August 29 ; Previous Crop = Flax

* Durum seeding rate used in this trial was 1,400,000 pure live seeds acre^{-1}.

Lodging Score: 0 = no lodging; 9 = plants lying flat.

Durum - Organic **Carrington**

Variety	Days to Head	Plant Lodge	Plant Height	-- Grain Protein -- 2019	3-yr. Avg.	1000 KWT	Test Weight	-------- Grain Yield -------- 2019	3-yr. Avg.
		0 to 9	inch	--------- % ---------		gram	lb/bu	---------- bu/ac ----------	
Maier	58.5	4.5	35.1	13.4	11.3	37.1	57.9	46.2	32.6
Mountrail	59.5	3.3	35.5	13.0	11.0	37.0	57.5	46.7	31.9
Alkabo	57.5	4.8	34.5	13.4	11.3	35.5	57.9	43.8	32.8
Divide	59.0	3.8	34.9	14.1	11.5	38.1	58.0	52.0	35.8
Grenora	58.8	4.8	34.0	13.8	11.6	36.5	56.6	45.1	34.0
Tioga	57.8	4.8	37.1	13.9	11.3	37.9	56.5	51.6	35.3
Carpio	60.3	5.0	36.7	13.6	11.3	37.2	58.4	47.2	32.9
Joppa	59.0	6.0	35.5	13.1	10.9	37.1	58.6	53.6	37.0
VT Peak	57.8	1.8	33.1	13.7	11.8	40.2	60.0	50.7	36.8
ND Grano	60.3	4.0	35.0	13.8	--	34.1	57.5	47.2	--
ND Riveland	58.8	3.5	35.9	13.4	--	38.8	58.2	52.4	--
Alzada	57.0	8.0	29.3	15.7	--	29.9	50.4	23.7	--
Strongfield	59.3	3.0	36.0	14.3	--	35.1	56.9	45.6	--
Mean	58.7	4.4	34.8	13.8	--	36.5	57.2	46.6	--
C.V. (%)	1.1	23.3	3.3	2.8	--	3.8	1.1	6.6	--
LSD 0.10	0.8	1.2	1.4	0.5	--	1.7	0.7	3.7	--
LSD 0.05	1.0	1.5	1.6	0.6	--	2.0	0.9	4.4	--

Planting Date = May 3; Harvest Date = August 23; Previous Crop = Buckwheat Cover Crop

Organic buckwheat variety trial.

Barley - Dryland **Carrington**

Variety	Days to Head	Plant Lodge	Plant Height	Stem Breakage[1]	Plump >6/64	Thin <5/64	-- Grain Protein -- 2019	3-yr. Avg.	Test Weight	----- Grain Yield ----- 2019	2-yr. Avg.	3-yr. Avg.
		0 to 9	inch	1 to 10	%	%	--------- % ---------		lb/bu	--------- bu/ac ---------		
Two Row												
Conlon	52.3	7.3	26.0	7.0	83.3	1.7	11.0	11.9	44.3	50.2	76.8	80.0
Pinnacle	54.8	5.0	28.1	4.5	72.4	3.9	10.7	11.0	39.4	49.6	66.6	78.2
ND Genesis	59.8	4.3	26.3	3.3	78.3	2.0	11.1	11.5	41.4	50.9	70.3	81.3
AAC Synergy	59.8	1.5	25.6	1.5	90.9	1.0	10.1	11.5	43.1	60.0	86.6	96.9
ABI Balster	61.5	3.5	26.7	2.8	81.0	2.6	11.5	12.1	41.5	55.5	80.0	90.2
Explorer	57.3	3.0	23.0	3.8	75.4	3.2	11.0	11.7	39.5	48.9	75.2	85.5
AAC Connect	57.5	0.3	27.1	0.3	80.4	2.2	10.8	--	43.4	64.6	--	--
CDC Bow	61.5	1.0	28.1	0.8	94.2	0.8	10.6	--	44.1	51.4	--	--
CDC Fraser	59.5	1.0	27.5	1.3	83.9	1.9	10.9	--	41.6	61.9	--	--
Lowe	63.3	2.5	32.5	2.5	81.9	1.2	12.3	12.2	44.2	58.8	86.0	92.1
Six Row												
Tradition	53.0	0.0	29.8	0.0	79.2	1.4	10.9	11.8	42.1	82.3	94.6	96.2
Lacey	54.0	0.3	27.8	0.5	83.4	1.0	12.1	12.2	43.4	76.5	93.3	95.0
MEAN	56.4	1.8	26.8	1.8	83.1	1.7	10.7	--	42.3	61.5	--	--
C.V. (%)	1.9	71.7	8.3	55.7	6.1	32.7	7.0	--	2.1	14.0	--	--
LSD 0.10	1.2	1.5	2.6	1.2	6.0	0.7	0.9	--	1.1	10.2	--	--
LSD 0.05	1.5	1.8	3.1	1.4	7.1	0.8	1.0	--	1.3	12.2	--	--

Planting Date = May 10; Harvest Date = August 7; Previous Crop = Flax

[1] Stem breakage, assessment of stems that are intact but result in exposing heads to lower reaches of the canopy. Scored 1 to 10 where 1 = no breakage to 10 = signficant breakage.

Barley seeding rate used in this trial was 1,100,000 pure live seeds acre^{-1}.

Lodging Score: 0 = no lodging; 9 = plants lying flat.

Barley - Irrigated **Carrington**

Variety	Days to Head	Plant Lodge	Plant Height	Plump >6/64	Thin <5/64	Grain Protein	Test Weight	Grain Yield
		0 to 9	inch	%	%	%	lb/bu	bu/ac
Two Row								
Conlon	55.5	5.3	35.5	96.5	0.6	13.4	48.9	111.2
Pinnacle	56.8	4.0	34.1	95.6	0.8	12.0	46.8	121.0
ND Genesis	61.8	7.8	34.4	93.4	1.1	13.6	44.3	83.7
AAC Synergy	59.3	7.0	36.0	94.8	0.8	13.6	46.5	107.2
ABI Balster	61.8	4.8	33.1	90.8	1.2	14.3	45.3	102.6
Explorer	58.8	7.3	33.5	85.3	3.5	13.9	44.4	101.7
AAC Connect	58.3	6.3	34.4	92.5	1.1	13.8	45.9	113.8
CDC Bow	63.3	5.5	34.0	94.3	1.0	13.7	46.0	105.6
CDC Fraser	61.8	6.8	34.9	92.3	1.4	13.5	44.5	93.5
Lowe	62.8	7.8	38.0	89.2	1.7	14.5	46.7	88.2
Six Row								
Tradition	55.0	3.5	35.6	94.4	0.8	14.0	46.4	115.7
Lacey	56.8	3.0	35.5	93.2	0.9	14.5	46.7	114.6
MEAN	58.3	5.5	34.7	93.4	1.1	13.4	46.1	109.5
C.V. (%)	1.3	24.1	4.1	2.5	37.9	3.2	1.5	7.5
LSD 0.10	0.9	1.6	1.7	2.7	0.5	0.5	0.8	9.8
LSD 0.05	1.0	1.9	2.0	3.2	0.6	0.6	0.9	11.7

Planting Date = May 7; Harvest Date = August 18; Previous Crop = Soybean

* Barley seeding rate used in this trial was 1,100,000 pure live seeds acre^{-1}.

Experimental soybean seed increase under irrigation.

Variety	Plant Height	Plant Lodge	Plump >6/64	Thin <5/64	--- Grain Protein --- 2019	3-yr. Avg.	Test Weight	---------- Grain Yield ---------- 2019	2-yr. Avg.	3-yr. Avg.
	inch	0 to 9	%	%	--------- % ---------		lb/bu	---------- bu/ac ----------		
Two Row										
Conlon	25.8	8.0	87.4	1.6	13.9	--	43.7	60.2	--	--
Pinnacle	26.6	7.0	83.5	3.1	12.8	12.6	41.3	58.9	60.9	76.1
ND Genesis	26.2	7.3	92.5	1.2	13.6	13.2	40.8	75.3	83.4	91.8
AAC Synergy	26.0	4.3	94.8	0.7	13.4	13.7	42.7	91.9	96.3	99.5
ABI Balster	27.2	7.0	90.7	1.4	14.1	14.4	41.1	79.1	83.9	93.4
Explorer	25.0	8.0	79.9	2.8	13.0	13.3	40.6	62.4	85.2	93.7
AAC Connect	26.2	5.3	93.3	1.2	13.4	--	41.0	86.8	--	--
CDC Bow	26.8	4.8	92.6	2.1	13.3	--	41.9	82.8	--	--
Six row										
Tradition	28.0	2.0	89.2	1.2	14.4	14.0	43.0	93.8	102.3	107.6
Lacey	28.3	3.0	93.2	0.8	14.1	14.3	43.4	89.7	100.2	100.7
MEAN	26.5	5.4	89.5	1.5	13.4	--	41.6	82.4	--	--
C.V. (%)	7.0	22.2	3.5	45.4	5.2	--	3.0	8.0	--	--
LSD 0.10	NS	1.4	3.8	0.8	0.8	--	1.5	7.9	--	--
LSD 0.05	NS	1.7	4.6	1.0	1.0	--	1.8	9.5	--	--

Planting Date = May 10 ; Harvest Date = September 6 ; Previous Crop = Soybean

* Barley seeding rate used in this trial was 1,100,000 pure live seeds acre^{-1}.

Omega flax in windrows.

Variety	Plant Lodge	Plant Height	Flag Leaf Disease	Plump >6/64	Thin <5/64	-- Grain Protein -- 2019	3-yr. Avg.	Test Weight	-------- Grain Yield -------- 2019	2-yr. Avg.	3-yr. Avg.
	0 to 9	inch	%	%	%	--------- % ---------		lb/bu	---------- bu/ac ----------		
Two Row											
Conlon	7.0	26.7	30.0	94.5	3.1	13.5	--	43.4	55.3	--	--
Pinnacle	4.5	26.7	23.8	94.2	3.3	11.6	12.5	44.0	66.5	69.8	56.8
ND Genesis	6.5	26.4	16.3	91.2	4.5	13.6	13.6	37.5	51.2	63.6	53.7
AAC Synergy	1.5	26.8	5.3	97.4	1.4	13.1	13.7	42.9	77.6	85.9	67.4
ABI Balster	3.5	26.8	30.0	91.2	4.8	14.7	14.9	39.6	51.0	65.7	54.0
Explorer	4.0	25.2	33.8	91.8	3.7	13.1	13.7	41.5	50.9	67.3	58.1
AAC Connect	1.0	26.6	8.8	96.0	2.1	12.7	--	41.2	75.9	--	--
CDC Bow	1.0	25.9	27.5	95.9	2.4	14.1	--	40.3	48.0	--	--
Six Row											
Tradition	1.0	29.2	10.0	97.0	1.2	13.9	13.8	45.0	80.1	87.8	71.1
Lacey	1.5	28.7	12.5	97.5	1.2	14.0	14.0	44.0	73.1	87.7	70.5
MEAN	3.0	26.8	20.6	94.6	2.7	13.1	--	42.3	66.3	--	--
C.V. (%)	43.4	8.3	36.2	1.4	24.0	3.9	--	1.8	7.5	--	--
LSD 0.10	2.8	2.6	8.9	1.5	0.8	0.6	--	0.9	5.9	--	--
LSD 0.05	3.9	3.2	10.7	1.8	0.9	0.7	--	1.1	7.1	--	--

Planting Date = May 30; Harvest Date = September 18 ; Previous Crop = Soybean

* Barley seeding rate used in this trial was 1,100,000 pure live seeds acre^{-1}.

ND Vitpro hard red spring wheat.

Barley - Organic **Carrington**

Variety	Days to Head	Plant Lodge	Plant Height	Plump >6/64	Thin <5/64	-- Grain Protein -- 2019	3 yr. Avg.	Test Weight	-- Grain Yield -- 2019	3-yr. Avg.
		0 to 9	inch	%	%	----- % -----		lb/bu	----- bu/ac -----	
Two Row										
Conlon	56.5	8.3	27.8	84.1	4.1	12.8	10.1	45.0	69.5	62.7
Rawson	59.3	3.0	27.1	88.2	2.3	11.9	10.0	46.1	85.8	69.8
Pinnacle	59.3	6.8	25.1	85.3	4.1	11.0	9.1	44.4	70.5	64.7
ND Genesis	63.3	7.0	29.5	68.6	6.1	12.3	9.7	39.8	62.6	63.8
ABI Balster	65.0	4.5	25.9	75.6	4.8	12.3	9.6	40.6	60.6	65.7
Six Row										
Lacey	58.8	0.5	30.9	89.9	1.0	13.1	10.5	46.2	96.5	76.9
Tradition	56.0	0.5	30.7	87.8	1.3	12.9	10.6	46.5	91.7	68.5
Mean	59.7	4.4	28.1	82.8	3.4	12.3	--	44.1	76.8	--
C.V. (%)	1.4	19.9	8.5	6.2	35.6	4.0	--	2.2	10.6	--
LSD 0.10	1.0	1.1	2.9	6.3	1.5	0.6	--	1.2	10.0	--
LSD 0.05	1.2	1.3	3.5	7.6	1.8	0.7	--	1.5	12.1	--

Planting Date = May 3; Harvest Date = August 6; Previous Crop = Buckwheat cover crop

Evaluation of spray droplet size with adjuvants for Sclerotinia in dry bean.

Oat - Dryland **Carrington**

Variety	Callisto Phyto[1]	Late Plant Disease[2]	Days to Head	Plant Height	Plant Lodge	Protein Content	Test Weight	------- Grain Yield ------- 2019	3-yr. Avg.
	%	%		inch	0 to 9	%	lb/bu	---------- bu/ac ----------	
Beach	6.7	3.3	56.5	38.3	6.8	14.2	34.6	114.0	110.6
CS Camden	5.0	0.5	58.3	37.9	6.8	13.1	30.5	142.0	130.4
CDC Dancer	3.8	21.0	58.0	39.0	7.3	12.1	33.7	126.6	128.6
Deon	22.5	0.3	60.5	40.6	8.0	13.4	32.9	130.6	129.1
Hayden	10.0	9.0	56.5	39.2	7.3	11.6	35.6	133.9	126.1
HiFi	3.8	14.8	57.5	36.8	8.3	12.4	31.0	100.1	108.3
Hytest	11.3	11.8	56.0	43.0	6.3	15.0	36.3	111.7	117.4
Jury	7.5	18.8	59.3	37.6	8.3	10.9	29.3	111.3	118.6
Killdeer	10.0	20.0	59.3	31.9	8.5	12.4	29.4	111.6	120.0
Legget	8.8	0.0	58.3	33.2	6.3	13.4	33.1	118.5	112.5
Minstrel CDC	11.3	23.8	57.5	37.9	6.0	10.9	28.6	115.8	118.5
Otana	3.8	30.5	58.8	38.7	8.8	12.4	27.5	96.0	113.1
Newburg	5.0	25.0	56.5	41.4	8.3	11.7	30.8	117.6	116.4
AC Pinnacle	6.3	13.0	55.8	42.0	8.8	12.0	32.6	121.6	122.7
Rockford	5.0	18.8	58.5	39.4	7.3	12.2	30.9	107.7	115.9
Souris	5.0	12.3	57.5	36.0	7.5	11.9	31.4	105.4	112.3
Stallion	8.8	1.3	60.0	38.7	7.8	12.8	35.1	126.3	125.5
Warrior	3.8	0.0	56.8	36.2	6.0	13.0	33.2	130.3	--
Paul	13.8	8.0	63.3	40.5	6.3	15.6	38.5	47.9	68.5
MEAN	7.2	9.7	58.3	38.8	6.8	12.6	33.2	115.1	--
C.V. (%)	48.5	81.0	2.8	5.6	14.8	3.7	4.2	9.0	--
LSD 0.10	4.1	9.2	1.9	2.6	1.2	0.5	1.7	12.1	--
LSD 0.05	4.9	11.0	2.3	3.1	1.4	0.7	2.0	14.5	--

Planting Date = May 7 ; Harvest Date = August 19 ; Previous Crop = Forage Barley

* Oat seeding rate used in this trial was 1,000,000 pure live seeds acre^{-1}.

[1] Callisto Phyto: An assessment of crop injury associated with the application of Callisto herbicide at the first leaf stage.

[2] Late Plant Disease: Represents an assessment of crown rust made on July 26, scored as plot severity.

Lodging Score: 0 = no lodging; 9 = plants lying flat.

Variety	Days to Head	Plant Lodge	Plant Height	Grain Protein	Test Weight	Grain Yield 2019	Grain Yield 3-yr. Avg.
		0 to 9	inch	%	lb/bu	bu/ac	bu/ac
Paul	63.8	3.5	41.7	12.7	42.6	93.3	61.6
Killdeer	59.0	6.3	38.2	11.1	33.9	147.8	95.8
HiFi	61.3	6.3	40.3	11.7	34.4	139.5	92.4
Souris	60.3	6.5	37.3	10.5	33.6	128.1	89.6
Rockford	60.3	5.3	39.7	10.6	35.8	146.2	94.5
Newburg	59.5	6.5	40.4	11.2	33.9	149.8	98.1
Jury	59.3	5.5	40.9	11.0	35.7	144.8	94.9
Deon	62.0	3.0	39.3	11.6	36.3	156.7	104.1
CDC Minstrel	60.3	2.8	38.2	11.5	34.0	167.1	104.2
CDC Dancer	61.5	3.0	37.2	11.9	35.0	144.1	90.5
AC Pinnacle	61.3	3.0	41.0	10.4	35.8	153.5	101.8
CS Camden	60.0	2.0	37.1	11.3	33.6	173.7	107.6
Reins	57.5	1.0	33.1	12.2	34.4	108.7	77.5
Hayden	59.5	4.3	39.7	10.8	36.8	146.9	--
Jerry	57.8	4.8	38.0	12.7	36.0	126.8	86.1
Leggett	61.0	4.5	38.8	10.3	32.9	154.6	--
Warrior	57.8	1.8	35.1	11.8	34.3	135.1	--
Somo	54.0	1.3	36.4	13.1	36.6	103.5	--
Mean	60.2	3.7	38.9	11.7	36.1	135.1	--
C.V. (%)	1.0	19.8	3.7	3.3	2.7	5.0	--
LSD 0.10	0.7	0.9	1.7	0.4	1.1	8.0	--
LSD 0.05	0.8	1.0	2.1	0.5	1.4	9.6	--

Planting Date = May 3; Harvest Date = August 16; Previous Crop = Buckwheat Cover Crop

Organic oat variety trial.

Canola - Clearfield Tolerant Cultivars **Carrington**

Brand	Cultivar	Herb. Trait[1]	Status[2]	Oil Type[3]	Blackleg Resistance[4]	Clubroot Resistance[4]	Days to Bloom	Bloom Duration	Days to PM	Plant Height	Plant Lodge	1000 KWT	Test Weight	Oil Content	--- Seed Yield --- 2019	2-yr. Avg.
										inch	0 to 9	gram	lb/bu	% @ 8.5%M	------ lb/ac ------	
Canterra Seeds	CS2500 CL	CL	CA	Trad.	R	No	46.0	18.5	94.3	50.9	1.5	4.26	51.1	44.4	2886	2208
Brett Young	5545 CL	CL	CA	Trad.	R	No	47.5	18.3	95.3	50.1	1.8	3.91	50.9	44.8	3197	--
Cargill	16MH6001	CL	EXP	HO	R	No	48.3	18.3	95.0	46.3	2.5	3.93	50.7	43.0	2781	--
Cargill	16MH6004	CL	EXP	HO	R	No	48.3	18.8	94.3	46.4	2.5	4.20	50.7	43.1	2816	--
						MEAN	47.5	18.4	94.7	48.4	2.1	4.08	50.8	43.8	2920	--
						C.V. (%)	1.4	11.6	2.1	15.2	59.5	3.8	0.6	1.4	11.3	--
						LSD 0.10	0.9	NS	NS	NS	NS	0.20	0.4	0.8	NS	--
						LSD 0.05	1.1	NS	NS	NS	NS	0.25	0.5	1.0	NS	--

Planting Date = May 13 ; Harvest Date = August 28 ; Previous Crop = Durum

[1] Herbicide Trait: Herbicide tolerance trait; CL = Clearfield tolerant.

[2] Status refers to availability to producers: CA = Commercially available, while EXP = Experimental line.

[3] Oil Type: Trad. = Traditional, and HO = High Oleic

[4] Disease Resistance: Information as provided by seed companies.

Canola - Roundup Ready Cultivars **Carrington**

Brand	Cultivar	Status[1]	Blackleg Resistance[2]	Clubroot Resistance[2]	Days to Bloom	Bloom Duration	Days to PM	Plant Height	Plant Lodge	1000 KWT	Test Weight	Oil Content	---- Seed Yield --- 2019	3-yr. Avg.
								inch	0 to 9	gram	lb/bu	% @ 8.5%M	-------- lb/ac -------	
Canterra Seeds	CS2100	CA	R	No	44.3	18.0	88.0	41.2	2.0	2.91	52.8	40.5	2474	2383
Canterra Seeds	CS2300	CA	R	No	47.0	18.8	93.3	45.5	6.0	3.29	51.8	41.5	2680	2578
Canterra Seeds	CS2600 CR-T	CA	R	Yes	44.8	18.0	87.8	37.2	4.0	2.75	52.4	41.9	2478	--
Proseed	300 Mag	CA	R	No	45.5	17.8	89.8	44.3	3.5	3.05	51.9	42.4	2400	--
Proseed	PS 5000	CA	R	Yes	45.5	17.3	86.0	42.5	2.3	2.74	52.4	41.8	2095	--
Star Specialty	StarFlex	CA	R	Yes	44.5	17.8	86.8	43.4	4.3	2.64	52.0	42.8	2850	--
Star Specialty	Star 402	CA	R	Yes	43.3	18.5	87.5	43.4	2.3	2.94	51.4	44.6	2524	2410
Brett Young	6074 RR	CA	R	No	46.0	19.3	91.3	45.0	6.0	2.91	52.3	42.1	2179	2394
Brett Young	6090 RR	CA	R	Yes	46.5	17.3	90.5	44.0	3.3	3.19	51.8	41.7	2643	--
Brett Young	4187 RR	CA	R	Yes	48.0	17.8	91.8	50.4	0.5	3.11	51.3	43.6	2903	2577
Pioneer	45CM39	CA	MR	Yes	43.8	18.3	90.5	44.3	2.0	3.18	50.8	44.1	2745	--
Pioneer	45M35	CA	MR	No	45.5	18.8	91.8	45.6	2.3	3.04	51.8	43.9	2934	2551
Croplan	CP930RR	CA	R	No	43.5	18.5	85.3	43.7	0.3	2.70	51.8	43.9	2512	2423
Croplan	CP955RR	CA	R	Yes	44.5	18.3	87.0	47.1	2.0	2.85	52.1	42.6	2235	2348
Croplan	CP9982RR	CA	R	Yes	47.3	18.5	93.0	45.8	4.5	3.10	52.4	40.5	2257	--
Croplan	CP9919RR	CA	R	No	42.8	19.3	85.0	38.7	2.3	2.81	52.0	40.5	1902	--
Croplan	CP9978TF	CA	R	No	43.5	18.5	87.5	40.2	2.3	3.11	52.3	41.5	2613	--
Dekalb	DKTF91SC	CA	R	No	42.8	19.0	85.0	42.0	1.5	3.02	51.7	41.9	2800	--
Dekalb	DKTF92SC	CA	R	No	43.3	18.8	86.3	39.4	1.3	2.91	52.2	41.3	2910	--
Integra	7389RT	CA	R	No	45.3	18.0	89.0	45.9	5.5	3.03	52.8	40.2	2741	--
	MEAN				45.1	18.3	88.9	44.1	3.1	2.95	52.0	42.1	2533	--
	C.V. (%)				1.2	3.1	2.2	10.5	70	5.7	0.8	2.5	15.6	--
	LSD 0.10				0.7	0.7	2.3	5.5	2.6	0.20	0.5	1.2	465	--
	LSD 0.05				0.8	0.8	2.7	6.5	3.1	0.24	0.6	1.5	557	--

Planting Date = May 14 ; Harvest Date = August 23 ; Previous Crop = Durum

* All hybrids entered in this trial are the 'Traditional' oil type

[1] Status refers to availability to producers: CA = Commercially available, while EXP = Experimental line.

[2] Disease Resistance: Information as provided by seed companies.

Non-Oilseed Sunflower **Carrington**

Brand	Hybrid	Type	Plant Height	Days to Bloom	Days to PM	Seeds >22/64	Seeds >20/64	Seeds >18/64	Harvest Moist.	Test Weight	Seed Yield 2019	Seed Yield 2-yr. Avg.	Seed Yield 3-yr. Avg.
			inch			%	%	%	%	lb/bu	lb/ac	lb/ac	lb/ac
USDA	924	Check Hybrid	63.7	70.8	115.8	32.8	65.6	81.8	15.8	20.2	889	1290	1355
Red River Commodities	2215	NuSun/Conv.	66.0	70.8	114.3	57.0	82.1	91.2	15.6	19.1	1243	1760	1732
Red River Commodities	2215 CL	NuSun/Clearfield	63.0	70.8	117.3	63.2	84.6	93.5	16.4	19.8	1233	1481	1562
Red River Commodities	2310	NuSun/Conv.	71.6	70.8	114.8	87.7	93.8	97.0	16.5	19.6	1737	1584	--
Red River Commodities	2414	NuSun/Conv.	70.0	71.3	121.3	82.6	91.3	96.0	16.9	19.2	1477	1594	--
Nuseed	NSKM53777	Trad./Clearfield	65.2	67.0	113.0	62.1	81.7	90.6	15.3	19.4	1330	1396	1501
Nuseed	X4334	Trad./Clearfield	61.2	70.3	115.5	76.7	89.1	93.8	15.8	18.9	1549	1403	1525
Sunopta	9583CLP	NuSun/Clearfield	65.6	69.5	119.8	80.0	88.2	93.8	16.0	21.4	1999	--	--
Valia Genetics	Valia 41	Traditional	66.0	71.0	119.3	73.4	86.5	93.4	18.6	18.8	1857	1688	1784
Valia Genetics	H9811 EXP	Traditional	64.6	70.3	113.3	67.1	83.4	92.3	16.5	18.8	1134	1432	--
Valia Genetics	H9814EXP	Traditional	64.8	71.0	120.3	83.1	87.8	93.4	17.3	17.3	1876	--	--
		MEAN	65.6	70.4	116.9	71.3	85.9	93.0	16.5	19.1	1480	--	--
		C.V. (%)	9.6	1.4	2.1	15.1	6.6	3.7	8.7	6.9	20.0	--	--
		LSD 0.10	NS	1.2	3.0	15.2	8.0	4.9	NS	NS	415	--	--
		LSD 0.05	NS	1.4	3.6	18.4	9.7	5.9	NS	NS	502	--	--

Planting Date = May 30 ; Harvest Date = November 14 ; Previous Crop = Durum

* One rep was abandoned for yield and quality determination due to damage caused by heavy snowfall.

Variety	Days to Bloom	Bloom Duration	Days to PM	Plant Height	Plant Lodge	Oil Content	Test Weight	Seed Yield 2019	Seed Yield 2-yr. Avg.	Seed Yield 3-yr. Avg.
				inch	0 to 9	% (9%M)	lb/bu	bu/ac	bu/ac	bu/ac
Bison	48.3	25.0	88.5	28.1	4.5	37.6	49.7	27.2	29.9	--
Carter	49.8	23.0	88.3	27.2	2.8	38.1	50.9	32.7	30.6	28.7
CDC Buryu	49.8	23.3	87.5	27.8	5.0	37.6	48.6	20.2	--	--
CDC Glas	51.0	21.5	85.5	26.8	0.5	39.1	46.1	35.1	--	--
CDC Melyn	53.5	18.0	83.0	26.0	3.3	40.4	42.8	22.3	--	--
CDC Neela	50.5	18.5	82.5	27.4	2.0	38.9	48.0	31.6	33.7	31.4
CDC Plava	50.3	20.8	81.8	26.0	4.3	39.3	44.4	23.5	--	--
Gold ND	51.5	21.0	87.8	27.6	4.5	38.7	48.1	21.3	27.1	27.6
ND Hammond	50.3	21.8	86.3	28.3	0.3	38.4	45.9	28.6	32.1	31.8
Omega	50.8	20.0	86.8	27.6	5.0	38.3	47.3	19.1	24.5	25.7
Prairie Thunder	51.3	22.0	89.5	28.0	3.8	37.6	48.6	24.4	29.9	31.1
Webster	51.5	19.5	87.0	29.7	4.3	38.7	47.4	22.7	29.9	30.6
York	48.8	24.5	85.5	27.4	2.3	37.8	47.4	29.5	31.8	32.4
PUSA FX 1801	48.3	24.8	89.5	25.2	1.5	40.3	49.3	33.3	--	--
PUSA FX 1802	47.0	26.0	90.3	27.0	1.5	40.5	47.7	35.7	--	--
AAC Bright	50.5	22.0	86.5	27.4	0.0	41.8	44.8	32.2	--	--
MEAN	50.7	21.5	87.2	27.7	3.0	38.9	47.9	27.6	--	--
C.V. (%)	1.0	4.5	1.7	6.4	57.4	1.9	3.6	17.0	--	--
LSD 0.10	0.6	1.1	1.7	2.1	2.0	0.9	2.0	5.5	--	--
LSD 0.05	0.7	1.4	2.0	2.5	2.4	1.1	2.4	6.6	--	--

Planting Date = May 13 ; Harvest Date = September 18 ; Previous Crop = Oats

* All varieties were planted at adjusted seeding rates to attain the planting of 3.2 million PLS/acre

Lodging Score: 0 = no lodging; 9 = plants lying flat.

Flax - Organic **Carrington**

Variety	Days to Bloom	Days to PM	Plant Lodge	Plant Height	Seed Oil	Seed Yield 2019	Seed Yield 2-yr. Avg.	Seed Yield 3-yr. Avg.
			0 to 9	inch	%	bu/ac	bu/ac	bu/ac
Omega	52.5	88.0	0.0	24.3	42.0	6.6	18.3	21.5
Carter	52.8	89.0	0.0	25.0	41.1	4.9	16.7	19.4
Gold ND	52.5	88.8	0.0	26.7	43.1	6.9	19.9	22.8
Pembina	53.8	87.3	0.0	25.1	41.2	5.1	20.0	22.3
York	50.3	91.0	0.0	24.5	40.2	8.8	21.5	25.5
Neela	52.3	84.5	0.0	23.3	41.3	5.1	20.4	22.5
Prairie Thunder	48.0	83.3	0.0	23.6	40.5	4.9	20.2	24.6
CDC Melyn	53.3	89.0	0.0	25.5	44.7	5.9	--	--
ND Hammond	51.5	91.3	0.0	25.8	40.8	6.3	20.9	24.4
Mean	51.9	88.0	0.0	24.9	41.6	6.0	--	--
C.V. (%)	1.4	0.7	.	4.6	2.0	19.7	--	--
LSD 0.10	0.9	0.8	NS	1.4	1.0	1.4	--	--
LSD 0.05	1.1	1.0	NS	1.7	1.2	1.7	--	--

Planting Date = May 14; Harvest Date = September 4; Previous Crop = Cover Crop (sorghum sudangrass, sudangrass, cowpea, soybean, crimson clover and turnip)

Safflower **Carrington**

Variety	Oil Type	Days to Bloom	Bloom Duration	Days to PM	Plant Height	Plant Lodge	Oil Content	Test Weight	Seed Yield 2019	Seed Yield 3-yr. Avg.
					inch	0 to 9	%	lb/bu	lb/ac	lb/ac
Cardinal	Linoleic	91.3	19.7	129.3	32.0	0.0	42.1	36.1	1998	2362
Chickadee	Oleic	90.0	19.3	128.3	31.2	0.0	34.4	37.1	2426	--
Finch	Oleic	89.7	19.3	127.7	31.0	0.0	29.8	33.6	1541	1926
Hybrid 1601	Oleic	89.7	21.0	128.3	33.9	0.3	33.2	28.8	1149	2449
Hybrid 200	Oleic	90.0	20.7	125.0	33.6	0.3	23.6	32.1	1308	2047
Hybrid 446	Oleic	89.3	20.0	126.3	34.1	0.3	21.7	32.6	1349	2301
MonDak	Oleic	91.3	19.3	127.0	31.1	0.0	32.1	35.9	2074	2614
Montola 2003	Oleic	92.3	19.7	128.0	30.4	0.0	32.3	34.4	2051	2449
NutraSaff	Linoleic	91.0	19.0	127.7	30.7	0.0	45.8	28.7	992	1679
Rubis Red	Linoleic	88.3	21.0	126.3	35.3	0.0	36.3	36.5	1878	--
MEAN		90.3	19.9	127.4	32.3	0.1	33.1	33.6	1677	--
C.V. (%)		0.8	4.2	0.8	6.3	316.0	5.0	2.9	11.5	--
LSD 0.10		1.1	1.2	1.4	2.9	NS	2.3	1.4	272	--
LSD 0.05		1.3	NS	1.7	NS	NS	2.8	1.7	330	--

Planting Date = April 24 ; Harvest Date = September 19 ; Previous Crop = Soybean
Lodging Score: 0 = no lodging; 9 = plants lying flat.

Einkorn - Organic **Carrington**

Variety	Days to Head	Plant Lodge	Plant Height	Test Weight	Grain Yield 2019	Grain Yield 3-yr. Avg.
		0 to 9	inch	lb/bu	lb/ac	lb/ac
CDC Marvel	60.8	8.5	39.4	30.5	2734	--
CDC Aixe	59.5	8.0	38.8	28.9	2604	--
TM 23	62.3	8.5	39.9	29.6	2078	1834
Mean	60.8	8.3	39.3	29.7	2472	--
C.V. (%)	0.6	5.7	3.4	1.6	11.8	--
LSD 0.10	0.5	NS	NS	0.7	400	--
LSD 0.05	0.6	NS	NS	0.8	504	--

Planting Date = May 3; Harvest Date = August 23; Previous Crop = Buckwheat Cover Crop

Lodging score: 0 = no lodging; 9 = plants lying flat

Emmer - Organic **Carrington**

Variety	Days to Heading	Plant Lodge	Plant Height	Test Weight	Grain Yield 2019	Grain Yield 2-yr. Avg.
		0 to 9	inch	lb/bu	lb/ac	lb/ac
CDC Tatra	59.8	5.3	34.3	30.9	2122	--
CDC Yon	58.8	3.0	37.8	30.8	2482	--
Lucille	60.8	5.5	36.8	32.3	2797	2535
ND Common	61.5	7.3	32.1	32.3	2535	2429
Mean	60.2	5.3	35.2	31.6	2484	--
C.V. (%)	1.4	11.0	5.0	4.5	9.0	--
LSD 0.10	1.1	0.7	2.3	NS	291	--
LSD 0.05	1.3	0.9	2.8	NS	359	--

Planting Date = May 8; Harvest Date = August 22; Previous Crop = Buckwheat Cover Crop

Lodging Score: 0 = no lodging; 9 = plants lying flat.

Variety	Winter Survival	Vigor	Early Plant Height	Jday of Heading	Plant Lodge	Plant Height	1000 KWT	Grain Protein	Test Weight	-- Grain Yield -- 2019	3-yr. Avg.
	%	1-10	inch		0 to 9	inch	gram	%	lb/bu	------ bu/ac ------	
Hancock	63.8	2.0	13.3	161.8	3.0	44.2	27.7	12.1	50.6	43.8	54.5
Spooner	80.0	5.8	13.8	161.0	3.3	44.1	25.0	12.2	49.3	44.6	50.1
Rymin	92.3	7.0	11.9	162.5	3.0	45.8	27.1	10.8	50.3	48.9	66.3
ND Dylan	93.8	4.5	12.0	163.0	2.5	44.7	24.0	11.2	49.4	45.5	64.2
Dacold	87.8	3.5	11.2	165.3	2.0	45.1	27.6	11.0	50.2	43.9	57.2
Aroostok	92.0	5.0	14.1	157.8	3.5	47.0	22.5	13.4	49.6	32.3	38.3
Hazlet	94.5	7.3	12.8	163.0	2.0	43.0	28.9	10.8	50.8	53.0	61.3
Wheeler	85.8	3.0	11.4	166.0	0.5	51.2	30.4	16.1	46.3	9.8	15.3
Brasetto	94.3	7.0	12.3	163.3	0.0	34.2	24.8	10.0	47.6	46.4	71.6
Bono	91.5	6.0	11.2	163.0	0.8	33.3	24.9	9.6	50.2	60.7	--
ND Gardner	95.5	8.5	14.4	156.8	3.5	43.9	22.7	12.5	49.7	42.3	53.0
Mean	88.3	42.1	12.6	162.1	2.2	43.3	25.9	11.8	49.5	42.8	--
C.V. (%)	7.0	5.4	10.5	0.5	34.5	5.4	5.0	1.8	0.9	16.0	--
LSD 0.10	7.5	2.7	1.6	1.0	0.9	2.9	1.6	0.3	0.6	8.2	--
LSD 0.05	9.0	3.3	1.9	1.2	1.1	3.5	1.9	0.3	0.7	9.9	--

Planting Date = September 18; Harvest Date = August 1; Previous Crop = Wheat

Lodging Score: 0 = no lodging; 9 = plants lying flat.

Cool-season forage variety trial.

Winter Rye - Organic **Carrington**

Variety	Winter Survival	Vigor	Early Plant Height	Jday of Heading	Plant Lodge	Plant Height	1000 KWT	Grain Protein	Test Weight	Grain Yield 2019	Grain Yield 2-yr. Avg.	Grain Yield 3-yr. Avg.
	%	1-10	inch		0 to 9	inch	gram	%	lb/bu	bu/ac	bu/ac	bu/ac
Hancock	61.3	2.3	14.2	161.5	1.8	46.3	32.5	12.5	51.2	53.9	60.2	63.8
Spooner	89.0	6.3	16.0	159.0	1.5	46.1	29.4	12.5	50.4	60.6	58.0	59.1
Rymin	89.5	7.8	13.8	161.5	2.5	46.4	32.2	11.2	51.9	68.9	71.8	75.8
ND Dylan	94.8	9.0	13.7	161.5	3.0	48.6	26.7	11.1	51.1	69.3	70.3	71.8
Dacold	86.0	7.0	12.9	164.0	2.3	43.0	33.0	11.2	51.9	67.0	66.9	68.9
Aroostok	91.3	8.0	15.8	156.5	2.8	48.0	25.6	13.4	50.7	53.8	50.4	48.9
Hazlet	92.3	8.3	12.6	162.0	1.8	44.3	33.4	11.0	52.1	68.5	72.2	74.5
Wheeler	89.0	5.8	13.0	165.0	0.3	53.3	37.4	15.8	44.8	20.6	21.5	22.2
Brasetto	95.3	9.8	12.6	162.3	0.0	36.1	28.0	10.1	49.8	61.7	73.6	76.6
Bono	95.0	9.5	12.8	162.0	0.0	34.9	28.7	9.7	51.8	83.9	--	--
ND Gardner	95.5	9.5	17.2	155.3	2.0	46.3	27.1	13.0	51.3	57.8	60.4	58.5
Mean	89.0	7.5	14.1	161.0	1.6	44.9	30.4	11.9	50.6	60.4	--	--
C.V. (%)	4.9	12.3	8.3	0.3	39.0	4.7	2.4	1.6	0.9	11.7	--	--
LSD 0.10	5.2	1.1	1.4	0.5	0.8	2.6	0.9	0.2	0.6	8.5	--	--
LSD 0.05	6.3	1.3	1.7	0.6	0.9	3.1	1.1	0.3	0.7	10.2	--	--

Planting Date = September 19; Harvest Date = August 2; Previous Crop = Buckwheat Cover Crop

Faba bean variety trial.

Variety	Height	Heading Date	Lodge[1]	Protein	Test Weight	KWT	Grain Yield Yield	Grain Yield 3-yr. Avg.
	inch		0 to 9	%	lb/bu	g/1000	bu/ac	bu/ac
NT09404	41.2	6/14	3.3	16.8	47.4	28.4	52.2	--
NE96T441	44.4	6/15	4.0	18.0	50.2	28.2	52.3	--
NT11406	37.8	6/17	2.0	17.0	48.6	25.7	45.7	59.2
NT13443	51.5	6/15	3.8	17.3	50.0	29.7	57.0	--
NT13416	44.6	6/15	3.0	17.7	50.0	28.6	45.9	53.7
NT12414	36.9	6/17	1.3	19.1	43.6	20.6	32.9	--
NT11428	48.6	6/14	3.5	16.4	49.8	28.4	57.0	57.6
NT09423	39.1	6/18	1.0	17.6	48.2	24.3	41.5	54.6
NT07403	36.9	6/13	1.8	18.2	46.3	22.4	42.7	48.1
NT12434	35.6	6/19	1.3	18.5	42.4	22.1	38.5	--
NT12403	42.6	6/16	1.8	17.1	49.3	26.5	45.1	--
Mean	41.7	6/16	2.4	17.6	47.8	25.9	46.4	--
C.V. (%)	7.1	0.1	23.7	4.6	2.7	9.9	16.7	--
LSD (0.10)	3.5	1.4	0.7	1.0	1.5	3.1	9.3	--
LSD (0.05)	4.3	2.0	0.8	1.2	1.9	3.7	11.2	--

Planting Date = September 18, 2018 ; Harvest Date = August 7 ; Previous Crop = Spring Wheat

[1]Lodging score: 0 = no lodging; 9 = plants lying flat

Organic intercropping demonstration.

Brand	Variety	Mat. Group[1]	Days to PM[2]	Pod Ht	Plant Ht	Seeds/ pound	Seed Oil	Seed Protein	Test Weight	Seed Yield 2019	Seed Yield 2-yr. Avg.	Seed Yield 3-yr. Avg.
				inch	inch		%	%	lb/bu	bu/ac	bu/ac	bu/ac
Conventional												
NDSU	ND Benson	0.4	117.8	4.1	32.1	3090	17.4	36.6	55.0	59.4	40.4	42.7
NDSU	ND Rolette	00.9	113.0	2.2	32.7	3691	17.7	35.8	55.4	52.8	40.9	42.9
NDSU	ND Henson	0.0	113.0	3.3	30.1	3070	18.4	34.7	55.7	57.8	40.2	40.4
NDSU	ND Stutsman	0.7	122.8	3.7	33.9	3102	17.7	34.4	55.3	65.6	45.2	50.9
NDSU	Ashtabula	0.4	116.0	2.4	35.8	3068	18.4	34.8	54.7	60.9	43.1	44.9
NDSU	Sheyenne	0.7	121.3	2.6	36.2	3164	17.4	34.5	54.9	56.1	41.9	47.0
Richland IFC	MK0249	0.2	115.8	2.8	29.3	4646	16.9	35.5	54.8	51.0	35.5	38.8
Richland IFC	MK0603	0.6	122.5	4.3	34.1	5055	15.1	38.1	55.4	39.0	26.9	32.7
Richland IFC	MK42	0.7	120.3	4.5	39.0	2532	15.8	38.7	55.4	51.6	35.0	--
Richland IFC	MK0508	0.8	122.0	6.3	34.4	5375	16.2	36.8	56.0	44.4	27.5	32.2
Richland IFC	MK808CN	0.8	121.3	3.3	33.1	3417	17.4	35.4	55.3	52.4	33.9	41.2
Sevita Int.	Panorama	0.3	117.0	3.0	32.8	2449	16.7	38.2	54.4	58.7	--	--
Sevita Int.	Genesis	0.9	124.0	5.9	35.4	2502	17.3	35.7	54.5	58.2	--	--
Sevita Int.	Emperor	1.0	127.5	3.2	34.8	2071	17.0	37.4	54.2	66.3	--	--
Sevita Int.	Skyline	1.1	135.0	3.4	36.4	2554	16.7	38.4	56.0	60.6	--	--
Caldbeck Consulting	ATSOY111298	0.5	118.0	3.7	39.9	2677	16.6	38.1	54.6	58.8	35.8	--
U of Minn	MN0810CN	0.8	124.0	3.8	36.4	3323	16.5	37.2	54.7	53.0	32.1	--
U of Minn	MN0083	00.8	113.0	3.9	36.8	3404	17.0	36.5	54.3	48.9	--	--
Liberty Link												
Latham	L0842L	0.8	130.3	5.1	34.3	2541	16.7	36.3	54.9	71.7	--	--
Latham	L0643L	0.6	124.3	2.8	33.9	2443	16.7	34.4	55.3	73.3	--	--
	MEAN		121.4	3.7	34.5	3080	17.2	35.9	54.9	58.0	--	--
	C.V. (%)		1.2	52.1	10.1	4.1	1.4	1.5	0.6	8.4	--	--
	LSD 0.10		1.8	NS	4.1	148	0.3	0.6	0.4	5.7	--	--
	LSD 0.05		2.1	NS	4.9	177	0.4	0.7	0.5	6.8	--	--

Planting Date = May 20 ; Harvest Date = October 31 ; Previous Crop = Durum

[1] Maturity group based on data provided by seed company.

[2] Days to PM: average of 121 = September 18.

* Plant lodging scores not recorded: Lodging was variable due to differential snow accumulations from Oct.10-11 blizzard.

Brand	Variety	Trait	Mat. Group[1]	Days to PM[2]	Pod Ht	Plant Ht	Seeds/ pound	Seed Oil	Seed Protein	Test Weight	------ Seed Yield ------ 2019	2-yr. Avg.	3-yr. Avg.
					inch	inch		%	%	lb/bu	--------- bu/ac ---------		
Croplan	RX0500	RR2XT	0.5	120.8	3.9	34.6	2734	17.8	34.8	56.2	68.4	--	--
Croplan	RX0700	RR2XT	0.7	122.8	3.5	32.3	2708	17.4	34.7	55.6	59.7	--	--
Dairyland Seed	DSR-C999R2Y	RR2Y	00.9	116.0	3.0	31.7	2362	17.7	35.2	55.3	59.9	47.0	--
Dairyland Seed	DSR-0200/R2Y	RR2Y	0.2	113.8	3.0	35.4	2229	17.1	36.0	56.7	59.7	--	--
Dairyland Seed	DSR-0577E	Enlist	0.5	123.0	2.8	31.5	2761	17.4	35.8	56.3	45.6	--	--
Dairyland Seed	DSR-0717E	Enlist	0.7	124.3	3.9	31.7	2838	17.5	35.7	56.1	70.9	--	--
Dairyland Seed	DSR0847E	Enlist	0.8	128.3	3.0	31.3	2642	18.1	34.4	58.5	68.4	--	--
Dyna-Gro	S03XT29	RR2XT	0.3	115.3	2.4	31.3	3007	17.1	34.9	56.2	69.6	51.8	--
Dyna-Gro	S05EN70	Enlist	0.5	121.3	4.1	31.9	2659	17.5	34.6	55.7	59.5	--	--
Dyna-Gro	S06XT59	RR2XT	0.6	122.8	3.4	34.1	3008	17.0	34.6	56.8	65.8	45.9	48.0
Genesis Distributed by Legend	G0440E	Enlist	0.4	119.3	4.1	30.7	2558	17.3	35.4	56.2	60.7	--	--
Integra	40129	Enlist	0.1	115.0	3.1	31.9	3405	17.6	35.1	56.2	60.2	--	--
Integra	40209	Enlist	0.2	114.0	3.6	36.3	3435	17.0	35.7	55.8	54.5	--	--
Integra	20215	RR2Y	0.2	114.5	3.7	29.5	2771	16.9	36.0	56.3	56.1	50.2	53.1
Integra	20300	RR2Y	0.3	121.5	3.0	30.9	2915	16.6	36.0	56.3	65.8	48.4	50.4
Integra	50309N	RR2XT	0.3	116.5	3.6	34.3	3031	17.1	34.8	55.8	66.3	51.5	--
Latham	L0438R2X	RR2XT	0.4	119.8	2.8	31.9	2345	17.6	34.3	56.4	64.0	--	--
Latham	L0595E3	Enlist	0.5	121.3	4.9	34.1	2681	17.7	34.3	55.9	62.9	--	--
Latham	L0553R2X	RR2XT	0.5	122.0	3.0	31.7	2439	17.6	35.3	56.2	67.2	--	--
Latham	L0883R2X	RR2XT	0.8	124.8	4.7	31.6	2920	17.1	34.5	56.9	68.5	--	--
Latham	L0982R2	RR2Y	0.9	126.8	3.7	32.5	2837	17.3	35.0	57.2	64.3	--	--
Legacy Seeds	LS-0438 RR2X	RR2XT	0.4	121.8	3.0	32.3	2597	17.8	35.4	55.4	65.9	49.8	53.2
Legacy Seeds	LS-0629N E3	Enlist	0.6	121.5	3.3	27.4	2708	17.9	34.7	57.0	64.7	--	--
Legacy Seeds	LS-0638N RR2X	RR2XT	0.6	122.8	3.5	32.5	3048	17.2	34.3	56.2	67.0	47.6	50.8
Legacy Seeds	LS-0738N RR2X	RR2XT	0.7	122.3	2.8	33.5	2705	17.3	35.0	55.9	72.7	49.7	51.7
Legend Seeds	LS 05X050N	RR2XT	0.5	121.0	2.2	32.5	2487	17.6	34.9	56.4	63.6	--	--
Legend Seeds	LS 06X950N	RR2XT	0.6	122.3	3.5	33.9	2654	17.5	34.8	55.5	62.7	46.8	
LG Seeds	LGS0355RX	RR2XT	0.3	115.5	2.6	31.7	3072	17.2	34.6	56.0	66.4	48.7	
LG Seeds	LGS0400RX	RR2XT	0.4	120.3	3.7	33.5	2490	17.5	34.3	55.8	69.0	49.4	
LG Seeds	LGS0735RX	RR2XT	0.7	125.3	3.1	35.4	2734	17.7	34.2	57.4	65.1	--	
NDSU	ND18008GT	GT	00.8	108.0	3.7	28.0	3067	17.8	36.0	56.9	50.1	39.4	41.1
NDSU	ND17009GT	GT	00.9	110.5	4.1	31.1	2572	18.2	36.5	58.6	56.2	43.7	45.5
NK Seeds	S02-F9X	RR2XT	0.2	115.3	3.4	31.3	2911	17.9	33.7	56.8	64.0	--	--
NK Seeds	S03-S6X	RR2XT	0.3	117.5	3.0	30.5	2928	17.0	34.4	56.3	56.6	--	--
	MEAN			120.9	3.4	31.8		17.3	35.3	56.4	64.7	--	--
	C.V. (%)			1.3	37.3	10.4		1.3	1.0	0.9	7.5	--	--
	LSD 0.10			1.8	NS	NS		0.27	0.4	0.6	5.6	--	--
	LSD 0.05			2.2	NS	NS		0.32	0.5	0.7	6.7	--	--

Planting Date = May 21 ; Harvest Date = October 30 ; Previous Crop = Durum

Brand	Variety	Trait	Mat. Group[1]	Days to PM[2]	Pod Ht	Plant Ht	Seeds/ pound	Seed Oil	Seed Protein	Test Weight	------ Seed Yield ------ 2019	2-yr. Avg.	3-yr. Avg.
					inch	inch		%	%	lb/bu	--------- bu/ac ---------		
NK Seeds	S05-N5X	RR2XT	0.5	120.5	2.5	30.3	2553	17.8	33.8	56.2	76.4	--	--
NK Seeds	S06-K4X	RR2XT	0.6	120.8	3.0	29.3	2684	16.4	35.3	56.6	69.2	--	--
NK Seeds	S07-Q4X	RR2XT	0.7	123.3	3.6	31.6	2500	17.3	35.0	55.8	72.1	--	--
NorCan	Nor0814	GT	0.8	141.0	2.5	32.7	3135	18.2	35.8	56.3	62.9	--	--
NorCan	Nor08	GT	0.8	143.0	4.7	35.0	3357	18.3	37.1	52.4	61.3	42.8	--
Northstar	NS 60264NXR2	RR2XT	0.2	116.3	3.5	32.1	3017	17.2	34.6	56.2	59.1	43.2	--
Northstar	NS 90334E3	Enlist	0.3	119.8	3.7	31.3	2551	17.1	35.5	56.4	62.4	--	--
Northstar	NS 80405LG+	LLGT27	0.4	124.3	4.1	32.1	2703	16.6	36.2	56.8	66.5	--	--
Northstar	NS 90544NE3	Enlist	0.5	120.0	3.0	31.1	2875	18.1	34.8	57.1	69.2	--	--
Northstar	NS 60555NXR2	RR2XT	0.5	120.8	3.1	33.1	2462	17.5	35.2	56.3	69.4	--	--
Northstar	NS 90764NE3	Enlist	0.7	123.0	3.2	29.3	2664	17.4	36.3	55.4	73.0	--	--
Northstar	NS 80854LG+	LLGT27	0.8	125.0	3.1	35.2	3114	16.8	37.1	56.7	72.8	--	--
Northstar	NS 60823NXR2	RR2XT	0.8	122.8	3.0	29.3	2643	17.3	34.7	55.9	67.3	48.9	--
Peterson Farm Seed	19X03	RR2XT	0.3	115.0	2.4	32.7	3048	17.3	34.8	56.1	61.8	50.0	--
Peterson Farm Seed	20X05	RR2XT	0.5	121.5	3.1	29.5	2525	17.8	34.9	56.3	64.8	--	--
Proseed	XT 80-20	RR2XT	0.2	117.5	2.7	32.9	2955	17.1	34.9	56.1	61.5	47.1	--
Proseed	BX 80-35	LLGT27	0.3	120.5	3.1	29.7	2913	16.9	38.0	56.7	70.5	--	--
Proseed	EL 80-33	Enlist	0.3	120.3	3.9	32.3	2653	17.1	35.8	56.2	63.6	--	--
Proseed	XT 60-40	RR2XT	0.4	118.3	3.0	31.5	2662	17.4	35.4	55.7	66.4	54.6	--
REA Hybrids	RX0330	RR2XT	0.3	122.0	3.5	31.3	2874	17.1	34.8	56.1	52.2	--	--
REA Hybrids	RX0520	RR2XT	0.5	121.8	3.5	30.3	2312	17.1	36.0	56.7	69.3	--	--
REA Hybrids	RX0719	RR2XT	0.7	120.8	2.6	32.1	2840	17.6	35.5	55.7	64.2	49.1	--
Thunder	SB8903N	RR2XT	0.3	116.8	3.1	30.4	3002	17.1	34.8	56.2	64.6	49.6	--
Thunder	TE7906N	Enlist	0.6	122.3	3.4	30.3	2912	17.9	34.8	56.9	63.7	--	--
Thunder	SB8906N	RR2XT	0.6	121.5	3.0	34.5	2557	17.5	34.7	55.0	64.9	47.4	--
Thunder	SB8807N	RR2XT	0.7	124.0	2.9	35.2	3069	17.2	34.4	56.8	64.8	--	--
Thunder	SB8009N	RR2XT	0.9	126.0	3.3	30.9	2889	17.0	34.5	57.2	61.0	--	--
	MEAN			120.9	3.4	31.8		17.3	35.3	56.4	64.7	--	--
	C.V. (%)			1.3	37.3	10.4		1.3	1.0	0.9	7.5	--	--
	LSD 0.10			1.8	NS	NS		0.27	0.4	0.6	5.6	--	--
	LSD 0.05			2.2	NS	NS		0.32	0.5	0.7	6.7	--	--

Planting Date = May 21 ; Harvest Date = October 30 ; Previous Crop = Durum

[1] Maturity group based on data provided by seed company.

[2] Days to PM: average of 121 = September 19.

* Plant lodging scores not recorded: Lodging was variable due to differential snow accumulations from Oct.10-11 blizzard.

Brand	Variety	Mat. Group[1]	Days to PM[2]	Pod Ht	Plant Ht	Seeds/ pound	Seed Oil	Seed Protein	Test Weight	Seed Yield 2019	Seed Yield 3-yr. Avg.
				inch	inch		%	%	lb/bu	bu/ac	bu/ac
Conventional											
NDSU	ND Benson	0.4	118.0	4.9	31.9	3000	17.1	37.5	57.3	54.3	54.0
NDSU	ND Rolette	00.9	113.3	3.8	34.1	3814	17.4	36.2	58.2	57.9	54.5
NDSU	ND Henson	0.0	112.5	3.9	30.3	2901	17.9	36.3	59.5	52.2	53.6
NDSU	ND Stutsman	0.7	121.5	5.3	38.0	3106	17.5	35.6	58.1	61.2	60.0
NDSU	Ashtabula	0.4	116.5	3.8	35.8	3081	18.1	35.6	57.2	58.7	56.1
NDSU	Sheyenne	0.7	120.0	4.3	33.3	3119	17.5	36.1	58.0	63.9	58.3
Sevita Int.	Panorama	0.3	117.0	4.5	30.5	2465	16.5	39.6	57.5	57.3	--
Sevita Int.	Genesis	0.9	125.8	6.3	36.2	2353	17.2	37.4	56.8	57.6	--
Sevita Int.	Emperor	1.0	124.0	6.0	35.4	2049	17.1	38.6	57.5	64.0	--
Sevita Int.	Skyline	1.1	127.8	4.9	34.3	2344	17.1	38.6	59.0	62.5	--
U of Minn	MN0810CN	0.8	121.3	5.4	37.2	3066	16.4	39.4	57.4	51.0	--
U of Minn	MN0083	0.8	110.8	5.5	37.1	3278	17.2	37.1	57.6	49.9	--
Liberty Link											
Latham	L0842L	0.8	124.3	6.6	37.8	2329	16.9	37.4	57.9	59.9	--
Latham	L0643L	0.6	121.5	4.7	31.5	2433	17.0	35.4	57.8	62.3	--
	MEAN		118.8	4.7	34.2	2803	17.4	36.8	57.8	57.4	--
	C.V. (%)		1.2	33.9	7.2	4.0	1.9	1.4	1.2	11.9	--
	LSD 0.10		1.7	NS	2.9	132	0.4	0.6	0.8	8.1	--
	LSD 0.05		2.1	NS	3.5	158	0.5	0.7	1.0	9.7	--

Planting Date = May 21 ; Harvest Date = October 29 ; Previous Crop = Durum

[1] Maturity group based on data provided by seed company.

[2] Days to PM: average of 119 = September 17.

* Plant lodging scores not recorded: Lodging was variable due to differential snow accumulations from Oct.10-11 blizzard.

Brand	Variety	Trait	Mat. Group[1]	Days to PM[2]	Pod Ht	Plant Ht	Seeds/ pound	Seed Oil	Seed Protein	Test Weight	Seed Yield 2019	Seed Yield 2-yr. Avg.	Seed Yield 3-yr. Avg.
					inch	inch		%	%	lb/bu	bu/ac	bu/ac	bu/ac
Dairyland Seed	DSR-0200/R2Y	RR2Y	0.2	117.3	4.8	39.9	2377	17.0	37.1	57.1	62.5	--	--
Dairyland Seed	DSR-0577E	Enlist	0.5	126.0	4.5	34.1	2857	16.9	37.1	55.8	52.9	--	--
Dairyland Seed	DSR-0717E	Enlist	0.7	127.8	5.1	35.3	2853	16.8	37.5	55.8	68.3	--	--
Dairyland Seed	DSR0847E	Enlist	0.8	128.8	7.0	34.1	2810	17.6	35.9	58.0	69.3	--	--
Dyna-Gro	S03XT29	RR2XT	0.3	117.8	3.9	34.4	3266	17.1	35.8	55.9	68.2	72.5	--
Dyna-Gro	S05EN70	Enlist	0.5	125.0	4.5	34.1	2928	17.1	35.5	55.4	59.9	--	--
Dyna-Gro	S06XT59	RR2XT	0.6	126.0	5.1	35.6	3138	16.8	35.3	55.4	66.6	68.9	--
Integra	40209	Enlist	0.2	117.3	5.0	32.3	3477	16.5	36.9	55.8	53.7	--	--
Integra	50309N	RR2XT	0.3	118.8	5.3	36.0	3237	17.2	35.6	56.1	62.8	70.9	--
Latham	L0438R2X	RR2XT	0.4	124.5	5.7	34.8	2745	17.0	35.6	56.2	67.5	--	--
Latham	L0595E3	Enlist	0.5	125.0	5.3	32.3	2765	17.2	35.6	54.6	57.9	--	--
Latham	L0553R2X	RR2XT	0.5	125.5	4.6	34.3	2665	17.7	36.2	56.4	70.9	--	--
Latham	L0883R2X	RR2XT	0.8	130.8	4.1	34.3	3014	16.8	36.3	57.3	67.1	--	--
Latham	L0995E3	Enlist	0.9	128.0	3.8	32.8	3156	17.0	35.7	56.4	65.0	--	--
Latham	L0982R2	RR2Y	0.9	130.8	5.6	34.6	2720	17.0	35.8	56.3	77.3	--	--
Legacy Seeds	LS-0438 RR2X	RR2XT	0.4	122.8	4.0	34.9	2783	17.9	36.7	55.7	73.5	76.2	72.7
Legacy Seeds	LS-0629N E3	Enlist	0.6	126.0	4.6	31.8	3172	17.7	35.5	58.0	62.3	--	--
Legacy Seeds	LS-0738N RR2X	RR2XT	0.7	126.3	3.1	35.1	2797	16.8	36.1	55.8	76.8	76.3	72.5
Legacy Seeds	LS-0829 E3	Enlist	0.8	126.5	4.7	34.6	2938	16.8	37.4	55.1	66.3	--	--
LG Seeds	LGS0355RX	RR2XT	0.3	118.5	5.7	36.3	3191	17.1	35.9	56.0	62.3	64.7	--
LG Seeds	LGS0400RX	RR2XT	0.4	122.0	4.2	35.0	2921	17.4	35.3	55.3	70.8	--	--
LG Seeds	LGS0735RX	RR2XT	0.7	126.5	4.6	34.3	2767	17.5	35.2	56.1	66.6	--	--
NDSU	ND18008GT	GT	00.8	114.3	3.3	31.1	2944	17.3	37.9	56.8	50.1	57.8	--
NDSU	ND17009GT	GT	00.9	115.3	4.7	35.6	3333	17.6	38.5	58.6	59.9	62.1	--
Norcan Seed	Nor08	GT	0.8	na[3]	5.5	43.1	3283	18.3	36.6	46.7	52.9	--	--
Peterson Farm Seeds	19X03	RR2XT	0.3	117.8	4.5	36.0	3385	17.1	35.6	56.4	64.9	69.0	--
Peterson Farm Seeds	20X05	RR2XT	0.5	125.3	4.8	33.5	2760	17.4	36.3	55.1	70.3	--	--
Proseed	XT 80-20	RR2XT	0.2	118.3	3.9	35.2	3228	16.9	35.7	55.3	61.1	69.9	--
Proseed	BX 80-35	LLGT27	0.3	124.0	5.0	33.5	3068	16.8	38.2	56.3	71.4	--	--
Proseed	EL 80-33	Enlist	0.3	123.0	5.4	34.1	2770	17.0	37.0	56.0	64.3	--	--
Proseed	XT 60-40	RR2XT	0.4	121.8	3.9	34.6	2765	17.1	36.4	55.4	73.8	74.8	--
REA Hybrids	RX0330	RR2XT	0.3	121.0	4.7	36.4	2872	17.0	35.6	55.6	61.6	--	--
REA Hybrids	RX0520	RR2XT	0.5	125.5	4.8	35.0	2698	16.5	37.0	55.9	72.0	--	--
REA Hybrids	RX0719	RR2XT	0.7	125.8	4.2	35.2	2913	17.4	36.2	56.1	67.4	72.4	--
Thunder	SB8903N	RR2XT	0.3	117.0	3.5	34.3	3324	17.4	35.7	56.2	58.1	67.9	--
Thunder	TE7906N	Enlist	0.6	126.0	3.1	30.3	3081	17.6	35.6	57.3	65.4	--	--
Thunder	SB8906N	RR2XT	0.6	126.0	3.9	38.4	2632	17.2	36.2	55.2	72.0	74.6	--
Thunder	SB8807N	RR2XT	0.7	126.0	4.5	34.3	3143	17.0	35.1	55.9	66.1	--	--
Thunder	SB8009N	RR2XT	0.9	130.3	4.5	36.2	3114	16.6	36.3	56.7	71.7	--	--
	MEAN			123.4	4.6	34.6	2970	17.1	36.3	56.2	65.0	--	--
	C.V. (%)			0.7	32.7	6.4	5.1	2.1	0.8	1.4	10.5	--	--
	LSD 0.10			1.0	NS	2.6	177	0.4	0.3	0.9	7.9	--	--
	LSD 0.05			1.2	NS	3.1	211	0.5	0.4	1.1	9.4	--	--

Planting Date = May 21 ; Harvest Date = October 29 ; Previous Crop = Soybean

[1] Maturity group based on data provided by seed company.

[2] Days to PM: average of 123 = September 21.

[3] The line did not reach physiological maturity.

* Plant lodging scores not recorded: Lodging was variable due to differential snow accumulations from Oct.10-11 blizzard.

Brand	Variety	Mat. Group[1]	Days to PM[2]	Pod Ht inch	Plant Ht inch	Plant Lodge 0 to 9	Seeds/ pound	Seed Oil[3] %	Seed Protein[3] %	Test Weight lb/bu	Seed Yield ----- 2019 -------- bu/ac	Seed Yield ----- 2-yr. Avg. -------- bu/ac	Seed Yield ----- 3-yr. Avg. -------- bu/ac
Conventional													
NDSU	ND Benson	0.4	111.5	1.8	34.6	2.0	3164	16.0	38.0	56.7	50.8	57.2	57.0
NDSU	ND-Rolette	00.9	106.8	2.8	33.7	1.8	4010	16.7	36.0	57.1	52.9	57.4	55.7
NDSU	ND Henson	0.0	106.8	2.8	32.1	4.0	3359	17.2	35.7	57.4	51.6	54.7	54.5
NDSU	ND Stutsman	0.7	114.5	1.4	31.7	3.3	3625	16.4	35.9	57.0	58.0	60.1	61.2
NDSU	Ashtabula	0.4	109.3	3.3	35.6	3.8	3475	17.0	36.2	56.2	62.6	61.0	58.1
NDSU	Sheyenne	0.7	112.8	2.6	33.7	2.3	3481	16.4	35.5	56.8	58.4	62.8	60.6
Richland IFC	MK0249	0.2	109.8	3.1	33.3	3.0	5109	15.4	36.9	56.8	46.3	50.2	50.2
Richland IFC	MK0603	0.6	118.3	2.8	33.7	7.5	5339	14.0	39.2	56.7	39.5	47.0	46.1
Richland IFC	MK42	0.7	112.5	2.6	32.3	2.5	2629	14.8	39.7	56.8	54.1	58.6	--
Richland IFC	MK0508	0.8	115.5	2.4	36.2	7.0	5917	14.9	38.3	57.7	43.3	50.8	50.2
Richland IFC	MK808CN	0.8	114.3	2.6	37.8	4.0	3478	16.6	36.6	56.5	61.2	66.7	63.3
Richland IFC	MK1016	1.0	121.0	2.6	30.7	6.3	4977	15.0	38.4	56.6	39.8	49.1	48.5
Richland IFC	MK9101	1.1	121.0	2.2	34.4	4.5	2363	16.4	na	56.0	59.8	62.2	57.6
Richland IFC	MK146	1.1	121.0	2.0	31.9	2.8	2936	16.3	37.7	55.4	55.1	62.7	--
Richland IFC	MK41	1.1	111.8	1.8	35.4	5.5	2588	15.0	38.8	56.1	56.5	60.4	58.5
U of Minn	MN0810CN	0.8	117.8	2.2	35.8	3.8	3676	15.5	38.7	55.8	50.3	57.0	--
U of Minn	MN0083	00.8	106.0	3.1	36.6	3.8	3749	16.1	37.2	56.3	51.0	--	--
Liberty Link													
Latham	L0842L	0.8	118.0	3.7	36.2	2.3	2570	15.9	37.2	55.9	65.6	--	--
Dairyland Seed	DSR-0929L	0.9	113.5	2.6	31.7	3.0	2706	16.6	36.9	56.1	65.0	--	--
Latham	L0643L	0.6	112.8	2.8	34.1	3.5	2671	15.9	35.5	56.5	62.1	--	--
	MEAN		113.6	3.7	34.1	2.6	3396	16.1	37.9	56.4	55.5	--	--
	C.V. (%)		1.7	32.8	9.0	46.7	5.0	1.5	1.1	0.5	8.6	--	--
	LSD 0.10		2.3	1.4	3.6	NS	198	0.28	0.5	0.36	5.6	--	--
	LSD 0.05		2.7	1.7	NS	NS	237	0.34	0.6	0.43	6.7	--	--

Planting Date = June 5 ; Harvest Date = October 21 ; Previous Crop = Spring Wheat

[1] Maturity group based on data provided by seed company.

[2] Days to PM: average of 114 = September 27.

[3] Seed oil and protein contents reported at 13% moisture.

Lodging Score: 0 = no lodging; 9 = plants lying flat.

Brand	Variety	Trait	Mat. Group[1]	Days to PM[2]	Pod Ht	Plant Ht	Plant Lodge	Seeds/ pound	Seed Oil	Seed Protein	Test Weight	Seed Yield 2019	Seed Yield 2-yr. Avg.	Seed Yield 3-yr. Avg.
					inch	inch	0 to 9		%	%	lb/bu	bu/ac	bu/ac	bu/ac
Dairyland Seed	DSR-0717E	Enlist	0.7	118.0	1.9	30.9	3.3	3432	15.6	35.8	55.5	56.5	--	--
Dairyland Seed	DSR0847E	Enlist	0.8	121.0	3.0	31.3	6.3	3222	16.2	35.3	55.6	47.1	--	--
Dairyland Seed	DSR0988-R2Y	RR2Y	0.9	120.3	2.4	32.5	2.5	3267	15.9	34.0	55.8	55.6	64.5	63.4
Dairyland Seed	DSR-1120/R2Y	RR2Y	1.1	121.0	1.6	32.5	5.0	2747	16.5	34.4	55.4	66.8	69.1	--
Dyna-Gro	S06XT59	RR2XT	0.6	114.3	1.4	31.7	2.0	3519	15.8	34.4	56.2	54.6	61.9	--
Dyna-Gro	S07XT28	RR2XT	0.7	113.3	2.2	32.9	3.0	3252	15.8	34.7	55.3	57.1	61.5	61.4
Dyna-Gro	S09XT50	RR2XT	0.9	120.0	2.6	30.1	3.5	3200	15.5	34.6	55.9	58.2	--	--
Genesis Distributed by Legend	G0641E	Enlist	0.7	117.5	3.0	29.1	5.0	3413	15.8	35.8	56.0	57.4	--	--
Integra Seed	50629		0.6	116.3	2.0	32.7	4.5	3424	15.5	34.6	55.6	49.6	--	--
Integra Seed	40829	Enlist	0.8	114.8	3.5	30.1	3.0	3454	15.6	35.9	55.7	67.2	--	--
Latham	L0595E3	Enlist	0.5	113.3	3.1	32.3	3.3	3121	15.9	34.2	55.4	55.0	--	--
Latham	L0883R2X	RR2XT	0.8	121.0	2.6	29.1	3.0	3233	15.5	34.3	55.3	56.4	--	--
Latham	L0995E3	Enlist	0.9	120.3	3.3	29.3	3.3	3668	15.9	34.3	55.4	50.7	--	--
Latham	L0982R2	RR2Y	0.9	121.0	3.1	33.9	6.5	3077	16.0	34.4	54.9	68.7	--	--
Latham	L1039R2X	RR2XT	1.0	121.0	2.8	32.3	4.8	2884	16.4	33.6	55.2	59.4	--	--
Legacy Seeds	LS-0738N	RR2XT	0.7	114.8	1.4	30.7	2.5	3265	16.0	34.2	55.2	55.5	63.6	62.7
Legacy Seeds	LS-0830N	RR2XT	0.8	119.3	3.0	32.1	3.3	3192	15.5	34.2	55.0	57.9	--	--
Legacy Seeds	LS-1138N	RR2XT	1.1	120.3	2.2	33.1	4.3	3002	16.3	34.8	56.0	65.3	70.6	67.3
Legend Seeds	LS 07X060N	RR2XT	0.7	116.3	1.8	30.9	2.3	3055	16.2	35.0	55.8	57.3	--	--
Legend Seeds	LS 08E965N	Enlist	0.8	117.8	3.7	30.7	3.3	3632	15.8	34.7	56.1	53.2	--	--
Legend Seeds	LS 09X960N	RR2XT	0.9	116.5	2.8	31.5	3.0	3072	15.9	34.2	56.0	51.4	--	--
LG Seeds	LGS0735RX	RR2XT	0.7	119.5	2.8	30.5	2.0	3244	16.2	33.9	56.0	47.2	--	--
LG Seeds	LGS1118RX	RR2XT	1.1	121.0	2.2	26.8	5.0	3261	16.4	33.0	54.8	52.1	--	--
NDSU	ND18008GT	GT	00.8	105.0	2.2	30.7	3.5	3590	16.5	35.6	55.6	55.5	51.3	--
NDSU	ND17009GT	GT	00.9	105.5	2.8	29.3	2.5	3093	16.6	36.2	57.5	52.8	51.5	52.0
NK Seeds	S03-S6X	RR2XT	0.3	109.8	2.0	29.3	2.3	3292	15.8	33.7	55.9	50.3	--	--
NK Seeds	S05-N5X	RR2XT	0.5	110.3	1.4	32.1	1.3	2976	16.1	34.0	55.5	63.7	--	--
NK Seeds	S07-Q4X	RR2XT	0.7	112.8	2.8	29.1	1.8	2893	16.1	34.6	55.8	55.0	--	--
NK Seeds	S09-D4X	RR2XT	0.9	114.8	1.8	31.5	1.3	2815	16.5	32.7	56.5	62.1	--	--
P3 Genetics	1906E	Enlist	0.6	118.0	2.6	27.2	4.8	3475	15.9	35.7	56.5	53.5	--	--
P3 Genetics	1907E	Enlist	0.7	115.8	2.8	32.3	2.3	3291	15.7	35.9	55.1	59.8	--	--
Proseed	EL 80-93	Enlist	0.9	121.0	2.2	30.7	3.8	3358	15.1	35.9	55.8	63.8	--	--
Proseed	XT 90-90	RR2XT	0.9	121.0	2.2	30.7	4.8	3149	15.5	34.9	55.0	52.8	--	--
Proseed	EL 91-23	Enlist	1.2	121.0	2.8	30.7	4.5	3484	14.7	35.2	54.3	48.1	--	--
		MEAN		116.8	2.4	31.2	3.6	3264	15.9	35	55.7	55.9	--	--
		C.V. (%)		1.2	39.6	9.4	44.9	3.4	1.5	1.3	0.9	10.7	--	--
		LSD 0.10		1.6	1.1	3.4	1.9	129	0.28	0.5	0.6	6.9	--	--
		LSD 0.05		1.9	NS	4.0	2.3	153	0.33	0.7	0.7	8.3	--	--

Planting Date = June 5 ; Harvest Date = October 31 ; Previous Crop = Spring Wheat

Brand	Variety	Trait	Mat. Group[1]	Days to PM[2]	Pod Ht inch	Plant Ht inch	Plant Lodge 0 to 9	Seeds/ pound	Seed Oil %	Seed Protein %	Test Weight lb/bu	Seed Yield 2019	Seed Yield 2-yr. Avg. bu/ac	Seed Yield 3-yr. Avg. bu/ac
Proseed	EL 91-33	Enlist	1.3	121.0	3.0	32.7	7.8	3221	15.8	35.1	54.0	52.2	--	--
Proseed	EL 81-13	Enlist	1.1	121.0	2.8	32.5	5.0	3133	15.6	35.2	55.7	59.0	--	--
Thunder	TE7906N	Enlist	0.6	118.0	2.8	28.3	3.3	3496	16.0	35.6	56.0	67.9	--	--
Thunder	SB8906N	RR2XT	0.6	114.5	2.4	36.2	4.0	3086	15.9	34.7	54.9	60.6	66.2	--
Thunder	SB8807N	RR2XT	0.7	114.3	2.8	31.5	3.5	3480	15.7	34.6	55.7	55.9	--	--
Thunder	SB8009N	RR2XT	0.9	121.0	2.6	31.7	4.5	3189	15.5	34.5	55.6	64.4	--	--
Thunder	TE7910N	Enlist	1.0	121.0	2.6	33.5	4.5	3262	15.2	35.5	55.7	53.7	--	--
		MEAN		116.8	2.4	31.2	3.6	3264	15.9	35	55.7	55.9	--	--
		C.V. (%)		1.2	39.6	9.4	44.9	3.4	1.5	1.3	0.9	10.7	--	--
		LSD 0.10		1.6	1.1	3.4	1.9	129	0.28	0.5	0.6	6.9	--	--
		LSD 0.05		1.9	NS	4.0	2.3	153	0.33	0.7	0.7	8.3	--	--

Planting Date = June 5 ; Harvest Date = October 31 ; Previous Crop = Spring Wheat

[1] Maturity group based on data provided by seed company.

[2] Days to PM: average of 117 = September 30.

* Soybean planting rate in this trial was 220,000 pure live seeds per acre.

Integrating crop and livestock production with cover crops.

Brand	Variety	Mat. Group[1]	Days to PM[2]	Pod Ht	Plant Ht	Plant Lodge	Seeds/ pound	Seed Oil[3]	Seed Protein[3]	Test Weight	Seed Yield 2019	Seed Yield 2-yr. Avg.	Seed Yield 3-yr. Avg.
				inch	inch	0 to 9		%	%	lb/bu	bu/ac	bu/ac	bu/ac
Conventional													
NDSU	ND Benson	0.4	121.0	2.4	28.5	1.5	2822	16.0	38.0	56.6	35.1	35.0	36.9
NDSU	ND-Rolette	00.9	110.8	2.8	27.6	0.3	3025	17.4	35.6	56.6	31.4	29.7	--
NDSU	ND Henson	0.0	108.8	2.0	25.2	2.8	2968	17.5	35.0	56.9	41.8	38.3	39.1
NDSU	ND Stutsman	0.7	121.0	2.8	30.9	2.0	2640	16.6	36.2	56.6	40.9	40.1	42.7
NDSU	Ashtabula	0.4	119.5	2.6	30.9	2.0	2455	17.1	36.8	55.8	33.6	33.5	35.9
NDSU	Sheyenne	0.7	116.5	3.0	29.3	1.5	2861	16.9	35.3	56.2	37.9	39.7	41.8
Richland IFC	MK0603	0.6	119.8	2.2	28.9	2.8	4948	16.0	36.4	56.0	26.9	31.2	32.1
Richland IFC	MK42	0.7	117.5	3.0	33.9	1.3	2450	15.1	38.8	56.6	37.8	36.8	39.7
Richland IFC	MK0508	0.8	117.0	2.8	29.7	6.0	5265	16.2	36.1	56.9	33.3	33.8	34.3
Richland IFC	MK808CN	0.8	115.3	2.4	29.3	1.5	3138	17.7	34.4	56.8	36.5	38.7	42.2
Richland IFC	MK1016	1.0	118.5	2.2	30.3	3.0	5277	16.1	35.5	56.9	28.4	32.3	33.6
Richland IFC	MK9101	1.1	121.5	4.1	38.0	3.8	2330	na	na	55.3	37.3	37.3	38.2
Richland IFC	MK146	1.1	125.5	2.2	29.9	3.3	2616	16.6	37.0	55.3	41.9	42.2	--
Richland IFC	MK41	1.1	118.8	2.0	31.1	2.8	2587	15.0	38.9	56.6	45.2	39.7	41.0
U of Minn	MN0810CN	0.8	120.0	3.0	32.9	2.3	3497	16.2	38.1	55.9	38.2	36.1	--
	MEAN		117.3	2.5	30.0	2.2	3069	16.6	36.2	56.2	37.3	--	--
	C.V. (%)		2.9	30.2	8.5	82.9	10.0	3.1	3.0	1.0	13.3	--	--
	LSD 0.10		4.0	0.9	3.0	2.1	361	0.6	1.3	0.7	5.9	--	--
	LSD 0.05		4.8	1.1	3.6	2.6	431	0.7	1.5	0.8	7.0	--	--

Planting Date = June 3 ; Harvest Date = November 6 ; Previous Crop = Spring Wheat

[1] Maturity group based on data provided by seed company.

[2] Days to PM: average of 117 = September 28.

[3] Seed oil and protein contents reported at 13% moisture.

Off-station corn tour at Fingal.

Soybean - Dryland, Roundup Ready Varieties **Tri-County - Wishek**

Brand	Variety	Trait	Mat. Group[1]	Days to PM[2]	Pod Ht	Plant Ht	Plant Lodge	Seeds/ pound	Seed Oil	Seed Protein	Test Weight	--- Seed Yield --- 2019	2-yr. Avg.
					inch	inch	0 to 9		%	%	lb/bu	------ bu/ac ------	
Integra	50510N	RR2XT	0.5	125.0	2.8	32.1	3.0	2369	16.4	35.7	53.7	43.9	--
Integra	50629N	RR2XT	0.6	124.0	2.0	32.1	3.0	3178	16.1	34.3	55.1	39.4	--
Integra	40129	Enlist	0.1	110.8	1.8	30.3	2.3	3322	16.4	36.3	55.4	38.3	--
Integra	40829	Enlist	0.8	120.5	2.2	32.7	2.8	2922	17.0	35.6	54.4	53.8	--
LG Seeds	LGS0735RX	RR2XT	0.7	124.3	2.4	32.8	3.0	2643	16.3	35.1	55.3	51.7	--
LG Seeds	C1000RX	RR2XT	1.0	126.3	2.0	32.5	3.5	2802	16.6	35.4	55.0	51.5	43.8
LG Seeds	LGS1118RX	RR2XT	1.1	126.0	2.8	31.1	6.5	2890	16.8	33.2	54.7	39.4	--
LG Seeds	LGS1337RX	RR2XT	1.3	125.8	2.6	34.6	4.3	2829	17.2	34.3	54.6	46.7	43.6
LG Seeds	LGS1575RX	RR2XT	1.5	127.8	2.6	32.5	3.8	2977	15.8	35.7	54.2	42.9	43.9
NDSU	ND18008GT	GT	00.8	106.5	2.0	28.0	1.8	3102	17.1	36.7	55.3	30.3	--
NDSU	ND17009GT	GT	00.9	107.5	2.2	32.1	1.3	2587	17.4	36.7	55.9	39.7	36.6
P3 Genetics	1906E	Enlist	0.6	124.8	2.2	29.4	6.0	3441	17.0	35.3	55.1	37.1	--
P3 Genetics	1910E	Enlist	1.0	125.5	2.8	32.9	3.3	2909	16.4	35.5	55.3	44.8	--
Proseed	EL 80-93	Enlist	0.9	126.8	2.8	35.0	4.3	2998	16.1	36.2	54.4	47.9	--
Proseed	XT 90-90	RR2XT	0.9	125.0	2.4	32.5	3.0	2831	15.9	35.4	54.9	48.4	--
Proseed	EL 81-13	Enlist	1.1	127.3	2.6	33.3	4.5	2653	16.0	36.1	54.0	43.9	--
Proseed	EL 91-23	Enlist	1.2	128.0	2.8	37.0	5.3	3351	14.7	37.0	52.8	33.8	--
Proseed	EL 91-33	Enlist	1.3	127.5	2.8	35.0	7.0	2748	16.2	35.1	52.8	36.0	--
REA Hybrids	RX0520	RR2XT	0.5	124.5	2.6	32.7	2.3	2384	15.5	36.5	55.0	41.0	--
REA Hybrids	RX0719	RR2XT	0.7	124.3	2.4	32.1	1.5	2699	16.2	35.6	55.3	47.4	42.9
REA Hybrids	RX0929	RR2XT	0.9	123.5	2.6	33.5	1.8	2759	16.1	35.9	55.4	54.8	51.9
REA Hybrids	RX1030	RR2XT	1.0	124.5	1.8	31.3	2.5	2652	16.8	34.1	54.8	48.9	--
	MEAN			122.4	2.3	32	3.4	2888	16.4	35.6	54.8	42.8	--
	C.V. (%)			1.5	26.5	7.1	46.5	4.6	1.7	1.8	1.5	12	--
	LSD 0.10			2.2	NS	2.7	1.8	156	0.3	0.8	1.0	6.1	--
	LSD 0.05			2.6	NS	3.2	2.2	186	0.4	0.9	1.2	7.3	--

Planting Date = June 3 ; Harvest Date = November 6 ; Previous Crop = Spring Wheat

[1] Maturity group based on data provided by seed company.

[2] Days to PM: average of 122 = October 3.

Brand	Variety	Mat Group[1]	Days to PM[2]	Plant Lodge[3] 0 to 9	Seeds/ Pound	Seed Oil[4] %	Seed Protein[4] %	Test Wt lb/bu	Seed Yield -- 2019 bu/ac	Seed Yield -- 2-yr. Avg. bu/ac	Seed Yield -- 3-yr. Avg. bu/ac
Conventional											
NDSU	ND Benson	0.4	111.3	4.0	2753	18.1	35.6	57.2	54.7	59.5	60.2
NDSU	ND Stutsman	0.7	117.3	4.3	2531	18.3	34.1	56.6	67.7	75.9	79.5
NDSU	Ashtabula	0.4	111.8	6.0	2495	19.1	34.0	56.3	58.0	73.5	62.2
NDSU	Sheyenne	0.7	116.3	4.3	2578	18.2	34.2	57.4	72.4	73.5	75.2
Richland IFC	MK0603	0.6	113.8	7.5	4541	17.2	35.3	56.1	53.4	56.2	56.0
Richland IFC	MK42	0.7	112.8	5.0	2224	17.2	37.1	56.0	57.2	61.2	--
Richland IFC	MK0508	0.8	112.8	7.5	5017	17.3	34.1	58.1	37.2	43.0	44.2
Richland IFC	MK808CN	0.8	113.8	6.3	2818	18.5	34.1	57.5	54.8	51.8	58.7
Richland IFC	MK1016	1.0	115.3	6.5	4751	16.4	36.3	57.1	43.1	64.0	65.0
Richland IFC	MK9101	1.1	116.3	4.3	1884	18.4	34.5	56.6	59.1	74.3	65.0
Richland IFC	MK146	1.1	118.3	2.8	2385	17.8	36.6	56.2	68.4	74.3	--
Richland IFC	MK41	1.1	113.0	6.8	2176	17.2	36.7	56.2	61.9	69.3	71.2
Brushvale Seed Inc	BS1146	1.1	121.8	3.3	2391	17.8	36.3	55.7	64.6	--	--
Brushvale Seed Inc	BS1512	1.3	123.8	3.0	2509	17.6	36.2	56.3	67.0	--	--
Sevita Int.	Panorama	0.3	112.8	4.5	2163	17.9	36.4	55.6	61.0	--	--
Sevita Int.	Genesis	0.9	120.8	6.5	2177	18.5	34.7	58.9	72.2	--	--
Sevita Int.	Emperor	1.0	124.8	4.3	1838	18.0	36.2	56.9	66.6	--	--
Sevita Int.	Skyline	1.1	128.0	6.5	2201	17.8	37.6	56.5	68.2	--	--
Liberty Link											
Dairyland Seed	DSR-0929L	0.9	113.0	3.3	2162	18.2	35.4	55.3	72.2	--	--
	Mean		116.7	5.1	2715	17.9	35.5	56.7	61.0	--	--
	C.V (%)		2.5	24.3	3	1.0	0.8	3.2	10.6	--	--
	LSD 0.10		3.5	1.5	92	0.2	0.3	2.2	7.5	--	--
	LSD 0.05		4.1	1.8	110	0.2	0.4	2.6	9.0	--	--

Planting Date = May 30; Harvest Date = October 28 and 29; Previous Crop = Corn

[1] Maturity group based on data provided by seed company.

[2] Days to PM: average of 117 = September 24.

[3] Plant lodge: 0 = no lodging; 9 = plants lying flat.

[4] Seed oil and protein contents reported at 13% moisture.

Brand	Variety	Trait	Mat Group[1]	Days to PM[2]	Plant Lodge[3]	Seeds/ Pound	Seed Oil[4]	Seed Protein[4]	Test Wt	Seed Yield 2019	Seed Yield 2-yr. Avg.	Seed Yield 3-yr. Avg.
					0 to 9		%	%	lb/bu	bu/ac	bu/ac	bu/ac
Dairyland Seed	DSR-0717E	Enlist	0.7	113.5	2.5	2510	18.0	35.5	55.9	68.1	--	--
Dairyland Seed	DSR0847E	Enlist	0.8	121.3	2.5	2437	18.2	34.4	56.3	82.4	--	--
Dairyland Seed	DSR0988-R2Y	RR2Y	0.9	116.3	2.5	2675	17.8	34.1	56.3	75.3	--	--
Dairyland Seed	DSR-1120/R2Y	RR2Y	1.1	121.5	4.3	2220	18.7	34.6	56.2	68.1	78.2	74.6
Dyna-Gro	S09XT50	RR2XT	0.9	121.0	1.3	2631	17.5	35.5	57.1	71.9	--	--
Dyna-Gro	S11EN40	Enlist	1.1	124.5	3.3	2615	17.1	35.2	57.6	72.9	--	--
Dyna-Gro	S11XT78	RR2XT	1.1	117.5	3.3	2377	17.9	35.2	57.1	73.3	67.6	66.6
Dyna-Gro	S13XT89	RR2XT	1.3	118.8	3.0	2644	17.7	34.7	55.9	72.5	--	--
Dyna-Gro	S14EN90	Enlist	1.4	127.3	4.0	2219	18.0	34.6	56.3	71.6	--	--
Integra Seed	50850N	RR2XT	0.8	114.5	1.5	2472	17.5	35.6	56.2	67.9	70.2	--
Integra Seed	51229N	RR2XT	1.2	123.8	3.0	2557	18.0	34.7	55.9	72.5	--	--
Legacy Seeds	LS-0830NRR2X	RR2XT	0.8	118.3	1.0	2696	17.5	35.2	56.6	71.4	--	--
Legacy Seeds	LS-1138N RR2X	RR2XT	1.1	118.5	2.5	1837	13.5	26.3	43.1	51.7	66.9	68.8
Legacy Seeds	LS-1220N E3	Enlist	1.2	127.0	3.8	2224	18.0	34.7	56.3	70.4	--	--
LG Seeds	C1000RX	RR2XT	1.0	120.8	2.5	2411	17.9	35.1	56.7	49.6	66.9	--
LG Seeds	LGS1118RX	RR2XT	1.1	118.5	1.3	2574	18.2	33.3	56.8	70.7	--	--
LG Seeds	LGS13377RX	RR2XT	1.3	122.3	3.5	2471	18.1	34.6	56.9	72.0	76.8	--
LG Seeds	LGS1575RX	RR2XT	1.5	121.0	1.8	2714	17.7	34.6	56.8	69.7	78.7	--
P3 Genetics	1910EN	Enlist	1.0	116.8	1.5	2470	17.6	35.5	56.3	68.9	--	--
Proseed	EL 80-93	Enlist	0.9	114.8	1.5	2457	17.9	35.2	56.2	52.9	--	--
Proseed	EL 81-13	Enlist	1.1	115.3	1.5	2500	17.7	35.0	56.7	72.7	--	--
Proseed	EL 91-23	Enlist	1.2	124.5	3.3	2582	16.9	35.1	57.0	72.0	--	--
Proseed	EL 91-33	Enlist	1.3	129.5	4.0	2230	18.1	34.4	57.0	79.2	--	--
Proseed	XT 90-90	RR2XT	0.9	121.0	1.5	2659	17.5	35.1	56.5	74.8	--	--
REA Hybrids	RX0929	RR2XT	0.9	113.8	1.5	2590	17.4	35.7	56.5	68.2	76.1	--
REA Hybrids	RX1030	RR2XT	1.0	116.5	1.3	2449	18.0	35.2	56.0	73.9	--	--
REA Hybrids	RX1439	RR2XT	1.4	124.3	2.3	2329	18.0	35.2	56.5	71.9	80.4	--
REA Hybrids	RX1529	RR2XT	1.5	128.0	1.3	2655	18.0	35.1	55.9	76.2	--	--
	Mean			120.4	2.4	2472	17.7	34.6	56.0		--	--
	C.V (%)			2.8	45.8	10	9.3	9.3	9.4	16.4	--	--
	LSD 0.10			3.9	1.3	281	1.9	3.8	6.2	13.4	--	--
	LSD 0.05			4.6	1.5	336	2.3	4.5	7.4	16.1	--	--

Planting Date = May 30; Harvest Date = October 28; Previous Crop = Corn

[1] Maturity group based on data provided by seed company.

[2] Days to PM: average of 120 = September 27.

[3] Plant lodge: 0 = no lodging; 9 = plants lying flat.

[4] Seed oil and protein contents reported at 13% moisture.

Brand	Variety	Trait	Mat. Group[1]	Days to PM	Pod Ht	Plant Ht	Seeds/ pound	Seed Oil	Seed Protein	Test Weight	Seed Yield
					inch	inch		%	%	lb/bu	bu/ac
Croplan	RX0500	RR2XT	0.5	135.0	1.9	28.7	2844	17.0	35.7	56.9	55.4
Croplan	RX0700	RR2XT	0.7	137.3	1.4	31.3	2941	16.8	35.3	56.8	54.2
Dairyland Seed	DSR-0200/R2Y	RR2Y	0.2	125.5	1.6	31.5	2407	16.8	36.1	57.2	44.9
Dairyland Seed	DSR-0717E	Enlist	0.7	140.5	1.8	29.5	3120	16.8	36.2	56.6	55.2
Dyna-Gro	S03XT29	RR2XT	0.3	125.8	1.4	29.9	3256	16.7	35.3	57.1	56.6
Dyna-Gro	S05EN70	Enlist	0.5	137.0	3.1	28.9	2877	16.9	35.2	56.5	48.2
Integra Seed	50510N	RR2XT	0.5	136.5	2.4	27.6	2758	17.1	35.2	57.0	59.8
Integra Seed	50629		0.6	140.0	1.6	30.1	3277	16.5	34.9	57.4	57.5
Integra Seed	40829	Enlist	0.8	140.3	1.4	31.9	2943	16.3	37.1	56.7	69.8
Latham	L0438R2X	RR2XT	0.4	131.8	3.0	30.5	2549	16.7	35.0	57.6	49.4
Latham	L0883R2X	RR2XT	0.8	141.3	1.0	28.7	2980	16.1	35.7	57.1	52.2
Legacy Seeds	LS-0438 RR2X	RR2XT	0.4	133.0	1.0	30.3	2946	17.3	35.6	56.3	64.1
Legacy Seeds	LS-0738N RR2X	RR2XT	0.7	134.8	2.4	32.7	2861	16.8	35.3	56.6	67.2
Genesis Distributed by Legend	G0440E	Enlist	0.4	131.5	1.8	29.1	2937	16.8	35.5	57.1	47.4
Genesis Distributed by Legend	G0641E	Enlist	0.7	138.5	1.6	27.8	3146	16.9	35.8	57.9	59.2
LG Seeds	LGS0355RX	RR2XT	0.3	128.3	1.4	30.3	3284	17.0	34.7	57.3	53.1
LG Seeds	LGS0735RX	RR2XT	0.7	140.8	2.8	31.5	2855	17.3	34.4	57.8	64.5
NDSU	ND18008GT	GT	00.8	121.5	1.2	27.8	3204	17.3	37.1	57.4	42.7
NDSU	ND17009GT	GT	00.9	123.3	2.5	37.4	2878	17.6	36.8	59.1	53.9
NK Seeds	S03-S6X	RR2XT	0.3	127.5	0.8	27.4	3215	16.7	34.6	57.1	45.1
NK Seeds	S07-Q4X	RR2XT	0.7	140.5	2.2	32.7	2682	16.9	35.3	56.7	58.7
Northstar	NS 90334E3	Enlist	0.3	131.8	2.4	31.7	2911	16.8	35.7	57.1	58.5
Northstar	NS 90764NE3	Enlist	0.7	139.8	1.4	29.5	2987	16.9	36.1	56.4	56.3
P3 Genetics	1910E	Enlist	1.0	143.0	2.8	29.1	2785	16.6	35.6	55.8	44.5
Proseed	EL 80-33	Enlist	0.3	134.0	2.8	27.4	2974	16.6	36.2	57.3	52.0
Proseed	EL 80-93	Enlist	0.9	143.3	3.0	31.5	2933	16.5	35.7	56.1	56.1
REA Hybrids	RX0330	RR2XT	0.3	135.5	2.6	30.9	2956	16.3	35.6	56.9	43.5
REA Hybrids	RX0719	RR2XT	0.7	139.0	3.1	30.1	2992	17.3	35.1	57.2	58.9
Thunder	SB8903N	RR2XT	0.3	126.3	1.8	28.0	3355	16.9	35.0	57.3	53.1
Thunder	SB8807N	RR2XT	0.7	139.0	2.4	30.7	3237	16.5	35.2	57.4	56.0
	MEAN			134.9	2.0	30.1	2983	16.8	35.6	57.1	54.8
	C.V. (%)			2.1	52.9	8.9	4.0	1.2	1.5	0.6	12.2
	LSD 0.10			3.3	1.3	3.1	142	0.2	0.6	0.4	7.9
	LSD 0.05			3.9	1.5	3.7	170	0.3	0.7	0.5	9.4

Planting Date = May 20 ; Harvest Date = November 5 ; Previous Crop = Spring Wheat

* This trial was planted into an area managed as a no-till system.

** Plant lodging scores not recorded: Lodging was variable due to differential snow accumulations from Oct.10-11 blizzard.

[1] Maturity group based on data provided by seed company.

[2] Days to PM: average of 135 = October 2.

Soybean - Dryland, Conventional and Liberty Link **LaMoure County**

Brand	Variety	Mat. Group[1]	Maturity Date[2]	Seed Yield 2019	Seed Yield 3-yr. Avg.
			%	bu/ac	bu/ac
Conventional					
Brushvale Seed Inc	BS1146	1.1	3-Oct	37.3	--
Brushvale Seed Inc	BS1512	1.3	4-Oct	47.1	--
Richland IFC	MK0603	0.6	25-Sep	30.4	42.1
Richland IFC	MK42	0.7	25-Sep	33.5	42.5
Richland IFC	MK0508	0.8	25-Sep	18.3	31.2
Richland IFC	MK808CN	0.8	25-Sep	25.4	43.7
Richland IFC	MK1016	1.0	26-Sep	23.4	35.9
Richland IFC	MK9101	1.1	27-Sep	32.8	38.6
Richland IFC	MK146	1.1	2-Oct	39.7	--
Richland IFC	MK41	1.1	26-Sep	42.0	48.6
NDSU	ND Benson	0.4	23-Sep	38.4	43.8
NDSU	ND Stutsman	0.7	25-Sep	36.7	52.5
Liberty Link					
Dairyland Seed	DSR-0929L	0.9	26-Sep	41.3	--
Latham	L1238L	1.2	4-Oct	43.9	--
	MEAN		28-Sep	35.0	--
	C.V. (%)		2.9	13.2	
	LSD 0.10		2	6.3	--
	LSD 0.05		2	7.5	--

[1] Maturity group based on information provided by seed company.

[2] Date of 95% brown pods.

Field tour at Dazey.

Soybean - Dryland, Roundup Ready Varieties **LaMoure County**

Brand	Variety	Trait	Mat. Group[1]	Maturity Date[2]	Seed Yield 2019	Seed Yield 2-yr. Avg.	Seed Yield 3-yr. Avg.
				%	bu/ac	bu/ac	bu/ac
Dairyland Seed	DSR-0717E	Enlist	0.7	26-Sep	53.3	--	--
Dairyland Seed	DSR0847E	Enlist	0.8	3-Oct	50.5	--	--
Dairyland Seed	DSR0988-R2Y	RR2Y	0.9	30-Sep	53.7	53.1	55.6
Dairyland Seed	DSR-1120/R2Y	RR2Y	1.1	5-Oct	54.3	53.3	53.8
Dyna-Gro	S07XT28	RR2XT	0.7	26-Sep	54.3	51.9	51.9
Dyna-Gro	S09XT50	RR2XT	0.9	28-Sep	51.4	--	--
Dyna-Gro	S11EN40	Enlist	1.1	3-Oct	54.5	--	--
Dyna-Gro	S11XT78	RR2XT	1.1	29-Sep	54.7	53.3	56.0
Genesis Distributed by Legend	G1041E	Enlist	1.0	28-Sep	47.2	46.7	--
Genesis Distributed by Legend	G1180GL	LLGT27	1.1	4-Oct	55.7	--	--
Genesis Distributed by Legend	G1141E	Enlist	1.2	5-Oct	48.1	--	--
Integra	20775	RR2Y	0.7	28-Sep	51.8	--	--
Integra Seed	50990N	RR2XT	0.9	26-Sep	54.2	--	--
Integra Seed	51229N	RR2XT	1.2	2-Oct	54.7	--	--
Latham	L0883R2X	RR2XT	0.8	29-Sep	50.5	--	--
Latham	L0995E3	Enlist	0.9	1-Oct	51.1	--	--
Latham	L0982R2	RR2Y	0.9	3-Oct	55.7	--	--
Latham	L1039R2X	RR2XT	1.0	28-Sep	51.2	--	--
Legacy Seeds	LS-0830N RR2X	RR2XT	0.9	28-Sep	55.4	--	--
Legacy Seeds	LS-1138N RR2X	RR2XT	1.1	1-Oct	53.4	51.7	54.9
Legacy Seeds	LS-1220N E3	Enlist	1.2	5-Oct	53.9	--	--
LG Seeds	LGS0735RX	RR2XT	0.7	27-Sep	50.7	--	--
LG Seeds	C1000RX	RR2XT	1.0	1-Oct	52.4	53.1	--
LG Seeds	LGS1118RX	RR2XT	1.1	3-Oct	54.1	--	--
P3 Genetics	1906E	Enlist	0.6	26-Sep	43.8	--	--
P3 Genetics	1907E	Enlist	0.7	26-Sep	52.4	--	--
P3 Genetics	1910E	Enlist	1.0	29-Sep	49.7	--	--
Proseed	EL 80-93	Enlist	0.9	28-Sep	49.3	--	--
Proseed	XT 90-90	RR2XT	0.9	30-Sep	52.9	--	--
Proseed	EL 91-23	Enlist	1.2	4-Oct	50.7	--	--
Proseed	EL 91-33	Enlist	1.3	5-Oct	50.7	--	--
Proseed	EL 81-13	Enlist	1.1	1-Oct	49.2	--	--
	MEAN			1-Oct	52.1	--	--
	C.V. (%)			2.3	6.3	--	--
	LSD 0.10			1.9	4.3	--	--
	LSD 0.05			2.2	5.1	--	--

[1] Maturity group based on information provided by seed company.

[2] Date of 95% brown pods.

Dry Edible Bean - Dryland **Carrington**

Variety	Market Class	Days to PM	Growth Habit[1]	Direct Harvest[2]	Seed Protein	Seeds/ Pound	Seed Weight	Seed Yield 2019	Seed Yield 3-yr. Avg.
			1 to 9	%	%		gram/100	lb/ac	lb/ac
Bill Z	Pinto	91.8	2.0	41.3	23.0	1301	34.9	2659	--
Centennial	Pinto	89.3	5.0	90.0	26.2	1233	36.9	2614	--
Cowboy	Pinto	86.8	7.5	92.3	23.9	1217	37.4	2640	--
Croissant	Pinto	88.8	3.0	71.3	26.1	1269	35.8	2694	--
DR Wood	Pinto	91.0	4.3	88.0	25.9	1209	37.6	2592	--
LaPaz	Pinto	88.5	6.3	93.5	23.3	1262	36.0	2693	2524
Lariat	Pinto	88.8	4.0	87.5	23.7	1285	35.3	2472	2247
Long's Peak	Pinto	88.8	4.5	85.3	25.4	1212	37.5	2457	--
Monterrey	Pinto	88.8	6.8	93.5	23.6	1279	35.6	2480	2440
Montrose	Pinto	88.8	2.0	43.8	23.5	1229	37.3	2600	--
ND Falcon	Pinto	93.0	6.3	95.0	26.2	1171	38.8	2662	--
ND Palomino	Pinto	91.3	5.0	88.5	26.3	1297	35.1	2487	2289
Radiant	Pinto	86.8	5.8	91.0	24.3	1393	32.6	2212	--
Stampede	Pinto	86.5	6.3	89.3	24.4	1336	34.0	2587	2425
StayBright	Pinto	93.3	3.3	86.0	26.1	1366	33.8	2533	--
Torreon	Pinto	88.0	6.5	95.0	23.4	1220	37.3	2558	--
Vibrant	Pinto	87.3	6.0	89.5	23.9	1356	33.5	2438	--
Windbreaker	Pinto	86.0	4.3	81.8	25.0	1230	36.9	2860	2524
Blizzard	Navy	90.5	8.0	97.0	26.0	2344	19.4	2313	--
HMS Medalist	Navy	91.3	7.0	95.5	24.5	2467	18.4	2153	2080
T9905	Navy	91.3	7.0	95.0	25.7	2161	21.0	2454	2251
Black Tails	Black	85.0	7.3	96.8	23.5	2311	19.7	2417	--
Eclipse	Black	88.0	8.0	97.5	23.7	2352	19.3	2437	2148
Loreto	Black	91.0	6.3	95.0	23.8	2362	19.3	2271	2041
Zorro	Black	88.5	7.0	95.3	24.6	2437	18.6	2478	2048
Merlot	Small Red	89.0	4.8	85.5	22.8	1252	36.4	2269	1971
Viper	Small Red	88.5	6.5	95.5	22.9	1598	28.7	2469	--
Rosetta	Pink	86.3	6.5	93.0	22.7	1438	31.6	2546	2191
ND Pegasus	Great Northern	91.0	5.3	90.8	25.2	1247	36.4	2528	--
Powderhorn	Great Northern	88.5	6.8	92.8	27.1	1264	35.9	2443	2345
	MEAN	89.1	5.6	87.9	24.5	1537	31.6	2511	--
	C.V. (%)	1.6	12.7	4.3	3.4	5.3	5.6	11.3	--
	LSD 0.10	1.7	0.8	4.4	1.0	96	2.1	NS	--
	LSD 0.05	2.1	1.0	5.3	1.2	114	2.5	NS	--

Planting Date = May 29 ; Harvest Date = September 6 & 17 ; Previous Crop = Durum

[1] Growth Habit : Scored on scale of 1 to 9. 1 = longer vine, low stature plant, pods lower to ground; 9 = very upright plant stature, pods held well off ground.

[2] Direct Harvest : A relative score to estimate % beans that would be successfully harvested in a direct/straight harvest system.

Dry Bean - Irrigated **Carrington**

Variety	Market Class	Days to PM	Growth Habit[1]	Direct Harvest[2]	Seed Protein	Seeds/ Pound	Seed Weight	Seed Yield 2019	Seed Yield 3-yr. Avg.
			1 to 9	%	%		gram/100	lb/ac	lb/ac
Bill Z	Pinto	95.5	1.0	26.3	22.8	1353	33.7	2517	--
Centennial	Pinto	96.3	4.0	61.3	24.7	1204	37.7	3372	--
Cowboy	Pinto	94.8	4.3	67.5	21.6	1160	39.2	3518	--
Croissant	Pinto	96.8	2.3	50.0	24.6	1247	36.5	3104	--
DR Wood	Pinto	99.0	3.8	58.8	24.8	1191	38.1	3265	--
LaPaz	Pinto	94.0	4.5	66.3	21.6	1297	35.2	3748	3733
Lariat	Pinto	94.8	3.3	48.8	21.4	1197	38.1	3327	3378
Long's Peak	Pinto	95.5	3.3	58.8	25.3	1146	39.6	2836	--
Monterrey	Pinto	95.0	4.5	68.8	22.1	1322	34.4	3417	3669
Montrose	Pinto	93.3	1.0	20.0	22.2	1254	36.2	2734	--
ND Falcon	Pinto	100.0	3.0	63.8	25.3	1185	38.5	2964	--
ND Palomino	Pinto	95.5	3.5	62.5	24.4	1169	38.9	3976	3578
Stampede	Pinto	93.0	2.8	57.5	22.4	1341	34.1	2488	3149
Torreon	Pinto	94.5	4.5	72.5	21.7	1177	38.6	3621	--
Vibrant	Pinto	93.5	4.5	73.8	21.8	1195	38.0	3309	--
Windbreaker	Pinto	93.5	2.5	32.5	23.3	1188	38.3	3723	3537
Blizzard	Navy	98.5	4.8	76.3	24.1	2342	19.4	3723	--
HMS Medalist	Navy	97.8	5.0	66.3	21.8	2511	18.1	3617	3596
T9905	Navy	98.0	4.0	55.0	25.0	2029	22.4	3868	3683
Black Tails	Black	92.8	5.0	72.5	22.3	2251	20.2	3670	--
Eclipse	Black	94.0	6.8	72.5	22.1	2180	20.8	3395	3256
Loreto	Black	94.3	5.0	72.5	22.8	2360	19.3	3146	3189
Zorro	Black	94.3	7.0	85.0	23.1	2250	20.2	3025	3062
Radiant	Pinto	93.5	5.3	70.0	21.8	1204	37.7	4334	--
Merlot	Small Red	96.3	2.0	37.5	21.8	1242	36.6	3229	3180
Viper	Small Red	96.0	3.3	62.5	22.6	1726	26.4	3248	--
Rosetta	Pink	94.5	4.3	62.5	22.2	1310	34.7	3303	3610
ND Pegasus	Great Northern	99.3	2.5	60.0	22.4	1221	37.2	4169	--
Powderhorn	Great Northern	93.8	3.3	63.8	24.1	1259	36.1	3240	3406
	MEAN	95.6	3.7	59.8	22.9	1500	32.5	3404	--
	C.V. (%)	0.9	29.5	12.4	2.1	4.7	4.4	17.3	--
	LSD 0.10	1.0	1.3	8.8	0.6	83	1.7	693	--
	LSD 0.05	1.2	1.5	10.5	0.7	100	2	829	--

Planting Date = May 29 ; Harvest Date = September 19 ; Previous Crop = Soybean

[1] Growth Habit : Scored on scale of 1 to 9. 1 = longer vine, low stature plant, pods lower to ground; 9 = very upright plant stature, pods held well off ground.

[2] Direct Harvest : A relative score to estimate % beans that would be successfully harvested in a direct/straight harvest system.

Dry Bean, Misc - Irrigated **Oakes**

Variety	Market Class	Days to PM	Seeds/ Pound	Seed Weight	Test Weight	Seed Yield 2019	Seed Yield 3-yr. Avg.
				grams/100	lb/bu	lb/ac	lb/ac
Black Tails	Black	83.0	2372	19.1	63.0	3612	--
Eclipse	Black	85.8	2148	21.2	63.1	4221	3574
Loreto	Black	93.3	2342	19.4	63.6	3630	3462
Zorro	Black	87.5	2055	22.1	63.2	4292	4342
ND-Pegasus	Great Northern	87.3	1210	37.6	62.7	4118	--
Powderhorn	Great Northern	83.0	1436	31.9	57.3	3174	2995
Rosetta	Pink	83.0	1448	31.4	60.3	4386	3622
Merlot	Small Red	93.0	1209	37.5	60.0	4895	3624
Viper	Small Red	93.0	1650	27.5	61.5	3530	--
Mean		87.7	1763.3	27.5	61.6	3984.1	--
C.V. (%)		1.4	4.0	5.1	0.7	19.5	--
LSD 0.10		1.4	83.5	1.7	0.5	956.87	--
LSD 0.05		1.7	100.4	2.1	0.6	1151.4	--

Planting Date = June 4; Harvest Date = September 18; Previous Crop = Soybeans

Dry Bean, Navy - Irrigated **Oakes**

Variety	Days to PM	Seeds/ Pound	Seed Weight	Test Weight	Seed Yield 2019	Seed Yield 3-yr. Avg.
			grams/100		lb/ac	lb/ac
Blizzard	91.3	2303	19.7	64.5	2797	--
HMS Medalist	92.5	2498	18.2	64.7	2393	2779
T9905	94.0	1948	23.3	64.7	2974	3029
Mean	92.6	2249.4	20.4	64.7	2721	--
C.V. (%)	2.0	4.5	4.3	0.5	7.1	--
LSD 0.10	2.6	138	1.2	0.4	228	--
LSD 0.05	3.2	174	1.5	0.5	287	--

Planting Date = June 4; Harvest Date = September 18; Previous Crop = Soybeans

Dry Bean, Pinto - Irrigated **Oakes**

Variety	Days to PM	Seeds/ Pound	Seed Weight	Test Weight	Seed Yield 2019	Seed Yield 3-yr. Avg.
			grams/100	lb/bu	lb/ac	lb/ac
LaPaz	84.5	1129	40.2	61.1	3734	3709
Lariat	86.0	1097	41.4	60.2	3333	3510
Monterrey	85.3	1212	37.5	60.8	3539	3525
ND-Falcon	89.8	1087	42.0	59.4	3211	--
Palomino	90.3	1153	39.4	59.9	3011	3264
Stampede	85.0	1174	38.7	59.0	2747	2709
Torrean	83.8	1158	39.2	60.5	3106	--
Vibrant	84.8	1118	40.7	62.1	3118	--
Windbreaker	83.8	1025	44.4	58.2	3563	3331
Mean	85.9	1128	40.4	60.1	3262.3	--
C.V. (%)	2.3	4.8	4.8	0.9	9.22	--
LSD 0.10	2.36	65	2.32	0.6	357	--
LSD 0.05	2.9	79	2.8	0.7	430	--

Planting Date = June 4; Harvest Date = September 17; Previous Crop = Soybeans

Buckwheat - Organic **Carrington**

Variety	Days to Bloom	Plant Height	Test Weight	Seed Yield 2019	Seed Yield 2-yr. Avg.	Seed Yield 3-yr. Avg.
	10%	inch	lb/bu	lb/ac	lb/ac	lb/ac
Springfield	37.3	52.4	49.2	1572	1300	1072
Horizon	37.3	50.6	49.6	1479	1304	1071
Koma	38.0	49.3	49.9	1189	949	775
Koto	35.0	52.1	49.7	1752	1392	1110
Manor	36.0	55.0	47.7	1282	1123	943
Mean	36.7	51.9	49.2	1454.8	--	--
C.V. (%)	0.7	6.0	0.7	11.9	--	--
LSD 0.10	0.3	3.9	0.4	218.3	--	--
LSD 0.05	0.4	4.8	0.5	266.8	--	--

Planting Date = May 31; Harvest Date = September 4; Previous Crop = Oats

Variety	Brand	Days to Bloom	Bloom Duration	Days to PM	Canopy Height	Lodge at PM	Harvest Ease[1] 2019	Harvest Ease[1] 3-yr. Avg.	Fusarium Wilt[2]	1000 KWT	Test Weight	Seed Protein	Seed Yield 2019	Seed Yield 3-yr. Avg.
			days		in.	0-9	0 to 9		% Affected	gram	lb/bu	%	bu/ac	
Yellow Cotyledon Type														
Agassiz	Meridian Seeds	59.0	18.0	95.3	22.8	3.8	5.8	3.7	14.8	233.9	63.8	25.43	43.7	49.1
DS Admiral	Pulse USA	59.8	12.0	92.5	19.7	3.5	4.3	2.9	12.3	247.0	66.2	24.90	51.9	47.4
Spider	Valesco Genetics	61.0	14.3	93.0	20.9	4.5	5.3	3.2	48.8	215.6	65.9	25.70	28.7	38.5
AAC Carver	Meridian Seeds	59.3	15.0	93.3	24.5	3.0	4.0	2.7	13.8	235.5	65.6	23.88	51.3	45.8
AC Earlystar	Meridian Seeds	60.3	15.8	93.0	23.1	4.3	5.8	4.4	10.0	223.4	65.7	23.93	53.2	49.6
CDC Amarillo	Meridian Seeds	61.5	15.5	95.0	28.0	2.8	3.5	2.1	9.8	238.0	64.6	25.35	53.7	47.9
CDC Saffron	Meridian Seeds	61.3	12.3	93.5	19.7	4.5	5.3	3.6	22.5	233.7	65.3	25.63	42.0	42.8
CDC Inca	Meridian Seeds	62.3	12.8	93.5	22.3	3.5	4.0	2.4	12.5	232.4	66.5	25.60	60.4	49.6
CDC Spectrum	Meridian Seeds	62.0	13.5	95.5	27.5	2.5	3.5	--	11.3	240.9	63.7	25.53	49.5	--
Jetset	Meridian Seeds	59.8	9.5	91.8	25.2	2.8	2.5	2.1	6.8	236.6	65.8	25.40	58.5	51.4
AAC Chrome	Valesco Genetics	60.5	13.5	93.3	23.6	3.8	4.8	--	37.5	221.7	65.6	24.50	34.0	--
Bridger	Valesco Genetics	58.8	16.0	94.0	26.1	3.5	3.5	2.3	16.3	239.0	66.3	25.55	56.6	51.3
Hyline	Valesco Genetics	61.3	14.8	93.5	17.7	5.8	7.5	4.2	13.3	228.3	66.1	24.45	46.0	44.4
Navarro	Valesco Genetics	54.0	17.3	92.3	20.4	2.8	2.8	3.4	32.5	254.9	65.0	25.58	38.6	40.4
Salamanca	Valesco Genetics	61.8	12.8	93.8	27.3	2.8	3.5	3.3	23.8	253.5	65.9	25.93	36.8	38.4
Majestic	JB Farms	61.3	12.5	93.5	29.2	2.0	1.8	1.3	20.0	251.6	65.6	26.53	33.8	40.4
LGPN4909	Limagrain	55.0	17.5	93.3	18.9	2.3	2.8	2.4	23.8	258.1	64.8	25.53	46.8	46.2
LGPN4913	Limagrain	59.0	15.5	93.3	22.6	3.3	3.5	--	18.8	246.6	66.6	26.43	48.7	--
LGPN4915	Limagrain	57.8	16.3	93.8	29.9	2.3	2.8	--	7.0	240.2	66.0	27.50	56.4	--
N13022-7	Limagrain	56.5	18.0	94.3	24.8	2.5	2.0	--	22.5	265.7	66.0	26.38	46.0	--
N13029-10	Limagrain	56.0	16.8	94.5	27.6	4.8	6.3	--	16.3	273.9	65.6	25.95	51.0	--
N13068-1	Limagrain	61.0	11.5	92.8	25.5	2.0	3.5	--	15.5	282.5	66.2	24.35	51.9	--
N13057-4	Limagrain	55.5	16.0	93.0	26.0	2.8	3.3	--	23.8	223.7	65.6	26.08	42.1	--
N13057-5	Limagrain	60.0	15.3	93.8	23.0	4.5	5.3	--	30.0	242.3	65.5	26.90	41.0	--
AAC Asher	Legume Logic	61.3	12.3	93.3	17.6	4.5	6.0	--	32.5	242.0	65.7	24.68	42.0	--
Mean		59.8	13.9	93.6	23.6	3.5	4.3	--	17.7	243.1	65.6	25.63	47.1	--
C.V. (%)		1.0	9.8	0.9	18.1	31.2	30.9	--	53.4	4.8	1.2	2.4	14.6	--
LSD (0.10)		0.7	1.6	1.0	5.0	1.3	1.6	--	11.0	13.8	0.9	0.71	8.0	--
LSD (0.05)		0.8	1.9	1.2	6.0	1.5	1.9	--	13.2	16.4	1.1	0.84	9.6	--

Planting Date = April 24; Harvest Date = August 2; Previous Crop = Spring Wheat

Variety	Brand	Days to Bloom	Bloom Duration	Days to PM	Canopy Height	Lodge at PM	---- Harvest Ease[1] ---- 2019	3-yr. Avg.	Fusarium Wilt[2]	1000 KWT	Test Weight	Seed Protein	------- Seed Yield ------- 2019	3-yr. Avg.
			days		in.	0-9	--------- 0 to 9 ---------		% Affected	gram	lb/bu	%	---------- bu/ac ----------	
Yellow Cotyledon Type														
CDC Dakota	Legume Logic	64.3	11.8	94.8	26.7	2.8	4.3	--	2.0	233.9	66.8	25.58	66.0	--
Astronaute	Legume Logic	59.8	14.0	93.0	25.6	1.5	1.5	--	23.8	253.3	65.7	25.58	44.4	--
AAC Profit	Birdsall Seed and Grain	62.8	12.0	94.3	21.6	3.3	4.5	--	16.8	225.5	64.8	26.13	53.4	--
DL Apollo	Pulse USA	60.3	10.8	93.0	21.8	2.3	2.3	--	22.5	216.8	66.3	27.30	38.3	--
Durwood	Pulse USA	59.0	14.8	94.3	30.7	2.3	2.3	1.7	8.5	259.9	65.5	26.10	55.6	47.7
Korando	Pulse USA	54.5	16.8	93.0	24.0	3.5	4.8	3.6	33.8	267.1	65.2	27.05	43.9	43.4
LG Amigo	Pulse USA	60.5	12.0	93.0	22.8	2.0	2.5	2.8	20.0	234.8	64.6	25.78	44.0	44.5
LG Sunrise	Pulse USA	56.0	19.5	93.8	29.1	1.8	2.5	--	6.0	246.9	66.7	24.75	64.3	--
Mystique	Pulse USA	60.8	15.3	93.8	28.8	2.0	2.5	2.6	12.5	251.9	65.0	25.05	49.3	44.3
Nette 2010	Pulse USA	57.0	14.0	90.5	20.5	2.0	1.5	2.1	26.3	235.2	66.9	24.23	45.1	44.7
SW Midas	Pulse USA	61.3	13.8	93.8	26.0	4.8	6.8	3.4	23.8	202.6	65.0	25.18	45.8	45.3
Pro 133-6243	Pulse USA	55.5	16.8	92.5	19.4	4.8	6.3	4.2	40.0	254.5	65.5	25.78	39.5	41.6
Pro 093-7410	Pulse USA	56.3	19.3	94.5	16.1	6.8	8.0	--	15.5	219.5	65.5	24.23	44.1	--
LGPN 4915	Pulse USA	58.3	15.3	93.8	29.4	2.3	2.3	--	5.0	235.5	65.2	27.80	61.4	--
SSR Exp 01	Star Specialty Seed	57.8	15.8	93.3	25.4	3.0	3.8	--	22.5	280.4	65.9	27.35	41.6	--
Green Cotyledon Type														
Arcadia	Pulse USA	59.5	12.8	92.3	12.6	6.8	8.5	5.5	16.3	199.8	65.9	23.83	44.1	47.4
Cruiser	Pulse USA	57.5	16.8	93.5	17.5	5.5	6.3	4.5	7.3	213.8	64.9	26.45	42.8	40.5
CDC Striker	Nodricks Norsask Seeds	61.8	11.3	92.8	20.8	3.5	4.3	4.0	4.5	240.8	66.3	27.58	48.6	47.4
AAC Comfort	Meridian Seeds	65.5	7.8	93.8	18.7	5.5	7.3	4.0	25.0	229.7	64.4	24.63	40.7	38.2
CDC Greenwater	Meridian Seeds	63.0	13.8	95.3	26.8	2.3	3.3	--	7.0	235.9	64.8	24.55	50.9	--
Hampton	USDA	59.8	14.0	94.3	11.5	8.8	9.0	--	9.5	225.3	65.2	27.10	42.2	--
Shamrock	Valesco Genetics	63.0	10.3	93.3	24.0	2.0	4.0	2.9	5.0	255.3	66.4	25.73	55.3	40.7
Empire	Valesco Genetics	61.3	14.0	95.0	33.0	1.8	3.0	--	0.5	238.4	67.1	25.03	60.2	--
Mean		59.8	13.9	93.6	23.6	3.5	4.3	--	17.7	243.1	65.6	25.63	47.1	--
C.V. (%)		1.0	9.8	0.9	18.1	31.2	30.9	--	53.4	4.8	1.2	2.4	14.6	--
LSD (0.10)		0.7	1.6	1.0	5.0	1.3	1.6	--	11.0	13.8	0.9	0.71	8.0	--
LSD (0.05)		0.8	1.9	1.2	6.0	1.5	1.9	--	13.2	16.4	1.1	0.84	9.6	--

Planting Date = April 24; Harvest Date = August 2; Previous Crop = Spring Wheat

Variety	Brand	Days to Bloom	Bloom Duration	Days to PM	Canopy Height	Lodge at PM	--- Harvest Ease[1] --- 2019	--- Harvest Ease[1] --- 3-yr. Avg.	Fusarium Wilt[2]	1000 KWT	Test Weight	Seed Protein	------- Seed Yield ------- 2019	------- Seed Yield ------- 3-yr. Avg.
			days		in.	0-9	-------- 0 to 9 --------		% Affected	gram	lb/bu	%	---------- bu/ac ----------	
Green Cotyledon Type														
Bluemoon	JB Farms	60.5	11.5	92.8	23.2	3.0	3.8	2.7	5.5	253.7	65.6	24.40	52.1	44.9
LN1131	Limagrain	58.0	15.5	93.0	21.1	5.3	5.8	--	36.3	265.0	65.4	25.85	39.7	--
12CP3032	Limagrain	62.0	11.3	94.0	21.9	3.8	4.5	--	32.5	272.8	65.3	24.53	36.9	--
N13073-19	Limagrain	55.0	17.8	93.8	22.5	4.5	5.0	--	35.0	254.6	65.8	26.18	41.5	--
N13073-17	Limagrain	62.0	11.5	93.5	25.8	2.5	2.5	--	15.0	255.0	65.0	25.83	50.9	--
LG Koda	Pulse USA	62.8	11.0	93.8	22.9	4.3	6.0	4.4	21.3	225.0	66.1	24.23	37.4	40.1
Majoret	Pulse USA	61.0	11.3	93.3	22.8	4.0	4.8	--	10.0	245.5	66.1	27.05	52.7	--
Viper	Pulse USA	58.8	13.0	93.8	27.8	3.0	3.5	3.2	12.5	240.9	65.4	26.48	44.2	39.6
Marrowfat														
DL Pioneer	Pulse USA	62.8	10.3	96.3	30.7	2.5	3.5	--	15.0	313.9	63.4	26.80	28.5	--
Mean		59.8	13.9	93.6	23.6	3.5	4.3	--	17.7	243.1	65.6	25.63	47.1	--
C.V. (%)		1.0	9.8	0.9	18.1	31.2	30.9	--	53.4	4.8	1.2	2.4	14.6	--
LSD (0.10)		0.7	1.6	1.0	5.0	1.3	1.6	--	11.0	13.8	0.9	0.71	8.0	--
LSD (0.05)		0.8	1.9	1.2	6.0	1.5	1.9	--	13.2	16.4	1.1	0.84	9.6	--

Planting Date = April 24; Harvest Date = August 2; Previous Crop = Spring Wheat

[1]Harvest Ease scores: 0 = all plants upright and easy to harvest; 9 = all plants flat on the ground and difficult to harvest

[2]Scores indicate an estimate of the % of plants affected by Fusarium wilt as rated at end bloom

Lodging Score: 0 = no lodging; 9 = plants lying flat.

Field Pea - Organic **Carrington**

Variety	Days to Bloom	Bloom Duration	Days to PM	Canopy Ht at Harvest	Plant Lodge	1000 KWT	Seed Protein	Test Weight	Seed Yield 2019	Seed Yield 3-yr. Avg.
				inch	0-9	gram	%	lb/bu	bu/ac	bu/ac
Yellow cotyledon type										
Agassiz	53.3	13.3	82.8	27.6	1.0	224.7	24.3	63.6	52.4	49.0
Spider	54.5	13.8	85.8	24.0	3.0	236.0	26.1	64.2	45.7	44.3
DS Admiral	53.5	10.8	80.5	28.1	1.8	215.6	23.2	64.0	44.9	43.3
PUSA 1904	55.0	13.3	86.0	28.5	2.8	265.9	24.8	64.3	44.3	--
PUSA 1909	51.3	12.8	79.0	22.7	3.0	243.5	24.5	63.7	48.7	--
PUSA 1914	54.5	12.8	86.0	30.3	0.0	206.5	27.0	62.9	42.7	--
PUSA 1919	55.5	11.5	87.3	32.6	1.3	242.6	26.8	62.1	46.4	--
PUSA 1926	53.0	12.0	84.5	25.0	3.0	252.1	23.7	64.4	44.2	--
G 161526	56.0	10.3	84.8	31.7	1.5	220.5	26.2	63.4	44.6	--
G 161527	56.8	9.3	85.8	26.5	2.8	224.3	26.6	63.2	45.4	--
Protecta	54.0	11.3	86.3	9.2	9.0	239.5	27.5	62.9	46.9	--
Nette 2010	52.5	10.0	80.5	27.4	0.3	219.9	23.1	64.7	45.9	48.4
AAC Profit	56.5	12.8	87.0	26.7	3.3	231.9	26.2	62.4	57.4	--
Green cotyledon type										
Shamrock	57.0	9.5	86.0	15.9	6.8	245.8	24.2	64.2	57.5	--
Viper	53.0	9.5	83.5	28.9	0.8	212.8	25.5	62.6	41.5	--
Arcadia	53.8	10.8	83.3	22.7	3.8	203.7	24.4	63.2	50.8	46.9
Cruiser	53.8	13.0	83.0	24.1	3.8	181.9	25.2	63.2	46.5	43.7
CDC Striker	56.3	8.3	83.5	27.6	1.8	232.4	26.0	64.8	48.7	48.0
Majoret	55.3	9.0	84.5	26.1	1.3	232.6	25.7	64.8	43.7	--
Bluemoon	58.3	6.5	85.3	28.2	2.5	223.4	24.7	64.3	38.7	--
Flute	56.8	12.8	87.8	31.5	0.8	210.2	25.4	63.7	40.1	45.5
Mean	54.7	11.1	84.3	26.0	2.5	226.3	25.2	63.7	46.5	--
C.V. (%)	1.3	10.2	1.4	16.4	78.3	4.0	2.6	0.8	10.8	--
LSD 0.10	0.8	1.3	1.4	5.0	2.3	10.7	0.8	0.6	5.9	--
LSD 0.05	1.0	1.6	1.7	6.0	2.7	12.8	0.9	0.7	7.1	--

Planting Date = May 6; Harvest Date = August 7; Previous Crop = Cover Crop (sorghum sudangrass, sudangrass, cowpea, soybean, crimson clover & turnip)

Field Pea - No-till **Carrington**

Variety	Days to Bloom	Bloom Duration	Days to PM	Plant Ht at Harvest	Plant Lodge	Harvest Ease[1]	Seeds/ Pound	1000 KWT	Seed Protein	Test Weight	Seed Yield
				inch	0 to 9	0 to 9		gram	%	lb/bu	bu/ac
Green Cotyledon											
AAC Comfort	61.0	11.3	96.3	26.6	2.8	6.8	1633	278	25.4	64.2	64.1
CDC Greenwater	59.8	13.3	95.5	30.7	3.0	6.0	1737	261	24.8	65.0	65.3
Empire	58.3	14.5	95.3	35.8	2.3	4.8	1838	247	25.2	65.5	61.7
Hampton	58.8	12.5	94.0	20.5	8.0	9.0	1963	231	27.3	63.8	51.4
LG Koda	59.0	13.3	93.8	25.4	3.3	7.5	1944	234	23.6	65.7	62.7
Shamrock	59.8	11.5	93.5	27.6	2.3	5.8	1795	253	25.9	64.9	59.9
Viper	56.8	12.5	93.8	24.3	3.0	5.3	1788	254	28.7	63.9	47.5
Yellow Cotyledon											
AA Carver	56.5	15.0	92.5	29.9	2.8	5.3	1765	258	23.9	64.3	69.3
AAC Asher	57.8	14.0	93.0	21.7	3.5	8.3	1636	278	26.1	64.3	64.1
AAC Chrome	58.0	13.3	94.5	25.6	3.0	7.5	1700	267	24.6	64.7	67.3
AAC Profit	59.8	12.8	95.0	29.9	2.5	7.0	1876	242	26.3	64.8	73.5
AC Earlystar	58.0	14.5	93.3	30.1	3.8	7.0	1931	235	24.2	65.0	63.1
Agassiz	57.8	15.0	94.0	28.6	3.5	6.3	1869	243	25.9	64.6	66.2
Bridger	56.3	15.0	91.5	25.3	2.0	5.8	1887	241	25.7	64.5	56.7
CDC Dakota	60.0	12.5	94.3	29.3	3.3	6.5	1987	229	26.5	65.2	72.3
CDC Inca	58.5	15.0	94.5	28.0	3.8	5.5	1986	229	25.3	65.1	72.9
CDC Spectrum	58.0	12.8	95.3	29.1	2.8	6.5	1712	266	26.1	63.7	60.6
DL Apollo	57.8	13.0	91.3	27.2	1.5	4.8	1923	237	26.7	65.0	65.9
Durwood	58.5	13.8	94.8	29.5	2.5	4.8	1759	258	25.9	65.0	68.3
Hyline	58.3	14.3	93.8	22.8	3.8	8.8	1706	266	25.4	64.4	67.2
Jetset	56.0	13.3	89.8	28.1	3.0	7.0	1779	256	26.8	64.2	58.1
Korando	55.5	16.3	94.5	28.2	2.5	5.8	1519	299	28.3	64.4	57.9
LG Amigo	56.8	12.0	90.3	22.6	2.3	6.5	1857	245	27.7	64.0	48.5
LG Sunrise	57.5	14.8	95.3	30.7	3.0	5.5	1845	246	24.4	65.0	68.0
LGPN 4915	56.3	14.8	92.5	25.8	2.3	3.8	1987	229	29.4	64.5	53.6
Majestic	58.5	12.0	95.0	31.5	2.0	3.5	1682	271	26.9	63.3	59.8
Navarro	54.0	16.0	92.8	25.2	3.5	5.8	1543	294	26.9	64.4	57.9
Nette 2010	57.0	13.8	93.3	26.0	2.5	6.5	1794	254	26.1	65.1	57.6
Salamanca	59.3	12.3	93.5	29.0	2.3	5.0	1656	275	28.1	65.0	63.5
Spider	58.3	14.0	94.3	26.5	2.8	6.8	1792	254	27.2	65.3	55.7
SW Midas	57.8	13.5	90.3	23.0	2.8	7.3	2015	225	25.8	64.5	52.5
MEAN	57.9	13.6	93.5	27.2	3.0	6.2	1803	254	26.1	64.6	61.7
C.V. (%)	1.2	5.9	1.0	10.2	27.4	13.1	3.7	3.5	2.3	0.6	10.2
LSD 0.10	0.8	1.0	1.1	3.2	1.0	1.0	78	10	0.7	0.5	7.4
LSD 0.05	1.0	1.1	1.3	3.9	1.1	1.2	93	13	0.8	0.6	8.8

Planting Date = May 3 ; Harvest Date = August 19 ; Previous Crop = Durum and Barley (within replicates)

[1] Harvest Ease scores; 0 = all plants upright ~ very easy harvest, to 9 = all plants flat ~ very difficult to harvest direct.

Faba Bean - Dryland **Carrington**

Variety	Days to Bloom	Plant Lodge	Pod Height	Plant Height	Seed Protein	1000 KWT	Test Weight	Seed Yield 2019	Seed Yield 2-yr. Avg.	Seed Yield 3-yr. Avg.
		0 to 9	inch	inch	%	gram	lb/bu	bu/ac	bu/ac	bu/ac
LG Cartouche	52.0	0.5	14.1	34.7	24.2	488.9	60.5	50.5	35.7	28.9
Boxer	45.8	1.3	13.4	33.4	26.4	508.6	60.1	40.9	32.6	31.4
Fanfare	51.5	0.8	12.9	34.6	24.6	495.6	60.6	49.2	38.2	35.1
PUSA 1802	50.0	0.8	14.3	36.5	22.9	442.3	60.4	46.2	31.0	--
PUSA 1920	49.5	1.3	14.7	35.3	24.2	495.2	60.7	48.4	--	--
Trumpet	49.5	0.5	14.5	32.5	23.0	484.3	59.8	44.7	34.8	34.8
CDC Snowdrop	51.0	0.8	14.0	31.6	20.4	447.0	58.5	44.4	--	--
Fabelle	46.8	0.8	15.0	36.6	24.1	465.9	60.5	48.7	41.0	36.6
Laura	51.3	1.3	14.6	33.9	22.6	434.9	60.2	46.1	35.3	--
Tiffany	51.0	0.8	14.0	31.3	21.0	426.1	59.6	41.3	--	--
Mean	49.8	0.9	14.1	34.0	23.3	468.9	60.1	46.0	--	--
C.V. (%)	4.8	99.5	10.6	13.0	11.4	16.1	2.3	15.3	--	--
LSD 0.10	2.9	NS	1.8	NS	3.2	NS	1.6	8.5	--	--
LSD 0.05	3.5	NS	NS	NS	3.9	NS	2.0	NS	--	--

Planting Date = May 6; Harvest Date = September 5; Previous Crop = Spring Wheat

Lodging Score: 0 = no lodging; 9 = plants lying flat.

Chopping corn for silage after early October snowfall.

Faba Bean - Organic **Carrington**

Variety	Days to Bloom	Plant Lodge	Pod Height	Plant Height	Seed Protein	1000 KWT	Test Weight	Seed Yield 2019	Seed Yield 2-yr. Avg.	Seed Yield 3-yr. Avg.
		0 to 9	inch	inch	%	gram	lb/bu	bu/ac	bu/ac	bu/ac
Boxer	45.5	0.5	16.1	36.2	25.3	500.6	60.9	48.2	36.0	36.0
Fabelle	50.3	0.3	18.6	36.1	26.7	499.5	60.3	24.2	--	--
LG Cartouche	49.5	0.3	16.5	34.8	26.5	485.6	60.7	43.0	33.6	--
Laura	48.0	0.3	17.5	36.2	25.9	495.6	61.0	47.7	--	--
Fanfare	48.5	0.8	18.5	39.7	25.4	519.1	61.2	50.7	37.7	36.6
Mean	48.4	0.4	17.5	36.6	26.0	500.1	60.8	42.7	--	--
C.V. (%)	0.8	120.8	8.2	8.4	1.0	4.8	0.5	9.2	--	--
LSD 0.10	1.5	NS	1.8	3.9	0.3	30.2	0.4	5.0	--	--
LSD 0.05	1.8	NS	2.2	4.7	0.4	NS	0.5	6.1	--	--

Planting Date = May 8; Harvest Date = September 5; Previous Crop = Cover Crop (sorghum sudangrass, sudangrass, cowpea, soybean, crimson clover & turnip)

Chickpea **Carrington**

Variety	Market Type	Days to Bloom	Days to PM	Plant Disease	Plant Height	Plant Lodge	Seed Protein	Test Weight	Seed Yield 2019	Seed Yield 2-yr. Avg.	Seed Yield 3-yr. Avg.
				%	inch	0 to 9	%	lb/bu	lb/ac	lb/ac	lb/ac
CDC ANNA	Desi	63.8	125.5	18.8	21.9	3.8	25.0	52.5	787	1716	1981
CDC FRONTIER	Small Kabuli	62.8	125.3	16.3	21.9	5.3	25.0	56.6	1147	2064	2198
CDC LUNA	Small Kabuli	61.8	124.8	17.5	22.6	4.8	25.2	55.0	992	1946	2029
CDC ORION	Small Kabuli	57.3	122.8	10.5	23.7	4.8	25.2	52.7	1074	2201	2118
SAWYER	Small Kabuli	60.8	119.8	30.0	21.1	6.0	26.8	51.1	544	1602	1604
SIERRA	Small Kabuli	62.5	117.5	61.3	21.9	4.0	na	na	na	2043	1765
GNC-18011	Small Kabuli	63.0	124.3	11.3	24.4	4.3	25.4	56.3	1421	--	--
	MEAN	61.5	121.9	23.1	22.1	5.2	25.6	53.7	995	--	
	C.V. (%)	1.8	0.8	35.8	12.4	21.5	2.4	3.5	36.0	--	
	LSD 0.10	1.3	1.2	9.8	3.3	1.3	0.7	2.3	432	--	
	LSD 0.05	3.2	1.4	11.8	3.9	1.6	0.9	2.7	521	--	

Planting Date = April 24 ; Harvest Date = September 16 ; Previous Crop = Spring Wheat

* Overall chickpea seed quality was very poor due to disease pressure. Seed size data not reported.

Variety	Days to Bloom	Days to PM	Plant Lodge	Plant Ht	Seed Protein	1000 Seed Wt.	Seeds / Pound	Test Weight	Seed Yield 2019	Seed Yield 2-yr. Avg.
			0 to 9	inch	%	gram		lb/bu	lb/ac	
AVONDALE	59.3	107.5	4.3	15.2	26.1	51.7	8,805	60.2	1508	--
CDC GREENLAND	63.5	110.8	6.0	12.3	29.1	67.5	6,737	58.0	1142	--
CDC LEMAY	60.0	105.3	5.5	13.4	30.3	41.0	11,447	59.8	1395	1181
CDC REDBERRY	60.5	108.3	2.0	14.6	28.2	44.0	10,477	60.9	1831	1512
CDC RED RIDER	62.3	107.0	5.3	15.2	27.1	47.8	9,527	60.3	1573	1360
CDC RICHLEA	60.8	106.5	5.5	14.4	28.6	51.6	8,801	59.7	1672	1500
CDC ROSETOWN	63.3	106.5	5.0	13.2	28.1	34.1	13,459	62.3	1438	--
CDC ROULEAU	62.5	108.0	5.3	15.6	27.7	36.5	12,464	59.0	1626	1412
CDC VICEROY	60.0	104.8	4.0	15.4	27.1	36.6	12,399	62.6	1740	1713
ND EAGLE	61.3	104.0	4.3	14.4	25.3	38.8	11,713	61.0	1768	1717
PARDINA	56.8	98.3	8.8	11.6	29.1	39.4	11,575	60.5	501	--
PENNELL	61.3	102.5	5.5	11.6	27.0	64.3	7,081	57.7	1562	1172
RIVELAND	58.7	104.5	5.3	14.2	27.7	72.2	6,312	56.7	954	--
MEAN	59.6	105.6	5.7	14.0	27.8	50.0	9,662	59.2	1335.0	--
C.V. (%)	2.3	2.3	22.1	16.9	5.1	8.4	8.2	2.1	20.1	--
LSD 0.10	1.6	2.9	1.5	2.8	1.7	5.0	935	1.4	317.0	--
LSD 0.05	1.9	3.4	1.8	NS	2.0	6.0	1119	1.7	379.0	--

Planting Date = April 23 ; Harvest Date = September 5 ; Previous Crop = Spring Wheat

Field pea variety trial.

Brand	Hybrid[1]	R.M.	Days to Silk	Ear Height	Plant Height	Grain Protein	Starch Content	Harvest Moisture	Test Weight	--- Grain Yield -- 2019	2-yr. Avg.
				inch	inch	%	%	%	lb/bu	------- bu/ac ------	
Proseed	1684	84	80.8	37.7	90.6	10.8	71.7	21.7	53.5	170.3	166.0
Proseed	1687	87	78.0	38.3	99.9	10.0	73.4	24.1	54.6	172.9	181.4
Proseed	1797	97	81.8	36.8	97.3	10.6	72.2	23.8	52.8	212.6	--
Proseed	1689	89	75.0	38.6	103.1	9.9	73.1	24.6	54.5	182.0	181.9
Renegade Seed	EXP89	89	82.0	38.6	105.3	11.0	71.9	24.3	53.3	221.1	--
Renegade Seed	R1-1592	92	82.0	39.6	102.2	10.0	73.0	24.0	55.0	174.4	--
Renegade Seed	R2-1695	95	82.0	39.3	98.1	9.8	72.6	24.0	54.4	215.3	--
Viking	O.99-79P	79	73.3	37.5	98.9	10.4	71.3	23.0	55.3	183.8	--
Viking	O.87-80P	80	77.5	37.4	101.2	9.6	72.3	22.4	52.6	156.0	--
Viking	O.58-85P	85	77.5	39.0	106.3	9.0	73.5	22.7	57.2	198.5	--
Viking	O.45-88P	88	78.8	38.6	103.5	9.7	72.9	24.2	54.6	192.8	--
Viking	O.71-90UPGS	90	82.0	39.8	105.8	9.8	73.2	23.6	53.2	203.4	--
	MEAN		79.2	38.4	101.0	10.1	72.6	23.5	54.2	190.4	--
	C.V. (%)		0.8	8.0	5.2	5.2	0.9	3.8	2.2	7.7	--
	LSD 0.10		0.8	NS	6.3	0.6	0.8	1.1	1.4	17.6	--
	LSD 0.05		0.9	NS	7.6	0.7	0.9	1.3	1.7	21.1	--

Planting Date = May 9 ; Harvest Date = November 21 ; Previous Crop = Durum ;
Final plant population = 28,000 plant acre^{-1}

[1] Hybrid traits as reported by seed company when hybrids submitted for evaluation.

* Plant lodging scores not recorded: Lodging was variable due to differential snow accumulations from Oct.10-11 blizzard.

Foundation seed prepared for load out.

Brand	Hybrid	R.M.	Hybrid Traits[1]	Ear Height	Plant Height	Grain Protein	Starch Content	Harvest Moist.	Test Weight	Grain Yield 2019	Grain Yield 2-yr. Avg.	Grain Yield 3-yr. Avg.
				inch	inch	%	%	%	lb/bu	bu/ac	bu/ac	bu/ac
Dairyland	DS-3370AM	93	AM	36.8	107.3	8.5	71.0	31.3	44.3	168.2	--	--
Dairyland	DS-3550AM	95	AM	35.2	103.9	7.6	72.2	31.9	43.4	189.1	--	--
Dairyland	RPM-3519AM	96	AM	40.6	115.2	8.7	71.2	29.4	47.4	179.2	233.7	--
Dairyland	DS-3750AM	97	AM	37.8	111.4	9.2	70.5	31.5	46.6	163.3	--	--
Dairyland	DS-3715AM	97	AM	40.2	113.8	7.8	71.6	28.1	45.8	194.7	252.0	--
Dyna-Gro	D27VC87	87		37.6	109.4	7.8	72.4	23.8	52.7	167.8	217.6	--
Dyna-Gro	D34VC54	92		35.8	112.2	8.5	71.0	31.1	46.1	173.3	232.2	--
Dyna-Gro	D35VC35	94		36.8	106.5	7.2	72.6	26.4	51.0	184.3	--	--
Integra Seed	3629	86	VT2PRO	35.8	107.9	7.7	72.6	23.9	53.1	173.8	222.6	--
Integra Seed	3718	87	VT2PRO	34.8	106.3	7.9	72.0	27.6	48.8	173.3	225.8	--
Integra Seed	4119	91	VT2PRO	35.6	106.3	8.2	71.2	27.9	48.7	185.2	234.0	--
Latham	LH 3695	86	VT2PRO	35.8	105.3	7.7	72.3	27.1	49.1	185.1	--	--
Latham	LH 3755	87	VT2PRO	38.6	107.1	8.2	71.9	27.2	49.2	177.3	--	--
Latham	LH 3937	89	VT2PRO	37.4	107.7	8.0	71.2	27.8	48.0	198.6	--	--
Latham	LH 4187	91	VT2PRO	35.2	108.5	8.0	71.7	29.4	46.7	144.0	--	--
Latham	LH 4242	92	VT2PRO	37.8	107.5	8.4	71.0	31.5	46.3	178.6	--	--
Latham	LH 4375	93	VT2PRO	37.6	107.9	8.1	71.6	28.0	49.4	169.8	--	--
Latham	LH 4517	95	VT2PRO	37.2	106.1	9.3	71.1	33.1	44.4	161.2	--	--
Legacy Seeds	L-2918	89	VT2P	37.0	104.9	7.7	72.4	26.8	49.1	187.0	--	--
Legacy Seeds	L-3017	90	VT2P	38.4	107.1	7.9	71.7	26.7	49.2	180.0	235.3	226.4
Legacy Seeds	L-3419	94	VT2P	36.6	106.5	7.8	72.2	29.1	48.0	176.5	--	--
Legacy Seeds	L-3517	95	VT2P	38.2	105.9	8.7	71.1	29.3	47.5	183.9	235.0	221.2
Legacy Seeds	L-3617	96	VT2P	36.8	107.1	9.0	71.2	33.3	44.9	181.2	241.4	--
Peterson Farm S	73S84	84	VT2P	35.4	105.3	7.4	73.0	23.8	52.1	170.7	--	--
Peterson Farm S	74J89	89	VT2P	38.4	109.6	7.9	72.0	25.7	50.2	178.7	234.8	--
Proseed	1790	90	VT2P	36.2	105.7	7.8	72.0	26.8	49.4	182.2	226.3	--
Proseed	1591	91	VT2P	37.0	107.1	8.0	71.8	25.8	50.2	177.7	--	--
Proseed	1794	94	VT2P	35.0	106.7	8.1	71.8	28.6	48.7	215.8	--	--
Proseed	1896	96	VT2P	35.6	110.4	8.3	71.3	34.3	44.4	182.9	--	--
Proseed	1797	97	VT2P	38.8	108.9	8.6	71.5	32.4	44.7	179.2	--	--
			MEAN	37.0	107.8	8.1	71.7	28.6	48.0	178.7	--	--
			C.V. (%)	6.4	2.7	5.6	0.8	4.9	2.5	8.8	--	--
			LSD 0.10	2.8	3.4	0.5	0.7	1.7	1.4	18.5	--	--
			LSD 0.05	NS	4.1	0.6	0.8	2.0	1.7	22.2	--	--

Planting Date = May 17 ; Harvest Date = November 15 ; Previous Crop = Soybean

[1] Hybrid traits as reported by seed company when hybrids submitted for evaluation.

Corn - Dryland **Dickey County - Oakes (Page 1 of 2)**

Brand	Hybrid	RM	Hybrid Traits[1]	Days to Silk	Ear Height	Plant Height	Grain Protein	Starch Content	Oil Content	Harvest Moisture	Test Weight	Grain Yield 2019	Grain Yield 2 yr. Avg.
					inch	inch	%	%	%	%	lb/bu	bu/ac	bu/ac
Dairyland	DS-3370AM	93	AM	58.3	50.8	101.9	9.0	70.6	4.3	24.9	51.9	226.7	--
Dairyland	DS-3750AM	97	AM	59.3	48.8	103.2	9.7	70.4	4.2	30.6	53.4	205.6	--
Dairyland	RPM-3519AM	96	AM	58.3	51.3	105.8	8.9	72.1	3.7	27.6	52.1	236.1	239.0
Innotech	RC4166-3110A	91	Agrisure Viptera	60.0	49.2	100.5	8.3	71.9	4.3	30.9	51.8	205.8	
Integra Seed	4509	95	VT2PRO	60.8	49.1	106.4	8.6	71.0	4.7	36.2	51.2	206.2	211.9
Legacy Seeds	L-3517	95	VT2P	61.5	51.4	103.0	9.1	70.6	4.7	31.8	51.8	210.6	216.2
Legacy Seeds	L-3617	96	VT2P	60.5	48.3	102.5	9.0	71.7	4.0	33.8	51.4	207.9	212.1
Legacy Seeds	L-3718	97	VT2P	61.5	51.7	106.8	8.0	71.9	4.4	35.0	49.8	213.1	223.1
Legacy Seeds	L-4118	99	GENSS	61.3	51.5	107.4	8.3	72.4	3.9	31.1	49.8	221.2	222.6
PFS	78G95	95	VT2P	61.3	49.0	105.6	8.4	71.5	4.6	36.6	49.9	195.1	--
PFS	79N94	94	VT2P	60.3	48.7	101.7	8.4	72.2	4.2	30.2	49.6	213.4	215.6
Proseed	1591	91	VT2P	60.5	49.9	103.8	8.6	71.5	4.1	27.4	50.6	217.0	--
Proseed	1790	90	VT2P	58.0	45.8	99.5	8.8	71.4	4.3	28.9	51.5	222.1	--
Proseed	1794	94	VT2P	58.5	45.1	100.6	8.6	71.0	4.5	33.5	52.2	217.2	215.9
Proseed	1896	96	VT2P	60.5	46.5	104.4	8.4	71.4	4.6	36.6	50.6	191.9	--
Proseed	1998	98	VT2P	61.3	48.7	107.2	9.0	71.1	4.3	29.8	50.3	198.1	--
	MEAN			60.3	50.5	104.4	8.7	71.4	4.2	31.4	51.1	213.6	--
	C.V. (%)			1.1	3.7	2.1	3.0	1.3	8.8	4.6	2.4	4.7	--
	LSD 0.10			0.8	2.2	2.5	0.3	1.1	0.4	1.7	1.5	11.8	--
	LSD 0.05			0.9	2.7	3.0	0.4	1.4	0.5	2.0	1.7	14.1	--

Planting Date = May 16; Harvest Date = November 17; Previous Crop = Soybean

Brand	Hybrid	RM	Hybrid Traits[1]	Days to Silk	Ear Height	Plant Height	Grain Protein	Starch Content	Oil Content	Harvest Moisture	Test Weight	----- Grain Yield ----- 2019	2 yr. Avg.
					inch	inch	%	%	%	%	lb/bu	--------- bu/ac ---------	
REA Hybrids	3B912	91	VT2PRO	59.8	48.8	97.8	8.9	72.2	3.8	28.7	51.8	219.9	--
REA Hybrids	3B923	92	VT2PRO	59.5	46.7	104.5	8.5	71.4	4.2	28.3	51.7	223.7	222.9
REA Hybrids	4B965	97	VT2PRO	60.8	50.7	106.4	8.3	71.4	4.5	32.0	51.5	218.5	--
REA Hybrids	4B975	97	VT2PRO	59.3	45.7	103.0	8.1	72.5	3.8	31.5	51.4	223.2	--
REA Hybrids	5B984	98	VT2PRO	62.5	50.4	104.9	8.5	71.2	4.3	33.0	49.1	228.2	--
Rob-See-Co	RC4227-3220	94	Agrisure Viptera	60.0	58.1	108.0	9.9	71.6	3.6	28.6	53.0	228.5	--
Rob-See-Co	RC4343-3220A	93	Agrisure Viptera	61.3	58.7	108.7	9.7	70.3	4.3	32.8	49.9	203.6	210.8
Rob-See-Co	RC4759-3220	97	Agrisure Viptera	61.8	55.8	106.5	8.9	72.0	3.8	30.5	50.4	208.8	--
Rob-See-Co	RC4848-3000GT	98	Agrisure	61.8	62.4	110.7	8.9	70.7	4.8	35.7	50.0	198.9	204.8
	MEAN			60.3	50.5	104.4	8.7	71.4	4.2	31.4	51.1	213.6	--
	C.V. (%)			1.1	3.7	2.1	3.0	1.3	8.8	4.6	2.4	4.7	--
	LSD 0.10			0.8	2.2	2.5	0.3	1.1	0.4	1.7	1.5	11.8	--
	LSD 0.05			0.9	2.7	3.0	0.4	1.4	0.5	2.0	1.7	14.1	--

Planting Date = May 16; Harvest Date = November 17; Previous Crop = Soybean

[1] Hybrid traits as reported by seed company when hybrids submitted for evaluation.

Corn - Irrigated **Dickey County - Oakes**

Brand	Hybrid	RM	Hybrid Traits[1]	Days to Silk	Ear Height	Plant Height	Grain Protein	Content Starch	Content Oil	Moisture	Test Weight	Grain Yield 2019	Grain Yield 2 yr. Avg.
					inch	inch	%	%	%	%	lb/bu	bu/ac	bu/ac
Dairyland	DS-3550AM	95	AM	56.3	35.9	76.4	8.5	73.5	3.0	22.9	51.2	275.3	--
Dairyland	DS_3715AM	97	AM	55.8	39.5	82.1	8.4	73.4	3.1	21.8	52.0	267.7	268.3
Dairyland	DS-3750AM	97	AM	54.5	34.5	78.5	9.2	72.8	3.4	21.6	55.3	258.4	--
Innotech	RC4166-3110A	91	Agrisure Viptera	53.5	36.0	78.0	8.2	73.6	3.3	20.8	55.0	249.0	--
Integra Seed	4509	95	VT2PRO	57.3	33.1	80.8	8.6	72.0	4.3	23.6	51.2	243.6	252.1
Legacy Seeds	L-3517	95	VT2P	56.0	37.0	82.9	9.1	72.4	3.9	23.0	52.9	263.4	252.1
Legacy Seeds	L-3617	96	VT2P	55.5	36.4	74.1	9.4	73.2	3.1	22.1	53.4	253.0	251.3
Legacy Seeds	L-3718	97	VT2P	57.0	37.2	79.2	8.3	72.8	3.8	22.6	52.1	257.9	264.2
Legacy Seeds	L-4118	99	GENSS	57.0	36.6	81.4	8.6	72.9	3.5	22.2	53.0	264.5	263.0
PFS	78G95	95	VT2P	56.8	36.6	83.2	8.4	73.1	3.8	22.7	52.3	252.2	--
PFS	79N94	94	VT2P	54.3	34.0	78.1	9.1	72.6	3.5	22.3	52.1	246.8	232.3
Proseed	1591	91	VT2P	55.5	34.3	76.7	8.9	72.9	3.5	21.5	53.7	240.2	--
Proseed	1790	90	VT2P	53.5	33.7	80.8	9.2	72.3	3.7	22.0	53.2	247.4	--
Proseed	1794	94	VT2P	53.8	32.6	82.4	8.8	72.7	3.7	22.6	52.4	247.4	234.1
Proseed	1896	96	VT2P	56.0	35.7	84.0	8.6	72.3	4.1	23.0	52.0	260.4	--
Proseed	1998	98	VT2P	56.8	35.0	81.7	9.3	72.4	3.5	21.8	53.2	247.4	--
REA Hybrids	3B923	92	VT2PRO	54.5	35.0	79.0	8.7	72.7	3.5	21.9	53.4	250.2	205.5
REA Hybrids	4B965	97	VT2PRO	54.5	34.0	81.0	8.4	73.3	4.0	24.0	52.0	266.2	259.8
REA Hybrids	4B975	97	VT2PRO	53.3	31.7	77.3	8.5	73.2	3.4	22.4	52.9	262.8	--
REA Hybrids	5B984	98	VT2PRO	58.5	34.0	78.0	8.7	71.9	4.1	23.2	50.7	264.6	--
Rob-See-Co	RC4343-3220A	93	Agrisure Viptera	57.0	39.7	78.2	9.6	72.9	3.0	22.2	53.0	249.3	243.9
Rob-See-Co	RC4759-3220	97	Agrisure Viptera	56.8	39.5	77.6	9.3	73.2	3.2	22.2	53.1	247.2	--
	MEAN			55.6	35.5	79.6	8.8	72.8	3.5	22.4	52.7	255.2	--
	C.V. (%)			1.6	5.5	4.4	2.2	0.7	8.3	2.3	1.2	4.5	--
	LSD 0.10			1.1	2.3	4.1	0.2	0.6	0.3	0.6	0.8	13.7	--
	LSD 0.05			1.3	2.8	4.9	0.3	0.7	0.4	0.7	0.9	16.4	--

Planting Date = May 15; Harvest Date = November 13; Previous Crop = Soybeans

[1] Hybrid traits as reported by seed company when hybrids submitted for evaluation.

Cereal Forage **Carrington**

Variety	Forage Type	Harvest Stage	Days to Heading	Plant Height	Plant Lodge	Harvest Moisture	Forage DM Yield	CP	ADF	NDF	TDN	Ash	Ca	P	Mg	K	S	RFV	RFQ
				inch	0 to 9	%	ton/ac	%	%	%	%	%	%	%	%	%	%		
AKF Axcel	forage barley	early milk	57.0	31.6	0.5	79.3	2.42	13.4	34.6	57.2	59.0	8.5	0.41	0.28	0.18	2.63	0.18	101	144
Everleaf 114	forage oats	30% headed	--	32.4	0.0	83.0	2.26	15.7	37.3	58.8	57.8	9.8	0.46	0.35	0.19	3.52	0.22	95	128
Everleaf 126	forage oats	late boot	--	33.1	0.0	86.5	2.21	15.6	35.9	55.4	60.4	10.5	0.55	0.36	0.20	3.73	0.20	102	142
Proleaf 234	forage oats	watery ripe	57.0	34.9	0.0	80.0	2.27	15.2	37.7	60.5	56.0	8.5	0.40	0.31	0.19	3.09	0.21	92	124
Surge	forage triticale	end anthesis	58.8	40.8	1.3	80.2	2.24	15.3	39.4	63.5	53.3	9.4	0.39	0.31	0.15	3.16	0.18	85	113
Everleaf 256	forage oats	50% headed	63.5	31.1	0.0	83.5	2.33	15.6	37.1	59.4	57.2	9.4	0.44	0.33	0.17	3.46	0.22	94	129
NZA 4,41	forage oats	watery ripe	61.0	32.5	0.0	83.0	2.34	15.8	36.1	58.2	58.5	9.0	0.48	0.33	0.19	3.06	0.23	97	135
WB 9490	forage wheat	end anthesis	55.8	29.0	0.0	78.2	1.93	17.0	35.8	58.7	55.6	10.9	0.53	0.31	0.20	2.44	0.22	97	127
WB 9699	forage wheat	watery ripe	53.5	28.1	0.0	74.8	1.91	15.9	34.4	57.3	58.4	9.3	0.54	0.29	0.21	2.12	0.20	101	140
WB 9990	forage wheat	end anthesis	57.0	28.4	0.0	78.3	1.78	16.5	36.0	59.4	57.0	9.9	0.51	0.32	0.23	2.76	0.21	95	130
WB Patron	forage wheat	early milk	50.0	27.2	0.0	73.4	1.70	16.2	32.5	54.7	59.0	8.3	0.52	0.29	0.18	1.99	0.21	108	146
GNO-19011	forage oats	watery ripe	59.5	46.3	2.0	78.4	2.28	14.7	41.0	64.6	51.6	8.3	0.43	0.29	0.18	2.61	0.21	82	105
Paul	naked oats	headed	59.0	37.8	1.3	80.2	2.34	15.3	37.2	60.0	56.0	8.2	0.50	0.29	0.19	2.49	0.21	93	127
Rockford	grain oats	early milk	55.0	38.9	0.0	79.1	2.51	13.7	39.0	62.1	53.8	8.5	0.44	0.29	0.17	2.85	0.18	88	119
Mean		--	57.3	33.7	0.3	80	2.18	15.5	36.6	59.2	56.9	9.2	0.47	0.31	0.19	2.84	0.21	95	130
C.V. (%)		--	0.8	4.4	155.6	1.5	7.20	6.2	3.5	2.4	2.5	6.2	12.5	4.50	9.20	8.00	7.7	4.0	5.0
LSD 0.10		--	0.6	1.7	0.6	1.4	0.19	1.3	1.8	2.0	2.0	0.8	0.08	0.02	0.02	0.32	0.02	5	9
LSD 0.05		--	0.7	2.1	0.7	1.7	0.23	1.6	2.2	2.4	2.4	1.0	0.10	0.23	0.03	0.38	0.03	6	11

Planting Date = May 10; Harvest Date = July 12; Previous Crop = Barley Forage

Lodging Score: 0 = no lodging; 9 = plants lying flat.

Cereal Pea Forage **Carrington**

Variety	Harvest Stage	Days to Heading	Days to Bloom	Cereal Height	Vine Length	Plant Lodge	Harvest Moisture	Forage DM Yield
				inch	inch	0 to 9	%	ton/ac
Everleaf 114/Fergie	10% headed/flat pod	--	54.5	32.0	46.1	2.0	85.6	1.97
Everleaf 126/Max	Late boot/flat pod	--	58.0	32.8	45.0	2.5	86.8	2.07
Proleaf 234/Fergie	Headed/flat pod	61.0	54.0	37.1	42.2	2.5	84.4	2.23
AKF Axcel/Fergie	Watery ripe/flat pod	59.3	54.3	31.9	41.4	5.3	83.7	2.01
Surge/Fergie	Heading/flat pod	--	54.0	34.4	44.9	5.8	85.3	1.86
Mean	--	60.1	55.0	33.6	43.9	3.6	85.2	2.02
C.V. (%)	--	0.6	1.2	3.4	7.8	25.2	1.0	9.7
LSD 0.10	--	0.6	0.8	1.5	4.3	1.1	1.1	0.25
LSD 0.05	--	0.8	1.0	1.8	NS	1.4	1.3	0.30

Variety	Harvest Stage	CP	ADF	NDF	TDN	Ash	Ca	P	Mg	K	S	RFV	RFQ
		%	%	%	%	%	%	%	%	%	%		
Everleaf 114/Fergie	10% headed/flat pod	16.9	37.7	53.9	58.0	10.6	0.72	0.37	0.26	3.47	0.24	103	126
Everleaf 126/Max	Late boot/flat pod	17.2	38.1	52.6	59.4	10.0	0.84	0.35	0.22	3.49	0.23	105	127
Proleaf 234/Fergie	Headed/flat pod	16.0	39.2	53.8	58.5	10.0	0.87	0.34	0.27	3.33	0.23	101	115
AKF Axcel/Fergie	Watery ripe/flat pod	16.6	36.4	52.4	59.3	9.7	0.77	0.33	0.25	2.81	0.22	108	124
Surge/Fergie	Heading/flat pod	16.7	38.9	52.4	57.5	9.5	0.93	0.33	0.25	3.13	0.22	104	116
Mean	--	16.7	38.0	53.0	58.5	9.9	0.83	0.34	0.25	3.25	0.23	104	121
C.V. (%)	--	2.9	6.4	3.3	2.6	8.7	17.8	7.1	7.0	5.0	3.9	5.8	5.2
LSD 0.10	--	0.7	NS	NS	NS	NS	NS	0.04	0.03	0.25	0.01	NS	10
LSD 0.05	--	0.9	NS	NS	NS	NS	NS	NS	0.03	0.31	0.02	NS	12

Planting Date = May 10; Harvest Date = July 12; Previous Crop = Barley Forage

Cool-Season Pea Forage **Carrington**

Variety	Days to Bloom	Vine Length	Plant Canopy Height	Plant Lodge	Harvest Moisture	- Forage DM Yield - 2019	2-yr. Avg.	CP	ADF	NDF	TDN	Ash	Ca	P	Mg	K	S	RFV	RFQ
		inch	inch	0 to 9	%	-------- ton/ac --------		%	%	%	%	%	%	%	%	%	%		
Flex	57.8	51.8	26.8	6.8	88.9	1.55	1.45	18.8	37.7	47.2	61.6	10.0	1.18	0.37	0.28	3.61	0.25	119	141
Max	57.5	52.6	31.2	5.8	89.1	1.61	--	16.9	39.1	51.7	57.5	8.9	1.01	0.32	0.26	3.01	0.23	105	121
Keystone	55.5	40.5	28.9	5.0	88.7	1.61	--	20.6	37.5	45.4	63.1	10.8	1.27	0.38	0.33	3.39	0.24	123	146
Fergie	53.3	51.7	31.0	5.3	88.2	1.56	1.33	17.0	39.0	48.5	58.2	8.8	1.11	0.32	0.29	2.81	0.22	112	124
PUSA-FP-1701	53.5	50.9	32.5	4.8	86.6	2.08	1.97	15.8	41.7	51.5	57.4	9.1	1.20	0.32	0.30	3.04	0.23	102	113
PUSA-FP-1901	57.3	57.8	29.7	7.3	87.8	1.93	--	17.5	38.2	51.1	59.4	9.4	1.00	0.32	0.26	2.94	0.23	108	133
Mean	55.8	50.9	30.0	5.8	88.2	1.72	--	17.8	38.8	49.2	59.5	9.5	1.13	0.34	0.29	3.10	0.23	112	130
C.V. (%)	1.2	8.5	17.4	25.3	1.6	12.5	--	13.0	8.2	7.9	4.4	9.5	14	11	7.3	9.7	12	12	15
LSD 0.10	0.9	5.4	NS	1.8	1.8	0.27	--	3.4	NS	5.7	3.9	1.3	0.2	0.1	0	0.5	NS	20	28
LSD 0.05	1.0	6.5	NS	2.2	2.2	0.32	--	4.2	NS	NS	4.8	1.6	NS	NS	0	0.6	NS	NS	NS

Planting Date = May 10; Harvest Date = July 11; Previous Crop = Barley Forage

Variety	Harvest Date	Spring Stand	Vigor	Jday of Heading	Plant Lodge	Plant Height	Harvest Moisture	Forage DM Yield 2019	Forage DM Yield 2-yr. Avg.	Forage DM Yield 3-yr. Avg.
		%	1-10		0 to 9	inch	%	ton/ac	ton/ac	ton/ac
Rymin	17-Jun	93.3	6.5	162.8	0.0	45.3	74.5	2.18	1.9	2.0
ND Dylan	17-Jun	95.5	8.5	162.8	0.0	44.0	74.7	2.32	2.0	2.2
Dacold	20-Jun	90.0	6.5	165.5	0.0	44.2	73.8	2.16	2.0	2.1
Aroostok	10-Jun	93.0	8.5	157.5	0.0	40.7	72.8	1.91	1.4	1.5
Wheeler	20-Jun	87.5	4.0	166.8	0.0	47.9	74.8	2.00	1.8	1.9
Progas	17-Jun	93.3	7.5	163.3	0.0	38.3	73.0	2.27	--	--
ND Gardner	10-Jun	95.8	9.0	156.0	0.0	42.7	72.9	2.02	1.7	1.9
	Mean	92.6	7.2	162.1	0.0	43.3	73.8	2.12	--	--
	C.V. (%)	2.1	16.6	0.4	NA	7.6	1.4	5.9	--	--
	LSD 0.10	2.3	1.5	0.8	NS	4.1	1.3	0.15	--	--
	LSD 0.05	2.8	1.8	1.0	NS	4.9	1.6	0.19	--	--

Planting Date = September 18, 2018; Harvest Date = June 10-20; Previous Crop = Wheat

Harvesting hemp.

Winter Triticale Forage **Carrington**

Variety	Spring Stand	Jday of Heading	Plant Height	Harvest Moisture	Forage DM Yield	CP	ADF	NDF	TDN	Ash	Ca	P	Mg	K	S	RFV	RFQ
	%		inch	%	ton/ac	%	%	%	%	%	%	%	%	%	%		
NT 13416	88.8	167.5	44.8	75.3	1.97	13.4	36.8	61.6	56.4	8.3	0.42	0.25	0.17	2.34	0.17	91	132
NE 96T441	89.3	166.5	49.0	71.7	2.34	13.6	35.4	61.2	56.6	7.3	0.40	0.24	0.17	1.95	0.17	94	135
NT 12434	81.0	169.0	39.7	78.3	1.79	15.6	35.9	59.9	56.6	9.0	0.40	0.29	0.18	2.64	0.19	95	131
NT 11428	90.0	167.3	47.1	75.4	2.27	14.4	37.3	61.7	54.9	9.0	0.40	0.27	0.16	2.55	0.18	90	124
NT 13443	91.3	167.8	47.1	76.2	2.29	14.3	37.6	62.4	54.6	8.5	0.38	0.27	0.16	2.48	0.18	89	123
NT 12403	86.0	166.5	43.2	75.5	2.21	13.7	38.2	62.6	54.1	9.0	0.43	0.28	0.18	2.42	0.18	88	122
NT 09423	82.8	168.5	41.4	75.3	2.15	15.8	34.8	60.8	56.9	8.7	0.40	0.29	0.18	2.35	0.20	95	132
NT 11406	87.5	167.5	39.7	74.8	1.98	15.6	34.5	60.1	56.7	8.6	0.44	0.27	0.18	2.34	0.19	96	134
NT 12414	80.5	168.0	35.8	74.6	1.86	14.7	34.8	59.8	58.2	8.0	0.45	0.27	0.18	2.15	0.19	96	140
NT 09404	87.3	166.3	42.8	74.4	2.16	14.3	35.9	60.9	56.5	8.0	0.44	0.26	0.18	2.13	0.18	93	132
NT 07403	82.8	164.5	40.2	72.7	1.78	13.1	36.5	61.5	56.0	7.5	0.43	0.24	0.17	2.01	0.17	91	132
Mean	86.1	167.2	42.8	74.9	2.07	14.4	36.1	61.1	56.1	8.4	0.42	0.27	0.17	2.31	0.18	93	131
C.V. (%)	8.3	0.6	4.1	1.0	8.7	10.1	3.9	2.5	2.6	5.6	11.7	7.4	10.6	5.5	8.7	4.3	4.8
LSD 0.10	8.5	1.2	2.1	0.9	0.22	2.1	2.0	2.2	2.1	0.7	0.07	0.03	NS	0.18	0.02	6	9
LSD 0.05	10.3	1.4	2.5	1.1	0.26	2.5	2.4	2.6	2.5	0.8	NS	0.03	NS	0.22	0.03	7	11

Planting Date = September 18; Harvest Date = June 24; Previous Crop = Wheat

TriCal Exp 917	42.5	168.0	37.4	75.1	1.66	14.8	34.7	59.6	57.4	8.5	0.43	0.28	0.20	2.31	0.19	97	136
TriCal Gaines 154	57.5	164.8	41.0	74.2	1.72	13.5	35.4	61.2	56.9	7.5	0.39	0.26	0.19	2.18	0.17	93	135
TriCal Exp 08TF01	58.8	172.3	43.9	77.4	1.80	14.4	36.4	62.2	55.6	8.8	0.36	0.29	0.18	2.62	0.18	91	128
TriCal Sytf 813	17.5	174.5	36.5	79.2	1.08	16.2	34.8	59.4	57.5	9.2	0.45	0.31	0.22	2.68	0.20	97	134
TriCal 718	75.0	169.8	44.9	76.1	1.74	14.6	36.3	61.4	55.6	8.9	0.41	0.29	0.19	2.45	0.18	92	128
TriCal Flex 719	80.0	169.3	45.0	76.1	1.90	14.8	36.8	62.4	55.9	8.2	0.37	0.28	0.18	2.54	0.18	90	127
Mean	55.2	169.8	41.5	76.3	1.65	14.7	35.7	61.0	56.5	8.5	0.40	0.29	0.19	2.47	0.18	93	132
C.V. (%)	23.8	0.4	5.5	1.6	9.0	7.0	3.6	2.3	2.7	7.8	10.5	5.6	9.4	5.5	8.0	3.9	5.1
LSD 0.10	16.3	0.9	2.8	1.5	0.18	1.5	1.9	2.1	NS	1.0	0.06	0.02	0.03	0.20	0.02	5	NS
LSD 0.05	20.0	1.1	3.5	1.9	0.22	1.9	NS	2.6	NS	1.2	0.08	0.03	0.03	0.25	0.03	7	NS

Planting Date = September 18; Harvest Date = June 24; Previous Crop = Wheat

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Throughout the year, the Center hires individuals on a part-time basis to help in the research effort. Many of these are students and local residents. We would like to acknowledge the following who helped at some time during the year: Eric Allmaras, Madeline Allmaras, Ryan Allmaras, Hunter Beumer, Trace Beumer, Taylor Braaten, Harley Burgard, Colton Buskness, Cayler Ellingson, Spencer Eslinger, Savanna Friedt, Allison Fugle, Lucas Geiszler, Spencer Grager, Jesse Hafner, Christine Halvorson, Gabriela Henson, Carsyn Hilbert, Alexa Holth, Cassidy Holth, Emma Janz, Xavier Klocke, Kambree Kvamme, Mathias Kubal, Marlys Lange, Tristin Larson, Madison LaQua, Elizabeth Lee, Justin Lee, Tyson Lee, Natasha Lesmann, Nicolas Lyman, Betty Montgomery, Jonathan Murphy, Austin Neumiller, Sean Nichols, Ella Nowatzki, Drew Page, Sylvie Pate, Brett Paulson, James Petsinger, Travis Scanson, Tyler Scanson, Cole Seaburg, Jacob Seaburg, Kylie Solwey, Kaylee Stevens, Kaitlyn Thompson, McCoy VandeHoven, Chase Wells, Gage Wells, Alexis Wells, Connor Wendel, Elizabeth Widmer, and Larissa Wolff.

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