Carrington Research Extension Center

NDSU NORTH DAKOTA AGRICULTURAL EXPERIMENT STATION

A Report of Agricultural Research and Extension in Central North Dakota

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Research Highlights from 2023

Crop Variety Comparison Data

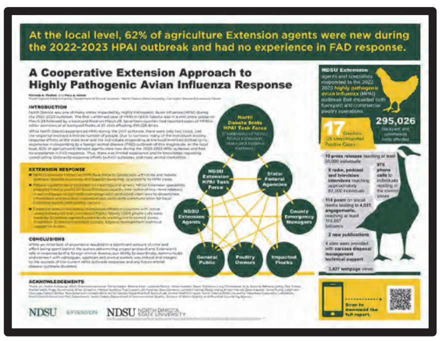
The Carrington Research Extension Center conducts research and hosts educational programs to enhance the productivity, competitiveness, and diversity of agriculture in central North Dakota and beyond. Research activities at the CREC include scientists and support staff trained in implementing programs 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 state 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.

Dakota Feeder Calf Show and North Dakota Angus University are feedout projects conducted in collaboration with North Dakota ranchers to learn about the performance of genetics and management. Feedlot weight gain and carcass information was collected for 224 cattle with 56 owners. The projects showed high value cattle returned $135 more per head than average and the difference in cattle value between low value and high value cattle was $352.

The Center's weed arboretum, established in 1993, continues to provide living exhibits of about 60 weed species, including the 13 noxious weeds. Hands-on training was conducted during the summer of 2023 for over 150 ag students, farmers and crop advisers on weed identification, biology and control. The five training events included ND Weed Control Association sprayer clinic, crop management field school, junior crop scout school, Bismarck State College and State College of Science (Wahpeton) ag students field lab, and sunflower field survey workshop.

The CREC hosted over 2,000 guests on-site in 2023 to take part in field tours, educational workshops, seminars, and research presentations. This is supplemented by online programming and data programming to deliver best recommendations and cutting-edge research to constituents across formats.

Cattle management information delivered by NDSU Extension and the Carrington Research Extension Center is sought by ranchers and cattle feeders. Feedlot School and Backgrounding Seminars/Webinars provide current production and management research and education and have reached over 6,400 producers. Individualized information is also provided to ranchers and cattle feeders throughout the year through on-farm consultations and telecommunications.



The NDSU Extension Disaster Response Team was part of a multi-agency effort during 2023 in response to animal disease outbreaks in North Dakota. Team members participated in state and local task forces leading education and outreach related to nine highly pathogenic avian influenza and 25 anthrax cases. The team developed talking points for Extension agents and specialists to use for media interviews and answering stakeholder questions. Outreach included eight news articles reaching 34,250 individuals, three television interviews reaching 165,000 individuals, and one radio interview reaching 50,000 individuals. Agents and specialists also provided support and education directly to impacted producers.

In 2023, the Northern Hardy Fruit Evaluation Project provided educational information to over 1,370 people with video conference programs, tours, meetings and personal phone calls. Field Day was attended by 125 people who learned about growing pears and the business of making cider. In addition to North Dakota, we provided information to people in Iowa, Minnesota, Montana, South Dakota, Texas and Wisconsin.

NDSU and University of Minnesota Extension have jointly planned and conducted the Advanced Crop Advisers Workshop as an annual program since 1993. In 2023, two general and 10 concurrent sessions provided information on topics including crop protection (weed, disease and insect management), soil management and plant nutrition, crop markets and cash flow, and professional development. Of 150 participants, 65% agreed or strongly agreed that they would change their recommendations due to the information at the workshop, while 80% indicated they would take new actions based on session learning.

Soybean hulls were tested as a source of nitrogen for wheat in anticipation of an abundance of soybean byproducts in the state. No response was detected in 2023, but seems likely that nitrogen is released too slowly to benefit the crops in the year the hulls are applied. Spring wheat will be planted back onto the trial areas in 2024 to test for residual effects.

The Plant Pathology program completed the second year (soybeans) and third year (dry beans) of field trials evaluating the impact of increased fungicide spray volume on white mold management. Preliminary findings of these studies have shown no gains in disease control or yield from increased fungicide volume above 10 gal/a, indicating that this lower volume may be the most efficient application strategy without compromising disease control.

The CREC conducted agronomic and quality testing on novel advanced lupin experimental varieties and worked with end-users of lupins to develop a comprehensive system to release lupins as a new cropping option in North America within the next few years.

Over the past year, the CREC Livestock Unit evaluated the effect of hybrid rye processing method in backgrounding rations and the substitution of corn with hybrid rye in finishing rations in feedlot steers. No detectable differences were reported in backgrounding. Results from the finishing trial indicated that the inclusion of hybrid rye improved animal feed efficiency. Also, no detectable differences were found due to the inclusion of hybrid rye on carcass characteristics which include hot carcass weight, marbling, calculated yield grade, and backfat thickness.

The CREC grew 23 different crop species in variety or breeding trials, testing over 650 lines/varieties under field conditions. Testing environments include dryland, irrigated, organic, no-till, and off-station sites at Dazey, Fingal, LaMoure, Oakes, and Wishek.

Completed a study with five site-years of data testing corn herbicide options to use in conjunction with mid-season cover crop planting. This was developed into a risk-based table that will be included in the 2024 North Dakota Weed Control Guide.

The Soil Science program tested two nitrogen fixing biological products applied to spring wheat near Carrington and Minot. The results showed no yield increase, but due to the low level of nitrogen response at both locations, further testing is needed to draw any conclusions. These two products have been previously tested in corn at four locations with similar results.

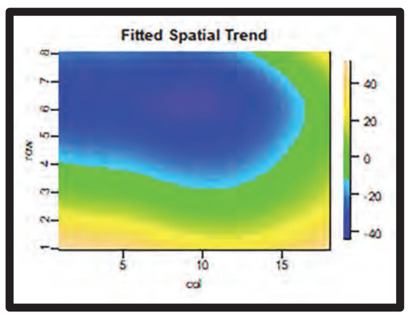
The CREC coordinated statewide variety testing for field pea, lupin, buckwheat, crambe, and winter rye. This ensures that field pea and specialty crop variety performance is current so informed variety selection can occur.

A field study was conducted at the Carrington and North Central (Minot) RECs during 2021-23 to examine if durum wheat seed quality can be improved with post-applied nitrogen (N) as a supplement to a base amount of preplant soil N. Averaged across four site-years with the standard management check averaging 11.9% seed protein and 84% vitreous kernels, protein improved 0.9 or 1.7 percentage points and vitreous kernels improved 6 or 12 percentage points with 30 lbs./a of N applied with durum growth stages at tillering or post-flower, respectively. This N application timing strategy can aid in producing high-quality durum and improving profitability.

Statewide phosphorus recommendations for soybean are being updated by testing a range of application rates across North Dakota. The CREC managed two locations on producers' fields that tested low in available phosphorus in 2023. Preliminary results indicated that optimum application rates for these two sites was higher than the current recommended practice. Once the statewide results are compiled, the recommended practice will be adjusted according to findings.

The Plant Pathology program completed a third year of field trials optimizing fungicide spray droplet size relative to canopy characteristics in pinto and kidney beans. Preliminary findings indicate that calibrating fungicide droplet size, versus the standard recommendation of applying with fine droplets, increases pinto and kidney bean yields under white mold pressure by 35-37%. This practice requires little or no additional cost and the increased effectiveness translates to increased profitability from fungicide applications.

Public variety trial accuracy was improved by adding an additional type of analysis when variability within the trial location impacted the results. This expands the applicability of variety and hybrid performance within testing regions of the trials.



Three site-years of data were completed to evaluate spring cover crop tolerance to herbicides ahead of dry bean planting. This information has led into second phase objectives to study the timing of cover crop removal.

Progress Update on the Development of Sweet White Lupin as a New Crop for North Dakota Producers

Kristin Simons, Mike Ostlie, and Blaine Schatz

Lupins, a legume, are commonly utilized in many regions of the world including Australia, South America and the Mediterranean region, as a food, feed and cover crop. The market for lupin is very diverse. Lupin can be used as green manure or ground into flour to use as a wheat flour alternative. Lupin can also be canned or eaten fresh. Lupins have the nutritional characteristics to become a large player in the plant-based protein market.

For consumers, lupins are a super food.

- Contain all essential amino acids
- High protein and low starch combination mean a low glycemic index
- High fiber and rich in ferritin
- Emulsifying properties to replace allergens like butter and eggs

For producers, lupins provide an alternative legume option.

- Fix nitrogen
- Low phosphate requirement
- Tap root to access deep water during dry conditions
- High harvest ease since pods are not at soil surface

No commercial sweet white lupin varieties are well adapted to North Dakota. To address this gap, the CREC has been screening germplasm, making selections and advancing breeding lines. Lines were evaluated primarily for maturity date, yield, seed size and sweetness. In 2022, fourteen preliminary lines underwent variety trials. Variety trials were planted in Carrington, Dickinson, Hettinger, Langdon, Minot, and Williston. Each trial consisted of three to four replicated plots arranged in a randomized complete block design.

Advanced breeding line selections of sweet white lupin.

In Carrington, the selected lines all reached maturity within 100 days after planting (Table 1). The protein content within the lines was similar with a range of 27.9 to 28.5%. Yield ranged from 2025 to

2630 pounds per acre. To assess the yield stability, variety trials were again executed statewide in 2023 with three additional lines. Yield was compared across all year and statewide locations using yield rank. No single line stood out as superior in the statewide tests as seen by the similar yield means in Figure 1. Individually, line LND0614 had ranked in the top three at both Hettinger and Langdon in 2022 and 2023. Line LND0617 was the most consistent at Carrington with a ranking of 1 and 4.

Table 1. 2022 Carrington Lupin Preliminary Yield Trial.

Line	Days to Maturity	Plant Height	Protein	Seeds/lb	Yield
	DAP	inch	%		lb/a
LND0127	98	25	28.2	1143	2252
LND0212	98	25	28.1	1182	2112
LND0228	99	25	28.1	1325	2146
LND0229	99	25	28.1	1311	2171
LND0431	100	25	28.5	1233	2075
LND0603	99	24	28.4	1277	2214
LND0605	98	24	28.2	1274	2162
LND0614	98	23	28.5	1242	2233
LND0617	99	24	28.2	1234	2630
LND0619	98	25	28.2	1272	2344
LND0621	99	25	28.1	1250	2348
LND0705	98	26	28.5	1301	2118
LND0727	99	27	28.4	1285	2142
LNDa210	98	26	28.3	1271	2195
Lupro 2085	99	21	28.5	1275	2025
NR55-Baer	100	21	27.9	1187	2226
*Mean	99	24	28.5	1219	1950
C.V. (%)	1.2	17.2	1.4	5.4	13.6
LSD (0.05)	2	7	0.7	109	502
LSD (0.10)	2	6	0.6	91	418

Planting Date = May 24; Harvest Date = September 22; Previous Crop = Corn

*Statistics were calculated from the larger trial.

Since lupin are consumed in various types of products, lines are undergoing further evaluations to aid in identifying the best lines for variety release. For example, in a preliminary test, green pods were harvested, shelled and cooked for four of the lines in the preliminary variety trial. Differences were noted for texture and flavor. Alkaloid testing will continue to ensure the lines remain sweet under various environmental conditions. As the plant-based protein market space continues to grow, lupins are an excellent option to meet the growing consumer demand for plant-based protein and provide an additional legume option for producers.

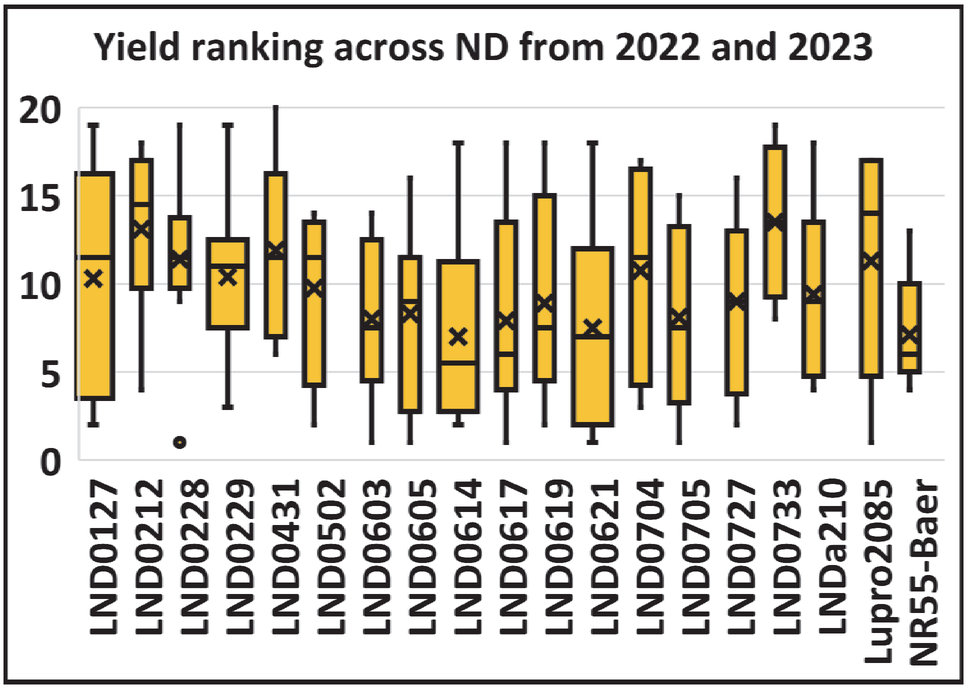


Figure 1. Yield rank results from the 2022 and 2023 statewide preliminary yield trials. Median is denoted by a line across the bar. Mean is denoted with an "x".

Funding for this project was made possible by a grant/cooperative agreement from the U.S. Department of Agriculture (USDA) Agricultural Marketing Service through the North Dakota Department of Agriculture. Its contents are solely the responsibility of the authors and do not necessarily represent the official views of the USDA.

Corn Grain Yield Response to Phosphorus and Zinc: Fertilizer Research Summary

Greg Endres, Mike Ostlie, Kristin Simons and Sam Richter

Phosphorus (P) starter fertilizer for corn is recommended by NDSU to promote early season plant growth by increasing nutrient uptake, and ultimately increase grain yield. Starter fertilizer will not satisfy total P needs of corn with soils testing less than medium for P (<8 ppm; Olsen test), thus supplemental P fertilizer (broadcast or deep-band application) would be recommended. Corn is expected to respond to zinc (Zn) fertilizer if soil levels are below 1 ppm. P and Zn fertilizer rate recommendations are in NDSU Extension publication SF722 'Soil Fertility Recommendations for Corn'.

The Carrington Research Extension Center (CREC) began a corn field study in 2007 to document response to **starter P fertilizer**, primarily using 10-34-0 with various application methods and rates on loam soil generally testing medium or less for P. Study details and a summary of results can be found in the NDSU Extension publication A1851 'Corn Response to P Starter Fertilizer'.

In 2016, the study's research focus transitioned to tests with **preplant incorporated** (PPI), **Zn** (PPI, in-furrow [IF] and foliar applications) **and specialty fertilizers** compared to IF-applied 10-34-0 at 2.75-3 gpa in soil with P levels at ≤8 ppm and Zn at ≤0.65 ppm. The following is a summary of corn grain yield results using multi-year means from trials conducted through 2023:

1. PPI triple super phosphate (TSP) plus ammonium sulfate (AMS) plus zinc sulfate (ZnS) followed by IF 10-34-0 was 5% greater than only PPI treatment (3 site-years).
2. PPI MESZ (MicroEssentials SZ [12-40-0-10S-1Zn]; Mosaic) was similar to PPI TSP plus AMS plus ZnS, with both treatments containing similar amounts of P, S and Zn on a plant food basis, and followed by IF 10-34-0 (5 site-years).
3. IF 10-34-0 plus Zn chelate (0.25 gpa) was 4% greater than sole 10-34-0 (7 site-years).
4. IF 10-34-0 plus Zn chelate was 4% greater than 10-34-0 followed by foliar-applied Zn chelate (5 site-years).
5. IF 10-34-0 plus Zn chelate was 3% greater than IF RiseR (7-17-3-0.95Zn; Loveland Products) at 2.5 gpa (3 site-years).

The following table displays multi-year yield means with selected treatments as described above.

Table 1. Corn yield response to phosphorus and zinc, Carrington, 2016-23.

Narrative bullet number	Treatment[1]	Average grain yield (bu/a)
		3 site-years
	untreated check	119.9
	PPI TSP+AS+ZnS	136.2
1	**PPI TSP+AS+ZnS/IF 10-34-0**	143.8
		5 site-years
	untreated check	124.6
	PPI TSP+AS+ZnS/IF 10-34-0	146.2
2	**PPI MESZ/IF 10-34-0**	147.6
		7 site-years
	untreated check	137.4
	IF 10-34-0	139.3
3	**IF 10-34-0 + Zn[2]**	145.1
		5 site-years
	untreated check	127.6
	IF 10-34-0 + Zn	136.0
4	**IF 10-34-0/POST Zn[2]**	130.3
		3 site-years
	untreated check	149.4
	IF 10-34-0 + Zn	157.4
5	**IF RiseR**	152.4

[1]Fertilizer product and rate: 10-34-0 at 2.75-3 gpa; TSP = Triple superphosphate at 174 lb/a; AMS = ammonium sulphate at 83 lb/a; ZnS = zinc sulphate at 5.6 lb/a; MESZ = MicroEssentials SZ (12-40-0-10S-1Zn; Mosaic) at 200 lb/a; Zn = NWC 10% (chelate; Northwest Chemical) or Ammend (9% chelate; CHS) at 0.25 gpa; and RiseR = 7-17-3-0.95Zn (Loveland Products) at 2.5 gpa. Fertilizer application method: PPI = preplant incorporated; IF = in-furrow; and POST = foliar at V4-6 growth stages.

[2]Zinc: NWC 10% used in 2016-18 and Ammend used in 2019-23.

Research reports for each year of the study period (2016-23) can be found at the following websites.
2016-20: https://www.ag.ndsu.edu/carringtonrec/archive/agronomy/crop-index/corn/fertility

2021-23: https://www.ndsu.edu/agriculture/ag-hub/research-extension-centers-recs/carrington-rec/research/agronomy/research-reports?page=0

Harvest of starter corn fertilizer trial.

Partial support for this research was provided by the North Dakota Corn Utilization Council.

Soybean Response to Prior-Year Application of Phosphorus Fertilizer

Greg Endres, Dave Franzen, Mike Ostlie and Kristin Simons

A common strategy in eastern corn belt states is for preplant phosphorus (P) fertilizer application prior to the year of soybean production, typically on corn ground with one total application rate for corn and subsequent soybean production. Advantages include reducing fertilizer input costs with one less trip across the field, and possibly more flexibility with available fertilizer supply and prices. Is this strategy effective for North Dakota farmers instead of the common practice of in-season P application for crops including soybean?

A field study was conducted at the NDSU Carrington Research Extension Center and supported by the North Dakota Soybean Council to examine soybean response to preplant-applied P for corn plus soybean the year prior to soybean production versus P application for corn followed by P application the next year for soybean. Experimental design was a randomized complete block with four replications. Treatments: 1) untreated check, 2) P preplant broadcast-applied, based on soil analysis and NDSU fertilizer rate recommendations, for corn; followed by P application the following year for soybean, and 3) P applied the initial year for corn plus soybean. The dryland trials were established on conventionally tilled Heimdal-Emrick loam soil with 3.0-3.4% organic matter, 7.7-8.0 pH (0- to 6-inch depth) and 2-7 ppm P (very low-low soil level; Olsen test). Triple super phosphate (0-46-0) was preplant broadcast applied and incorporated prior to crop planting each year. P fertilizer application strategies and amounts are listed in the following table.

Table. P_2O_5 rates using preplant applied triple super phosphate fertilizer[1], Carrington, 2020-23.

P treatment		2020 corn	2021 soybean	2021 corn	2022 soybean	2022 corn	2023 soybean
No.	Application strategy	lb/A P_2O_5					
2	Yearly for each crop	67	15	67	26	104	52
3	Total for both crops during corn year	93	x	93	x	156	x

[1]Includes in-furrow applied 10-34-0 at 2.5-3 gpa for corn.

‘DKC32-12RIB’ corn was planted in 30-inch rows with the following planting and harvest dates: May 26 and October 7, 2020; May 10 and November 2, 2021; and May 26 and November 2, 2022. Corn grain yield averaged 66.5 bu/a in 2021 and 130.3 bu/a in 2022 with no differences among treatments for each trial. ‘AG03X7’ soybean were planted in 30-inch rows on May 18, 2021 resulting in established average stand of 123,500 plants/a and harvested September 23; ‘AG03XF2’ soybean were planted in 22-inch rows on June 2, 2022 resulting in 146,900 plants/a and harvested October 4; and ‘AG03XF2’ soybean were planted in 30-inch rows on June 2, 2023 resulting in 101,400 plants/a and harvested October 12.

Soybean plant development (emergence, flower and physiological maturity dates) were generally similar among treatments each year. Plant populations were similar among treatments. Plant canopy, measured mid-July to mid-August during the R2-6 growth stages, generally was slightly greater with sequentially applied P compared to the untreated check. Seed quality (test weight, seed count, and seed oil and protein content) generally were similar among treatments.

Soybean seed yield averaged among the three trials: 1) untreated check = 40.8 bu/a, 2) P application each year = 44.4 bu/a, and 3) Total P application during corn year = 43.8 bu/a. Yield increased with P application compared to the untreated check (LSD [0.10] = 2.8 bu/a) but was similar between the P application strategies. Under conditions of this study, including very low to low soil P levels and soil pH ranging from 7.7-8, the results indicate application of P fertilizer at NDSU recommended amounts in the preceding year of soybean production is an acceptable alternative strategy versus in-season P application for the crop.

Partial support for this research was provided by the North Dakota Soybean Council.

Utilizing Soybean Hulls as a Supplemental Slow-release Nitrogen Source in Crop Production

Szilvia Yuja and Mike Ostlie

In the growing season of 2023, a study was conducted to test the potential use of soybean hulls as a source of nitrogen fertilizer at the Carrington Research Extension Center on three sites: a dryland site that is managed with conventional tillage, a dryland long-term no-till site, and an irrigated site with conventional tillage. The same treatments were applied on each site. Spring wheat was used for this evaluation.

The objective was to evaluate the potential of utilizing soybean hulls as a supplemental slow-release nitrogen source in crop production by measuring yield impact and soil residual nitrogen after harvest. To achieve this objective, the following treatments were applied on a dryland site with conventional tillage, an irrigated site with conventional tillage and a dryland no-till site:

- Check, no N
- 40 lbs. N applied as urea
- 40 lbs. N from soybean hulls
- 90 lbs. N rate from a mix of 40 lbs. N from hulls + urea
- 90 lbs. N applied as urea

Treatments were replicated four times.

To determine soybean hulls application rates, a sample of the hulls was sent to Agvise Laboratories for chemical analysis (Table 1).

Table 1. Soybean hulls nutrient analysis.

N	P	K	S	Mg	Zn	Mn	Na	Cu	Ca	B	Fe	Carbon	C/N ratio
%					ppm							%	
2.3	0.13	1.4	0.12	0.23	33	36	0.01	6	0.46	24	416	44.4	19.3

Results

There were no significant differences observed at the irrigated site for any variables. The treatments where soybean hulls were applied at the 40 lb./a nitrogen rate did not yield significantly different from the untreated check at any of the sites. Urea at the 40 lb. N rate produced a significant yield increase compared to both the check and the soybean hulls treatment at both dryland sites (Figures 1,2,3). This shows that there was a nitrogen response at those sites, but the nitrogen from the soybean hulls was not available to the plants when they needed it. Similarly, the treatments where soybean hulls were applied in combination with urea yielded significantly worse than where only urea was applied at the same rate. The grain protein results followed a similar pattern, as well. The application of urea increased protein content, but the soybean hulls had no effect (Figures 4,5,6). Unsurprisingly, grain nitrogen uptake, which was calculated from grain yield and grain crude protein, also followed this same trend. Post-harvest soil nitrates were highest in the check and the 90 lb. urea-nitrogen treatments. The rest of the treatments were not significantly different from each other (Figures 10,11,12).

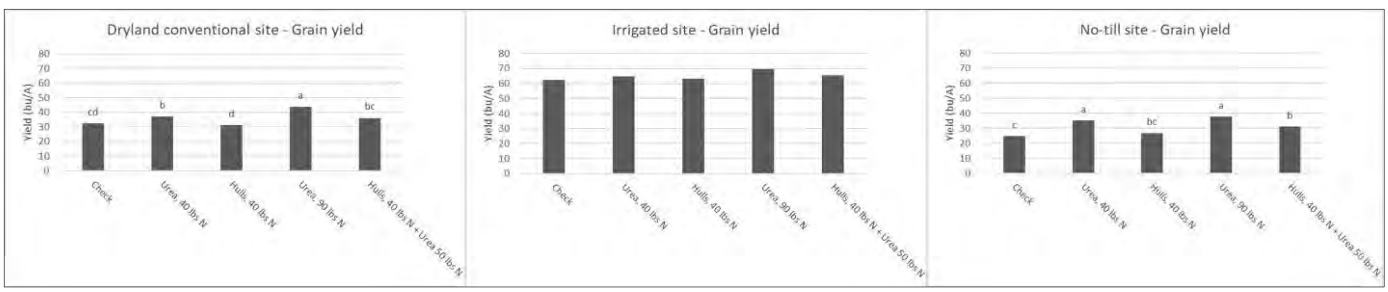


Figure 1,2,3. Grain yield by treatment from the conventional dryland, the conventional irrigated and the no-till dryland sites.

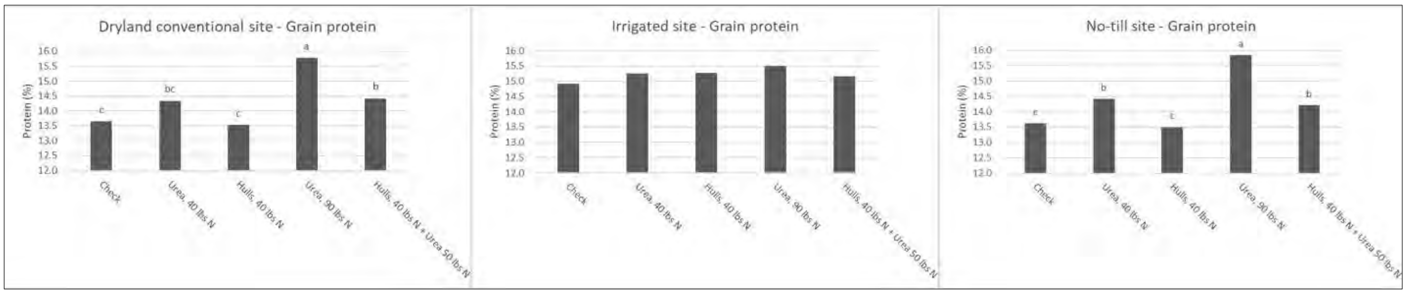


Figure 4,5,6. Grain protein by treatment from the conventional dryland, the conventional irrigated and the no-till dryland sites.

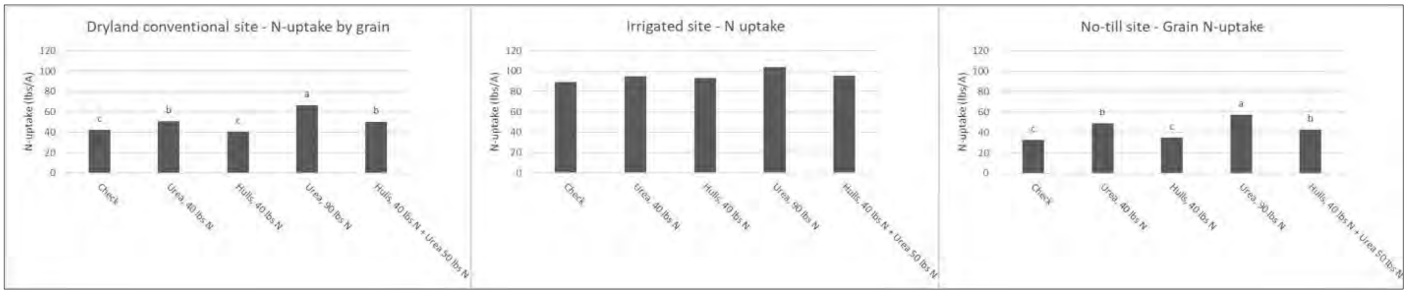


Figure 7,8,9. Grain N-uptake by treatment from the conventional dryland, the conventional irrigated and the no-till dryland sites.

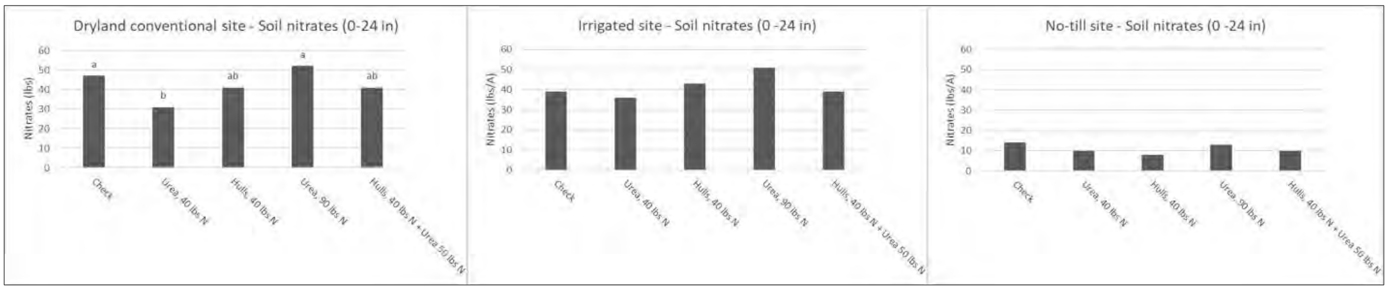


Figure 10,11,12. Post-harvest soil nitrate content by treatment from the conventional dryland, the conventional irrigated and the no-till dryland sites.

Discussion

Based on the results, it seems that nitrogen release from soybean hulls was slow to non-existent in the year it was applied under all three management practices. This is could be caused by a carbon to nitrogen ratio that is too high for quick breakdown under the climatic conditions of the trial year. The no-till trial area will be planted back to spring wheat, to observe the soybean hulls' nitrogen contribution to the next year's crop.

Partial support for this research was provided by the North Dakota Soybean Council.

Efficacy of Peroxide-based Products for Management of White Mold in Soybeans and Dry Beans

Michael Wunsch, Jesse Hafner, Aaron Fauss, Heidi Eslinger, Spencer Eslinger, and Suanne Kallis

The use of peroxide-based fungicides has been adopted by some producers in our region as a tool for inhibiting the development of white mold and this study was designed to provide rigorous data to growers, agronomists, and crop advisors who have inquired about the efficacy and profitability of this management tool.

Applications of the peroxide-based fungicides OxiDate 5.0 (hydrogen peroxide, 27%; peroxyacetic acid, 5%) and SaniDate 12.0 (hydrogen peroxide 18.5%, peroxyacetic acid 12.0%) were made to irrigated soybeans in Carrington and Oakes, ND. The efficacy of OxiDate 5.0 was tested at 1.0% v/v in 15 gal/a tank-mixed with traditional fungicides at standard fungicide application timing and as a stand-alone application after white mold disease development to dry beans and soybeans that received the two-application sequence of traditional fungicides. The impact of application rate and spray volume on the efficacy of OxiDate 5.0 was tested with applications at the R3 and/or R4 growth stage with a tractor-mounted sprayer equipped with a pulse-width modulation system. Pulse width was manually calibrated on the basis of the measured spray output to maintain a constant driving speed across treatments differing in spray volume. Applications of OxiDate 5.0 were made with flat-fan nozzles and medium or coarse droplets, with spray droplet size calibrated relative to canopy closure. Applications of SaniDate 12.0 were conducted via chemigation, with SaniDate applied at 0.02% v/v in 0.19 inch of irrigation at the early R3 and full R4 growth stages. To facilitate proper randomization of treatments, chemigation was delivered via rotating micro-sprinklers established in an offset, overlapping pattern. To ensure rigorous results, all studies were conducted with 6 to 12 experimental replicates.

Applications of OxiDate 5.0 and SaniDate 12.0 were often associated with moderate improvements in white mold management and soybean yield, but variability in the response to the peroxide-based fungicides was high and no statistically significant responses were observed. The impact of OxiDate 5.0 on end-of-season white mold severity and soybean yield were similar irrespective of application rate and spray volume. Applications of the traditional fungicides Endura, Topsin and ProPulse conferred stronger, more consistent improvements in white mold that were often statistically significant ($P < 0.05$). The results suggest that OxiDate 5.0 and Sanidate 12.0 may have limited effectiveness against white mold in kidney beans and soybeans.

Harvest of soybeans in the peroxide-based products evaluation.

KIDNEY BEANS: Carrington, ND (2023)

White mold incidence 5-10% in non-treated control at the second fungicide application

White mold incidence in fungicide-treated plots to which OxiDate was applied 9 days after 2nd fungicide application: 20%, Red Hawk; 43%, Pink Panther.

		White mold % of canopy, KIDNEY BEAN VARIETY: PINK PANTHER	White mold % of canopy, KIDNEY BEAN VARIETY: RED HAWK	White mold % of canopy average across varieties	Yield pounds/acre, KIDNEY BEAN VARIETY: PINK PANTHER	Yield pounds/acre, KIDNEY BEAN VARIETY: RED HAWK	Yield pounds/acre average across varieties	Yield gain conferred by fungicide program (Bar = average; Circle = result from one kidney bean variety)
Non-treated control		41 b*	34 b*	37 b*	3103 c*	2595 b*	2849 c*	
Single application of **T-Methyl**		38 ab	20 a	29 ab	3147 bc	2787 ab	2967 bc	+118 b**
T-Methyl followed by **ProPulse**	Standard fungicide	26 a	18 a	22 a	3419 ab	2879 a	3149 ab	+301 ab
	OxiDate tank-mixed with second fungicide	34 ab	19 a	27 a	3367 abc	2920 a	3143 ab	+295 ab
	OxiDate at 9 days after second fungicide	29 ab	18 a	23 a	3406 ab	2983 a	3195 a	+346 ab
T-Methyl followed by **Endura**	Standard fungicide	27 a	20 a	23 a	3397 abc	2854 a	3126 ab	+277 ab
	OxiDate tank-mixed with second fungicide	27 a	19 a	23 a	3518 a	2934 a	3226 a	+377 a
	OxiDate at 9 days after second fungicide	30 ab	15 a	23 a	3351 abc	3004 a	3178 a	+329 ab
	CV:	28.8	46.0	35.5	6.1	5.2	5.8	

SOYBEANS: Carrington, ND (2023)

No white mold observed in applications made at the R2 or R3 growth stages.

Percent of plants wilted due to white mold in fungicide-treated plots to which OxiDate was applied at R4 growth stage: 11% (Topsin, ProPulse); 8% (Endura)

		White mold % of canopy, STANDARD FUNGICIDE: TOPSIN 20 fl oz	White mold % of canopy, STANDARD FUNGICIDE: PROPULSE 6.0 fl oz	White mold % of canopy, STANDARD FUNGICIDE: ENDURA 5.5 oz	White mold % of canopy average across fungicide **programs**	Yield bushels/acre, STANDARD FUNGICIDE: TOPSIN 20 fl oz	Yield bushels/acre, STANDARD FUNGICIDE: PROPULSE 6.0 fl oz	Yield bushels/acre, STANDARD FUNGICIDE: ENDURA 5.5 oz	Yield bu/ac average across fungicide **programs**	Yield gain conferred by fungicide program (Bar = average; Circle = result from one fungicide program)
Non-treated control		60 b*	42 a*	50 c*	51 b*	32 a*	44 b*	41 b*	39 b*	
Single application of standard fungicide at R2	Standard fungicide	48 a	41 a	34 bc	41 ab	38 a	48 ab	49 ab	45 a	+5.4 a*
	OxiDate tank-mixed at R2	55 ab	35 a	34 bc	42 ab	33 a	49 ab	50 a	44 a	+4.5 a
	OxiDate applied at R3	50 ab	32 a	36 bc	42 ab	35 a	53 a	49 ab	44 a	+6.5 a
Two applications of standard fungicide (R2, R3)	Standard fungicide	47 a	30 a	29 ab	36 a	40 a	51 ab	53 a	49 a	+8.6 a
	OxiDate tank-mixed at R3	50 ab	40 a	24 ab	35 a	36 a	49 ab	52 a	46 a	+6.5 a
	OxiDate applied at R4	48 a	33 a	21 a	34 a	38 a	51 ab	52 a	47 a	+7.7 a
	CV:	15.4	35.9	11.9	10.4	17.0	12.5	12.9	3.4	

Figure 1. Efficacy of Oxidate 5.0 applied at 1.0% v/v in 15 gal/a applied as a tank-mix with traditional fungicides at standard fungicide application timing or applied as a stand-alone application to kidney beans or soybeans that received two applications of a standard fungicide. In dry beans, testing was conducted with T-methyl @ 40 fl oz/ac or T-methyl followed by Endura @ 8 oz/ac. In soybeans, testing was conducted by a single or two sequential applications of T-methyl @ 20 fl oz/ac, ProPulse @ 6 fl oz/ac, and Endura @ 5.5 oz/ac. Within-column means followed by different letters are significantly different (P < 0.05; Tukey multiple comparison procedure).

SOYBEANS: Carrington, ND (2023)

OxiDate treatments applied at late R3 before the development of white mold and at late R4 when incidence of wilted plants due to white mold was 8% in 14" rows and 5% in 28" rows

	Application at R3 and R4	Spray Volume	White mold % of canopy ROW SPACING: 14"	White mold % of canopy ROW SPACING: 28"	White mold % of canopy average across 14" and 28" rows	Yield bushels/acre ROW SPACING: 14"	Yield bushels/acre ROW SPACING: 28"	Yield bushels/acre average across 14" and 28" rows	Yield gain conferred by fungicide program (Bar = average; Circle = result from one row spacing)
No fungicide applied at early R2	Non-treated		69 a*	73 a*	71 a*	36 a*	22 a*	29 a*	
	OxiDate @ **0.5% v/v**	**20** gal/ac	61 a	73 a	67 a	38 a	23 a	30 a	+1.7 b*
	OxiDate @ **1% v/v**	**20** gal/ac	62 a	72 a	67 a	38 a	23 a	30 a	+3.6 b
	OxiDate @ **1% v/v** + **Topsin** 20 fl oz/ac	**20** gal/ac	58 a	65 a	61 a	43 a	27 a	35 a	+6.2 a
	OxiDate @ **0.5% v/v**	**10** gal/ac	63 a	71 a	67 a	40 a	26 a	33 a	+3.8 ab
	OxiDate @ **1.0% v/v**	**10** gal/ac	61 a	68 a	64 a	39 a	26 a	33 a	+3.7 ab
	OxiDate @ **2.0% v/v**	**10** gal/ac	67 a	70 a	68 a	37 a	24 a	30 a	+1.5 b
	OxiDate @ **1.0% v/v** + **Masterlock** 6.4 fl oz	**10** gal/ac	67 a	69 a	68 a	37 a	23 a	30 a	+1.4 b
		CV:	20.4	10.9	12.8	22.5	18.8	19.3	
Endura applied at early R2	Non-treated		52 a*	63 a*	58 a*	46 a*	29 a*	38 a*	
	OxiDate @ **0.5% v/v**	**20** gal/ac	55 a	64 a	59 a	45 a	29 a	37 a	- 0.6 ab*
	OxiDate @ **1% v/v**	**20** gal/ac	49 a	57 a	53 a	46 a	32 a	39 a	+1.6 ab
	OxiDate @ **1% v/v** + **Topsin** 20 fl oz/ac	**20** gal/ac	49 a	55 a	52 a	49 a	33 a	41 a	+3.3 a
	OxiDate @ **0.5% v/v**	**10** gal/ac	49 a	66 a	58 a	46 a	27 a	37 a	- 1.0 ab
	OxiDate @ **1.0% v/v**	**10** gal/ac	52 a	64 a	58 a	47 a	30 a	39 a	+1.2 ab
	OxiDate @ **2.0% v/v**	**10** gal/ac	46 a	62 a	54 a	46 a	30 a	38 a	+0.4 ab
	OxiDate @ **1.0% v/v** + **Masterlock** 6.4 fl oz	**10** gal/ac	52 a	68 a	60 a	44 a	28 a	36 a	- 1.6 b
		CV:	25.7	15.2	17.1	19.4	19.3	18.2	

SOYBEANS: Oakes, ND (2023)

OxiDate treatments applied at R4 before the development of white mold

	Application at R4	Spray Volume	White mold % of canopy ROW SPACING: 14"	White mold % of canopy ROW SPACING: 28"	White mold % of canopy average across 14" and 28" rows	Yield bushels/acre ROW SPACING: 14"	Yield bushels/acre ROW SPACING: 28"	Yield bushels/acre average across 14" and 28" rows	Yield gain conferred by fungicide program (Bar = average; Circle = result from one row spacing)
No fungicide applied at early R2	Non-treated		33 a*	33 a*	33 a*	71 a*	61 b*	66 a*	
	OxiDate **0.5% v/v**	**20** gal/ac	23 a	33 a	28 a	73 a	63 ab	68 a	+1.7 b**
	OxiDate **1% v/v**	**20** gal/ac	31 a	34 a	33 a	74 a	61 b	68 a	+1.5 b
	OxiDate **1% v/v** + **Topsin** 20 fl oz/ac	**20** gal/ac	18 a	25 a	22 a	78 a	70 a	74 a	+7.8 a
		CV:	38.3	41.8	32.1	6.2	6.8	4.6	
Endura applied at early R2	Non-treated		24 a*	33 b*	29 a*	72 a*	62 a*	67 a*	
	OxiDate **0.5% v/v**	**20** gal/ac	32 a	32 ab	32 a	71 a	63 a	67 a	+ 0.3 a*
	OxiDate **1% v/v**	**20** gal/ac	16 a	25 ab	20 a	76 a	63 a	69 a	+2.4 a
	OxiDate **1% v/v** + **Topsin** 20 fl oz/ac	**20** gal/ac	24 a	20 a	22 a	74 a	64 a	69 a	+2.3 a
		CV:	65.1	29.2	42.6	6.5	7.1	5.7	

Figure 2. Impact of application rate, spray volume, and tank-mix partners on efficacy of Oxidate 5.0. Applications were made with a tractor-mounted sprayer at the R3 and/or R4 growth stages. Within-column means followed by different letters are significantly different (P < 0.05; Tukey multiple comparison procedure).

SOYBEANS: Carrington, ND (2023)

SaniDate treatments applied at early R3 before the development of white mold and at R4 when incidence of wilted plants due to white mold was 3-11%

		Irrigation quantity	White mold % of canopy ROW SPACING: 14"	28"	White mold % of canopy **average** across 14" and 28" rows	Yield bushels/acre ROW SPACING: 14"	28"	White mold % of canopy **average** across 14" and 28" rows	Yield gain conferred by chemigation (**Bar** = average; **Circle** = result from one row spacing)
No foliar fungicide	Water	**0.19** inch	**66** a*	**56** a*	61 a*	**30** a*	**32** a*	31 a*	
	SaniDate **0.02% v/v**	**0.19** inch	**57** a	**55** a	56 a	**38** a	**34** a	36 a	**+5.2**
		CV:	16.4	19.6	16.4	18.5	21.7	18.1	
Endura applied at R2	Water	**0.19** inch	**30** a*	**36** a*	33 a*	**54** a*	**46** a*	50 a*	
	SaniDate **0.02% v/v**	**0.19** inch	**34** a	**30** a	32 a	**52** a	**48** a	50 a	**+0.4**
		CV:	25.3	42.5	32.0	13.3	17.1	14.9	

Figure 4. Efficacy of SaniDate 12.0 (0.2% v/v) applied via chemigation in 0.19 inch of water at the early R3 and full R4 growth stages, Carrington, ND (2023). Within-column means followed by different letters are significantly different (P < 0.05; Tukey multiple comparison procedure).

Partial support for this research was provided by the North Dakota Soybean Council.

Risk of Injury to Midseason-planted Cover Crops in Corn

Mike Ostlie and Joe Ikley

Cover crop adoption in the Northern Great Plains is often limited by a combination of low moisture, short growing season length, and the overlapping of planting windows with harvest season. These are difficult to overcome in a traditional fall cover crop system that follows harvest of a cereal or cool-season legume. Winter rye has been one of the more successful cover crops in the Northern Great Plains due to its wide planting window, a growing season that requires winter, and easy emergence under most conditions. However, fall-planted winter rye comes with many other risks when preceding a crop like corn. Some of the major risks include high early spring water-use and nutrient tie-up. Other options may be preferred in most cropping systems.

Previous research at the CREC and elsewhere has demonstrated that cover crops of various species can be successfully planted between the corn rows mid-season with a high establishment success rate and minimal risk to corn yields. This overcomes the limitations of low fall moisture and short growing season. Cover crops can be readily established between corn rows when planted or drilled. Broadcast seeding cover crops can also be done at this stage but the success rate is much lower compared to the seed-soil contact that planting provides. A reliably established corn cover crop would be especially important to livestock producers. Fall, winter, or spring grazing after corn, with other species growing between rows, would make a great addition nutritionally for the animals and likely extend the grazing period of the land. Be sure to check herbicide labels for grazing restrictions.

From a cropping systems perspective, mid-season cover crops have some logistical concerns that need to be addressed. In particular, one needs to be very familiar with how a weed management program is going to interact with a cover crop planting. On one hand, effective herbicides should be utilized as to not sacrifice weed control. Glyphosate-resistant weeds are too common to rely on glyphosate alone. But on the other hand, residual herbicides are likely to impact at least some of the cover species of interest.

Methods

Between 2021 and 2023 trials were conducted near Carrington and Prosper, ND to determine the effect of corn residual herbicides on common cover crop species. Herbicides were applied around corn growth stages V3-4 each year, and cover crops were planted 10-14 days later (v4-5) with a modified planter that goes between the corn rows. In all, ten herbicides and a check, and ten cover crops were tested in all combinations and replicated three times in each site-year. Each plot was evaluated three and eight weeks after planting to determine differences in cover crop emergence and survival. Ratings were then categorized for simplicity. If an herbicide reduced cover crop emergence by 20% or less it was considered a low risk product for that cover crop. If the reduction ranged from 21-50% it was considered medium risk. If the reduction was greater than 50% it is a high-risk (HR) combination. At each site and year, ratings were combined to get an average rating for each combination. The highest rating of each combination across sites was then used to generate the final table. So essentially, if even one of the sites had an injury rating above 50%, then that treatment combination would be categorized as high risk, and for a combination to maintain the low-risk (LR) label it means there were no instances in all the trials when injury rose above 20%.

Effect of corn residual herbicides on cover crops.

Results

As Figure 1 illustrates, a number of herbicide and cover crop combinations will not be recommended. Several of the tested herbicides are very effective broad spectrum residual products. Even products such as 2,4-D have a short duration residual component which caused substantial injury to lentils. Lentils in particular serve as a good indicator of potential herbicide carryover issues, and in this study only three of the tested products caused little to no injury. The surprising aspect is that Armezon and Laudis were two of the products which did not impact the stand. These products have long residuals which often impact cool-season legumes the following season. However, it is believed that if the lentils were allowed to grow as a cash crop then injury would occur, but as an understory cover crop there was not enough growth and biomass to impact the production. Carryover damage from this family of herbicides often does not show up until the bloom stage in legumes. As lentils are one of the more herbicide-sensitive, cool-season legumes, it can be reasoned that other cool-season legumes are likely to be more tolerant of nearly all herbicides. Unfortunately, the scale of the study made it extremely difficult to test all cover crop species of interest. After lentils, turnips were the next most sensitive species, followed by radish and crimson clover.

Winter rye, oats, and flax had little to no observable injury to the products. When incorporating cover crops into corn, these would make a good base for potential species mixes. Herbicide programs could be molded to work with other desired species (such as a legume), or cover crop species could be altered to fit the existing programs. It should be noted that when used in this manner, oats and other spring cereals like barley will head out as an understory species. Since the winter rye would be planted late June-early July it would not head out until the following season. Radish would also potentially produce seed as an understory crop. Both radish and turnip are susceptible to flea beetles. If the radishes are small at the time of regional canola swathing/harvest then it could result in substantial damage as flea beetles migrate to greener material.

Treatment	Turnip	Radish	Rye	Oat	Lentil	Crimson Clover	Flax
Atrazine	HR	HR	LR	LR	MR	HR	LR
Dual II Magnum	LR	LR	LR	LR	LR	LR	LR
Callisto	HR	MR	LR	LR	HR	LR	LR
Atz + Dual + Callisto	HR	LR	LR	LR	HR	MR	LR
Status	LR	MR	LR	LR	HR	LR	LR
Armezon	HR	LR	LR	LR	LR	LR	LR
2,4-D	LR	LR	LR	LR	HR	LR	LR
Widematch	LR	MR	LR	LR	HR	HR	LR
Harness	LR	MR	LR	LR	MR	LR	LR
Laudis	LR	LR	LR	LR	LR	LR	LR

Figure 1. Relative risk of cover crop injury when residual herbicides were applied at least 10 days prior to cover crop planting. LR = Low Risk (0-20% injury); MR = Medium Risk (21-50% injury); HR = High Risk (51-100%).

This dataset is meant to be a starting point for cover crop and herbicide decision-making. Soil texture and chemical property variability, weather patterns, and the planting operation could create observations that occur in contrast to this table. In fact, in many cases, even combinations which are listed as high risk in the table may cause minimal injury 'most' of the time. Also, when serving as a cover crop, some level of injury may be acceptable to an operations' goals. For instance, if a cover crop is 25% less productive (MR), it may still achieve some goals such as ground coverage or forming a deep taproot. Most goals would fail if injury escalates above 50%.

Testing Nitrogen Fixing Biologicals in Spring Wheat

Szilvia Yuja and Leandro Bortolon

This summer season two biological products that have symbiotic nitrogen fixing bacteria as their active ingredient were tested: Envita by Azotic North America and Utrisha by Corteva Agriscience. The premise is that once applied to crops, the microbes will work to fix nitrogen that the crops can use and in turn require less nitrogen fertilizer than otherwise needed. The bacteria that are in these products form symbiosis with non-nodule forming plants such as wheat and corn. Rhizobia that infect soybean nodules need an anaerobic environment to fix nitrogen. The species in these products, on the other hand, thrive in oxygen rich environments, therefore, nodules are not needed. They enter the plants through the tissues, stomata or root hairs. Once they infect the plant, they get carbohydrates from the plant in exchange for the nitrogen they fix, similar to legumes. Both bacterium species exist naturally in warmer climates but neither of them form spores, therefore they need a living host to survive and cannot endure North Dakota winters.

The trial with Utrisha and Envita was conducted in Carrington and Minot. The products were foliar applied to spring wheat at the end of the tillering stage (Feekes 5) on plots that had nitrogen applied at the 0 or 60 lbs. per acre rate as a starter. Additionally, there were plots that received 30, 90, 120 or 150 lbs. of nitrogen per acre as a starter, to get a nitrogen yield response curve. All other nutrients were uniformly applied based on soil test. The biological treatments were mixed with chlorine-free water on the field, right before application.

Our results showed no significant yield increase from either Utrisha or Envita at either of the locations (Figures 1 and 2). However, it's important to point out that at the Minot site there was no significant response to nitrogen fertilizer either. For this reason, it is not surprising that biological products which were meant to augment nitrogen uptake also did not have an effect at that location. At the Carrington site there was a weak nitrogen yield-response which plateaued at the 30 lb. N rate. In light of this, the lack of response from biologicals at the 60 lb. N rate is not surprising. However, Utrisha and Envita did not increase yield even when no nitrogen was applied.

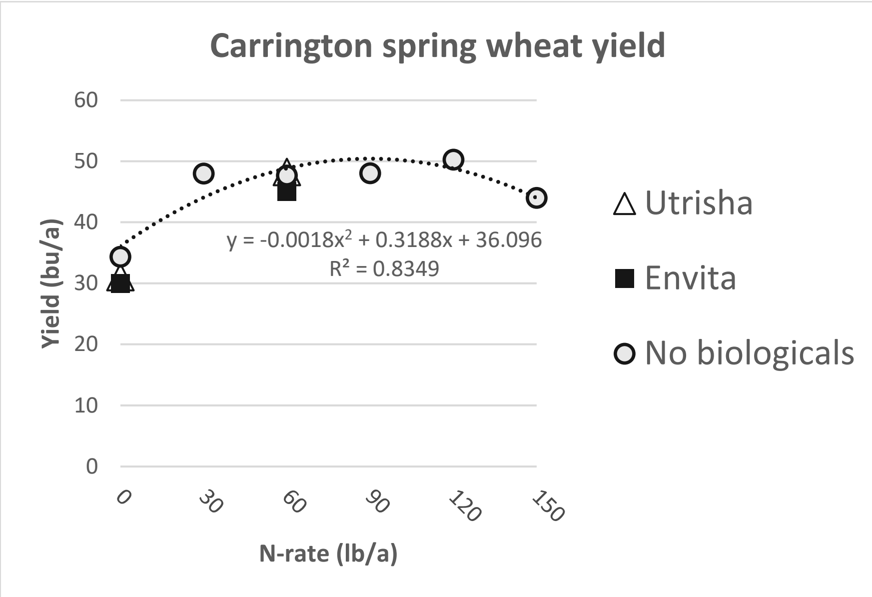


Figure 1. Spring wheat yield response to nitrogen rates and biological products Utrisha and Envita at the Carrington site.

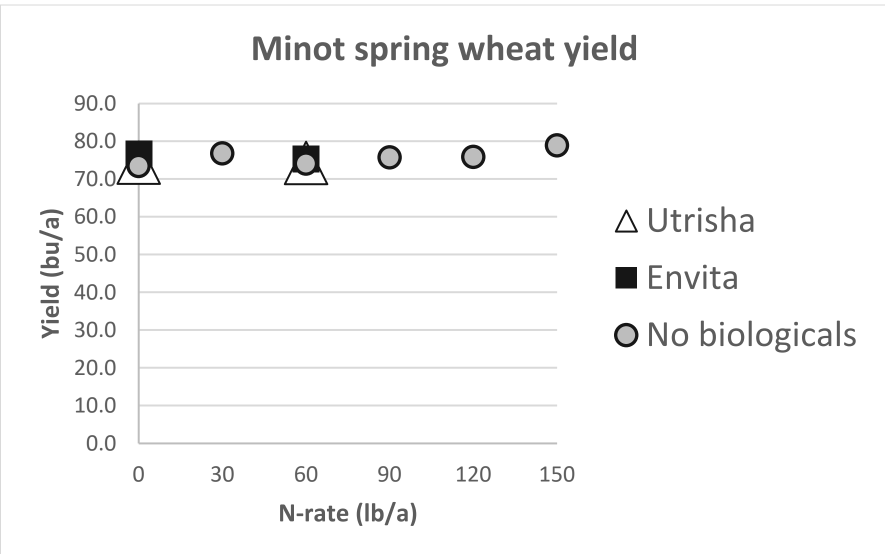


Figure 2. Spring wheat yield response to nitrogen rates and biological products Utrisha and Envita at the Minot site.

We cannot draw any long-standing conclusions based on these results. More site-years of data will be necessary to accurately judge the efficacy of these products.

Partial support for this research was provided by the North Dakota Wheat Commission.

Optimizing Fungicide Spray Droplet Size for Improved Management of White Mold in Pinto Beans

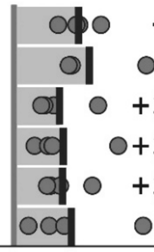
Michael Wunsch, Jesse Hafner, Heidi Eslinger, Spencer Eslinger, Suanne Kallis, Kelly Cooper, and Aaron Fauss

Calibrating fungicide spray droplet size relative to canopy closure confers strong improvements in fungicide efficacy against white mold in soybeans, and this research sought to evaluate whether a similar response might be observed in pinto beans.

The impact of fungicide spray droplet size was tested with a PTO-driven tractor-mounted sprayer equipped with a pulse-width modulation system (Capstan AG; Topeka, KS). Pulse width was modified as needed to maintain a constant spray volume (15 gal/a) and constant driving speed across nozzles differing in output, with pulse width calibrated on the basis of measured output immediately before spraying treatments. The fungicide Topsin or T-methyl (40 fl oz/a) was applied at early bloom followed by Endura (8 oz/a) 11-14 days later. Applications were made at 6.0, 10.0, or 10.5 mph, depending on the study, using TeeJet extended-range flat fan nozzles. Fungicides were applied with XR11004 or XR11005 nozzles at 60 psi (fine droplets); XR11006 nozzles at 35 psi (medium droplets), and XR11010 nozzles at 30 psi (coarse droplets). To permit overspray of plots, treatment plots were bordered by 5- or 10-foot wide non-harvested plots. On ends of each treatment plot, a non-harvested plot was established to permit turning on and off the sprayer at full driving speed. Dry beans were seeded to rows 14, 15, or 28 inches apart at a seeding rate of 90,000 viable seeds. Seven treatments were evaluated: Non-treated, fine followed by fine droplets, fine followed by medium droplets, fine followed by coarse, medium followed by medium, medium followed by coarse, and coarse followed by coarse. All testing was conducted under conventional tillage except in Oakes in 2021, where testing was conducted with dry beans direct-seeded into fallow ground, into winter rye with rye terminated 12 days prior to planting, and into winter rye terminated 2 days after planting. To ensure rigorous results, testing was conducted with 8 to 12 experimental replicates.

The droplet size that optimized fungicide performance was contingent on canopy characteristics. In four studies, yields were maximized with fine droplets at the first application and fine or medium droplets at the second application (**Figure 1**). In four studies, yields were optimized with medium droplets at the first application and coarse droplets at the second application (**Figure 2**). Visual estimates of canopy closure were similar across these eight studies, and additional research is needed to identify the canopy characteristics when fine droplets vs. medium droplets are optimal in the first application. When canopy closure averaged 94% at the first application and 97-99% at the second application, yields were optimized with coarse droplets at both applications (**Figure 3**).

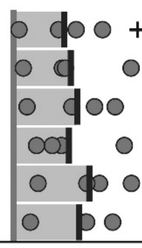
Location, year	Oakes, 2021	Carrington, 2022	Oakes, 2022	Oakes, 2022	COMBINED ANALYSIS	YIELD GAIN conferred by the fungicide
Variety	'Palomino'	'Palomino'	'Palomino'	'Palomino'	**Average** across four studies	**Bar =** average **Circle** = result from one study
Row spacing	15"	14"	28"	14"		
Canopy closure, applic. #1	68% (45-95%)	61% (50-75%)	59% (40-80%)	78% (60-100%)		
Canopy closure, applic. #2	86% (60-100%)	90% (75-98%)	96% (90-100%)	98% (85-100%)		
YIELD (pounds/acre)						
Non-treated control	2912 a*	2612 b*	2987 b*	3529 a*	3010 b*	
Fine f.b. **fine** droplets	**3407** a	3277 a	**3461** a	3861 a	3502 a	+492 ab**
Fine f.b. **medium**	3336 a	**3631** a	3426 a	**3942** a	3584 a	+574 a
Fine f.b. **coarse**	3208 a	3254 a	3210 ab	3728 a	3350 a	+340 b
Medium f.b. **medium**	3060 a	3411 a	3240 ab	3816 a	3382 a	+371 ab
Medium f.b. **coarse**	3186 a	3210 ab	3332 ab	3774 a	3375 a	+365 ab
Coarse f.b. **coarse**	3173 a	3606 a	3366 ab	3630 a	3444 a	+434 ab
CV:	13.6	9.0	9.1	8.0	4.1	



WHITE MOLD (% of canopy)	Oakes, 2021	Carrington, 2022	Oakes, 2022	Oakes, 2022	COMBINED ANALYSIS
Non-treated control	**29** b*	**69** b*	**42** b*	**37** b*	44 b*
Fine f.b. fine droplets	**16** ab	**54** ab	**22** a	**24** a	29 a
Fine f.b. medium droplets	**10** a	**43** a	**25** a	**19** a	24 a
Fine f.b. coarse droplets	**14** ab	**39** a	**28** ab	**28** ab	27 a
Medium f.b. medium droplets	**21** ab	**40** a	**28** ab	**20** a	27 a
Medium f.b. coarse droplets	**16** ab	**48** a	**24** a	**19** a	27 a
Coarse f.b. coarse droplets	**16** ab	**43** a	**24** a	**20** a	26 a
CV:	45.4	19.4	38.5	39	14.7

Figure 1. Applying fungicides with fine droplets at the early bloom and fine or medium droplets 10-14 days later optimized yields in four studies. T-methyl (40 fl oz) was applied first followed by Endura (8 oz) 10-14 days later. Within-column means followed by different letters are significantly different (*P* < 0.05) or (*P* < 0.10) if followed by two asterisks.

Location, year	Carrington, 2022	Carrington, 2021	Oakes, 2021	Oakes, 2021	COMBINED ANALYSIS	YIELD GAIN conferred by the fungicide
Variety	'Palomino'	'Palomino'	'Palomino'	'Palomino'	**Average** across four studies	**Bar =** average **Circle** = result from one study
Row spacing	28"	14"	15"	15"		
Canopy closure, applic. #1	61% (55-68%)	52% (40-60%)	79% (60-90%)	64% (40-85%)		
Canopy closure, applic. #2	88% (80-98%)	95% (80-100%)	92% (75-100%)	96% (90-100%)		
YIELD (pounds/acre)						
Non-treated control	2444 b*	2161 a*	2944 b*	3363 a*	2728 b*	
Fine f.b. **fine** droplets	3137 a	2642 a	3282 ab	3382 a	3111 a	+383 b**
Fine f.b. **medium**	3369 a	2529 a	3337 a	3416 a	3163 a	+435 ab
Fine f.b. **coarse**	3241 a	2605 a	3573 a	3445 a	3216 a	+488 ab
Medium f.b. **medium**	3316 a	2522 a	3230 ab	3523 a	3148 a	+420 ab
Medium f.b. **coarse**	**3373** a	**2829** a	**3510** a	**3536** a	3312 a	+584 a
Coarse f.b. **coarse**	3220 a	2716 a	3509 a	3473 a	3230 a	+502 ab
CV:	8.4	9.8	8.1	7.4	4.5	



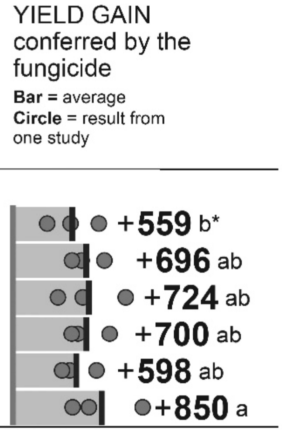
WHITE MOLD (% of canopy)	Carrington, 2022	Carrington, 2021	Oakes, 2021	Oakes, 2021	COMBINED ANALYSIS
Non-treated control	**69** b*	**55** b*	**27** b*	**12** a*	41 b*
Fine f.b. fine droplets	**50** a	**46** a	**12** a	**8** a	29 a
Fine f.b. medium droplets	**46** a	**45** a	**14** a	**9** a	29 a
Fine f.b. coarse droplets	**49** a	**47** a	**16** a	**10** a	31 a
Medium f.b. medium droplets	**43** a	**48** a	**14** a	**10** a	29 a
Medium f.b. coarse droplets	**52** a	**43** a	**14** a	**7** a	29 a
Coarse f.b. coarse droplets	**47** a	**42** a	**15** a	**7** a	28 a
CV:	12.0	13.2	34.1	48.4	11.1

Figure 2. Applying fungicides with medium droplets at the early bloom and coarse droplets 10-14 days later optimized yields in four studies. T-methyl (40 fl oz) was applied first followed by Endura (8 oz) 10-14 days later. Within-column means followed by different letters are significantly different (*P* < 0.05) or (*P* < 0.10) if followed by two asterisks.

Location, year	Carrington, 2023	Carrington, 2023	Carrington, 2023	COMBINED ANALYSIS Average across three studies
Variety	'ND Rodeo'	'Torreon'	'Vibrant'	
Row spacing	14"	14"	14"	
Canopy closure, applic. #1	**94%** (87-97%)	**94%** (92-96%)	**94%** (88-97%)	
Canopy closure, applic. #2	**97%** (95-99%)	**99%** (96-100%)	**99%** (97-100%)	
Lodging, application #2	**24%**	**9%**	**7%**	

YIELD (pounds/acre)

Non-treated control	1832 b*	1948 b*	2064 b*	1948 b*
Fine f.b. **fine** droplets	2657 a	2490 a	2374 a	2507 a
Fine f.b. **medium**	2711 a	2601 a	2621 a	2644 a
Fine f.b. **coarse**	2923 a	2612 a	2482 a	2672 a
Medium f.b. **medium**	2765 a	2562 a	2618 a	2648 a
Medium f.b. **coarse**	2633 a	2483 a	2523 a	2546 a
Coarse f.b. **coarse**	**3093** a	**2674** a	**2627** a	2798 a
CV:	13.3	15.1	17.6	4.9



WHITE MOLD (% of canopy)

Non-treated control	**67** b*	**67** a*	**64** a*	66 b*
Fine f.b. fine droplets	**52** a	**59** a	**60** a	57 a
Fine f.b. medium droplets	**51** a	**58** a	**56** a	55 a
Fine f.b. coarse droplets	**50** a	**58** a	**58** a	55 a
Medium f.b. medium droplets	**52** a	**61** a	**54** a	56 a
Medium f.b. coarse droplets	**55** a	**60** a	**57** a	58 a
Coarse f.b. coarse droplets	**47** a	**56** a	**56** a	53 a
CV:	15	17.2	15.2	4.5

Figure 3. Applying fungicides with coarse droplets at the early bloom and coarse droplets 10-14 days later optimized yields in three studies. T-methyl (40 fl oz) was applied first followed by Endura (8 oz) 10-14 days later. Within-column means followed by different letters are significantly different ($P < 0.05$).

Significant Reduction of Available Soil Nitrate (NO3-N) through Fall-planted Cereal and Brassica Cover Crops in North Dakota

Sergio Cabello-Leiva and Marisol Berti

Introduction

Cover crops are temporary cover that provides soil protection when cash crops are prevented from being planted, are seeded but not well established or following harvest. Cover crop benefits include decreased soil erosion and improved soil aggregation, enhanced water infiltration, better root growth, added rhizosphere diversity, reduced nitrate leaching and/or denitrification depending on the weather, and decreased soil compaction depending on clay type and cover crop species (1,2).

Soil nitrate (NO_3-N) leaching and denitrification in some soils are major sources of N loss in agricultural activities, estimated to be more than 19% of the total fertilizer N applied to crops globally (3,4). Cover crops can take up soil residual NO_3-N, preventing its loss. Brassica species cover crops are good at scavenging leftover N from 34 to 180 pounds per acre of N uptake under different cropping systems (5,6). Cereal cover crops are also excellent scavengers of leftover N and were found to decrease nitrate leaching by 59% in one study (7).

We hypothesized that seeding forage radish, winter camelina, winter wheat, and winter rye would decrease residual soil NO_3-N, limit erosion, and might release N the following season for a subsequent non-legume crop.

Methods

This research was conducted at the NDSU Prosper Research Farm and at a farmer's field near Hickson, ND, under dryland transitional no-till conditions in a wheat-cover crop-sugarbeet rotation, replicated over two years, resulting in four different environments. Spring wheat was seeded in 6-inch rows at 1,802,000 pure live seed (PLS) per acre in late April each year, and the crop was fertilized based on soil analysis and North Dakota wheat nutritional recommendations.

Cover crops were seeded following spring wheat harvest in early August into wheat stubble without tillage using an XL Plot Seeder (Wintersteiger, Austria). The cover crop treatments were arranged within the spring wheat stubble in a randomized complete block design (RCBD) with four replicates at both locations in both years. Cover crop treatments were winter rye, winter camelina, winter wheat, oat, radish, and a check without a cover crop.

Cover crop above-ground biomass samples were collected before the first frost of the fall by cutting the plants directly above the soil surface from a four square foot area in each experimental unit. Samples were dried at 70°C until they reached a constant weight, and total N accumulation was determined. Cover crop ground coverage was obtained in late fall (before the first frost) using Canopeo © imagery through a cell phone app (Canopeo™, Oklahoma State University, Stillwater, OK), and it was expressed as a percentage of the total surface area.

In late fall, soil samples were collected, with three cores per experimental unit from the 0-6 inch and 6-24 inch depths. The soil samples were then dried and analyzed for NO_3-N.

Results

Cover crops' above-ground biomass, soil green cover, biomass N accumulation, and fall soil NO3-N presented significant differences among cover crop averages across four environments.

Figure 1 (a) shows that cover crop biomass was greater in oats (1614 pounds per acre) and radish (1585 pounds per acre) than in winter camelina and winter wheat. However, when winter camelina and winter wheat are fall-seeded, it is expected that they will provide growth the following spring, adding more biomass to the system at this time rather than in the fall. Soil green cover surface area (Figure 1, b) was significantly greater in oat (52%), radish (56%), and winter rye (45%), providing an excellent physical barrier against particularly soil wind erosion.

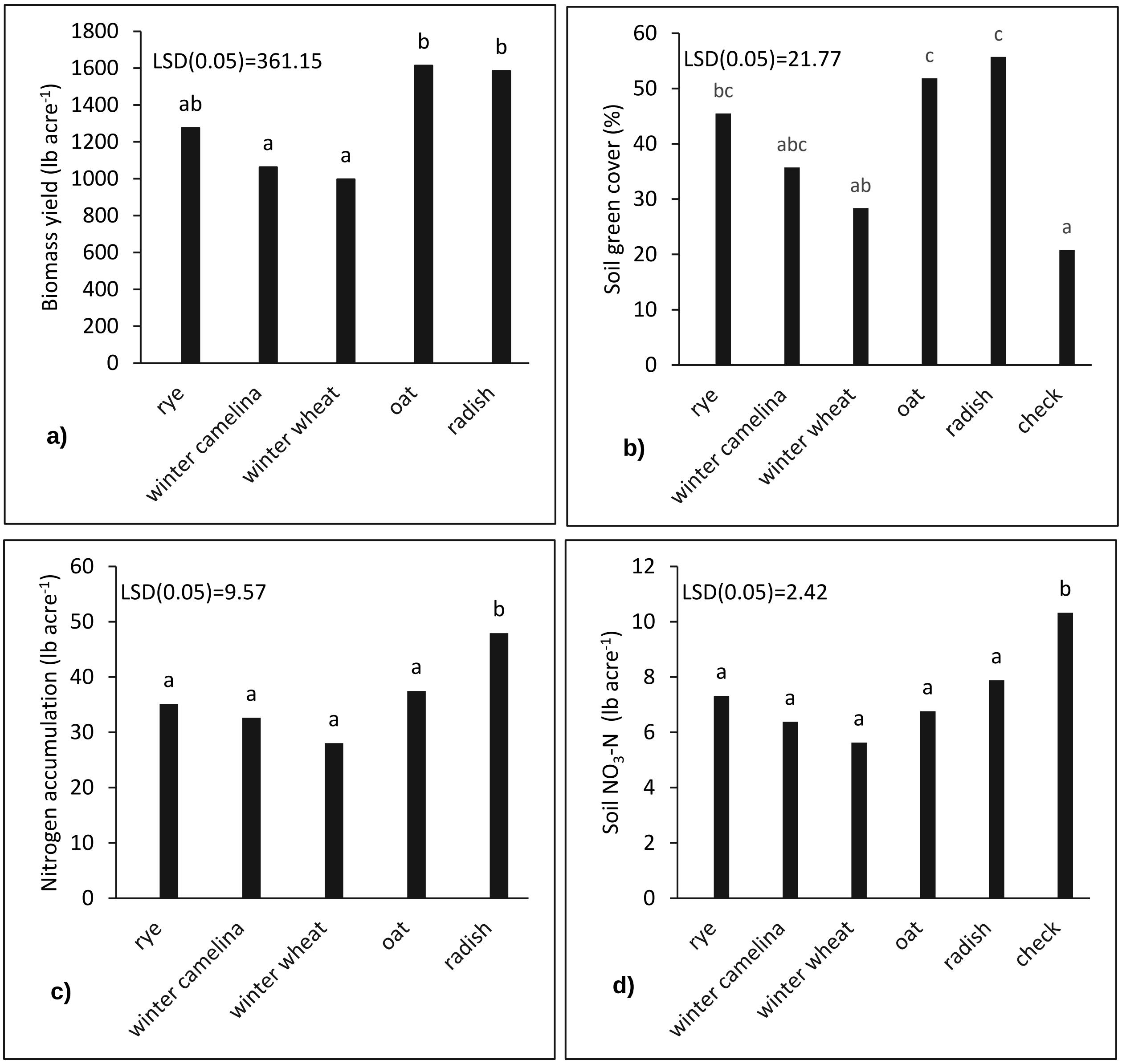


Figure 1. Cover crop aboveground biomass (a), soil green cover (b), Nitrogen biomass accumulation (c), and Soil NO_3-N (d) averaged across four environments, Prosper and Hickson, ND. (From Cabello-Leiva S, 2022).

Nitrogen accumulation in the biomass (Figure 1, c) was greater in forage radish (48 pounds per acre). Soil residual NO_3-N (6-24 inches) was less under all cover crops, with 24-46% less soil NO_3-N (Figure 1, d) than in the check treatment, indicating that the use of cover crops was actively scavenging soil NO_3-N, reducing the risk of system N loss.

Summary

Fall cover crop biomass and soil green cover surface area were greater in radish and oats than in the winter hardy cover crops. Of all cover crop treatments, forage radish had the greatest N accumulation.

In late fall, soil NO3-N (0-24 inches) was lower under all cover crops compared with the check treatment. The results indicate that cover crops actively scavenged NO_3-N from the soil profile, protecting the residual N from some losses. Presumably, this N would be cycled back into the soil system, where it would be released through physical chemistry or biological pathways for future crops.

Acknowledgments:
This project was funded by USDA-NIFA, Coordinated Agricultural Program, Award no. 2016-69004-24784,"CropSys - A novel management approach to increase productivity, resilience, and long-term sustainability of cropping systems in the northern Great Plains", and ANID (Agencia Nacional de Investigacion y Desarrollo, Chile) scholarship folio: 72180579.

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Normalized Difference Vegetation Index as an Accurate Yield Prediction for Corn and Sugarbeet under Different Nitrogen and Cover Crop Treatments in North Dakota

Sergio Cabello-Leiva and Marisol Berti

Introduction

Crop yield and quality are among the main objectives in all cropping systems. A valuable tool to achieve this goal is multispectral active sensors technology, such as GreenSeeker™, that can collect crop information when plants are actively growing, allowing Normalized Difference Vegetation Index (NDVI) to be obtained.

The NDVI index is defined by the difference between near-infrared and red radiation, divided by near-infrared and red radiation. This index has been used as a crop predictor of plant biomass, leaf area, grain yield, soil vegetation cover, leaf chlorophyll, and nutrient status (1,2). NDVI is widely used to predict accurately biomass and vigor in the early stages of corn and sugarbeet (3,4).

The main objective of this study was to predict corn grain yield and recoverable sucrose (RS) in sugarbeet early in the season, using the NDVI index under different cover crop and nitrogen rate treatments in North Dakota.

Methods

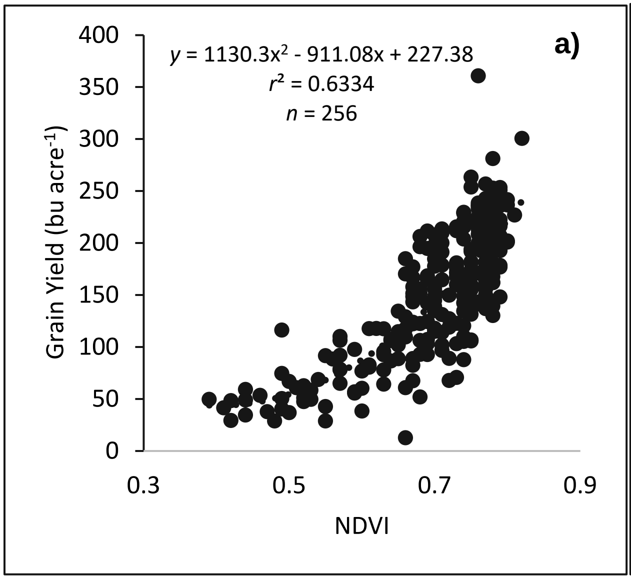
This research was conducted at the NDSU Prosper Research Farm and a farmer's field near Hickson, ND, under dryland transitional no-till conditions in wheat-cover crop-corn and wheat-cover crop-sugarbeet rotations, replicated over two years, resulting in four different environments.

Corn was established where cover crop treatments were present the previous fall. The experimental design used was a randomized complete block design (RCBD) with a split-plot arrangement and four replicates. The main plots were the last season's cover crop treatments: faba bean, winter pea, winter camelina, and check plot without a cover crop. Sub-plots included four nitrogen rates: 0 (check), 36, 71, and 143 lbs./a. The NDVI index was recorded at the V8 growth stage using a handheld GreenSeeker™ active-optical sensor (Trimble Inc., Sunnyvale, CA); 256 reads were recorded across the four environments. All plots were harvested and grain yield was determined.

Sugarbeet was established where cover crop treatments were present the previous fall. The experiment was an RCBD with a split-plot arrangement and four replicates. The main plots were the last season's cover crop treatments: winter rye, winter camelina, winter wheat, oat, radish, and check without a cover crop. Sub-plots were the two N rates, 0 (check) and 100 lbs./a. The NDVI index was recorded at the V10 growth stage using a hand-held GreenSeeker™; 192 reads were recorded across the four environments. All plots were harvested, and recoverable sucrose (RS) was determined.

Results

Figure 1 shows the NDVI measured with the Greenseeker™ sensor at the V8 stage in corn and V10 stage in sugarbeet, showing a significant positive relationship with grain yield and recoverable sucrose, respectively. In both crops, healthy plants cover more soil surface, absorbing light in the red spectrum wavelength and transmitting most of the incident near-infrared light (NIR), resulting in higher NDVI values and, consequently, higher yields.



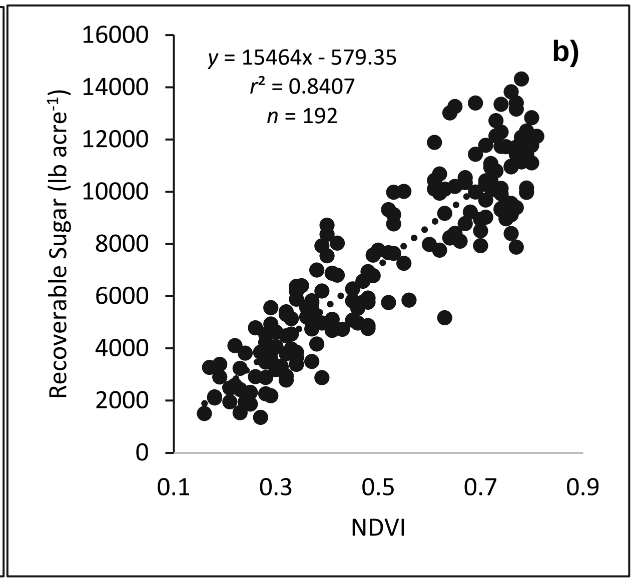


Figure 1. Corn and sugarbeet NDVI prediction models across cover crops and nitrogen rates in four environments: a) Corn grain yield vs. NDVI measured at the V8 stage, b) Sugarbeet recoverable sucrose vs. NDVI measured at the V10 stage.

The corn grain yield model had a coefficient of determination (r^2) greater than 0.63 in all treatments averaged across environments. This confirms a good prediction early in the season, where lower NDVI values result in lower grain yield, and higher NDVI values result in higher yields.

The sugarbeet RS had a coefficient of determination (r^2) greater than 0.84 in all treatments averaged across four environments. This confirms an excellent prediction early in the season, where lower NDVI values result in lower RS and higher NDVI values result in high RS. This prediction is critical because payment to farmers is based on RS yield.

Summary

Normalized difference vegetation index, measured with an active-optical sensor, is a powerful tool to predict corn grain yield and recoverable sucrose in sugarbeet. This research demonstrated that NDVI accurately predicts corn grain yield (V8 stage) and RS (V10 stage) regardless of cover crop, N rate treatment, and environment. These results have considerable potential when cover crops are included in the cropping systems, allowing farmers to correct deficient N status early in the season to achieve target corn grain yield and sugarbeet root yield and quality parameters.

Acknowledgments
This project was funded by USDA-NIFA, Coordinated Agricultural Program, Award no. 2016-69004-24784,"CropSys - A novel management approach to increase productivity, resilience, and long-term sustainability of cropping systems in the northern Great Plains", and ANID (Agencia Nacional de Investigacion y Desarrollo, Chile) scholarship folio: 72180579.

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Remote Controlled Automated Drip Irrigation for Watermelon, Muskmelon and Squash Production

Bhuwan Shah, Xinhua Jia, Harlene Hatterman-Valenti, and Michael Ostlie

Introduction
In North Dakota, horticultural specialty crops, such as fruits and vegetables, constitute a small fraction of the state's agricultural production due to the challenging cold weather and limited growing season (NASS, 2021). In 2017, there were only 26 muskmelon farms and 46 winter squash farms, averaging 10 and 24 acres respectively (NASS, 2017). Additionally, while some individuals grow these crops in their gardens, these yields often go unrecorded.

To mitigate the challenges of water management and cold temperatures, the use of clear plastic mulch can be employed to increase soil temperature and extend the growing season. Drip irrigation, as a water source, complements this approach. This combination of drip irrigation and mulch is already a successful strategy for high-value specialty crops in other regions, suggesting it could be effective for cultivating watermelon, muskmelon, and squash in North Dakota. Implementing an automatic sensor-controlled drip irrigation system could further elevate production to a commercial scale, offering significant benefits in water conservation and labor efficiency.

Materials and Methods
In 2022 and 2023, field trials were conducted to assess the growth of four varieties each of watermelon, muskmelon, and squash (Table 1), all cultivated under clear plastic mulch. These trials employed a soil water sensor-controlled surface drip irrigation system, testing four distinct irrigation treatments: Time-based, 10% MAD (Management Allowed Depletion), 30% MAD, and 60% MAD. The experimental design was a split-plot randomized complete block design (RCBD), with three crops as the main plots and four irrigation treatments as sub-plots, each replicated four times. The chosen plant density for this study was 5.57 m^2 per plant. Irrigation scheduling was determined by soil water potential, corresponding to the predefined MAD levels derived from the soil water release curve. The system was programmed to automatically initiate irrigation whenever the soil water potential fell below these threshold levels. More details about the experiments can be found from Shah et al. (2023) and Shah (2023). Comprehensive statistical analysis was conducted to evaluate the impact of these irrigation

treatments on both yield and quality of the produce, providing valuable insights into optimal irrigation practices for these crops.

Table 1. Varieties of crop used in study.

Watermelon	Muskmelon	Squash
Sweet Dakota Rose	Ambrosia	Atlas
Sangria	Aphrodite	Butterscotch
Crimson Sweet	Athena	Butterbaby
Sunshine	Goddess	Waltham

Results and Discussions

The harvesting of watermelon and muskmelon started in August, with squash being harvested once at the end of the growing season in September 2022. In 2023, the harvest of watermelons and muskmelons began in August as in the previous year, but it concluded by mid-September due to temperature fluctuations during the growing season. Unlike 2022's single harvest, squash in 2023 required three harvests on September 19, 28, and October 04, as the fruits matured at different times. The total yields of watermelon, muskmelon, and squash under the various irrigation treatments are detailed in Table 2 for both growing seasons. Watermelons showed the highest yield under the 30% MAD irrigation treatment, but the difference was not statistically significant when compared to other treatments (Table 3). Among the watermelon varieties (Table 4), the Crimson Sweet variety yielded the most at 46.35 Mg/ha, whereas the Sunshine variety had the lowest yield at 29.75 Mg/ha. Parameters like average weight, diameter, and length of the fruits did not show significant differences across varieties under different irrigation treatments. Similarly, muskmelon and squash yields and quality were not significantly affected by the irrigation treatments. Both crops responded similarly to watermelon, with no notable difference in yield and quality under the various irrigation treatments.

Table 2. Watermelon, muskmelon, and squash quality parameter analysis on irrigation, variety, and the interaction of irrigation and variety across years of 2022 and 2023 using analysis of variance, Pr > F values shown with at p < 0.05.

Crop	Source	DF	N fruit	Yield	Weight	Brix	pH	EC	Diameter	Length	Flesh
				(Mg/ha)	(kg)	(%)		(mS/cm)	(cm)	(cm)	(cm)
Muskmelon	Irr	3	0.819	0.927	0.843	1	0.43	0.734	0.474	0.727	0.73
	Var	3	0.95	0.481	0.28	1	0.8	0.288	0.129	0.331	0.75
	Irr*Var	9	0.863	0.587	0.921	1	0.49	0.26	0.686	0.814	0.51
Watermelon	Irr	3	0.696	0.684	0.623	1	0.88	0.447	0.659	0.623	-
	Var	3	0.288	0.047*	0.246	1	0.87	0.368	0.351	0.306	-
	Irr*Var	9	0.717	0.296	0.477	1	0.86	0.168	0.718	0.615	-
Squash	Irr	3	0.815	0.376	0.662	-	-	-	-	-	-
	Var	3	0.393	0.73	0.537	-	-	-	-	-	-
	Irr*Var	9	0.715	0.609	0.816	-	-	-	-	-	-

Table 3. Yield of watermelon, muskmelon, and squash in Mg ha^{-1} under different irrigation treatments in 2022 and 2023.

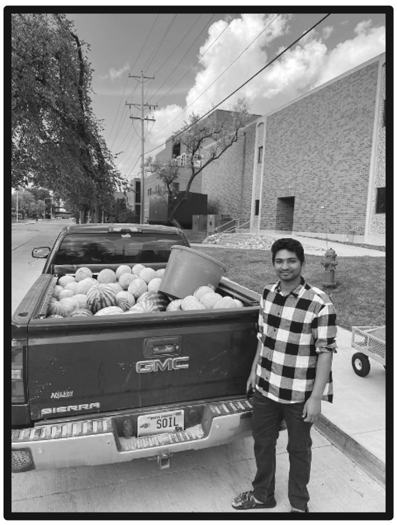
Treatments	Watermelon	Muskmelon	Squash
Time-based	40.4	26.34	35.63
10% MAD	41.52	28.1	43.09
30% MAD	44.82	26.76	41.34
60 % MAD	38.79	27.26	41.88

Table 4. Yield of Watermelon Varieties in 2022 and 2023.

Variety	Mean Yield (Mg ha-1)	
Crimson Sweet	46.3493	A
Sweet Dakota Rose	46.0544	A
Sangria	44.2683	A
Sunshine	29.7544	B

Note: LS-means with the same letter are not significantly different.

The results indicated that the irrigation treatments did not affect the yield and yield quality of fruits significantly. Thus, higher MAD treatments with less irrigation water frequency and amounts can be a viable strategy for good fruit yield and quality. This sensor-controlled automatic drip irrigation system provides exciting opportunities for the large-scale cultivation of horticultural crops in regions characterized by cold weather and a short growing season, such as North Dakota.



Melons from drip irrigation project.

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Evaluation of Fine-ground Rye, Dry Rolled Hybrid Rye, and Dry Rolled Corn in Backgrounding Steer Rations

Colin Tobin, Zachary Carlson, Kendall Swanson, Zachary Smith, Warren Rusche, and Karl Hoppe

Cereal rye offers flexibility to producers when included into their crop rotation. Rye can be grazed, hayed or ensiled for forage production, or harvested as grain and straw (Rusche et al., 2020). Typically harvested for grain in early- to mid-summer, rye can be utilized in backgrounding and early finishing rations while producers await row crop harvest.

The objectives of this experiment were to 1) determine the effects of hybrid rye substitution of dry rolled corn (DRC) on dry matter intake (DMI), growth performance and feed efficiency and 2) evaluate efficiency differences between dry rolled and ground hybrid rye. Our hypotheses were that 1) steers fed hybrid rye would have similar growth performance as steers fed only dry rolled corn and 2) grinding hybrid rye will have improved growth performance compared dry rolled hybrid rye.

Materials and Methods
All procedures involving the use of animals in this experiment were approved by the North Dakota State University Institutional Animal Care and Use Committee (approval number IACUC20220074). The experiment was conducted at the North Dakota State University Carrington Research Extension Center (CREC) located near Carrington, ND.

Experimental Design and Treatments
Three treatments were used in a randomized complete block design to evaluate animal performance traits during the backgrounding phase. Hybrid rye was substituted for DRC in the backgrounding ration as follows: a basal diet formulated with 22% corn grain (CON) on a dry matter (DM) basis with two additional diets formulated with either ground (GRYE) or rolled (RRYE) hybrid rye (Table 1).

Table 1. Diet formulations.

Item	CON	RRYE	GRYE
	Treatment		
Ingredient Composition, %			
Dry rolled corn (DRC)	22.1	0	0
Hybrid rye	0	22.1	22.1
MDGS	17.5	17.5	17.5
Corn silage	33.8	33.8	33.8
Barley hay	23.6	23.6	23.6
Dry supplement	2.1	2.1	2.1
Limestone	0.9	0.9	0.9
Nutrient Composition			
NEm, Mcal/kg	1.51	1.67	1.71
Neg, Mcal/kg	0.77	0.9	0.93
CP, %	13.24	14.6	15.25
NDF, %	39.01	38.28	37.35
ADF, %	24.93	23.41	23.49
Ash, %	14.62	9.24	9.48
EE, %	3.36	2.7	3.09

Animals, Initial Processing, Study Initiation

One hundred fifty cross-bred steers (597 ± 51.3 lbs., initial body weight [BW]) were used in this experiment. Steers were consigned to the Dakota Feeder Calf Show (DFCS) from multiple ranches which were collected at the Turtle Lake Weigh Station, ND, vaccinated with Pyramid 5 + Presponse SQ, Inforce 3, Bar-Vac 7/Somnus, poured with Cydectin, given broad spectrum antibiotic, and implanted with Synovex S, and delivered to the CREC on October 15, 2021.

Body weights were collected on two consecutive days, averaged for initial body weights, were stratified by weight, and randomly assigned to pen. Steers were fed in eight dirt and seven cement-surfaced pens (*n* = 15; 10 steers/pen), resulting in five replications per treatment with 50 steers per treatment. Calves were housed in pens which had 1 m concrete bunk space, 3.5 m concrete feed apron, and 39.1 m^2 of pen space per steer.

The experiment was initiated on October 24, 2021, after steers were adapted to the control ration and were fed for 63 days. Steers were fed a high forage backgrounding ration for the first 63 d. Due to extreme cold conditions on December 20, 2021 (day 56), final weights were postponed to December 27, 2022.

Diets and Intake Management

Steers were fed once daily at 0800. Steers were placed on a basal high forage backgrounding diet prior to the beginning of the study. Bunks were managed to be devoid of feed at 0700 h.

All rye grain was received from a single source and was the same hybrid (KWS Bono, KWS Cereals, LLC; Champaign, IL). Rye was processed by passing through a hammermill. Wet chemistry of the individual ingredients was analyzed at Dairyland Laboratories, Inc (Arcadia, WI) prior to study initiation to balance initial ration. Analysis included ash, ether extract, neutral detergent fiber, acid detergent fiber, and crude protein. Wet chemistry of the total mixed ration was analyzed at Dairyland Laboratories, Inc. with similar methods as individual ingredients.

The monthly average of growth performance (weight, ADG, DMI, G:F) were analyzed using the repeated measures procedure of PROC MIXED in SAS 9.4 (SAS Inst Inc., Cary, NC; Littell et al., 2006) with pen serving as the experimental unit. The fixed effects in the model include linear function of month (1 to 2), ration (CON, RRYE, GRYE) and the interaction of month by ration. The subjects repeated measures analysis was pen (1 to 15). Least squares means were generated using the LSMEANS statement of SAS and treatment effects were evaluated using orthogonal polynomials (Steel and Torrie, 1960). Pre-planned contrasts were analyzed to identify specific differences between control vs. rye; rolled rye vs. ground rye, rolled rye vs. control, and ground rye vs. control.

Results

No differences in weight were detected due to the inclusion of processed rye in the ration on the weight (*P* = 0.35). No interaction of month by ration (*P* = 0.16) was detected. There was a detected difference due to month (*P* < 0.0001). Across the 63 d study, steers assigned to CON, RRYE, and GRYE gained 204, 197, and 214 lbs., respectively. No differences in weight were detected during the first 28 days (*P* = 0.14) or from days 28-63 (*P* = 0.26). Calves that were fed rolled rye weighed less throughout the study than calves fed DRC (*P* = 0.0241) and a tendency for calves fed rolled rye to weigh less than those fed ground rye (*P* = 0.0951). During the initial 28 d period, there was a tendency of lower weights for steers fed hybrid rye compared to corn (*P* = 0.0646) and for calves that were fed rolled rye compared to rolled corn (*P* = 0.0609). From day 28-63, there were no detectable differences in weights due to the inclusion of rye in the ration (Table 2).

Table 2. Effects of treatment on backgrounding steers.

	Dietary Treatment				*P*-value			
	CON	RRYE	GRYE	SEM	Corn vs. Rye	GRYE vs. RRYE	RRYE vs. CON	GRYE vs. CON
Initial BW, lbs	600	596	596	5.4	-	-	-	-
Initial to day 28								
BW day 28, lbs	713	698	703	4.6	**0.0646**	0.53	0.609	0.1647
ADG, lbs	3.84	3.53	3.62	0.1323	0.11	0.61	0.11	0.23
DMI, lbs	15.50	15.21	15.06	0.41895	0.33	0.69	0.61	0.3
G:F, lbs	0.25	0.23	0.24	0.0067	0.2	0.4	14	0.47
Day 29-63								
BW day 56, lbs	805	793	811	7.3	0.73	0.12	0.27	0.59
ADG, lbs	2.56	2.62	3.00	0.18	0.16	**0.0751**	0.75	**0.0451**
DMI, lbs	19.62	20.29	20.66	0.49	0.18	0.6	0.35	0.16
G:F, lbs	0.1314	0.1303	0.1456	0.01	0.51	0.2	0.92	0.23

No differences in ADG due to the inclusion of processed hybrid rye was detected (*P* = 0.19) throughout the study. No interaction of month by ration (*P* = 0.15) was detected. There was a detected difference due to month (*P* < 0.0001). Across the 63 d study, steers assigned to CON, RRYE, and GRYE had an average daily gain of 3.20, 3.06, and 3.31 lbs., respectively. No differences in ADG were detected during the first 28 days (*P* = 0.24), but there was a tendency effect detected from days 28-63 (*P* = 0.0898). No differences were detected in preplanned contrasts during day 1-28 (*P* > 0.10). From day 28-63, steers assigned to GRYE had greater ADG than steers assigned to CON (*P* = 0.0451) and tended to have higher ADG than those assigned to RRYE (*P* = 0.0751). Calves that were fed rolled rye weighed less throughout the study than calves fed DRC (*P* = 0.0241) and a tendency for calves fed rolled rye to weigh less than those fed ground rye (*P* = 0.0951). There was a detected difference due to month (*P* < 0.0001). During the initial 28 d period, there was a tendency of lower weights for steers fed hybrid rye compared to corn (*P* = 0.0646) and for calves that were fed rolled rye compared to rolled corn (*P* = 0.0609). From day 28-63, there were no detectable differences in weights due to the inclusion of rye in the ration (Table 2).

No differences in DMI due to the inclusion of processed hybrid rye were detected (*P* = 0.83) throughout the study. No interaction of month by ration (*P* = 0.28) was detected. There was a detected difference due to month (*P* < 0.0001). Across the 63 d study, steers assigned to CON, RRYE, and GRYE had an average daily dry matter intake of 17.56, 17.75, and 17.85 lbs. , respectively. Throughout the study, no differences within contrasts were detected (*P* > 0.1; Table 2).

No differences in G:F due to the inclusion of rye in the ration were detected (*P* = 0.21). No interaction of month by ration was detected (*P* = 0.50). There was a detected difference due to month (*P* < 0.0001). Across the 63 d study, steers assigned to CON, RRYE, and GRYE gained 0.1897, 0.1813, and 0.1931 lbs. per lb. of feed consumed, respectively. Throughout the study, no differences within contrasts were detected (*P* > 0.1; Table 2).

Partial funding for this project was provided by the State Board of Agricultural Research and Education Animal Committee.

Feeding Hybrid Rye as One-third of the Concentrate in Finishing Rations: Two Methods with Improved Results

Colin Tobin

Useful as a concentrate in backgrounding rations, hybrid rye can be used successfully as a concentrate in finishing rations. Higher inclusions of hybrid rye reduced performance due to lower net energy for maintenance and gain (NEm and NEg) (Buckhaus et al., 2021; Rusche et al., 2020). Rusche et al. (2020) fed rolled hybrid rye at increasing substitution levels to finishing steers. Steers fed one-third of the concentrate within the ration had similar feed efficiency performance and carcass characteristics as steers fed entirely corn as the concentrate. From day 1-47 of finishing, calves fed hybrid rye one-third and two-thirds of the concentrate within the diet had comparable performance to those fed solely corn as the concentrate. Calves fed two-thirds of their concentrate had reduced gains from day 48-117 but had comparable carcass characteristics (Rusche et al., 2020).

Additionally, as with other concentrates, increased processing by rolling and grinding has shown improvements in animal performance. Grinding hybrid rye tended to improve feed efficiency over dry rolling (Tobin, Evaluation of fine-ground rye, dry rolled hybrid rye, and dry rolled corn in backgrounding steer rations). Due to rapid fermentation and rapid pH level changes, feeding ground small grains as concentrates can lead to acidosis if improperly managed. Increasing substitutions of hybrid rye for barley led to decreases in ruminal pH (Zhang et al., 2023).

The objectives of this experiment were to determine the effectiveness of feeding one-third of the concentrate as hybrid rye for the entire duration of finishing or as a transition diet on dry matter intake (DMI), growth performance and feed efficiency. Our hypothesis is that steers fed a transition diet will have improved performance over the two-thirds and corn control diets.

Materials and Methods

All procedures involving the use of animals in this experiment were approved by the North Dakota State University Institutional Animal Care and Use Committee (approval number IACUC20220074). The experiment was conducted at the North Dakota State University Carrington Research Extension Center (CREC) located near Carrington, ND.

Experimental Design and Treatments

Three treatments were used in a randomized complete block design to evaluate animal performance traits during the finishing phase. Hybrid rye was substituted for DRC in the finishing ration as follows: a basal diet formulated with 68.2% corn grain (CON) on a dry matter (DM) basis with two additional diets formulated at 44.7% corn grain and 23.6% ground hybrid rye (1/3 rye) or 22.5% corn grain and 45.3%

ground rye (2/3 rye) (Table 1). After 65 days on feed, the 2/3 ration was transitioned to the control diet for the remainder of the finishing period. Transitioning the 2/3 diet ensured that both hybrid rye rations fed similar amounts of rye grain.

Table 1. Diet forumulations.

	Treatment		
Item	CON	1/3 Rye	2/3 Rye
Ingredient Composition, %			
Dry rolled corn (DRC)	68.3	45.7	22.5
Hybrid rye	0	22.5	45.3
MDGS	19	19	19.3
Corn silage	2.9	2.9	2.9
Barley hay	7	7.1	7.1
Dry supplement	1.5	1.5	1.5
Limestone	1.3	1.3	1.4
Nutrient Composition			
NEm, Mcal/kg	2.25	2.21	2.19
Neg, Mcal/kg	1.36	1.32	1.31
CP, %	13.6	14.2	14.8

Animals, Initial Processing, Study Initiation

One hundred fifty cross-bred steers (765 ± 8 lbs., initial body weight [BW]) were used in this experiment. Steers were consigned to the Dakota Feeder Calf Show (DFCS) from multiple ranches which delivered to the CREC on October 15, 2021. Steers were implanted with Synovex Choice on January 24, 2023.

Steers consigned to the Dakota Feeder Calf Show Feedout project.

Body weights were collected on two consecutive days, averaged for initial body weights, and steers randomly assigned to pen. Steers were fed in eight dirt and seven cement-surfaced pens (*n* = 15; 11 steers/pen), resulting in five replications per treatment with 55 steers per treatment. Calves were housed in pens which had 1 m concrete bunk space, 3.5 m concrete feed apron, and 39.1 m^2 of pen space per steer.

The experiment was initiated on December 27, 2022. Steers transitioned from a high forage backgrounding ration over the first 21 days to their assigned finishing ration and were fed for a total of 155 days.

Diets and Intake Management
Steers were fed once daily at 0800. Steers were placed on a basal high forage backgrounding diet prior to the beginning of the study. Bunks were managed so as to be devoid of feed at 0700 h.

All rye grain was received from a single source and was the same hybrid (KWS Bono, KWS Cereals, LLC; Champaign, IL). Rye was processed by passing through a hammermill. Wet chemistry of the individual ingredients was analyzed at Dairyland Laboratories, Inc (Arcadia, WI) prior to study initiation to balance initial ration. Analysis included ash, ether extract, neutral detergent fiber, acid detergent fiber, and crude protein. Wet chemistry of the total mixed ration was analyzed at Dairyland Laboratories, Inc with similar methods as individual ingredients.

Steers were harvested at a regional abattoir. Carcass characteristics including hot carcass weight (HCW), yield grade (YG), ribeye area (REA), marbling score, and backfat thickness (BF) were recorded.

The monthly average of growth performance (weight, ADG, DMI, GF) were analyzed using the repeated measures procedure of PROC MIXED in SAS 9.4 (SAS Inst Inc., Cary, NC; Littell et al., 2006) with pen serving as the experimental unit. The fixed effects in the model include linear function of month (1 to 6), ration (CON, 1/3 rye, 2/3 rye) and the interaction of month by ration. The subjects repeated measures analysis was pen (1 to 15). Carcass characteristics (hot carcass weight, dressing percentage, yield grade, ribeye area, marbling score, and backfat) were analyzed by PROC MIXED in SAS 9.4. Least squares means were generated using the LSMEANS statement of SAS and treatment effects were evaluated using orthogonal polynomials (Steel and Torrie, 1960). Pre-planned contrasts were analyzed to identify specific differences between CON vs. rye and 1/3 rye vs. 2/3 rye.

Results
There was a treatment tendency for increasing levels of rye to improve overall weight gain over the course of the study ($P = 0.0781$) with calves gaining 540, 564, and 573 when fed the CON, 1/3, and 2/3 rations, respectively. Steers fed rye had higher overall weight gains compared to the corn control ($P = 0.0308$) while no differences in weight were detected between the 1/3 and 2/3 rations due to the inclusion of processed rye in the ration ($P = 0.55$).

No differences in ADG due to the inclusion of processed hybrid rye were detected ($P = 0.28$) throughout the study. No interaction of month by ration ($P = 0.90$) was detected. There was a detected difference due to month ($P < 0.0001$). Across the 155 d study, steers assigned to CON, RRYE, and GRYE had an average daily gain of 3.65, 3.79, and 3.85 lbs., respectively. No differences in ADG were detected among all of the pre-planned contrasts ($P < 0.05$).

Dry matter intake tended to be lower due to the inclusion of processed hybrid rye ($P = 0.0909$) throughout the study. There was a detected difference due to month ($P < 0.0001$). Across the 155 d study, steers assigned to CON, RRYE, and GRYE had an average daily dry matter intake of 24.8, 23.1, and 23.8 lbs. , respectively. Steers fed rye tended to have lower daily intake than steers that were fed the corn control ration ($P = 0.0504$).

The G:F ratio was higher due to the inclusion of rye in the ration ($P = 0.0497$). No interaction of month by ration was detected ($P = 0.77$). There was a detected difference due to month ($P < 0.0001$). Across the 155 d study, steers assigned to CON, RRYE, and GRYE gained 0.15, 0.17, and 0.17 lbs. per lb. of feed consumed, respectively. Throughout the study, steers fed hybrid rye had improved G:F over those fed the corn control ration ($P = 0.0165$).

No differences were detected in HCW, YG, REA, MARB, and BF due to the inclusion of hybrid rye in the ration ($P > 0.05$). Similarly, no differences were detected between corn and rye treatments or between the 1/3 and 2/3 rations.

Producers Find Value in Feeding Calves to Finish: Dakota Feeder Calf Show Feedout 2022-2023

Karl Hoppe and Colin Tobin

North Dakota cow calf producers need to be competitive with increasing production costs. To offset increasing cow herd costs, either calf value needs to increase or efficiency of increasing calf value must improve. By determining calf value through a feedout program, cow-calf producers can identify profitable genetics under common feedlot management. Substantial marketplace premiums are provided for calves that have exceptional feedlot performance and produce a high-quality carcass.

Cost-effective feeding performance is needed to justify the expense of feeding cattle past weaning. Price premiums are provided for cattle producing highly marbled carcasses. Knowing production and carcass performance can lead to profitable decisions for ranchers raising North Dakota born and fed calves.

This ongoing feedlot project provides cattle producers with an understanding of cattle feeding and cattle selection in North Dakota.

The Dakota Feeder Calf Show was developed for cattle producers willing to consign steer calves to a show and feedout project. The calves were received in groups of three or four on October 15, 2022, at the Turtle Lake Weighing Station, Turtle Lake, ND, for weighing, tagging, veterinary processing, and display. The number of cattle consigned was 168, of which 147 competed in the pen-of-three contest.

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

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 reimplanted with Synovex-Choice on January 24, 2023.

The cattle were harvested on June 1, 2023 (164 head). The cattle were sold to Tyson Fresh Meats, Dakota City, Nebraska, 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 577.5 pounds upon delivery to the Carrington Research Extension Center Livestock Unit on October 15, 2022. After an average 228-day feeding period, cattle averaged 1,325.7 pounds (at plant, shrunk weight).

Average daily feed intake per head was 31.2 pounds on an as-fed basis and 21.0 pounds on a dry-matter basis. Pounds of feed required per pound of gain were 9.8 on an as-fed basis and 6.62 pounds on a dry-matter basis.

The overall feed cost per pound of gain was $0.826. The overall yardage cost per pound of gain was $0.124. The combined cost per pound of gain, including feed, yardage, veterinary, trucking and other expenses except interest, was $1.151.

Overall, the carcasses contained U.S. Department of Agriculture Quality Grades at 2.4 percent Prime, 75.0 percent Choice (including 17.0 percent Certified Angus Beef), and 22.5 percent Select and 0 percent ungraded, and USDA Yield Grades at 3.7 percent YG1, 40.1 percent YG2, 49.4 percent YG3, and 6.8 percent YG4.

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 25, 2022, was $291.23 Choice YG3 base with premiums: Prime $25, CAB $6, YG1 $6.50 and YG2 $3, and discounts: Select minus $21, Standard (ungraded - no roll) minus $25.50, YG4 minus $8, YG5 minus $20, Mature minus $10 and carcasses heavier than 1075 pounds minus $20.

Dakota Feeder Calf Show calves performed well in the tough spring of 2023.

Overall, the pen-of-three calves averaged 425.6 days of age and 1,332.8 pounds per head at slaughter. The overall pen-of-three feedlot average daily gain was 3.34 pounds, while weight gain per day of age was 3.10 pounds. The overall pen-of-three marbling score was 490.5 (average choice, modest marbling).

The top-profit pen-of-three calves with superior genetics returned $669.92 per head, while the bottom pen-of-three calves returned $206.97 per head. For the pen-of-three competition, average profit was $476.94 per head. The spread in profitability between the top and bottom five herds was $312.11 per head.

Exceptional profit per head was a result of exceptional market price improvement in 2023. Feedout projects continue to provide a source of information for cattle producers to learn about feedlot performance and individual animal differences, and discover cattle value.

Performance in Feedlot Calves is Influenced by Cow Herd – 2023 North Dakota Angus University Feedout

Karl Hoppe and Colin Tobin

The North Dakota Angus University Feedout program is a summer, retained-ownership project where cattle producers raising spring-born black Angus cattle can learn more about the feeding performance, carcass characteristics and profitability of their yearling steers.

Through involvement in this calf value discovery program, cow-calf producers raising black Angus calves can benchmark performance and identify superior genetics when fed with common feedlot management.

Calves (54 head) were received in groups ranging from 10 to 34 head from three owners prior to June 6, 2023. Upon delivery to the Carrington Research Extension Center Livestock Unit, calves were weighed, tagged, and veterinary processed.

Calves were penned by owner and provided a corn-based receiving diet. After a 10-day ration adaptation, 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 implanted with Synovex-Choice.

Cattle were harvest in two groups. The first group of cattle was harvested on October 12, 2023 (43 head) and the second group was harvested on October 23, 2023 (10 head). The cattle were sold to Tyson Fresh Meats, Dakota City, Nebraska, on a grid basis, with premiums and discounts based on carcass quality. Carcass data were collected after harvest.

Cattle consigned averaged 920.6 pounds upon delivery to the Carrington Research Extension Center Livestock Unit on June 12, 2023. After an average 123-day feeding period, cattle averaged 1440.6 pounds (at plant, shrunk weight).

Black Angus influenced cattle fed to finish at the CREC Livestock Unit.

Average daily feed intake per head was 43.5 pounds on an as-fed basis and 28.7 pounds on a dry-matter basis. Pounds of feed required per pound of gain were 10.8 on an as-fed basis and 7.1 pounds on a dry-matter basis.

The overall feed cost per pound of gain was $0.87. The overall yardage cost per pound of gain was $0.10. The combined cost per pound of gain, including feed, yardage, veterinary, trucking and other expenses except interest, was $1.186.

Calves were priced at $212.72 per hundred weight upon delivery to the feedlot.

Overall, the carcasses contained U.S. Department of Agriculture Quality Grades at 24.5 percent Prime, 75.5 percent Choice (including 56.6 percent Certified Angus Beef), 0 percent Select, and 0 percent no roll. USDA Yield Grades for the carcasses were 3.7 percent YG2, 62.3 percent YG3, 34.0 percent YG4 and 0 percent YG5. One carcass weighed greater than 1075 pounds.

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 October 12, 2023, was $289.98 base with premiums: Prime $25, CAB $6, Choice $6.81,YG2 $3, and discounts: YG4 $4.80, YG5 $20 and carcasses greater than 1075 pounds $20. The grid price received for October 24, 2023, was $293.58 base with similar premiums and discounts except for Choice $4.66 and YG4 $4.36/cwt. Feeding results from the calves by owner are listed in Table 1.

Table 1. Feeding results for ND Angus University feedout calves, 2023.

Pen	In Weight	Out Weight	Average Daily Gain	Feed Cost of Gain	Total Cost of Gain	Prime Carcass	CAB Carcass	Profit per Head
	lbs	lbs	lbs					
1	962	1481	4.09	$ 0.823	$ 1.124	10.0%	80.0%	$ 201.40
2	767	1298	3.84	$ 0.823	$ 1.139	0.0%	50.0%	$ 177.64
3 (dead included)	953	1471	3.7	$ 0.901	$ 1.228			$ 147.91
3 (dead excluded)	951	1471	4.06	$ 0.823	$ 1.127	36.3%	51.5%	$ 233.06
overall (dead included)	920	1440	4.0	$ 0.870	$ 1.186	24.5%	56.6%	$ 165.43

The top-profit pen of calves returned $201.40 per head, while the bottom pen returned $147.91 per head including death loss. The spread between the top profit pen and the lowest profit pen was $53.49 per head.

Yearling Angus steer performance varied between owners. Average daily gain (pounds per head) by owner was 4.09, 3.88, and 3.70 (4.06 dead excluded).

Feedout projects provide cattle producers an opportunity to learn about feedlot performance, individual carcass differences, and discover cattle value.

Summary of NDSU Extension 2023 Crop Surveys in South-Central North Dakota

Greg Endres and Regan Jones

Integrated pest management (IPM) survey

During the 2023 crop season, the annual IPM small grain, soybean and sunflower field survey was conducted across North Dakota by NDSU Extension, in cooperation with the North Dakota Department of Agriculture, to identify crop agronomic factors and presence of disease and insects. The survey data is used for educational and research programs for farmers, crop advisers, and personnel from university, government and ag industry. The survey data also supports export of North Dakota crops.

Regan Jones surveying a rye field.

Regan Jones, crop scout based at the CREC, surveyed 358 fields in 11 south-central counties: Burleigh, Dickey, Eddy, Emmons, Foster, Kidder, LaMoure, Logan, McIntosh, Stutsman, and Wells.

The small grain survey was conducted in 106 **spring wheat** and 24 **barley** fields during June through early August. Primary diseases targeted in the survey were bacterial leaf spot, barley yellow dwarf virus, rust (leaf, stem and stripe), Septoria, tan spot (wheat), net and spot blotch (barley), ergot, Fusarium head blight (scab) and loose smut. Primary insects surveyed were grasshoppers, aphids, wheat stem maggot and sawfly, and barley thrips.

The **soybean** survey was conducted in 173 fields during mid-June through mid-August to detect grasshoppers, soybean aphid, bean leaf beetle, spider mites and gall midge. Intermediate-spaced rows (12- to 24-inches) comprised 94% of surveyed fields.

The survey included 55 **sunflower** fields inspected during mid-July to mid-August for grasshoppers, red seed weevil, downy mildew, rust and Verticillium wilt. Red sunflower weevils were found in 13% of fields.

Maps displaying summaries of the state survey results by crop and pest are available at the following website: https://www.ndsu.edu/agriculture/ag-hub/ag-topics/crop-production/diseases-insects-and-weeds/integrated-pest-management.

Insect traps were used during mid-June to mid-August in three **wheat** fields (Foster [CREC], McIntosh [Tri-county research site] and Wells counties) to sample for armyworm, black cutworm, Hessian fly and old world bollworm. Also, Arthur sunflower moth, banded sunflower moth and sunflower head moth pheromone traps were located at the CREC to monitor the presence of these **sunflower** insects. Also, Swede midge, canola flower midge, diamondback moth and Bertha armyworm traps were placed in a CREC **canola** trial. In addition, soil samples for nematodes were collected from three **wheat** fields per county for the ND Department of Agriculture.

Sunflower survey

A **sunflower** field survey was conducted during fall 2023 by NDSU Extension in cooperation with the National Sunflower Association. Data collected included plant population, row spacing, tillage system, estimates of seed yield, and presence of or damage by birds, disease, insects and weeds. In south-central North Dakota, 28 fields were surveyed during September 14-28 in Burleigh, Dickey, Eddy, Emmons, Foster, Kidder, LaMoure, Logan, McIntosh, Sheridan, Stutsman and Wells counties by Greg Endres, team leader, and the following Extension agents: Tyler Kralicek, Breana Kiser, Michelle Gilley, Emily Leier, Jeff Gale, Monica Fitterer, Julianne Racine, Justin Leier, Crystal Schaunaman, Sarah Crimmins, Ashley Wolff and Hannah Peterson.

Jeff Gale and Michelle Gilley surveying a sunflower field in Eddy County.

Across these fields, average seed yield was estimated at 2165 lbs./a, with a range of 655 to 3340 lbs./a. Harvestable stands averaged 16,580 plants/a, with a range of 11,000 to 26,000 plants/a. Most common prior crops were corn (46% of fields), small grain (29%) or soybean (25%); fields were primarily reduced- or no-till (70%); and 85% of fields were planted in 30-inch rows. Plant lodging at 10% or greater incidence occurred in 14% of fields. With the exception of two fields (Emmons County), sclerotinia disease incidence was low. Seed loss from bird feeding at greater than 10% occurred on 25% of fields. The most common yield-limiting factor was low plant population.

Details from the field surveys may be obtained by contacting NDSU Extension agents or the CREC.

2022-23 Getting-it-Right Crop Production Webinar Program

Greg Endres, Hans Kandel, Anitha Chirumamilla and Linda Schuster

NDSU Extension, in cooperation with commodity organizations, conducted the educational crop production program series titled “Getting-it-Right” (GIR) during the winter of 2022-23. The live webinars provided research-based production information for soybean, dry bean, corn, canola and sunflower. The webinars were hosted by the Carrington Research Extension Center using Zoom. Targeted audience is North Dakota farmers and crop advisers, and the information presented primarily by NDSU crop specialists and researchers. The following table lists general information about the meetings.

Table 1. 2022-23 Getting-it-Right Crop Production Webinar

Crop	Date	Cooperating commodity group
Soybean	12/20/2022	North Dakota Soybean Council
Dry bean	12/21/2022	Northarvest Bean Growers Association
Corn	1/24/2023	North Dakota Corn Utilization Council
Canola	3/9/2023	Northern Canola Growers Association
Sunflower	3/21/2023	National Sunflower Association

General topic areas were cultivar selection, plant establishment, plant nutrition and soil management, plant protection (disease, insect and weed management), market update and commodity organization overview. Following webinar presentations, the audience had the opportunity to submit written questions, which were answered orally or written by presenters. Presentations were recorded, edited and posted for future reference by program participants as well as other interested people: https://www.ndsu.edu/agriculture/ag-hub/getting-it-right. As of November 2023, the 43 videos were viewed by a total of about 3850 people.

Participants totaled over 700 people among the five webinars, primarily from North Dakota, but also the Midwest and beyond. Participants were requested to complete meeting evaluations. For example, participants were asked to place a value on knowledge received when applied to their business and the average among meetings ranged from $10 to 14 per acre. Also, participants were asked to rate “plan to take action based on what I learned” using the following scale: Strongly agree; Agree; Somewhat agree; Somewhat disagree; Disagree; or Strongly disagree. Among meetings, 77 to 93% of respondents indicated they agreed or strongly agreed.

During the 2023-24 winter meeting season, GIR webinars are being planned for soybean (December 19, 2023), dry bean (January 30, 2024), sunflower (February 27, 2024) and canola (March 12, 2024). Interested participants may preregister at the same website as listed above.

Northern Hardy Fruit Evaluation Project – Orchard Update 2023
Kathy Wiederholt

This year, the Northern Hardy Fruit Evaluation Project provided educational information to over 1,370 people with video conference programs, tours, meetings and personal phone calls. 74 people attended the Fruit Project Field Day tour to learn about the orchard and to learn about growing pears from Gretchen Merryweather, owner of Sweetland Orchard, in Webster, Minnesota. In the afternoon, on a second tour sponsored by Northern Plains Sustainable Ag Society, 51 people learned about the cider-making business and had an orchard tour. In addition to North Dakota, we provided information to people in Iowa, Minnesota, Montana, South Dakota, Texas and Wisconsin.

After many years of dry weather, we had a year of plentiful and timely moisture. Fall 2022 was still dry, but then from November 10 through April 2023, there was 118” of snow. Mid-March through April was especially cold (15.7^{o} F below average) and this delayed the snowmelt and pruning. In May through early June, however, conditions reversed and temperatures were about 9^{o} F warmer than average. By the end of June, we were over 370 GDD^{41F} units ahead of normal, and the season continued like this. All months except August had plentiful rainfall. The first frost was October 6th, but lows were only in the upper 20s, as were the subsequent freezes. The first snowfall of 11” came October 26 followed by 10 days of temperatures that averaged 20° F below normal. The snow subsequently melted and mild temperatures reappeared.

Spotted wing drosophila control began June 12 because of the warm weather and continued through aronia harvest in late August. Control was good. Several early coverages were also applied to currants for control of the currant fruit fly, *Euphranta canandensis*. This program was a success as currant berries did not fall early this year and production reflected this.

Another management program for currant borer, *Synanthedon tipuliformis*, which began last year using beneficial wasps and targeted fungus, showed signs of success. The black currant canes looked healthy this year but results won’t be known until pruning in Spring 2024. There were some infected canes this past spring, but overall, the plants looked healthier.

Notable events in the orchard:

- All crops, except apples, were ahead of schedule due to the early and sustained warmth in May.
- Two ‘Honeycrisp’ apple trees were removed in spring due to black rot and *Schizopyllum commune* infection. The remaining four were also infected and were removed in fall 2023. One ‘Zestar!’ tree had oozing wood and was removed as well.
- A ‘Toka’ plum tree was removed in spring due to its death. There was gummosis over much of the tree. There is now only one ‘Toka’ left among the other varieties.
- ‘Waneta’ trees had the best crop of plum fruit we have ever had at CREC. Very few were affected by plum curculio insects this year.
- ‘Ayers’ pear tree had a good crop but the fruit was underwhelming.

Nova pears in the orchard.

Northern Hardy Fruit Project - Yearly Production Records										
		No. of plants	**2020**		**2021**		**2022**		**2023**	
			Date	pounds	Date	pounds	Date	pounds	Date	pounds
Aronia	Nero	4	19-Sep	26.3	15-Sep	70.5	12-Sep	42.0	29-Aug	55.6
	Raintree Seedling	4	10-Sep	15.1	15-Sep	47.6	19-Sep	54.0	29-Aug	26.7
	Raintree Select	4	11-Sep	14.4	12-Sep	95.4	9-Sep	26.0	30-Aug	59.0
	Viking	4	14-Sep	NA	8-Sep	104.5	12-Sep	32.0	30-Aug	30.6
	McKenzie	4	14-Sep	NA	14-Sep	78.6	14-Sep	59.3	1-Sep	56.7
	Galicjanka	4	12-Sep	4.3	8-Sep	49.1	9-Sep	36.3	31-Aug	33.0
				apx. 90		**445.7**		**249.6**		**261.6**
			Drought, fruit droppe		*Drought, irrigated*		*Wet then drought*			
Hardy Cherrie:	Evans / Bali	2	29-Jul	*WD loss*	*removed*	*removed*	*removed*	*removed*	*removed*	*removed*
	SK Romeo	3	26-Jul	*Birds*	26-Jul	*Birds*	5-Aug	*Birds*	27-Jul	*x*
	SK Juliet	5	13-Jul	41.0	16-Jul	73.8	19-Jul	19.2	11-Jul	98.9
				41.0		**73.8**		**19.2**		**98.9**
			Still SWD loss in all		*Drought, No SWD*		*Wet early; disease*			
New	*Blackcomb*	7	13-Aug	48.2	*did not pici*	NA	19-Aug	27.9	4-Aug	33.4
Black Currant	*Cheakamus*	7	5-Aug	19.2	*did not pici*	NA	10-Aug	17.5	31-Jul	49.9
Variety Trial	*Stikine*	7	8-5	12.4	*did not pici*	NA	15-Aug	11.5	28-Jul	34.7
	Tahsis	8	30-Jul	47.6	*did not pici*	NA	15-Aug	13.8	29-Jul	36.7
	Tiben	8	14-Aug	64.0	*did not pici*	NA	16-Aug	15.0	7-Aug	60.3
	Nechako -2 ft space	7	13-Aug	6.8	*did not pici*	NA	*did not pici*	x	*removed*	*removed*
	Nechako -3 ft space	7	13-Aug	9.4	*did not pici*	NA	*did not pici*	x	*removed*	*removed*
				207.6		**0.0**		**85.7**		**215.0**
			SWD, summer prur		*Borer pruning*		*Wet then insect*			
Black Currant	Ben Lomand	4	27-Jul	3.4	*did not pici*	NA	9-Aug	2.8	31-Jul	17.0
	Blackcomb	4	12-Aug	19.8	*did not pici*	NA	19-Aug	10.9	4-Aug	26.4
	Champion	4	30-Jul	6.4	*did not pici*	NA	15-Aug	2.0	30-Jul	15.9
	Minaj Smyriou	4	27-Jul	6.6	*did not pici*	NA	8-Aug	8.6	29-Jul	29.7
				36.2		**0.0**		**24.3**		**89.0**
			SWD losses in all		*Borer pruning*		*Wet then insect*			
Red Currant	Jhonkheer Van Tets	4	*x*	*x*	*did not pici*	*NA*	8-Aug	4.5	19-Jul	43.8
	Rosetta	4	*2019 fall freeze; no fr*		*did not pici*	NA	8-Aug	24.1	*removed*	*removed*
	Rovada	4	*2019 fall freeze; no fr*		*did not pici*	NA	9-Aug	10.0	*removed*	*removed*
				133.4		**0.0**		**38.6**		**43.8**
			SWD losses		*Borer pruning*		*Wet then drought*			
Juneberry	*Honeywood*	20/152021	8-Jul	NA	6-Jul	NA	15-Jul	NA	4-Jul	NA
Variety Trial	*JB30*	20/152021	6-Jul	NA	30-Jun	NA	11-Jul	NA	28-Jun	NA
	Martin	20/152021	6-Jul	NA	30-Jun	NA	11-Jul	NA	28-Jun	NA
	Smoky	20/152021	10-Jul	NA	6-Jul	NA	17-Jul	NA	6-Jul	NA
	Thiessen	20/152021	6-Jul	NA	30-Jun	NA	11-Jul	NA	28-Jun	NA
				EST. 5-600 lbs		**EST. 4-500 lbs**	**Total wt**	**769.2**	**Total wt**	**696.2**
			Covid; open picking		*Remv'd 1/4, open pic*		*Open pick*		*Open pick*	
The Project was planted in 2007, except Juneberries 2006.										

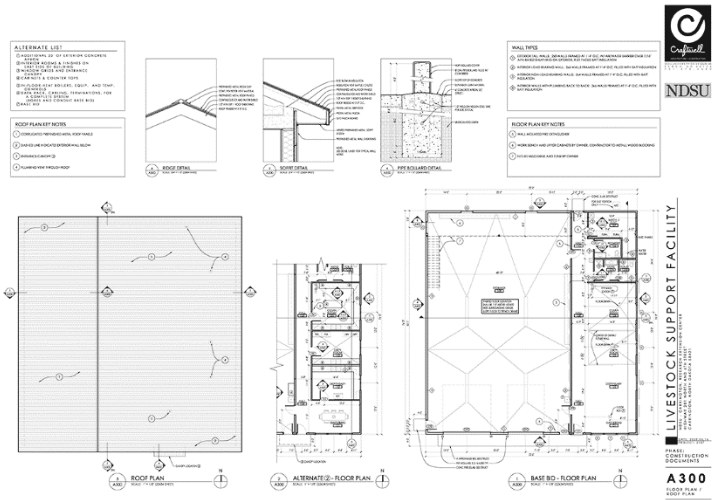
Northern Hardy Fruit Project - Yearly Production Records										
		No. of plants	2020		2021		2022		2023	
			Date	pounds	Date	pounds	Date	pounds	Date	pounds
Japanese	21-20	3/1 2021	*did not pic*	x	30-Jun	2.4	x	x	x	x
Haskap	22-14	3/1 2021	*did not pic*	x	16-Jul	1.5	x	x	x	x
2012	22-26	3/1 2021	*did not pic*	x	15-Jul	2.1	x	x	x	x
	41-75	3/1 2021	*did not pic*	x	27-Jun	2.3	x	x	x	x
	44-19	3/1 2021	*did not pic*	x	19-Jul	2.5	x	x	x	x
	57-49	3/1 2021	*did not pic*	x	9-Jul	2.4	x	x	x	x
	88-92	3/1 2021	*did not pic*	x	27-Jun	1.5	x	x	x	x
	88-102	3/1 2021	*did not pic*	x	27-Jun	2.6	10-Jul	5.0	26-Jun	2.4
	108-23	3/1 2021	*did not pic*	x	27-Jun	5.2	x	x	x	x
	131-08	3/0 2021	*removed*	x	*removed*	x	*removed*	x	*removed*	x
	142-30	3/1 2021	*did not pic*	x	6-Jul	1.6	26-Jul	1.9	29-Jun	2.3
	78-89	2	*did not pic*	x	6-Jul	5.3	21-Jul	5.8	3-Jul	5.8
			Covid &	**0.0**		**29.6**		**12.7**		**10.5**
			Heavy prune, left to I		*Drought, irrigated*		*Wet then drought*			
						4.4		**21.1**		**14.6**
					1st year of productio		*Wet then drought*			
		No. of plants	2020		2021		2022		2023	
			Date	pounds	Date	pounds	Date	pounds	Date	pounds
Japanese	119-08	2					28-Jul	1.8	*removed*	x
Haskap	120-15	2					29-Jul	4.7	*removed*	x
2019	122-26	2					20-Jul	2.0	*removed*	x
	129-06	1					13-Jul	0.5	1-Jul	0.7
	132-05	2					25-Jul	1.7	10-Jul	5.9
	133-07	2					21-Jul	2.9	7-Jul	4.1
	133-09	2					26-Jul	3.1	14-Jul	3.2
	134-08	2					28-Jul	0.6	14-Jul	0.5
	135-01	2					26-Jul	1.2	*removed*	x
	136-17	2					28-Jul	1.6	10-Jul	2.7
	138-18	1					*birds*	x	10-Jul	0.1
	140-14	2					5-Aug	1.1	17-Jul	1.7
	140-16	2					27-Jul	0.2	*removed*	x
	141-04	1					*birds*	x	7-Jul	1.0
	141-05	2					*birds*	x	14-Jul	2.8
	141-06	2					5-Aug	0.1	10-Jul	x
	141-07	2					*birds*	x	7-Jul	0.7
	144-17	2					*birds*	x	7-Jul	0.4
								21.5		**23.8**
							Wet then drought			
Haskaps	Boreal Beast	1			7/6	0.6	26-Jul	2.5	28-Jun	3.8
Canadian	Boreal Beauty	2			7/4-13	1.7	14-Jul	3.9	10-Jul	4.2
2018	Boreal Blizzard	1			4-Jul	0.4	12-Jul	*missing*	23-Jun	5.4
	Aurora	2			>7/20	x	7/21-26	3.8	5-Jul	9.2
	Blue Sky	2							25-Jun	4.1
				0.0		**2.7**		**10.2**		**26.8**
			Left for birds		*Left for birds*		*Wet then drought*			

CREC 2023 Administrative Updates

Mike Ostlie

At the Carrington Research Extension Center, 2023 was a busy year full of challenges and progress. The growing season began late with a record snowfall over the winter, but a quick thaw and above average temperatures through June. For the second year in a row, we experienced some of the latest beginning planting dates in recent memory. Overall, precipitation was below average for the station and many of the off-station sites, but the frequency of rainfall was such that yields were generally average to excellent for all crops. Frequent fall rains kept the crops out in the field for longer than expected, resulting in a late finish to harvest.

Spring of 2023 marked the end of another legislative session. There were several important legislative actions that directly impacted the CREC. Additional funds were granted to the livestock improvement projects as a result of the recent unprecedented increases in construction costs. Construction of the Livestock Support Facility began in October 2023 and will be completed in the summer of 2024. This building will contain space for lab work, vet supplies, and heated shop space for feeding equipment. As of this writing, we are in the final design phases of a feedlot pen expansion (equipped with smart feeders and other precision ag technologies) and commodity storage building to finish off the projects within this supported initiative. These last two structures are slated for construction in 2024.



Schematic of livestock support facility currently under construction.

Operating funds were also approved by the legislature to support the Oakes Irrigation Research Site. These funds have solidified the long-term stability of the OIRS along with other recent infrastructure improvements to the site. The largest improvement is currently ongoing. As of this writing, a new mixed-use (office, meeting room, lab, and shop) building is being erected in collaboration with the Garrison Diversion Conservancy District. A ground-breaking ceremony was held for this building in August 2023 which included representation from local, state, and federal organizations which have worked together over the years to bring this project to fruition.

There were many personnel changes in 2023. We celebrated a number of retirements including Tom Smith (Agronomy) and Tim Indergaard (Agronomy), along with the departure of Jesse Nelson (Livestock) and Dave Widmer (Agronomy). We also have welcomed several new additions to CREC including Justin Martin (Livestock), Victor Nava (Agronomy), and Sergio Cabello Leiva (Soil Science). Through it all, most teams at CREC have worked through being short-handed this year, yet all have been able to meet major annual milestones in their respective projects.

CREC Journal Publications

Registration of 'ND Victory' Green Field Pea

Nonoy Bandillo, Thomas Stefaniak, Hannah Worral, Shalu Jain, Michael Ostlie, Blaine Schatz, John Rickertsen, Cameron Wahlstrom, Meridith Miller, Kyle Dragseth, Justin Jacobs, Brian Hanson, Glenn Martin, Audrey Kalil, Michael Wunsch, Julie Pasche, William Franck, Chengci Chen, Shana Forster, Kevin McPhee

Journal of Plant Registrations

Abstract:
'ND Victory' (Reg. no. CV-31, PI 701908) is the first semi-leafless, green cotyledon field pea cultivar (*Pisum sativum L.*) developed by the North Dakota State University Pulse Crops Breeding Program and approved for release by the North Dakota Agricultural Experiment Station. It has white flowers, opaque seed coat, and smooth, round seed. It is semi-dwarf, with lodging score of 3.3/9 and canopy height of 57 cm. Based on 30 environments (location-year) of replicated yield trials in North Dakota, seed yield of ND Victory (2847 kg ha−1) was similar to commercial cultivar 'CDC Striker' (2819 kg ha−1) but significantly greater than 'Cruiser' (2653 kg ha−1) and 'Aragorn' (2639 kg ha−1) by 7.3 and 7.9%, respectively. ND Victory was also tested across 14 environments in Montana, where it had an average seed yield of 3264 kg ha−1, which was similar to 'Hampton' (3355 kg ha−1) but significantly greater than Aragorn (3110 kg ha−1) by 4.9%. ND Victory matures in approximately 90 days. ND Victory is a high protein cultivar, with protein content of 25.2%, exceeding the premium protein threshold of 24%. ND Victory (20%) is resistant to powdery mildew and performed similarly with resistant check 'Spider' (15%) and had significantly lower disease severity than 'Salamanca' (97%, susceptible check) and CDC Striker (82%). In irrigated field trials conducted under high Ascochyta blight pressure, ND Victory (5%) had lower disease severity than 'AC Agassiz' (10%) and CDC Striker (14%). ND Victory and CDC Striker exhibited similar response but significantly lower severity than AC Agassiz to Fusarium root rot inoculated with multiple Fusarium species pathogenic to pea.

Aerial-Based Weed Detection Using Low-Cost and Lightweight Deep Learning Models on an Edge Platform

Nitin Rai, Xin Sun, C. Igathinathane, Kirk Howatt, Michael Ostlie

Journal of the American Society of Agricultural and Biological Engineers

Abstract:
Deep learning (DL) techniques have proven to be a successful approach in detecting weeds for site-specific weed management (SSWM). In the past, most of the research work has trained and deployed pre-trained DL models on high-end systems coupled with expensive graphical processing units (GPUs). However, only a limited number of research studies have used DL models on an edge system for aerial-based weed detection. Therefore, while focusing on hardware cost minimization, eight DL models were trained and deployed on an edge device to detect weeds in aerial-image context and videos in this study. Four large models, namely CSPDarkNet-53, DarkNet-53, DenseNet-201, and ResNet-50, along with four lightweight models, CSPMobileNet-v2, YOLOv4-lite, EfficientNet-B0, and DarkNet-Ref, were considered for training a customized DL architecture. Along with trained model performance scores (average precision score, mean average precision (mAP), intersection over union, precision, and recall), other model metrics to assess edge system performance such as billion floating-point operations/s (BFLOPS), frame rates/s (FPS), and GPU memory usage were also estimated. The lightweight CSPMobileNet-v2 and YOLOv4-lite models outperformed others in detecting weeds in aerial image context. These models were able to achieve a mAP score of 83.2% and 82.2%, delivering an FPS of 60.9 and 61.1 during near real-time weed detection in aerial videos, respectively. The popular ResNet-50 model achieved a mAP of 79.6%, which was the highest amongst all the large models deployed for weed detection tasks. Based on the results, the two lightweight models, namely, CSPMobileNet-v2 and YOLOv4-lite, are recommended, and they can be used on a low-cost edge system to detect weeds in aerial image context with significant accuracy.

Registration of ‘ND Frohberg’ hard red spring wheat
Andrew J. Green, Mohamed Mergoum, Richard Frohberg, Jesse Underdahl, Adam Walz, Thor Selland, Andre Miranda, Senay Simsek, Brian Otteson, Ana Maria Heilman-Morales, Didier Murillo, Andrew Friskop, John Rickertsen, Mike Ostlie, Blaine Schatz, Bryan Hanson, Randy Mehlhoff, Eric Eriksmoen, Glenn Martin, Jason Fiedler, Jack Rasmussen, Shaobin Zhong, Zhaohui Liu, Tim Friesen, Matthew Rouse, Yue Jin, Ruth Dill-Macky, Rebecca D. Curland, Upinder Gill
Journal of Plant Registrations
Abstract:
‘ND Frohberg’ (Reg. no. CV-1200, PI 698310) is a hard-red spring wheat (HRSW; *Triticum aestivum L.*) developed at North Dakota State University (NDSU) and released by the North Dakota Agricultural Experiment Station (NDAES) in 2020. ND Frohberg was selected from the cross ND709-9/ND2902. ND709-9 was an experimental line with the pedigree (ND 2709/3/’Grandin’*3//’Ramsey’/ND 622). ND2902 was an experimental line with the pedigree (ND674//ND2710/ND688). It was tested as experimental line NDHRS16-13-97 and released because of improved straw strength, yield potential, strong disease resistance and end-use quality. ND Frohberg is highly resistant to stem rust (caused by Puccinia graminis f.sp. tritici), and moderately resistant to leaf rust (caused by Puccinia triticina), bacterial leaf streak (caused by Xanthomonas translucens pv. undulosa), and Fusarium head blight (caused by Fusarium graminearum). The name ND Frohberg was chosen to honor Dr. Richard Frohberg, hard red spring wheat breeder at NDSU for 37 years. During his tenure at NDSU, Dr. Frohberg's varieties were widely cultivated, reaching as much as 65% of the acreage in North Dakota in 2003. He was responsible for the cross that resulted in this variety.

An evaluation of nitrogen indicators for soil health in long-term agricultural experiments
Daniel Liptzin, Elizabeth L. Rieke, Shannon B. Cappellazzi, G. Mac Bean, Michael Cope, Kelsey L. H. Greub, Charlotte E. Norris, Paul W. Tracy, Ezra Aberle, Amanda Ashworth, Oscar Bañuelos Tavarez, Andy I. Bary, R. Louis Baumhardt, Alberto Borbón Gracia, Daniel C. Brainard, Jameson R. Brennan, Dolores Briones Reyes, Darren Bruhjell, Cameron N. Carlyle, James J. W. Crawford, Cody F. Creech, Steve W. Culman, Bill Deen, Curtis J. Dell, Justin D. Derner, Thomas F. Ducey, Sjoerd W. Duiker, Robert S. Dungan, Miles F. Dyck, Benjamin H. Ellert, Martin H. Entz, Avelino Espinosa Solorio, Steven J. Fonte, Simon Fonteyne, Ann-Marie Fortuna, Jamie L. Foster, Lisa M. Fultz, Audrey V. Gamble, Charles M. Geddes, Deirdre Griffin-LaHue, John H. Grove, Stephen K. Hamilton, Xiying Hao, Zachary D. Hayden, Nora Honsdorf, Julie A. Howe, James A. Ippolito, Gregg A. Johnson, Mark A. Kautz, Newell R. Kitchen, Sandeep Kumar, Kirsten S. M. Kurtz, Francis J. Larney, Katie L. Lewis, Matt Liebman, Antonio Lopez Ramirez, Stephen Machado, Bijesh Maharjan, Miguel Angel Martinez Gamiño, William E. May, Mitchel P. McClaran, Marshall D. McDaniel, Neville Millar, Jeffrey P. Mitchell, Amber D. Moore, Philip A. Moore Jr., Manuel Mora Gutiérrez, Kelly A. Nelson, Emmanuel C. Omondi, Shannon L. Osborne, Leodegario Osorio Alcalá, Phillip Owens, Eugenia M. Pena-Yewtukhiw, Hanna J. Poffenbarger, Brenda Ponce Lira, Jennifer R. Reeve, Timothy M. Reinbott, Mark S. Reiter, Edwin L. Ritchey, Kraig L. Roozeboom, Yichao Rui, Amir Sadeghpour, Upendra M. Sainju, Gregg R. Sanford, William F. Schillinger, Robert R. Schindelbeck, Meagan E. Schipanski, Alan J. Schlegel, Kate M. Scow, Lucretia A. Sherrod, Amy L Shober, Sudeep S. Sidhu, Ernesto Solís Moya, Mervin St. Luce, Jeffrey S. Strock, Andrew E. Suyker, Virginia R. Sykes, Haiying Tao, Alberto Trujillo Campos, Laura L. Van Eerd, Harold M. van Es, Nele Verhulst, Tony J. Vyn, Yutao Wang, Dexter B. Watts, David L. Wright, Tiequan Zhang, Cristine L. S. Morgan, C. Wayne Honeycutt
Soil Science Society of America Journal
Abstract:
Various soil health indicators that measure a chemically defined fraction of nitrogen (N) or a process related to N cycling have been proposed to quantify the potential to supply N to crops, a key soil function. We evaluated five N indicators (total soil N, autoclavable citrate extractable N, water-extractable organic N, potentially mineralizable N, and N-acetyl-β-D-glucosaminidase activity) at 124 sites with long-term experiments across North America evaluating a variety of managements. We found that 59%–81% of the variation in N indicators was among sites, with indicator values decreasing with temperature and increasing with precipitation and clay content. The N indicators increased from 6%–39% in response to decreasing tillage, cover cropping, retaining residue, and applying organic sources

of nutrients. Overall, increasing the quantity of organic inputs, whether from increased residue retention, cover cropping, or rotations with higher biomass, resulted in higher values of the N indicators. Although N indicators responded to management in similar ways, the analysis cost and availability of testing laboratories is highly variable. Further, given the strong relationships of the N indicators with carbon (C) indicators, measuring soil organic C along with 24-h potential C mineralization could be used as a proxy for N supply instead of measuring potentially mineralizable N or any other N indicator directly.

Opportunities to monitor animal welfare using the five freedoms with precision livestock management on rangelands
Colin T. Tobin, Derek W. Bailey, Mitchell B. Stephenson, Mark G. Trotter, Colt W. Knight and Akasha M. Faist
Frontiers in Animal Science
Abstract:
Advances in technology have led to precision livestock management, a developing research field. Precision livestock management has potential to improve sustainable meat production through continuous, real-time tracking which can help livestock managers remotely monitor and enhance animal welfare in extensive rangeland systems. The combination of global positioning systems (GPS) and accessible data transmission gives livestock managers the ability to locate animals in arduous weather, track animal patterns throughout the grazing season, and improve handling practices. Accelerometers fitted to ear tags or collars have the potential to identify behavioral changes through variation in the intensity of movement that can occur during grazing, the onset of disease, parturition or responses to other environmental and management stressors. The ability to remotely detect disease, parturition, or effects of stress, combined with appropriate algorithms and data analysis, can be used to notify livestock managers and expedite response times to bolster animal welfare and productivity. The “Five Freedoms” were developed to help guide the evaluation and impact of management practices on animal welfare. These freedoms and welfare concerns differ between intensive (i.e., feed lot) and extensive (i.e., rangeland) systems. The provisions of the Five Freedoms can be used as a conceptual framework to demonstrate how precision livestock management can be used to improve the welfare of livestock grazing on extensive rangeland systems.

Yield and Grain Quality Response of Spring Wheat Varieties to Irrigation and Fertility Management
Nanthana Chaiwong, Chanakan Prom-U-Thai, and Michael Ostlie
Agricultural Sciences
Abstract:
Experiments were conducted in 2020 and 2021 in North Dakota to determine the effects of foliar and soil applied fertilizers, variety and irrigation on yield and grain quality of spring wheat. Foliar application of N did not consistently increase yield and protein indicating the soil N levels were adequate to optimize yield. The variety Bolles had higher protein content than Faller. Zinc (Zn) content in the grain was greatest when applied at either flowering or post anthesis. It was also found to be correlated with grain protein content. Yield and grain protein content were negatively related. There was no consistent effect of phosphorous or Zn when applied to the soil on yield, protein, gluten, or Zn content in the grain. Zinc concentration in the grain was significantly correlated with the protein, gluten and P content of the grain. The timing of Zn application was critical to the success of translocating Zn to the grain. Grain Zn concentration increased with most late season foliar Zn applications to both varieties indicating potential for enriching spring wheat nutrient content through production management practices already common in areas that grow spring wheat.

Inoculant and fertilizer effects on lentil yield and protein in the northern Great Plains

P Miller, SC Atencio, CA Jones, E Eriksmoen, W Franck, J Rickertsen, SI Fordyce, M Ostlie, PF Lamb, MA Grusak, C Chen, PM Carr, M Bourgault, ST Koeshall, KW Baber

Agronomy Journal

Abstract:

Lentil (*Lens culinaris* Medikus) is an important crop, averaging more than 250,000 ha in Montana and North Dakota during 2016-21. However, relatively little is known about inoculant and fertility response in lentil in the U.S. northern Great Plains. The objective of this study was to evaluate the effect of rhizobial inoculant formulations (seed-coat and soil-applied) and nutrient additions (K, S, and micronutrients), on lentil yield and seed protein concentration. This study was conducted at seven university research centers in Montana and North Dakota from 2019-21, resulting in 20 location-years of data. In six of 20 experiments, inoculant application increased seed yield by an average of 36% (323 kg ha-1, $P < 0.05$) but had no consistent effect on seed protein concentration. Lentil or pea crop history among locations did not explain inoculant response. Inoculant formulations (seed coat vs. soil applied) and K fertilizer had inconsistent and small effects on seed yield and protein concentration. However, S fertilizer (5.6 kg S ha-1) increased seed yield in four of 20 experiments ($P < 0.02$) by an average of 14.5% (255 kg ha-1) in those experiments and decreased seed yield for one experiment ($P = 0.05$) by 5.8% (153 kg ha-1). Pre-plant SO4-S soil test levels did not predict lentil response to S fertilizer. Micronutrient application was assessed in 12 location-years but had no effect on lentil yield or protein concentration. This research suggests a need to better understand what factors control lentil yield and protein response to rhizobial inoculant and S fertilization.

Lentil variety trial at Carrington.

Weather Summary

Monthly Temperatures (°F) and Normals

Month	Max Temp 2023	Max Temp Norm*	Max Temp 2022	Max Temp 2021	Min Temp 2023	Min Temp Norm*	Min Temp 2022	Min Temp 2021	Monthly Avg. Temp 2023	Monthly Avg. Temp Norm*	Monthly Avg. Temp 2022	Monthly Avg. Temp 2021
Apr	39	53	40	54	24	29	25	27	32	41	33	40
May	74	67	63	66	49	42	44	40	62	54	53	53
June	81	76	76	83	60	53	54	55	70	65	65	69
July	77	81	80	86	55	57	59	60	66	69	70	73
Aug	77	81	79	83	56	54	56	56	67	67	68	69
Sept	73	72	73	75	49	45	47	49	61	58	60	62
Avgs:	70	72	69	75	49	47	48	48	60	59	58	61

*Normals = 1991-2020 averages

Monthly Precipitation (in) and Normals

Month	2023 Monthly Precipitation* NDAWN	2023 Monthly Precipitation* NOAA	Normal[1]	2022	2021
Apr	1.39	1.69	1.25	3.76	0.51
May	4.19	3.89	2.76	6.66	1.35
June	3.33	3.64	3.78	2.86	1.82
July	2.09	2.30	3.60	1.46	0.13
Aug	1.83	1.60	2.33	1.23	2.56
Sept	2.24	2.77	1.97	0.62	1.96
Totals:	15.08	15.89	15.69	16.59	8.34

[1] Normals = 1991-2020 averages * NDAWN and NOAA are two different weather stations at the CREC.

Monthly Growing Degree Days and Normals

Month	Wheat GDD 2023	Wheat GDD Norm*	Wheat GDD 2022	Wheat GDD 2021	Sunflower GDD 2023	Sunflower GDD Norm*	Sunflower GDD 2022	Sunflower GDD 2021	Corn GDD 2023	Corn GDD Norm*	Corn GDD 2022	Corn GDD 2021
Apr	132	311	124	328	---	---	---	---	---	---	---	---
May	911	694	665	671	577	360	341	362	424	258	226	249
June	1154	982	1005	1107	794	622	647	754	597	461	474	556
July	1049	1159	1169	1265	654	787	798	894	498	583	605	672
Aug	1072	1098	1106	1151	724	726	734	782	513	540	551	573
Sept	874	792	831	895	529	445	492	548	377	322	353	397
Totals	5192	5036	4900	5417	3278	2940	3012	3340	2409	2164	2209	2447

*Normals = 1991-2020 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
2021	Oct 16	32	2566	Oct 21	22	3321
2022	Sept 2	30	2135	Oct 6	25	2907
2023	*Oct 6	28	2470	**Oct 26	22	3242

*Normal Corn GDD for date = 2203 **Normal Sunflower GDD for date = 2903

Total corn GDD = May 1 to frost date Total sunflower GDD = May 20 to frost date

Normals = 1991-2020 averages Source: NDAWN

Agronomic Research Trials

If you have questions or feedback, please contact us at NDSU.Carrington.REC@ndsu.edu or visit our website (https://www.ag.ndsu.edu/CarringtonREC) to find specific individuals. We are happy to help whenever possible.

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
Dry Bean: Dry bean cover crop herbicide tolerance
Wheat: Cover crop timing
Wheat: Legume interseeding Year 1
Wheat: Legume interseeding Year 2

Crop Fertility
Corn: Preplant and starter PZn fertilizer; *North Dakota Corn Utilzation Council*
Lupin: Phosphorus yield response in lupin
Soybean: Foliar application of amino acids on soybeans; *ConceptAgriTek*
Soybean: Phosphorus recommendation update for soybean - low P site; *North Dakota Soybean Council / Franzen/Malone (School of Natural Resources)*
Soybean: Phosphorus recommendation update for soybean - medium P site; *North Dakota Soybean Council / Franzen/Malone (School of Natural Resources)*
Soybean: PPI phosphorus in corn/soybean rotation; *North Dakota Soybean Council*
Wheat: Wheat trial with N rates and fungicides; *Bais (Plant Sciences)*

Crop Management
Canola: Canola planting date by variety; *Johnson (Plant Sciences)*
Durum: Intensive management trial; *North Dakota Wheat Commission/Bortolon (North Central REC)*
Field Pea: Organic winter pea date of planting
Intercropping: Soybean and canola intercropping seeding rates
Intercropping: Soybean and flax intercropping seeding rates
Kernza: Kernza salt tolerant treatments
Misc: Cover crop species evaluation on high calcium carbonate equivalent (CCE) soil
Misc: Crop staging/management demonstration
Sunflower: Early planting and early maturity to manage red sunflower seed weevil; *National Sunflower Association/Praska (USDA)*
Wheat: Organic wheat trial for quality testing; *Horsley/Green (Plant Sciences)*
Wheat: Wheat variety seeding rate trial; *Keene (Plant Sciences)*

Crop Rotation
Barley: Cropping systems experiment - rotation, tillage, and fertility
Corn: Cropping systems experiment - rotation, tillage, and fertility
Field Pea: Cropping systems experiment - rotation, tillage, and fertility
Soybean: Cropping systems experiment - rotation, tillage, and fertility
Sunflower: Cropping systems experiment - rotation, tillage, and fertility
Wheat: Cropping systems experiment - rotation, tillage, and fertility

Inoculants and Plant Health Promotors
Field Pea: Inoculant screening; *Novozymes*
Lentil: Lentil inoculation; *Novozymes*

Lupin: Lupin yield response to various inoculants
Soybean: Soybean inoculation study – high rhizobium; *North Dakota Soybean Council / Geddes (Microbiological Sciences)*
Soybean: Soybean inoculation study – low rhizobium; *North Dakota Soybean Council / Geddes (Microbiological Sciences)*
Soybean: Inoculant screening; *Novozymes*

Product Evaluation
Chickpea: Seed treatment study; *Germains*
Corn: Applying ESN with the seed in corn
Corn: Biostimulant product evaluation in corn; *Mosaic*
Corn: Fertility product evaluation: Humega (a humic acid product); *Bioflora*
Corn: Fertility product evaluation: Resurge; *Helena*
Corn: Fertility product evaluation: starter fertilizer enhancement; *Bioflora*
Corn: Phosphorus product evaluation in corn; *Mosaic*
Dry Bean: Dry bean in-furrow nutrient combinations; *CHS*
Soybean: Seed treatment trial 1; *BASF*
Soybean: Seed treatment trial 2; *BASF*
Soybean: Soybean IDC treatments; *Component Ag*
Wheat: Biologicals applied to wheat; *North Dakota Wheat Commission*
Wheat: Fertility product evaluation: Resurge; *Helena*
Wheat: Product evaluation in wheat; *Mosaic*
Wheat: Soybean hulls as fertilizer in wheat - dryland; *North Dakota Soybean Council*
Wheat: Soybean hulls as fertilizer in wheat - irrigated; *North Dakota Soybean Council*
Wheat: Soybean hulls as fertilizer in wheat - no-till; *North Dakota Soybean Council*
Wheat: Spring wheat seed treatment combinations; *CHS*

Plant Pathology
Alfalfa: Field evaluation of foliar fungicides in alfalfa; *Corteva*
Alfalfa: Field evaluation of seed treatments for management of Rhizoctonia root rot in alfalfa (seeded in 2022); *McGregor*
Barley: Field evaluation of fungicides for management of Fusarium head blight of barley; *BASF*
Canola: Field evalaution of bee-vectored Clonostachys rosea for management of white mold in canola; *Northern Canola Growers Assoc.*
Canola: Field evaluation of fungicides for canola plant health; *BASF*
Canola: Field evaluation of fungicides for management of white mold in canola; *Syngenta*
Canola: Field evaluation of fungicides for management of white mold in canola; *BASF*
Chickpea: Field evaluation of foliar fungicides for management of Ascochyta blight of chickpeas; *Certis*
Chickpea: Field evaluation of foliar fungicides for management of Ascochyta blight of chickpeas; *BASF*
Chickpea: Field evaluation of foliar fungicides for management of Ascochyta blight of chickpeas; *Bayer*
Chickpea: Field evaluation of foliar fungicides for management of Ascochyta blight of chickpeas; *Corteva*
Chickpea: Field evaluation of foliar fungicides for management of Ascochyta blight of chickpeas; *FMC*
Chickpea: Field evaluation of foliar fungicides for management of Ascochyta blight of chickpeas; *Syngenta*
Chickpea: Field evaluation of foliar fungicides for management of Ascochyta blight of chickpeas - impact of fungicide droplet size (TeeJet); *ND Crop Protection Product Harmonization & Registration Board*
Chickpea: Field evaluation of foliar fungicides for management of Ascochyta blight of chickpeas - impact of fungicide droplet size (Wilger); *ND Crop Protection Product Harmonization & Registration Board*
Chickpea: Field evaluation of foliar fungicides for management of Ascochyta blight of chickpeas; *ND Crop Protection Product Harmonization & Registration Board*

Chickpea: Field evaluation of seed treatments for management of Pythium seed and seedling decay in chickpeas; *BASF*
Corn: Corn Goss's Wilt evaluation; *North Dakota Corn Utilization Council/Friskop (Plant Pathology)*
Dry bean: White mold - impact of fungicide application timing (kidney beans); *Northarvest Bean Growers Assoc.*
Dry bean: White mold - impact of fungicide droplet size; *Northarvest Bean Growers Association / ND Crop Protection Product Harmonization & Registration Board*
Dry bean: White mold - impact of fungicide spray volume; *Northarvest Bean Growers Assoc.*
Dry bean: White mold - susceptibility of dry bean breeding lines; *USDA National Sclerotinia Initiative/ Chilvers (Michigan State Univ.)*
Dry bean: Field evaluation of fungicides for efficacy against white mold; *Gowan*
Dry bean: Field evaluation of fungicides for efficacy against white mold; *Syngenta*
Dry bean: Field evaluation of fungicides for efficacy against white mold; *BASF*
Dry bean: Field evaluation of fungicides for efficacy against white mold - in-furrow; *Bayer*
Dry bean: Field evaluation of fungicides for efficacy against white mold - kidney beans; *BASF*
Dry bean: Field evaluation of fungicides for efficacy against white mold - pinto beans; *BASF*
Dry bean: Field evaluation of fungicides for efficacy against white mold - registered products; *Bayer*
Dry bean: Field evaluation of seed treatments for management of Rhizoctonia root rot in kidney beans; *Albaugh*
Dry bean: Field evaluation of seed treatments for management of Rhizoctonia root rot in kidney beans; *McGregor*
Durum: Prosaro Pro efficacy in durum; *Bayer*
Faba bean: Field evaluation of fungicides for management of Botrytis in faba beans, protocol 1; *BASF*
Faba bean: Field evaluation of fungicides for management of Botrytis in faba beans, protocol 2; *BASF*
Field pea: Field evaluation of fungicides for efficacy against Ascochyta blight in field peas; *Bayer*
Field pea: Field evaluation of fungicides for efficacy against Ascochyta blight in field peas; *FMC*
Field pea: Field evaluation of fungicides for efficacy against powdery mildew in field peas - peroxide-based fungicides; *SBARE New and Emerging Crops*
Field pea: Field evaluation of fungicides for efficacy against powdery mildew in field peas - standard fungicides; *SBARE New and Emerging Crops*
Field pea: Field evaluation of seed treatments for management of Fusarium root rot in field peas; *Corteva*
Field pea: Field evaluation of seed treatments for management of Fusarium root rot in field peas; *Syngenta*
Field pea: Impact of crop rotation interval, planting date, and fungicide seed treatment on field pea agronomic performance under root rot pressure; *Northern Pulse Growers Assoc. / ND Crop Protection Product Harmonization & Registration Board*
Field pea: Impact of crop rotation on root rot management in field peas; *Northern Pulse Growers Assoc.*
Field pea: Improving the management of Ascochyta blight in field peas - fungicide application timing; *USDA Specialty Crop Block Grant Program*
Field pea: Improving the management of Ascochyta blight in field peas - fungicide droplet size, TeeJet; *USDA Specialty Crop Block Grant Program*
Field pea: Improving the management of Ascochyta blight in field peas - fungicide droplet size, Wilger; *USDA Specialty Crop Block Grant Program*
Field pea: Improving the management of powdery mildew in field peas - fungicide application timing; *USDA Specialty Crop Block Grant Program*
Field pea: Improving the management of powdery mildew in field peas - fungicide droplet size, TeeJet; *USDA Specialty Crop Block Grant Program*
Field pea: Improving the management of powdery mildew in field peas - fungicide droplet size, Wilger; *USDA Specialty Crop Block Grant Program*
Field pea: Screening of varieties for resistance to Fusarium and Aphanomyces root rot; *Pure Line Seed*
Lentil: Field evaluation of fungicides for efficacy against anthracnose in lentils; *Bayer*
Lentil: Field evaluation of fungicides for efficacy against anthracnose in lentils; *Corteva*
Lentil: Field evaluation of fungicides for efficacy against anthracnose in lentils; *FMC*

Lentil: Field evaluation of seed treatments for management of Fusarium root rot in field peas; *Syngenta*
Snap bean: Field evaluation of fungicides for efficacy against white mold and Botrytis; *BASF*
Soybean: Efficacy of peroxide-based fungicides for management of white mold in soybeans - Carrington; *North Dakota Soybean Council*
Soybean: Efficacy of peroxide-based fungicides for management of white mold in soybeans - Oakes; *North Dakota Soybean Council*
Soybean: Efficacy of peroxide-based products delivered through chemigation for management of white mold in soybeans; *North Dakota Soybean Council*
Soybean: Field evaluation of fungicides for efficacy against white mold; *BASF*
Soybean: Field evaluation of fungicides for efficacy against white mold; *Bayer*
Soybean: Field evaluation of fungicides for efficacy against white mold; *Corteva*
Soybean: Field evaluation of fungicides for efficacy against white mold; *Syngenta*
Soybean: Field evaluation of fungicides for efficacy against white mold - registered products; *Bayer*
Soybean: Field evaluation of seed treatments for management of Pythium seed and seedling decay in soybeans; *Syngenta*
Soybean: Impact of fungicide spray volume for management of white mold in soybeans - Carrington; *North Dakota Soybean Council*
Soybean: Impact of fungicide spray volume for management of white mold in soybeans - Oakes; *North Dakota Soybean Council*
Soybean: White mold - efficacy of Endura applied alone and with peroxide-based products; *North Dakota Soybean Council*
Soybean: White mold - efficacy of ProPulse applied alone and with peroxide-based products; *North Dakota Soybean Council*
Soybean: White mold - efficacy of Topsin applied alone and with peroxide-based products; *North Dakota Soybean Council*
Soybean: White mold - impact of droplet size and application timing; *North Dakota Soybean Council*
Sunflower: Field evaluation of fungicides for management of rust in sunflowers; *FMC*
Sunflower: Head rot - efficacy of bee-vectored biological control; *USDA Specialty Crop Block Grant Program*
Sunflower: Head rot - impact of bagging heads, early planting date; *USDA Specialty Crop Block Grant Program*
Sunflower: Head rot - impact of bagging heads, late planting date; *USDA Specialty Crop Block Grant Program*
Wheat: Field evaluation of fungicide seed treatments for management of Fusarium root rot in spring wheat; *Valent*
Wheat: Field evaluation of fungicide seed treatments for management of Fusarium, Bipolaris/Cochliobolus, & Rhizoctonia root rot in spring wheat; *Bayer*
Wheat: Field evaluation of fungicide seed treatments for management of Rhizoctonia root rot in spring wheat; *Valent*
Wheat: Field evaluation of fungicide seed treatments in wheat without supplemental pathogen pressure; *BASF*
Wheat: Field evaluation of fungicide seed treatments in wheat without supplemental pathogen pressure; *Valent*
Wheat: Field evaluation of fungicides for management of Fusarium head blight of wheat; *BASF*
Wheat: Field evaluation of fungicides for management of Fusarium head blight of wheat; *Cibus*
Wheat: Prosaro Pro efficacy in spring wheat; *Bayer*
Wheat: Prosaro Pro ergot evaluation; *Bayer*

Seed Increase
Lupin: Drill strip increases
Oats: Drill strip demonstration plots

Salinity
Canola: Canola hybrid tolerance to salinity; *Croplan/Winfield*
Field Pea: Field pea saline gene regulation; *USDA Specialty Crop Block Grant Program / Bandillo (Plant Sciences)*

Germplasm Evaluation / Cultivar Development
Barley: Barley breeder nursery; *Horsley (Plant Sciences)*
Barley: Drill strip demonstration plots
Barley: Dryland variety trial
Barley: Irrigated variety trial
Barley: Organic variety trial
Barley: Barnes County (Dazey) variety trial
Barley: Tri-County (Wishek) variety trial
Buckwheat: Dryland variety trial
Buckwheat: Organic variety trial
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: Dryland corn silage performance test; *Industry*
Corn: Irrigated corn silage performance test; *Industry*
Crambe: Variety trial; *Johnson (Plant Sciences)*
Crambe: Organic variety trial
Dry Bean: Dry bean breeder nursery; *Osorno (Plant Sciences)*
Dry Bean: Dryland variety trial
Dry Bean: Irrigated variety trial
Dry Bean: Tri-County/Wishek variety trial
Durum: Drill strip demonstration plots
Durum: Dryland variety trial
Durum: Organic variety trial
Durum: Uniform Regional Durum Nursery - dryland; *Elias (Plant Sciences)*
Durum: Uniform Regional Durum Nursery - irrigated; *Elias (Plant Sciences)*
Field Pea: Field pea nursery; *Equinom*
Field Pea: Field pea breeder nursery - AYT; *Bandillo (Plant Sciences)/Worral (North Central REC)*
Field Pea: Field Pea breeder nursery - PYT; *Bandillo (Plant Sciences)/Worral (North Central REC)*
Field Pea: Organic variety trial
Field Pea: Protein management; *Pulse Crop Health Initiative/Miller (Montana State Univ.)*
Field Pea: Variety trial; *Industry*
Field Pea: Organic winter pea nursery
Flax: Organic variety trial
Flax: Variety trial
Flax: Flax breeder nursery; *Rahman (Plant Sciences)*
Forages: Winter rye forage variety trial
Kernza: Kernza demonstration plot; *Bandillo (Plant Sciences)/Worral (North Central REC)*
Lentil: Lentil breeder nursery - AYT; *Bandillo (Plant Sciences)/Worral (North Central REC)*
Lentil: Core variety trial; *Bandillo (Plant Sciences)/Worral (North Central REC)*
Lupin: Blue and yellow lupin demonstrations
Lupin: Evaluation of advanced lupin selections; *USDA Specialty Crop Block Grant Program*
Lupin: Evaluation of advanced lupin selections REP 4; *USDA Specialty Crop Block Grant Program*
Lupin: Variety evaluation
Misc: Adzuki and other dry bean performance comparisons; *SB&B*
Misc: Wishek demonstration plots
Oats: Oat breeder nursery; *McMullen (Plant Sciences)*
Oats: Dryland variety trial

Oats: Organic variety trial
Oats: Organic oat nursery; *Jackson (25-2)*
Oats: Uniform Midseason Oat Performance Nursery; *McMullen (Plant Sciences)*
Rye: Spring rye hybrid variety trial; *KWS*
Rye: Winter rye organic variety trial
Rye: Winter rye variety trial
Sorghum: Forage sorghum nursery; *SBARE New and Emerging Crops*
Sorghum: Grain sorghum nursery; *SBARE New and Emerging Crops*
Soybean: Barnes County (Dazey) Roundup Ready variety performance test
Soybean: Breeder Nursery: 23 CAR third/fourth year conventional - dryland; *Miranda (Plant Sciences)*
Soybean: Breeder Nursery: 23 CAR third/fourth year conventional - irrigated; *Miranda (Plant Sciences)*
Soybean: Breeder Nursery: 23 CAR third/fourth year conventional - Wishek; *Miranda (Plant Sciences)*
Soybean: Breeder Nursery: 23 CAR third/fourth year conventional - Dazey; *Miranda (Plant Sciences)*
Soybean: Breeder Nursery: 23 CAR third/fourth year Roundup Ready - Dazey; *Miranda (Plant Sciences)*
Soybean: Breeder Nursery: 23 CAR third/fourth year Roundup Ready - dryland; *Miranda (Plant Sciences)*
Soybean: Breeder Nursery: 23 CAR third/fourth year Roundup Ready - irrigated; *Miranda (Plant Sciences)*
Soybean: Breeder Nursery: 23 CAR third/fourth year Roundup Ready - Wishek; *Miranda (Plant Sciences)*
Soybean: Breeder Nursery: 23 CAR Tofu/Natto - dryland; *Miranda (Plant Sciences)*
Soybean: Dryland soybean agronomic performance trial - Carrington; *BASF*
Soybean: Dryland soybean agronomic performance trial - Oakes; *BASF*
Soybean: Irrigated soybean agronomic performance trial - Carrington; *BASF*
Soybean: Irrigated soybean agronomic performance trial - Oakes; *BASF*
Soybean: LaMoure Roundup Ready variety performance test
Soybean: Organic variety performance trial
Soybean: Soybean agronomic performance trial - Barnes County (Dazey); *BASF*
Soybean: Soybean agronomic performance trial - Tri-County (Wishek); *BASF*
Soybean: Dryland conventional performance test
Soybean: Dryland Roundup Ready variety performance test
Soybean: Irrigated conventional variety performance test
Soybean: Irrigated Roundup Ready variety performance test
Soybean: Tri-County (Wishek) Roundup Ready variety performance test
Soybean: Barnes County (Dazey) conventional variety performance test
Soybean: LaMoure conventional variety performance test
Soybean: Tri-County (Wishek) conventional variety performance test
Sunflower: Hybrid nursery; *Sunrich Products*
Sunflower: Non-oil sunflower hybrid performance test
Sunflower: Oil sunflower hybrid performance test
Sunflower: Hybrid tolerance to salinity; *Croplan*
Wheat: Barnes County (Dazey) variety trial
Wheat: Drill strip demonstration plots
Wheat: Organic variety trial
Wheat: Spring wheat breeder nursery; *Greene (Plant Sciences)*
Wheat: Dryland variety trial
Wheat: Irrigated variety trial
Wheat: Tri-County (Wishek) variety trial
Wheat: Uniform Regional Spring Wheat Nursery; *Greene (Plant Sciences)*
Wheat: Wheat variety tolerance to salinity; *Croplan/Winfield*
Winter Wheat: Winter Wheat Elite Breeder's Nursery; *Marais (Plant Sciences)*
Winter Wheat: Variety trial

Weed Science

Canola: Evaluation of glufosinate formulations; *BASF*
Canola: Zalo and Ambush combinations for canola; *AMVAC*
Canola: Zalo and Stinger combinations for canola; *AMVAC*
Corn: Corn herbicide by cover crop evaluation; *North Dakota Corn Council*
Dry Bean: Ground roll impact on herbicide; *Northarvest Bean Growers Assoc. / Ikley (Plant Sciences)*
Misc: Burndown options with Vida; *Gowan*
Misc: Foxtail barley management with Zalo; *AMVAC*
Misc: Glyphoste and nutrient antagonism; *CHS*
Misc: Herbicide site of action demonstration
Misc: Residual control duration for kochia PREs; *FMC*
Soybean: Soybean PRE safety evaluation; *UPL*
Sunflower: Sunflower herbicide timing trial; *Winfield United*
Wheat: Foxtail control with Vios FX herbicide; *Bayer*
Wheat: Kochia control with Huskie FX herbicide; *Bayer*
Wheat: Kochia management in wheat; *Corteva*
Wheat: Kochia management in wheat; *Nufarm*
Wheat: Kochia management in wheat; *Winfield United*

Cover crop species evaluation on high calcium carbonate equivalent (CCE) soil.

Variety	Days to Heading	Plant Height	Protein 2023	Protein 3-yr. Avg.	Gluten	BLS[1]	KWT	Test Weight	Yield 2023	Yield 2-yr. Avg.	Yield 3-yr. Avg.
	DAP	inch	%	%	%	1-9	g/1000	lb/bu	bu/a	bu/a	bu/a
SY Valda	45.3	26.9	15.1	14.0	35.6	5.8	36.1	61.6	72.4	63.8	61.8
SY Ingmar	45.5	25.4	15.8	15.0	39.1	5.8	30.4	61.4	60.7	55.5	55.1
AP Murdock	46.3	23.0	15.4	14.4	37.0	6.3	33.4	60.2	65.5	60.0	58.0
WB9590	44.3	24.1	15.3	14.7	38.8	7.3	35.2	59.5	68.8	62.8	60.6
WB9719	47.0	25.1	14.5	--	37.3	4.8	31.1	63.0	71.3	--	--
Shelly	46.8	25.0	14.6	14.1	36.6	6.0	29.2	58.7	65.5	65.3	63.1
ND Vitpro	43.8	25.8	16.0	15.2	39.4	7.3	31.3	61.8	57.3	52.9	52.8
Elgin-ND	43.0	29.4	14.5	--	36.4	7.3	30.6	60.0	67.8	--	--
AAC Starbuck	45.8	29.1	15.7	15.3	39.1	6.5	34.5	61.3	73.7	67.2	63.9
AP Gunsmoke CL2	44.3	25.7	15.6	14.7	36.7	8.0	32.7	60.0	72.1	64.9	62.5
AP Smith	46.0	25.2	15.3	14.5	36.5	6.3	31.9	60.5	64.5	59.0	57.7
AR3530	46.3	28.6	14.8	14.5	36.9	5.5	33.3	60.0	70.7	64.7	63.0
AR3915	45.8	25.9	15.0	--	36.7	6.0	26.9	60.7	67.5	--	--
Ascend-SD	45.5	29.2	15.3	--	37.4	4.8	29.9	60.9	83.4	71.9	--
Bolles	47.0	28.2	17.5	16.4	40.1	5.0	33.0	59.8	68.5	57.3	57.4
Boost	46.3	28.6	15.8	--	39.6	5.0	35.8	60.8	70.3	--	--
Brawn-SD	45.8	27.1	14.5	--	35.3	5.3	31.5	61.9	73.8	63.8	--
CAG Justify	46.5	27.2	14.1	13.6	34.1	5.8	29.4	58.0	69.9	65.3	63.7
CAG Reckless	45.5	27.5	14.8	14.6	37.6	6.0	32.5	61.9	71.3	62.3	59.7
CDC Landmark	46.0	28.1	15.9	--	40.1	6.0	35.7	61.2	68.1	--	--
CP3099A	48.0	30.5	12.0	12.6	28.5	7.5	31.1	56.0	62.8	61.3	60.0
CP3188	45.3	28.6	13.5	13.0	33.1	6.5	29.2	58.0	53.3	59.8	59.1
CP3322	48.0	26.1	13.6	--	31.7	4.0	25.7	59.2	72.3	--	--
Driver	45.8	26.8	14.3	13.9	34.5	6.0	29.5	61.2	73.6	66.0	64.7
Glenn	44.0	30.3	15.5	14.7	40.0	6.8	30.0	62.5	64.4	55.9	55.4
Lang-MN	46.0	29.7	15.0	--	38.1	5.3	29.4	61.3	71.6	--	--
Lanning	47.0	28.1	15.7	15.0	39.4	4.8	31.1	58.4	70.1	59.6	58.6
LCS Ascent	43.5	25.2	14.8	--	37.9	7.0	29.7	60.6	59.2	55.3	--
LCS Boom	42.8	21.9	16.0	--	40.6	6.8	32.5	61.5	54.1	--	--
LCS Buster	46.8	26.8	12.7	12.8	31.3	5.0	31.3	58.3	71.3	64.5	59.2
LCS Cannon	45.0	26.1	14.8	14.4	37.3	7.5	30.8	60.2	57.7	56.6	55.2
Mean	46.0	27.3	15.0	--	37.0	5.8	32.1	59.3	68.8	--	--
C.V. (%)	2.5	9.2	3.2	--	2.7	12.3	5.5	1.4	10.9	--	--
LSD (0.05)	1.6	3.6	0.7	--	1.4	1.0	2.4	1.1	10.4	--	--
LSD (0.10)	1.4	3.0	0.6	--	1.2	0.8	2.1	1.0	8.7	--	--

Planting Date = May 11; Harvest Date = August 28; Previous Crop = Field Pea

Variety	Days to Heading	Plant Height	Protein 2023	Protein 3-yr. Avg.	Gluten	BLS[1]	KWT	Test Weight	Yield 2023	Yield 2-yr. Avg.	Yield 3-yr. Avg.
	DAP	inch	%	%	%	1-9	g/1000	lb/bu	bu/a	bu/a	bu/a
LCS Dual	43.3	28.1	14.8	--	35.6	7.0	27.2	60.2	60.2	63.0	--
LCS Hammer AX	45.0	25.1	15.1	--	38.6	6.8	32.9	60.1	64.0	63.6	--
LCS Trigger	49.0	29.3	12.8	12.9	31.3	3.8	30.4	60.2	72.7	65.6	63.3
MN Rothsay	48.0	24.8	15.2	--	38.5	4.8	29.3	60.1	72.8	61.9	--
MN Torgy	47.0	26.9	15.7	14.7	39.4	5.3	30.1	59.3	58.4	60.3	61.3
MS Charger	43.5	21.9	14.2	--	34.4	7.0	31.5	60.4	63.8	62.4	--
MS Cobra	44.5	24.9	15.8	14.6	39.7	7.3	30.4	61.2	62.3	61.5	59.9
MS Ranchero	53.0	32.6	14.7	13.9	37.2	2.8	31.7	60.0	81.2	68.4	65.6
ND Frohberg	45.5	28.5	15.6	14.5	39.6	5.8	35.5	61.3	69.1	64.3	63.7
ND Heron	42.5	26.4	15.7	14.7	39.8	7.3	32.4	60.9	57.5	56.2	56.6
ND Thresher	47.8	27.1	14.5	14.8	36.3	5.0	30.0	59.5	69.5	59.3	56.0
PFS Buns	53.5	27.6	13.6	13.9	32.7	3.0	31.1	58.5	80.2	61.8	61.1
SY611 CL2	45.5	26.9	15.7	14.5	38.8	5.3	33.6	62.4	72.8	65.1	63.2
SY Longmire	45.8	25.3	15.5	14.9	39.4	5.8	33.4	61.4	71.0	60.0	60.7
SY McCloud	45.0	28.1	16.1	15.5	39.1	6.0	36.8	60.8	66.9	59.6	60.6
TCG Heartland	43.3	24.9	16.2	15.5	40.2	6.5	34.6	61.8	65.1	55.0	53.5
TCG Spitfire	47.0	27.1	14.5	14.2	35.8	5.0	35.4	60.4	81.1	69.7	66.3
TCG Teddy	45.8	25.0	15.6	--	36.0	6.3	31.1	59.0	73.4	--	--
TCG Wildcat	45.8	26.1	16.1	15.2	40.5	7.0	37.4	61.5	71.6	63.2	59.1
WB9606	46.5	27.2	13.8	--	34.3	5.8	32.3	61.4	70.2	--	--
Red Fife	47.5	42.9	14.2	--	36.0	5.5	33.6	59.5	61.9	--	--
AAC Rimbey	47.0	28.0	13.5	--	34.0	6.8	38.0	59.5	73.5	--	--
AAC Westlock	49.3	31.2	14.1	--	35.5	4.3	32.7	60.0	82.9	--	--
GP250 Allota	48.3	27.5	12.4	--	30.3	4.5	38.1	58.3	84.9	--	--
AC Lillian	48.8	31.0	16.0	--	39.5	6.0	32.5	58.6	54.1	--	--
Faller	46.8	28.6	13.9	--	34.7	4.8	35.3	60.2	73.4	--	--
Mean	46.0	27.3	15.0	--	37.0	5.8	32.1	59.3	68.8	--	--
C.V. (%)	2.5	9.2	3.2	--	2.7	12.3	5.5	1.4	10.9	--	--
LSD (0.05)	1.6	3.6	0.7	--	1.4	1.0	2.4	1.1	10.4	--	--
LSD (0.10)	1.4	3.0	0.6	--	1.2	0.8	2.1	1.0	8.7	--	--

Planting Date = May 11; Harvest Date = August 28; Previous Crop = Field Pea

No significant lodging.

[1] BLS: Bacterial Leaf Streak; 1 = no symptoms; 9 = plant death

Hard Red Spring Wheat - Irrigated — Carrington (Page 1 of 2)

Variety	Days to Heading	Plant Height	Lodging	Protein 2023	Protein 3-yr. Avg.	Gluten	KWT	Test Weight	Yield 2023	Yield 3-yr. Avg.
	DAP	inch	0-9	%	%	%	g/1000	lb/bu	bu/a	bu/a
SY Valda	44.5	25.7	1.0	13.1	13.0	31.3	40.5	60.5	77.7	79.9
SY Ingmar	45.3	26.3	1.0	14.6	14.1	37.9	34.8	60.7	58.6	68.2
AP Murdock	44.3	25.0	1.0	13.7	13.1	33.3	37.6	59.5	73.9	76.2
WB9590	44.5	24.6	1.0	13.3	13.4	34.6	38.4	59.9	68.3	74.5
WB9719	45.0	25.0	1.0	12.9	--	34.4	37.6	62.7	71.5	--
Shelly	46.0	26.1	1.3	13.0	13.0	33.1	32.5	58.9	58.5	71.7
ND Vitpro	44.8	28.1	1.0	14.1	14.0	36.2	36.1	62.2	66.5	66.8
Elgin-ND	44.0	31.3	2.5	13.2	--	34.1	35.6	59.6	70.4	--
AAC Starbuck	44.8	29.5	1.3	14.4	14.3	37.2	38.0	61.0	68.8	74.3
AP Gunsmoke CL2	44.3	25.5	2.0	12.9	13.0	29.7	36.2	59.1	61.8	74.5
AP Smith	45.0	25.5	1.0	14.3	13.9	35.5	35.3	60.4	72.1	77.8
AR3530	45.5	29.5	2.5	13.1	13.2	33.0	37.7	59.9	71.4	75.1
AR3915	45.0	27.1	1.0	13.8	--	35.6	33.5	61.2	67.2	--
Ascend-SD	44.8	30.2	1.0	13.3	--	32.4	32.9	61.2	88.6	--
Bolles	45.5	30.6	2.0	14.8	14.8	35.8	37.7	60.0	62.1	68.4
Boost	45.5	29.7	1.3	14.4	--	37.1	38.4	59.9	69.0	--
Brawn-SD	44.8	26.9	1.8	12.6	--	30.7	35.9	61.8	75.2	--
CAG Justify	45.5	29.6	1.8	12.3	12.0	30.3	36.5	58.5	72.9	77.9
CAG Reckless	44.8	27.7	2.0	13.5	13.2	36.2	36.1	61.0	73.1	76.1
CDC Landmark	45.0	30.0	1.3	14.3	--	37.9	39.3	61.4	67.2	--
CP3099A	46.0	32.2	1.3	10.9	11.3	26.5	38.1	58.6	78.5	81.3
CP3188	45.0	28.7	2.0	11.9	11.9	30.3	34.9	58.9	73.8	75.5
CP3322	48.3	30.1	1.0	11.8	--	27.6	30.7	59.8	70.6	--
Driver	45.0	28.6	1.5	12.4	13.0	30.3	34.0	60.9	63.8	72.0
Glenn	44.3	29.3	1.8	13.9	14.2	37.5	34.9	62.4	62.4	66.3
Lang-MN	45.3	28.9	1.0	12.8	--	32.7	33.1	61.2	67.7	--
Lanning	45.8	28.4	1.3	13.6	13.8	35.4	36.1	59.1	62.3	66.5
LCS Ascent	44.0	26.4	1.5	13.2	--	35.1	35.3	60.7	68.0	--
LCS Boom	43.3	26.7	1.3	13.3	--	35.7	36.3	61.3	68.1	--
LCS Buster	47.0	30.4	1.0	11.5	11.7	28.2	35.2	57.7	71.3	78.6
LCS Cannon	43.5	27.6	2.0	13.5	13.4	36.4	35.9	61.0	67.6	77.0
Mean	45.2	28.3	1.4	13.1	--	33.5	36.2	60.3	68.0	--
C.V. (%)	1.4	6.4	30.2	4.8	--	6.0	3.9	0.6	9.0	--
LSD (0.05)	0.9	2.5	--	0.9	--	8.1	2.0	0.5	8.5	--
LSD (0.10)	0.8	2.1	--	0.7	--	6.8	1.7	0.4	7.1	--

Planting Date = May 5; Harvest Date = August 16; Previous Crop = Field Pea

Variety	Days to Heading	Plant Height	Lodging	------ Protein ------ 2023	3-yr. Avg.	Gluten	KWT	Test Weight	-------- Yield -------- 2023	3-yr. Avg.
	DAP	inch	0-9	--------- % ---------		%	g/1000	lb/bu	-------- bu/a --------	
LCS Dual	44.0	29.2	2.3	12.3	--	30.2	36.3	61.2	63.1	--
LCS Hammer AX	43.8	24.2	2.3	12.9	--	34.1	36.9	60.0	59.9	--
LCS Trigger	46.0	29.0	1.0	10.9	11.5	25.9	33.4	59.8	65.5	79.8
MN Rothsay	45.3	25.6	1.0	12.9	--	33.3	32.4	60.3	69.7	--
MN Torgy	45.0	26.6	1.3	12.9	13.3	33.7	34.2	59.8	65.1	75.1
MS Charger	44.3	27.2	2.0	12.3	--	31.4	37.3	60.2	74.3	--
MS Cobra	44.8	25.4	1.3	13.0	13.4	33.5	33.4	60.6	60.1	69.7
MS Ranchero	47.5	33.0	1.3	11.9	12.3	29.5	35.5	59.5	66.9	79.0
ND Frohberg	45.0	27.2	1.5	13.2	13.4	35.3	40.3	61.0	63.8	69.2
ND Heron	43.8	27.9	2.0	14.1	14.0	38.4	37.0	61.6	63.4	69.1
ND Thresher	45.5	28.1	1.0	12.9	13.2	32.3	34.2	59.7	74.1	74.3
PFS Buns	52.0	28.9	1.0	11.8	11.9	27.9	32.9	57.2	66.1	76.4
SY611 CL2	45.0	24.6	1.0	13.3	13.1	34.5	34.9	61.2	70.8	75.7
SY Longmire	44.8	27.5	1.3	13.6	13.6	35.9	36.5	60.6	66.3	75.7
SY McCloud	44.8	27.7	1.0	14.3	14.0	37.7	40.3	60.6	63.5	71.0
TCG Heartland	43.8	24.9	1.0	13.5	13.9	35.7	38.0	61.0	61.8	67.7
TCG Spitfire	46.0	28.7	1.0	12.8	13.0	31.9	37.7	60.1	76.3	79.8
TCG Teddy	45.0	24.1	1.0	12.9	--	31.9	37.4	59.8	65.0	--
TCG Wildcat	45.3	28.3	1.0	13.1	13.4	34.8	38.4	60.8	72.8	75.0
WB9606	45.0	29.2	1.5	11.8	--	27.2	36.1	60.7	73.4	--
Red Fife	46.5	42.7	4.0	12.4	--	30.7	36.9	58.6	54.9	--
FP23SW001	44.5	27.1	1.0	13.5	--	34.5	34.5	61.4	61.3	--
FP23SW002	44.0	30.1	1.3	13.6	--	36.3	35.8	60.6	62.1	--
AC Lillian	48.3	34.2	3.0	14.5	--	36.8	36.0	57.4	50.5	--
Faller	45.8	30.1	1.8	12.4	12.5	31.7	39.8	59.8	77.2	80.2
Mean	45.2	28.3	1.4	13.1	--	33.5	36.2	60.3	68.0	--
C.V. (%)	1.4	6.4	30.2	4.8	--	6.0	3.9	0.6	9.0	--
LSD (0.05)	0.9	2.5	--	0.9	--	8.1	2.0	0.5	8.5	--
LSD (0.10)	0.8	2.1	--	0.7	--	6.8	1.7	0.4	7.1	--

Planting Date = May 5; Harvest Date = August 16; Previous Crop = Field Pea

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

Hard Red Spring Wheat										**Barnes County - Dazey**
			------ Protein -------					---------- Yield ----------		
Variety	Days to Heading	Plant Height	2023	3-yr. Avg.	Gluten	KWT	Test Weight	2023	2-yr. Avg.	3-yr. Avg.
	DAP	inch	--------- % ---------		%	g/1000	lb/bu	---------- bu/a ----------		
SY Valda	47.0	31.5	14.4	13.9	32.3	32.6	58.9	71.0	77.4	71.3
SY Ingmar	49.3	30.9	15.5	14.6	36.7	29.1	59.3	55.7	67.3	64.4
AP Murdock	47.3	31.9	14.7	14.1	34.6	32.3	60.1	67.5	76.2	71.6
WB9590	47.5	29.1	15.1	14.8	36.4	32.5	59.3	72.2	76.7	70.7
WB9719	50.0	30.5	14.5	--	36.8	32.8	61.9	76.2	--	--
Shelly	48.8	30.7	13.9	13.7	35.7	32.3	60.6	73.0	78.4	69.5
ND Vitpro	47.8	31.7	15.6	15.0	38.1	30.8	61.7	67.2	68.1	65.0
Elgin-ND	44.5	37.4	14.1	--	35.0	31.5	59.9	69.2	--	--
AAC Starbuck	47.0	34.1	15.6	--	35.8	31.2	59.5	76.2	69.7	--
AP Smith	48.8	29.7	15.0	--	31.9	27.7	58.3	68.3	--	--
Ascend-SD	47.5	36.2	14.5	--	34.1	29.1	60.2	86.2	83.7	--
Bolles	52.0	33.9	16.6	16.1	36.7	32.3	58.5	70.0	69.0	63.3
Brawn-SD	46.3	34.6	14.0	--	32.0	32.5	61.4	87.0	--	--
CP3188	49.0	32.5	12.7	--	31.9	30.5	58.3	59.3	--	--
Driver	47.3	32.5	14.2	--	32.6	28.3	59.6	76.7	--	--
Glenn	46.5	34.4	15.4	14.9	40.0	30.9	62.5	67.4	68.9	63.8
Lang-MN	50.5	36.2	15.2	--	38.3	30.2	60.9	71.6	--	--
LCS Ascent	44.8	30.9	13.8	--	35.5	28.6	60.6	70.6	75.6	--
LCS Boom	43.8	29.5	14.7	--	38.2	29.7	60.4	61.1	--	--
LCS Buster	52.0	35.8	12.3	--	30.1	33.3	57.8	83.0	--	--
LCS Cannon	42.8	34.1	14.0	14.0	35.7	29.9	58.9	62.5	70.8	69.7
LCS Dual	45.8	31.9	13.9	--	32.3	28.7	59.8	70.1	68.9	--
LCS Hammer AX	45.5	29.9	14.0	--	34.9	30.5	58.9	64.1	--	--
LCS Trigger	47.3	33.7	12.1	12.5	29.0	30.0	59.1	71.3	78.5	70.6
MN Rothsay	51.8	31.5	14.6	--	37.6	30.5	59.7	71.2	74.8	--
MN Torgy	50.0	35.8	15.5	14.7	39.1	34.2	60.2	59.0	69.4	66.4
ND Frohberg	47.8	34.6	14.6	14.1	36.8	34.1	60.8	75.5	73.9	68.4
ND Heron	45.0	31.9	15.1	14.9	37.0	30.5	60.7	69.9	70.3	66.9
ND Thresher	52.3	31.7	15.2	15.2	36.0	31.1	58.9	70.7	68.7	66.3
SY Longmire	46.8	31.7	14.9	--	35.9	29.2	59.1	72.6	--	--
CDC Landmark	47.3	33.7	15.1	--	38.0	32.0	60.3	73.9	--	--
Faller	52.8	35.8	14.4	13.9	35.7	36.4	60.0	81.5	82.0	75.8
Mean	48.0	33.0	14.6	--	35.5	31.1	59.8	71.2	--	--
C.V. (%)	3.7	3.3	2.0	--	2.8	3.3	0.8	12.1	--	--
LSD (0.05)	2.5	1.5	0.4	--	1.4	1.4	0.7	12.0	--	--
LSD (0.10)	2.1	1.3	0.3	--	1.2	1.2	0.6	10.1	--	--

Planting Date = May 23; Harvest Date = August 31; Previous Crop = Soybean

No significant lodging.

Hard Red Spring Wheat										**Tri-County - Wishek**
			-------- Protein --------					---------- Yield ----------		
	Days to	Plant		3-yr.			Test		2-yr.	3-yr.
Variety	Heading	Height	2023	Avg.	Gluten	KWT	Weight	2023	Avg.	Avg.
	DAP	inch	---------- % ----------		%	g/1000	lb/bu	---------- bu/a ----------		
SY Valda	43.8	27.7	13.9	14.8	31.5	32.1	56.3	73.4	68.9	56.9
SY Igmar	45.5	26.2	15.0	15.4	35.4	27.2	56.4	52.8	58.8	50.9
AP Murdock	44.0	28.1	13.4	14.6	29.9	28.9	57.1	81.3	76.6	63.9
WB9590	42.8	25.1	14.6	15.3	34.1	26.8	56.3	67.2	63.4	55.2
WB9719	46.0	27.4	13.4	--	33.5	28.2	58.9	81.0	--	--
Shelly	45.3	26.6	13.5	14.2	33.9	27.8	57.5	73.8	69.3	60.1
ND Vitpro	42.8	26.6	14.6	15.3	36.2	27.4	59.4	66.5	60.9	54.3
Elgin-ND	41.3	30.3	13.8	--	34.0	28.7	56.8	71.2	--	--
AAC Starbuck	44.5	28.6	15.0	--	35.7	28.1	57.3	70.3	66.4	--
AP Smith	46.3	25.6	14.2	--	30.6	26.3	56.1	71.3	--	--
Ascend-SD	44.5	29.9	14.0	--	33.1	26.8	57.6	82.7	78.6	--
Bolles	48.3	29.4	16.4	17.1	36.2	29.2	55.0	70.5	65.7	55.8
Brawn-SD	42.8	27.5	13.5	--	30.6	28.4	58.4	84.6	79.5	--
CP3188	41.8	28.4	12.4	--	30.1	25.8	54.9	58.3	--	--
Driver	41.8	26.3	13.9	14.7	33.6	27.6	56.9	68.3	67.8	55.4
Glenn	42.0	30.3	14.4	15.1	37.8	28.7	59.9	74.8	68.4	58.9
Lang-MN	46.5	28.6	14.5	--	36.3	26.7	58.7	70.0	--	--
LCS Ascent	40.3	27.1	13.0	--	33.0	26.4	58.5	76.9	71.2	--
LCS Boom	39.0	21.9	14.2	--	36.9	27.9	59.3	59.2	--	--
LCS Buster	48.8	32.2	12.0	--	30.2	31.3	53.8	75.3	--	--
LCS Cannon	38.8	26.4	13.3	14.6	33.7	29.1	56.6	57.5	58.8	50.1
LCS Dual	40.5	26.9	13.6	--	31.2	25.9	56.7	69.1	67.0	--
LCS Hammer AX	41.8	24.6	13.1	--	32.4	26.8	56.3	61.9	--	--
LCS Trigger	49.0	29.5	11.6	13.2	27.3	29.0	56.5	77.7	74.1	58.2
MN Torgy	47.3	25.3	14.5	15.4	37.0	30.6	58.4	74.3	67.5	54.1
MN Rothsay	48.0	25.7	14.4	--	37.7	28.3	57.5	72.1	70.0	--
ND Frohberg	43.0	27.2	13.9	14.9	35.7	31.2	58.3	66.5	61.5	54.6
ND Heron	40.0	24.8	14.3	15.2	34.8	28.0	58.3	63.4	61.5	49.6
ND Thresher	48.0	26.7	14.4	--	33.4	27.3	56.6	63.7	64.0	--
SY Longmire	46.3	28.2	14.7	--	35.5	27.3	56.1	70.6	--	--
CDC Landmark	46.0	29.9	14.5	--	36.9	28.7	57.6	71.6	--	--
Faller	47.5	31.1	13.3	14.3	33.4	33.2	57.8	79.3	77.5	63.8
Mean	44.5	27.5	14.0	--	33.8	28.2	57.2	71.2	--	--
C.V. (%)	3.7	8.9	2.4	--	3.2	5.4	1.3	11.5	--	--
LSD (0.05)	2.3	3.4	0.5	--	1.5	2.1	1.0	11.5	--	--
LSD (0.10)	1.9	2.9	0.4	--	1.3	1.8	0.9	9.6	--	--

Planting Date = May 19; Harvest Date = August 25; Previous Crop = Soybean

No significant lodging.

Hard Red Spring Wheat - Organic — Carrington

			Protein					Yield	
Variety	Days to Heading	Plant Height	2023	3-yr. Avg.	Gluten	KWT	Test Weight	2023*	3-yr. Avg.
	DAP	inch	%	%	%	g/1000	lb/bu	bu/a	bu/a
Glenn	46.0	21.7	11.2	12.9	28.0	26.4	61.7	9.8	14.1
Faller	49.5	23.0	10.1	11.9	22.7	30.6	58.3	17.3	19.3
Bolles	50.3	23.2	11.1	13.3	24.0	28.3	59.0	12.1	15.5
Shelly	50.0	20.1	10.7	12.4	24.6	26.3	58.1	13.2	15.7
Elgin-ND	46.3	22.4	10.3	12.6	22.9	27.4	58.9	13.0	18.3
ND Vitpro	47.0	21.1	11.3	13.4	27.1	27.5	61.2	10.0	14.2
ND Frohberg	48.3	23.6	11.5	12.9	28.5	30.8	60.3	16.2	18.8
MN Torgy	48.0	21.9	11.0	12.4	25.4	26.6	58.3	12.8	17.9
Driver	49.3	22.6	9.6	11.8	19.9	28.2	59.3	13.7	19.1
MN Rothsay	48.3	19.3	11.2	--	26.5	27.3	59.4	15.8	--
ND Heron	45.5	18.9	11.5	--	27.6	27.0	59.9	6.1	--
Dapps	47.5	24.8	11.9	14.1	28.2	29.4	59.2	13.5	14.4
Mida	49.8	27.8	11.0	12.6	24.7	35.0	58.4	13.7	16.5
Ceres	49.0	26.0	10.3	12.3	22.3	28.2	57.9	13.5	15.6
FBC Dylan	47.5	29.3	10.2	12.0	22.6	30.4	58.1	17.7	18.0
Red Fife	50.5	32.9	10.1	10.7	22.6	32.4	56.7	17.1	20.7
Mean	48.3	23.7	10.8	--	24.9	28.8	58.9	13.5	--
C.V. (%)	1.9	12.9	4.3	--	6.6	4.5	0.6	15.3	--
LSD (0.05)	1.3	4.3	0.7	--	2.3	1.8	0.5	1.9	--
LSD (0.10)	1.1	3.6	0.5	--	2.0	1.5	0.5	1.6	--

Planting Date = May 12; Harvest Date = August 16; Previous Crop = Cover Crop

No significant lodging.

*Best Linear Unbiased Estimate

Hard Red Winter Wheat											Carrington
						--- Grain Protein ---				--- Grain Yield ---	
Variety	Days to Heading	Plant Height	Lodging	Harvest Moisture	Gluten	2023	2-yr. Avg.	1000 KWT	Test Weight	2023	2-yr. Avg.
	DAP	inch	0-9	%	%	---------- % ----------		gram	lb/bu	------- bu/ac -------	
Jerry	6/9	27.8	3.0	13.4	30.5	12.9	13.3	36.3	61.7	56.3	70.0
ND Noreen	6/11	27.4	2.8	15.6	32.2	13.9	13.9	38.4	63.7	57.2	71.6
Northern	6/11	22.9	2.5	13.7	29.9	12.9	13.2	33.6	62.2	65.0	75.4
SD Andes	6/10	24.6	1.8	13.8	29.0	12.1	12.5	37.1	63.6	65.6	77.5
SD Midland	6/9	25.0	2.5	12.6	28.8	12.1	12.6	39.3	62.7	66.0	78.7
Winner	6/6	22.8	3.0	13.1	30.7	12.9	13.1	36.5	62.2	57.8	72.9
AAC-Wildfire	6/12	26.8	2.3	12.9	29.5	12.4	12.9	35.9	62.5	59.0	67.8
AAC Vortex	6/10	24.4	2.0	13.6	32.5	13.8	13.8	34.9	62.2	56.3	70.1
Goldrush	6/11	26.6	1.8	13.7	30.4	12.7	--	34.3	62.4	61.4	--
AC Emerson	6/11	25.2	1.5	14.1	32.1	13.8	14.1	28.8	62.2	49.6	64.3
MS Sundown	6/5	22.5	4.3	13.5	32.1	13.4	--	32.4	61.7	48.1	--
MS Maverick	6/8	22.3	3.3	13.4	30.9	13.0	13.0	38.0	62.7	51.1	71.1
AP Bigfoot	6/4	19.9	3.0	13.4	31.2	13.2	13.0	29.8	61.8	50.9	70.6
SY Monument	6/7	20.7	3.0	12.9	29.7	12.5	12.6	34.0	60.9	58.4	71.2
SY Wolverine	6/5	19.3	3.5	13.4	32.4	13.4	13.3	34.3	61.8	39.6	56.9
WB4422	6/12	23.6	2.3	13.8	29.1	12.1	--	33.8	62.6	61.6	--
Keldin	6/11	24.0	3.3	13.1	28.8	12.4	12.7	40.4	62.6	66.5	80.4
WB4309	6/6	19.7	4.0	12.6	32.7	13.2	13.1	30.9	61.1	47.1	67.4
AAC Coldfront	6/10	23.2	2.3	14.1	29.9	12.8	--	34.8	62.6	54.5	--
Mean	6/9	23.9	2.7	13.5	30.2	12.8	--	34.8	62.3	57.5	--
C.V. (%)	0.9	5.8	30.2	4.2	3.9	3.3	--	3.0	0.4	9.8	--
LSD (0.05)	1.9	2.0	--	0.8	1.7	6.4	--	1.5	0.4	7.9	--
LSD (0.10)	1.6	1.6	--	0.7	1.4	5.4	--	1.2	0.3	6.6	--

Planting Date = September 14; Harvest Date = August 4; Previous Crop = Durum

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

Durum - Dryland											Carrington
				------ Protein ------					---------- Yield ----------		
Variety	Days to Heading	Plant Height	Lodging	2023	3-yr. Avg.	KWT	Test Weight	Seeds / Pound	2023*	2-yr. Avg.	3-yr. Avg.
	DAP	inch	0-9	--------- % ---------		g/1000	lb/bu		bu/a		
Maier	50.5	27.7	1.8	13.8	15.4	38.8	60.5	11,698	44.2	47.6	46.4
Mountrail	50.5	29.1	2.5	13.1	14.5	39.7	60.2	11,449	48.0	52.1	53.4
Alkabo	50.3	29.4	1.0	13.6	14.6	39.8	60.6	11,418	49.0	48.3	47.9
Divide	51.3	31.2	1.5	13.3	14.6	41.2	60.3	11,010	53.9	51.0	49.7
Tioga	50.8	32.7	1.8	12.7	14.5	45.3	61.2	10,036	55.2	52.5	51.7
Carpio	51.0	29.0	2.8	13.7	14.8	41.0	60.2	11,087	48.2	52.9	50.9
Joppa	50.8	28.1	2.0	12.5	13.8	41.5	61.0	10,945	45.5	48.7	50.2
ND Grano	51.0	30.0	1.5	13.2	14.5	40.7	60.9	11,145	51.7	52.1	50.6
ND Riveland	51.0	31.4	1.0	13.2	14.7	42.0	60.7	10,813	54.6	51.1	50.9
ND Stanley	51.3	28.1	1.0	13.4	14.9	41.8	61.2	10,849	50.2	48.0	50.0
Strongfield	52.3	29.7	1.3	14.1	15.0	38.9	60.1	11,678	50.2	52.7	53.5
AAC Stronghold	51.8	26.8	1.0	14.4	15.3	39.6	60.2	11,485	50.3	49.1	50.3
CDC Defy	51.3	31.9	1.3	12.9	14.5	41.3	61.6	11,002	56.9	54.9	54.9
CDC Vantta	59.0	29.1	1.0	14.3	--	37.0	58.6	12,274	42.5	41.6	--
FP23DW001	55.0	34.9	1.0	14.8	--	39.2	59.0	11,587	51.6	--	--
Mean	51.8	30.8	1.5	13.7	--	41.7	60.6	10,910	52.8	--	--
C.V. (%)	2.0	6.8	40.9	5.9	--	4.0	1.0	4.1	8.7	--	--
LSD (0.05)	1.4	2.9	0.9	1.1	--	2.3	0.9	624	4.1	--	--
LSD (0.10)	1.2	2.5	0.7	0.9	--	2.0	0.7	522	3.4	--	--

Planting Date = May 5; Harvest Date = August 18; Previous Crop = Flax

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

* Best Linear Unbiased Estimate

Durum intensive management study.

Durum - Irrigated						Carrington
Variety	Days to Heading	Plant Height	Protein	KWT	Test Weight	Yield
	DAP	inch	%	g/1000	lb/bu	bu/a
Mountrail	57.0	38.4	12.8	33.6	56.6	39.7
Divide	60.8	35.9	12.9	36.4	57.9	44.0
Carpio	59.5	35.9	13.2	35.3	57.9	43.4
Joppa	56.5	39.4	12.5	36.1	57.9	47.5
ND Riveland	59.8	39.6	12.8	35.3	57.8	54.1
ND Grano	59.3	39.8	13.0	33.7	58.3	46.9
ND Stanley	59.3	38.5	12.7	36.5	59.0	51.1
Mean	59.2	38.4	13.0	35.9	57.9	46.3
C.V. (%)	1.4	11.1	3.0	4.5	1.1	11.8
LSD (0.05)	1.2	6.0	0.6	2.3	0.9	7.7
LSD (0.10)	1.0	5.0	0.5	1.9	0.7	6.4

Planting Date = May 26; Harvest Date = September 19; Previous Crop = Soybeans
Multiple weather events caused severe lodging across the trial.

Barley breeder nursery.

Barley - Dryland										**Carrington**
					-------- Protein --------			---------- Yield ----------		
	Days to	Plant				3-yr.	Test		2-yr.	3-yr.
Variety	Heading	Height	Plump	Thin	2023	Avg.	Weight	2023	Avg.	Avg.
	DAP	inch	%	%	---------- % ----------		lb/bu	---------- bu/a ----------		
Two Row										
Conlon	44.8	23.8	96.6	0.4	16.0	14.2	57.0	59.3	68.9	60.7
Pinnacle	43.5	25.2	95.7	0.6	14.9	12.9	57.1	59.6	69.0	62.8
ND Genesis	43.3	28.9	94.9	0.4	14.0	12.5	55.8	74.4	80.7	70.7
AAC Synergy	46.3	26.0	93.8	0.7	16.3	14.0	55.8	69.4	81.7	71.9
CDC Fraser	45.0	25.2	93.2	0.7	16.1	14.1	54.2	76.7	79.0	69.9
Explorer	43.8	23.4	94.7	0.7	16.2	14.2	55.2	61.0	73.2	65.7
AAC Connect	45.5	24.8	92.5	1.0	16.4	14.3	55.6	68.4	77.6	69.1
Brewski	45.3	24.2	96.3	0.4	14.5	13.3	55.2	83.2	85.5	73.9
CDC Prairie	44.8	25.9	91.7	0.7	15.6	--	56.0	70.2	--	--
ABI Cardinal	45.3	24.6	94.8	0.5	15.7	13.8	54.8	75.8	80.6	73.0
2IK18-4680	46.5	25.9	88.6	1.3	16.4	--	53.9	55.7	--	--
CDC Renegade	45.8	27.0	90.1	1.4	16.3	--	54.6	75.2	--	--
CDC Durango	45.8	26.2	92.3	0.7	15.7	--	56.5	94.4	--	--
Six Row										
Tradition	41.5	25.6	93.4	0.3	15.4	14.1	55.0	80.6	81.3	71.9
ND Treasure	41.5	23.2	91.1	0.6	15.1	13.3	52.7	91.5	89.8	78.0
Mean	44.4	25.5	94.0	0.5	15.1	--	55.0	74.7	--	--
C.V. (%)	3.9	8.4	1.9		2.9	--	1.2	11.9	--	--
LSD (0.05)	2.5	3.0	2.5		0.6	--	0.9	12.5	--	--
LSD (0.10)	2.1	2.5	2.1		0.5	--	0.8	10.5	--	--

Planting Date = May 12; Harvest Date = August 30; Previous Crop = Soybean

No significant lodging.

Barley - Irrigated **Carrington**

Variety	Days to Heading	Plant Height	Plump	Thin	Protein 2023	Protein 3-yr. Avg.	Test Weight	Yield 2023	Yield 3-yr. Avg.
	DAP	inch	%	%	%	%	lb/bu	bu/a	bu/a
Two Row									
Conlon	45.3	25.8	93.0	0.9	15.7	13.3	55.5	62.4	76.2
Pinnacle	46.3	23.3	94.6	0.8	13.6	11.7	54.9	67.7	87.2
ND Genesis	47.5	26.4	92.8	1.0	13.5	11.8	54.1	83.1	100.3
AAC Synergy	51.5	26.5	93.0	0.9	15.1	12.8	56.2	66.9	91.7
CDC Fraser	52.5	24.1	96.0	0.5	14.2	12.6	56.2	83.4	93.2
Explorer	49.0	22.2	93.5	1.1	15.0	12.9	54.8	70.2	87.8
AAC Connect	50.8	22.8	91.2	1.3	14.9	13.0	55.9	77.7	91.1
Brewski	51.5	24.6	94.8	0.9	13.8	12.2	55.1	87.1	99.2
CDC Prairie	49.8	25.7	90.1	1.4	14.5	--	55.6	71.8	--
ABI Cardinal	51.3	26.2	94.7	0.6	14.4	12.7	54.9	84.9	98.3
2IK18-4680	42.3	29.0	91.7	1.1	15.3	--	55.2	76.7	--
Six Row									
Tradition	44.3	24.5	88.8	1.6	14.8	13.4	53.6	75.4	87.7
ND Treasure	44.5	25.6	89.5	1.3	14.4	12.6	53.6	96.9	102.7
Mean	47.9	25.5	92.5	1.1	14.3	--	54.8	80.2	--
C.V. (%)	2.4	11.1	1.8	26.2	3.3	--	1.4	5.5	--
LSD (0.05)	1.7	4.0	2.3	0.4	0.7	--	1.1	6.3	--
LSD (0.10)	1.4	3.3	1.9	0.3	0.6	--	0.9	5.2	--

Planting Date = May 5; Harvest Date = August 15; Previous Crop = Field Pea

No significant lodging.

Barley											Barnes County - Dazey
						----- Protein ------			---------- Yield ----------		
	Days to	Plant					3-yr.	Test		2-yr.	3-yr.
Variety	Heading	Height	Lodging	Plump	Thin	2023	Avg.	Weight	2023	Avg.	Avg.
	DAP	inch	0-9	%	%	-------- % --------		lb/bu	---------- bu/a ----------		
Two Row											
Conlon	46.8	30.7	3.8	86.6	1.2	15.2	14.5	52.4	70.7	71.3	67.6
Pinnacle	50.0	33.7	0.8	92.4	0.9	13.0	12.8	52.5	93.9	85.1	82.5
ND Genesis	48.8	36.6	0.0	95.6	0.3	13.0	12.5	55.1	103.2	93.9	89.4
AAC Synergy	51.5	33.3	0.8	93.1	0.8	13.9	13.7	53.2	104.0	92.2	85.4
CDC Fraser	52.8	32.1	0.5	92.4	1.0	14.0	13.9	52.4	108.5	87.0	83.4
Explorer	47.8	26.0	1.5	92.8	1.1	14.4	13.6	52.9	96.4	88.7	82.4
AAC Connect	53.3	31.5	0.5	91.9	1.3	14.1	13.9	53.9	109.7	94.9	89.6
Brewski	50.8	31.5	0.8	96.3	0.5	12.7	12.6	53.0	99.2	90.6	86.2
ABI Cardinal	51.0	31.7	1.3	91.1	1.0	14.2	14.0	51.6	103.6	84.8	83.2
2IK18-4680	51.5	31.5	1.3	87.2	1.7	15.0	--	52.0	84.8	--	--
Six Row											
Tradition	48.8	35.2	0.5	88.0	0.9	14.1	13.8	52.3	112.7	101.6	93.8
ND Treasure	48.0	31.1	1.5	84.6	1.2	13.7	13.4	48.0	100.9	95.8	84.5
Mean	49.8	31.8	1.0	89.9	1.1	13.8	--	52.1	100.1	--	--
C.V. (%)	2.3	4.7	55.4	4.5	54.8	3.2	--	1.9	8.5	--	--
LSD (0.05)	1.6	2.2	0.8	5.8	0.9	0.6	--	1.4	12.1	--	--
LSD (0.10)	1.3	1.8	0.7	4.9	0.7	0.5	--	1.2	10.1	--	--

Planting Date = May 23; Harvest Date = August 24; Previous Crop = Soybean

Barley										**Tri-County - Wishek**
					-------- Protein --------			---------- Yield ----------		
	Days to	Plant				3-yr.	Test		2-yr.	3-yr.
Variety	Heading	Height	Lodging*	Plump	2023	Avg.	Weight	2023*	Avg.	Avg.
	DAP	inch	0-9	%	---------- % ----------		lb/bu	---------- bu/a ----------		
Two Row										
Conlon	48.0	25.3	4.9	92	15.1	14.9	45.6	68.6	57.0	48.9
ND Genesis	52.0	29.5	2.2	94	13.3	13.6	44.2	91.1	82.6	63.9
AAC Synergy	54.0	27.2	3.2	95	14.7	15.0	45.2	95.5	80.7	64.9
CDC Fraser	55.8	26.7	2.3	94	14.1	15.1	43.4	96.2	74.8	61.2
Explorer	50.3	22.4	3.8	81	14.3	15.1	41.3	65.5	55.7	46.5
Brewski	52.3	26.5	3.2	94	13.9	14.0	44.6	78.9	80.0	63.9
ABI Cardinal	52.0	26.4	3.5	88	14.8	15.0	43.6	94.0	75.4	60.8
2IK18-4680	50.0	25.6	4.2	70	14.7	--	39.0	58.7	--	--
Six Row										
Tradition	47.0	26.0	3.3	88	15.1	14.9	43.2	93.6	85.1	67.3
ND Treasure	47.0	25.0	3.3	83	14.8	15.1	42.0	88.7	78.5	63.2
Mean	50.2	26.0	3.2	88.0	14.4	--	42.9	82.7	--	--
C.V. (%)	3.2	6.8	16.1	4.9	3.4	--	1.5	3.1	--	--
LSD (0.05)	2.3	4.6	1.1	0.5	0.7	--	0.9	6.6	--	--
LSD (0.10)	1.9	3.8	0.4	0.4	0.6	--	0.7	2.5	--	--

Planting Date = May 19; Harvest Date = August 25; Previous Crop = Soybean

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

*Best Linear Unbiased Estimate

Irrigated barley variety trial.

Barley - Organic — Carrington

Variety	Days to Heading	Plant Height	Plump	Thin	Protein	Test Weight	---------- Yield ---------- 2023*	2-yr. Avg.	3-yr. Avg.
	DAP	inch	%	%	%	lb/bu	---------- bu/a ----------		
Two Row									
Conlon	46.8	24.8	93.8	0.5	11.4	46.3	38.8	39.1	36.0
ND Genesis	47.3	26.4	90.4	0.7	9.8	44.2	57.3	54.8	50.2
AAC Synergy	49.8	28.0	92.5	0.6	10.4	44.4	49.5	45.0	41.7
CDC Fraser	49.3	26.2	90.4	0.9	11.2	44.2	51.0	41.1	39.0
Explorer	48.3	22.8	90.7	0.8	11.0	43.6	46.4	43.6	42.0
Brewski	47.8	25.4	91.5	0.8	11.1	44.0	61.7	57.0	51.6
ABI Cardinal	44.5	26.2	88.3	0.9	11.1	44.1	50.5	--	--
2IK18-4680	45.8	28.7	90.5	0.7	11.5	45.1	55.4	--	--
Six Row									
Tradition	44.0	27.6	96.3	0.3	11.5	45.2	60.3	56.0	48.4
ND Treasure	45.0	27.6	90.8	0.5	11.5	45.2	54.5	--	--
Mean	47.2	26.6	92.0		11.0	44.6	54.0	--	--
C.V. (%)	6.1	12.3	4.1		6.1	3.1	13.7	--	--
LSD (0.05)	4.1	4.6	5.5		1.0	2.0	7.0	--	--
LSD (0.10)	3.5	3.9	4.5		0.8	1.7	5.8	--	--

Planting Date = May 17; Harvest Date = August 11; Previous Crop = Soybean

No significant lodging.

*Best Linear Unbiased Estimate

Oat - Dryland								Carrington
							---------- Yield ----------	
Variety	Days to Heading	Plant Height	Lodging*[1]	Protein	KWT	Test Weight	2023*	3-yr. Avg.[2]
	DAP	inch	0-9	%	g/1000	lb/bu	---------- bu/a	----------
AAC Douglas	43.7	40.8	1.2	12.7	35.6	35.2	168.7	--
Beach	43.7	31.2	2.0	15.0	34.4	34.7	91.9	87.9
CS Camden	44.0	35.2	1.4	13.5	34.5	36.6	149.9	115.7
Deon	46.3	37.3	2.0	14.0	32.5	35.8	134.1	110.4
Endure	45.7	37.8	1.8	13.3	36.9	35.2	152.3	--
Hifi	45.3	32.0	1.1	14.0	27.9	31.1	87.7	86.6
Jury	45.7	34.1	3.5	13.5	30.0	31.9	103.2	105.0
Killdeer	44.0	31.0	1.0	14.3	27.7	30.4	105.5	89.0
Leggett	44.3	30.7	1.3	14.3	30.9	33.5	112.6	95.3
MN Pearl	45.0	35.3	1.9	13.1	33.1	34.6	128.4	--
ND Carson	45.3	32.4	2.0	13.0	32.5	33.2	138.8	108.1
ND Crema	49.7	39.6	1.8	20.0	27.4	45.0	79.8	62.4
ND Heart	45.3	32.2	1.0	14.5	27.0	30.6	86.9	89.6
ND Spilde	45.3	35.3	2.1	14.0	30.0	30.2	106.5	102.7
Newburg	46.0	32.8	1.5	13.2	31.4	31.3	120.3	108.2
Otana	46.3	37.1	2.4	14.5	29.2	35.2	91.7	103.1
Paul	47.0	40.7	2.7	17.6	26.6	40.5	90.0	65.1
Rockford	46.3	38.8	1.1	14.2	29.3	35.6	115.9	96.6
SD Buffalo	44.3	37.7	1.2	13.7	32.8	34.3	121.8	--
AAC Nevel	46.7	32.5	1.0	13.2	33.1	31.6	118.9	--
OT7104	48.0	31.9	1.3	13.6	40.9	32.7	118.2	--
OT6037	52.3	35.3	2.0	13.7	36.3	26.4	105.8	--
Mean	46.4	36.0	1.7	14.1	32.9	34.0	105.3	--
C.V. (%)	1.9	8.9	20.5	3.6	7.6	5.1	6.2	--
LSD (0.05)	1.4	5.2	0.8	0.8	4.1	2.8	15.0	--
LSD (0.10)	1.2	4.4	0.3	0.7	3.4	2.3	5.4	--

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

[1] Lodging Score: 0 = no lodging; 9 = plants lying flat. Lodging was highly variable across trial.

[2] Three-year average is for 2020, 2022 and 2023, as 2021 trial was lost due to drought.

*Best Linear Unbiased Estimate

Oat - Organic **Carrington**

Variety	Days to Heading	Plant Height	Protein	KWT	Test Weight	Yield 2023	Yield 3-yr. Avg.
	DAP	inch	%	g/1000	lb/bu	bu/a	bu/a
AAC Douglas	45.5	34.6	8.5	36.5	36.2	91.3	--
Beach	44.3	36.4	10.2	39.2	39.2	88.6	80.6
CDC Minstrel	48.8	34.8	7.7	35.4	34.6	100.1	--
CS Camden	48.5	32.7	8.3	34.0	35.0	103.6	94.0
Deon	49.8	37.4	9.1	31.7	36.6	102.5	97.9
HiFi	49.3	39.8	8.7	30.8	36.4	88.3	81.3
Jury	50.0	43.5	8.4	31.9	36.6	72.5	85.0
Killdeer	44.0	31.1	8.5	29.8	34.6	93.0	91.3
Leggett	47.3	32.9	9.4	34.2	38.3	93.0	84.6
ND Carson	49.3	35.6	8.4	34.8	37.5	106.4	--
ND Crema (hull-less)	53.3	44.1	11.0	27.0	41.6	28.9	--
ND Heart	46.8	39.0	9.4	34.2	36.8	95.8	85.0
ND Spilde	47.5	37.6	7.9	35.2	35.2	101.2	
Newburg	50.0	38.6	7.5	30.2	34.7	100.8	92.7
Otana	50.5	41.9	7.8	28.6	36.6	80.0	80.8
Paul (hull-less)	52.5	41.7	9.4	26.7	40.3	46.2	46.1
Rockford	48.8	39.6	7.8	27.0	36.9	74.9	77.5
Jerry	42.3	32.1	9.2	29.3	36.3	78.1	67.5
Morton	48.0	38.8	8.7	29.6	35.5	71.8	--
Streaker	45.5	35.0	9.3	28.0	45.7	51.5	53.6
Mean	48.5	37.9	8.9	32.8	37.2	83.5	--
C.V. (%)	1.5	5.3	8.1	7.9	1.7	15.4	--
LSD (0.05)	1.0	2.8	1.0	3.7	0.9	18.2	--
LSD (0.10)	0.8	2.4	0.8	3.1	0.7	15.2	--

Planting Date = May 17; Harvest Date = August 15; Previous Crop = Cover Crop
No significant lodging.

Oil Sunflower

Carrington (Page 1 of 2)

Brand	Hybrid	Hybrid Status	Oil Type	Conoil	Trait	DM Resist.[1]	Days to Bloom	Days to Maturity	Plant Height	Harvest Moisture	Oil Content	Test Weight	Yield 2023*	Yield 2-yr. Avg.
							DAP	DAP	inch	%	%	lb/bu	lb/a	lb/a
Check	8N270CLDM	Check	NS	---	CL	---	64.0	119.0	58.3	7.0	37.9	28.5	1423	1667
Pioneer Hi-Bred	P63HE920	CA	HO	No	EX	Yes	66.3	130.0	71.1	7.0	36.0	30.2	3675	2769
Pioneer Hi-Bred	P64HE101	CA	HO	No	EX	Yes	66.0	131.3	72.4	6.7	35.1	29.7	3073	2573
CROPLAN	CP4157E	CA	HO	No	EX	Yes	64.5	126.3	71.1	6.7	38.8	29.7	3235	--
CROPLAN	CP450E	CA	HO	No	EX	Yes	64.5	129.0	72.0	6.2	38.1	31.1	2970	--
CROPLAN	CP455E	CA	HO	No	EX	Yes	64.5	129.8	73.4	6.2	37.8	29.8	3182	2467
CROPLAN	CP5249CL	CA	HO	---	CL	---	64.5	122.8	65.2	5.9	42.8	29.2	2534	--
CROPLAN	CP5045CL	CA	NS	No	CL	Yes	65.5	124.8	69.7	6.5	41.2	31.1	2760	2490
CROPLAN	CP7919CL	CA	HO	No	CL	Yes	66.0	128.3	64.4	6.9	42.4	29.9	3157	2883
Red River Commodities	8D310CL	CA	TRAD	Yes	CL	No	66.0	127.5	77.7	6.6	34.8	28.7	3627	--
Proseed	50068 CL	CA	HO	No	CL	Yes	64.0	133.3	77.2	6.3	39.4	31.1	3107	--
Proseed	50502 CL	CA	HO	No	CL	Yes	66.5	124.8	66.7	6.2	42.9	29.7	2061	--
Proseed	E-94 CP	CA	HO	No	CP	Yes	65.0	126.5	77.9	6.2	40.1	31.2	2619	--
Proseed	E-91 E	CA	HO	No	EX	Yes	66.0	123.0	76.8	6.0	39.6	30.5	2166	2023
Proseed	E-93 E	CA	HO	No	EX	Yes	65.5	121.5	81.0	6.1	38.0	29.6	2662	1835
Proseed	EXP 109L-E	Exp	HO	No	EX	Yes	64.5	122.8	76.5	6.1	39.6	30.4	2546	--
Proseed	EXP 2346-E	Exp	HO	No	EX	Yes	69.0	128.3	80.1	7.0	38.0	30.3	2571	--
Thunder Seed Inc.	TEX2301SF	Exp	HO	---	EX	---	65.0	124.5	72.2	6.1	38.7	30.6	2203	--
Thunder Seed Inc.	TEX2302SF	Exp	HO	---	EX	---	65.5	121.5	80.5	6.3	37.7	30.0	2478	--
Thunder Seed Inc.	TEX2303SF	Exp	HO	---	EX	---	67.0	124.0	78.3	6.6	40.1	29.8	2647	--
Thunder Seed Inc.	TEX2304SF	Exp	HO	---	EX	---	67.0	127.0	76.0	6.3	39.7	29.9	2362	--
RAGT Semences	AC2101	Exp	HO	---	CP	Yes	65.0	122.8	77.8	6.6	38.5	30.0	2429	2091
RAGT Semences	AC2201	Exp	HO	---	CL	Yes	65.5	129.8	78.6	6.7	38.0	30.8	2698	2306
RAGT Semences	AC2202	Exp	HO	---	CL	Yes	66.0	135.3	80.7	6.1	40.8	31.1	2055	--
Mean							65.5	125.4	73.0	6.5	39.2	30.2	2588	--
C.V. (%)							2.0	2.6	6.7	8.8	3.9	3.0	8	--
LSD (0.05)							1.8	4.6	6.8	0.8	2.2	1.3	230	--
LSD (0.10)							1.5	3.9	5.7	0.7	1.8	1.1	193	--

Planting Date = May 30; Harvest Date = November 15; Previous Crop = Soybean

Oil Sunflower **Carrington (Page 2 of 2)**

Brand	Hybrid	Hybrid Status	Oil Type	Conoil	Trait	DM Resist.[1]	Days to Bloom	Days to Maturity	Plant Height	Harvest Moisture	Oil Content	Test Weight	Yield 2023*	Yield 2-yr. Avg.
							DAP	DAP	inch	%	%	lb/bu	lb/a	lb/a
Sunrich Products	4415 HO/DM/CLP	CA	HO	No	CP	Yes	65.5	121.3	72.4	6.5	38.8	29.5	2219	2106
Sunrich Products	4425CL	CA	MO	Yes	CL	No	64.0	128.5	77.7	7.0	36.2	29.1	3080	2572
Dyna-Gro	H42HO18CL	CA	HO	No	CL	No	64.0	120.5	67.3	6.4	38.1	29.6	1271	1352
Dyna-Gro	H49HO19CL	CA	HO	No	CL	No	66.0	123.8	70.1	6.9	40.3	29.4	3270	2854
Dyna-Gro	H45NS16CL	CA	NS	No	CL	No	64.7	119.3	68.8	6.3	40.2	30.5	1611	1678
Dyna-Gro	H50HO20CP	CA	HO	No	CP	No	66.3	124.0	69.3	6.6	42.8	31.2	2619	2442
Dyna-Gro	H45HO10EX	CA	HO	No	EX	No	64.5	119.5	66.5	6.0	40.3	28.3	2074	2028
Dyna-Gro	H47HO11EX	CA	HO	No	EX	No	65.0	135.8	76.2	6.4	38.2	30.8	2741	2594
Nuseed	Hornet	CA	HO	No	CL	Yes	66.3	125.5	75.2	6.5	41.4	29.8	2447	--
Nuseed	N4H422 CL	CA	HO	No	CL	Yes	64.5	127.3	79.1	6.0	40.4	31.1	3066	2750
Nuseed	N4H470 CLP	CA	HO	No	CP	Yes	64.7	125.0	73.0	6.0	41.2	30.6	2358	1994
Nuseed	N4H521 CL	CA	HO	No	CL	Yes	66.3	128.0	68.5	6.9	41.4	29.9	3413	2972
Nuseed	Badger DMR	CA	NS	Yes	CL	Yes	64.0	122.0	73.0	6.7	36.6	29.8	1940	--
Nuseed	Falcon	CA	NS	No	EX	No	65.0	124.5	69.9	6.4	39.9	31.9	2459	2432
Nuseed	N4H490 E	Exp	HO	No	EX	Yes	66.8	123.5	74.0	6.1	43.0	31.5	3274	--
Nuseed	N5H493 CL	Exp	HO	Yes	CL	Yes	65.5	122.5	71.3	6.8	34.9	29.0	2149	--
Nuseed	N4L215 E	Exp	MO	No	EX	Yes	66.0	120.0	68.5	6.3	41.3	30.3	1871	--
Nuseed	N4H202 E	Exp	HO	No	EX	Yes	66.0	120.5	67.3	6.2	38.7	30.4	1700	--
Advanta Seeds	ADV XH136	Exp	HO	---	Conv	---	67.0	120.5	66.7	6.7	40.6	31.1	2052	--
Advanta Seeds	ADV XH182IT	Exp	HO	---	CL	---	67.0	122.5	74.4	6.3	39.8	31.2	2082	--
Advanta Seeds	ADV XH302IT	Exp	HO	---	CL	---	67.3	124.7	66.4	6.7	38.6	31.2	2670	--
CROPLAN	CP4255E	CA	HO	No	EX	Yes	64.0	136.5	70.9	6.4	37.7	29.2	3301	--
CROPLAN	CP4475E	CA	HO	---	EX	---	64.0	126.0	76.3	6.6	38.9	30.7	2716	--
Mean							65.5	125.4	73.0	6.5	39.2	30.2	2588	--
C.V. (%)							2.0	2.6	6.7	8.8	3.9	3.0	8	--
LSD (0.05)							1.8	4.6	6.8	0.8	2.2	1.3	230	--
LSD (0.10)							1.5	3.9	5.7	0.7	1.8	1.1	193	--

Planting Date = May 30; Harvest Date = November 15; Previous Crop = Soybean

[1] Downey Mildew Resistance.

Trait based on data provided by seed company.

*Best Linear Unbiased Estimate

Non-Oilseed Sunflower — Carrington

Brand	Variety	Hybrid Status	Trait	DM Resist.	Days to Bloom	Days to Maturity	Plant Height	Harvest Moisture	Test Weight	Seeds > 22/64	Seeds > 20/64	Seeds > 18/64	Yield 2023*	Yield 2-yr. Avg.	Yield 3-yr. Avg.
					DAP	DAP	inch	%	lb/bu	%	%	%	bu/a	bu/a	bu/a
Red River Commodities	RH1121	CA	Conv	No	66.5	130.0	71.5	7.9	21.9	60	75	83	2003	--	--
Red River Commodities	RH609CLP	CA	CP	No	65.0	124.0	73.2	8.7	21.2	67	81	87	3149	--	--
Red River Commodities	RH396-EX	CA	EX	No	69.0	140.0	77.2	8.8	19.1	69	82	89	4091	--	--
Red River Commodities	RR2319	CA	Conv	No	66.3	133.3	70.5	8.3	21.3	68	84	91	2227	--	--
Red River Commodities	RR2414	CA	Conv	No	68.0	136.5	85.8	7.6	21.2	73	85	92	2572	--	--
Sunrich Products	SS91	CA	Conv	No	64.0	135.3	77.9	8.2	22.1	46	66	82	2648	2608	2160
Sunrich Products	EXP92CL	EXP	CL	No	59.0	117.5	67.5	8.0	20.8	49	79	90	2564	--	--
Sunrich Products	EXP93CL	EXP	CL	No	59.0	116.0	71.5	7.8	21.4	40	68	84	1742	--	--
Valia Genetics	Valia 41	CA	Conv	No	67.8	128.0	75.4	7.7	21.2	56	77	88	1708	1810	1678
Valia Genetics	VALIA V51	CA	Conv	No	66.0	130.5	71.9	7.8	20.8	70	82	89	2724	--	--
Nuseed	Panther DMR	CA	Conv	Yes	59.0	120.3	59.8	8.0	20.8	65	83	92	1805	1777	--
Nuseed	NJKM65961	EXP	CL	Yes	64.5	123.3	68.3	8.4	20.7	70	84	91	2974	--	--
Nuseed	NJKM65960	EXP	CL	Yes	65.0	123.5	74.8	7.1	19.3	67	82	89	1884	--	--
USDA	Hybrid 924	Check			68.0	128.5	78.0	8.7	21.4	41	66	83	2521	--	--
Mean					64.7	127.6	72.9	8.0	20.9	60.7	78.6	88.0	2505	--	--
C.V. (%)					2.5	2.4	7.0	9.9	4.8	15.7	8.8	5.8	17.3	--	--
LSD (0.05)					2.3	4.4	7.3	1.1	1.4	13.6	9.9	7.3	402	--	--
LSD (0.10)					1.9	3.7	6.1	1.0	1.2	11.4	8.2	6.1	334	--	--

Planting Date = May 30; Harvest Date = November 22; Previous Crop = Soybean

*Best Linear Unbiased Estimate

Flax									**Carrington**
							---------- Yield ----------		
Variety	Color	Flowering	Maturity	Plant Height	Oil Content	Test Weight	2023*	2-yr. Avg.	3-yr. Avg.[1]
		DAP	DAP	inch	%	lb/bu	---------- bu/a ----------		
Gold ND	Yellow	48.0	98.0	25.1	47.6	53.4	27.9	26.0	23.7
Carter	Yellow	45.3	94.5	23.2	46.1	53.8	30.1	24.4	22.9
Omega	Yellow	44.8	92.3	22.8	45.8	53.1	28.6	23.2	19.7
AAC Bright	Yellow	47.3	93.0	23.6	47.6	50.2	31.0	27.1	26.4
ND Hammond	Brown	46.0	94.0	23.6	45.6	50.9	28.1	24.3	22.6
York	Brown	46.0	95.5	23.4	44.7	52.2	31.9	26.3	24.1
Bison	Brown	46.0	93.0	23.8	44.1	53.2	22.8	21.2	20.3
Webster	Brown	46.8	93.8	24.8	46.6	52.9	27.7	25.7	24.7
CDC Neela	Brown	46.8	91.5	22.7	45.6	54.5	30.2	27.7	26.1
AAC Marvelous	Brown	46.5	94.5	24.5	47.7	52.9	31.1	28.7	--
CDC Rowland	Brown	47.8	94.3	22.2	45.3	52.6	26.1	25.8	26.0
CDC Buryu	Brown	42.3	92.3	23.9	45.3	52.3	24.4	22.1	20.7
CDC Glas	Brown	46.5	91.0	23.7	47.0	52.4	30.9	25.6	24.2
CDC Kernen	Brown	47.5	92.5	24.2	46.8	52.8	29.5	26.0	--
MS-22B8.1	Brown	44.7	90.7	24.1	47.4	50.2	22.5	--	--
MS-022Y15.1	Yellow	48.7	94.3	24.5	45.8	52.4	26.8	--	--
MS-22Y16.2	Yellow	46.0	89.7	24.5	45.3	51.5	32.8	--	--
Lion	Brown	46.8	91.8	23.6	-	53.4	27.9	25.3	26.8
Mean		47.2	93.5	23.6	46.2	52.7	28.3	--	--
C.V. (%)		2.3	3.0	8.6	2.6	2.7	10.5	--	--
LSD (0.05)		1.5	3.9	2.8	1.7	2.0	2.7	--	--
LSD (0.10)		1.3	3.3	2.4	1.4	1.7	2.2	--	--

Planting Date = May 11; Harvest Date = August 30; Previous Crop = Durum

No significant lodging.

* Best Linear Unbiased Estimate

[1] Three-year average is for 2020, 2022 and 2023. Data is not available for 2021.

Winter Rye						**Carrington**
Variety	Heading	Lodging	Harvest Moisture	Protein	Test Weight	Yield
	date	0-9	%	%	lb/bu	bu/ac
Spooner	6/3	5.8	14.2	13.8	55.4	45.8
Rymin	6/4	4.8	12.8	13.6	55.0	48.9
ND Dylan	6/5	7.5	12.0	12.5	55.9	54.2
Aroostook	5/31	6.5	12.4	15.1	55.4	43.0
Hazlet	6/6	4.8	12.7	12.4	56.2	58.8
ND Gardner	5/29	7.8	11.7	13.8	55.6	51.0
Danko	6/4	3.0	12.7	12.6	56.2	55.3
KWS Receptor	6/5	2.5	12.7	10.5	56.0	80.4
KWS Serafino	6/5	2.5	11.0	11.0	55.2	71.5
KWS Tayo	6/5	3.0	12.1	11.2	54.7	75.6
Mean	6/4	4.3	12.4	12.2	55.5	59.6
C.V. (%)	0.5	16.1	6.4	3.2	0.8	6.9
LSD (0.05)	1.2	1.0	1.1	0.6	0.6	5.9
LSD (0.10)	1.0	0.8	0.9	0.5	0.5	4.9

Planting Date = September 14; Harvest Date = August 4; Previous Crop = Durum

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

Winter rye variety trial.

Winter Rye - Organic — Carrington

Variety	Heading	Plant Height	Harvest Moisture	Protein	1000 KWT	Test Weight	Yield 2023	Yield 2-yr. Avg.	Yield 3-yr. Avg.
	date	inch	%	%	g	lb/bu	bu/ac	bu/ac	bu/ac
Spooner	6/2	44.5	13.2	14.0	30.9	55.3	37.1	45.9	38.2
Rymin	6/2	40.6	12.9	13.3	28.9	54.7	36.6	49.5	37.8
ND Dylan	6/3	44.9	13.0	12.2	29.6	55.6	39.2	53.0	44.2
Aroostook	5/30	46.1	13.2	15.1	26.9	54.8	34.9	40.7	32.1
Hazlet	6/3	38.8	13.0	12.7	35.5	56.3	41.3	54.2	45.2
ND Gardner	5/28	45.1	13.2	13.5	27.0	55.3	39.0	48.2	37.0
KWS Serafino	6/4	33.5	13.1	10.8	29.2	54.6	50.1	67.9	54.7
Mean	6/3	41.1	13.1	12.9	30.0	55.3	40.2	--	--
C.V. (%)	0.3	5.4	2.0	4.9	3.9	0.6	15.4	--	--
LSD (0.05)	0.7	3.2	0.4	0.9	1.7	0.5	9.1	--	--
LSD (0.10)	0.5	2.7	0.3	0.8	1.4	0.4	7.5	--	--

Planting Date = September 16; Harvest Date = August 4; Previous Crop = Fallow

No significant lodging.

Organic winter rye variety trial.

Soybean - Dryland, Conventional Varieties **Carrington**

Brand	Variety	Mat Group	Maturity Date	Pod Ht	Plant Ht	Lodging	Oil	Protein	KWT	Seeds Per Pound	Test Weight	Yield 2023	Yield 2-yr. Avg.	Yield 3-yr. Avg.
				inch	inch	0-9	%	%	g/1000		lb/bu	bu/a	bu/a	bu/a
NDSU	ND Stutsman	0.7	9/13	5.1	36.1	5.5	18.8	32.1	151	3,012	55.1	76.3	64.8	49.3
NDSU	ND Rolette	00.9	9/8	3.0	32.9	2.5	18.2	34.0	151	3,005	54.4	67.5	62.4	46.4
NDSU	ND Benson	0.4	9/15	4.7	33.3	4.3	18.2	35.3	163	2,780	54.9	66.3	59.5	45.1
NDSU	ND Dickey	0.7	9/14	5.7	33.1	4.0	18.6	32.9	176	2,586	54.3	67.2	64.7	50.6
Richland IFC	MK009	00.9	9/10	5.7	34.3	4.5	17.3	33.2	82	5,536	55.2	58.8	51.8	--
Richland IFC	MK0249	0.2	9/10	3.9	31.7	5.0	18.1	31.8	105	4,324	54.9	66.4	60.9	45.3
Richland IFC	MK0603	0.6	9/18	6.1	42.4	6.5	17.2	33.7	94	4,816	54.6	61.6	54.0	42.8
Richland IFC	MK808CN	0.8	9/16	5.5	40.0	5.3	19.4	32.0	148	3,069	55.3	71.5	64.4	49.4
Proseed	PXC05992	0.5	9/12	4.3	38.4	4.5	17.9	35.2	222	2,049	54.9	86.4	--	--
Proseed	PXC0899	0.8	9/15	5.1	38.8	5.0	17.9	32.3	184	2,469	55.5	91.1	--	--
	RR Check 1	0.4	9/14	4.5	32.5	2.5	19.3	32.3	169	2,682	53.9	67.4	--	--
	RR Check 2	0.7	9/14	4.5	35.6	2.3	19.1	32.1	173	2,626	54.2	87.2	--	--
Mean			9/13	4.9	35.7	4.3	18.3	33.1	151	3,246	54.8	72.3	--	--
C.V. (%)			0.0	28.7	7.4	40.0	0.8	1.1	3.1	3.9	0.7	10.8	--	--
LSD (0.05)			2.1	2.0	3.8	2.5	0.2	0.5	6.8	183	0.5	11.3	--	--
LSD (0.10)			1.7	1.7	3.2	2.1	0.2	0.4	5.7	153	0.5	9.4	--	--

Planting Date = May 22; Harvest Date = October 9; Previous Crop = Winter Rye

Maturity group based on data provided by seed company.

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

Soybean - Dryland, Roundup Ready Varieties **Carrington (Page 1 of 3)**

Brand	Variety	Trait	Mat Group	Maturity Date	Pod Ht	Plant Ht	Lodging	Oil	Protein	KWT	Seeds Per Pound	Test Weight	Yield 2023	Yield 2-yr. Avg.	Yield 3-yr. Avg.
					inch	inch	0-9	%	%	g/1000		lb/bu	bu/a	bu/a	bu/a
NDSU	ND21008GT20	GT	00.8	8/29	3.1	37.3	3.5	18.9	33.4	144	3,143	55.3	49.0	51.0	40.0
NDSU	ND2108GT73	GT	0.8	9/19	3.3	34.0	3.5	19.5	33.4	148	3,069	56.5	63.8	62.8	49.9
NDSU	ND17009GT	GT	00.9	8/31	2.8	37.5	3.0	19.5	35.2	163	2,791	56.6	53.0	50.8	40.6
REA Hybrids	R0422XF	RR2XF	0.4	9/12	2.6	34.4	2.0	20.2	33.2	167	2,714	55.6	66.2	60.9	--
REA Hybrids	R0743XF	RR2XF	0.7	9/17	3.0	37.3	2.3	19.9	33.1	166	2,741	55.9	72.0	--	--
Integra Seeds	E0324	E3	0.3	9/13	3.0	31.1	2.3	19.7	32.9	156	2,906	55.8	57.4	--	--
Integra Seeds	E0544	E3	0.5	9/13	4.1	36.6	3.5	19.7	33.1	163	2,779	55.9	72.0	--	--
Integra Seeds	XF0212	RR2XF	0.2	9/5	3.9	41.4	2.0	20.0	32.8	172	2,633	55.3	69.1	--	--
Integra Seeds	XF0493	RR2XF	0.4	9/12	2.8	37.9	2.0	20.4	32.9	169	2,681	55.5	66.2	--	--
Integra Seeds	XF0674	RR2XF	0.6	9/13	3.7	36.6	2.0	19.5	33.2	163	2,782	55.7	70.8	--	--
NK Seeds	NK02-H6E3	E3	0.2	9/8	4.1	36.0	2.0	18.5	34.6	164	2,769	55.7	69.8	--	--
NK Seeds	NK04-A9E3	RR2XF	0.4	9/11	4.3	34.0	2.3	18.8	34.3	173	2,623	55.5	74.4	--	--
NK Seeds	NK03-J1XF	RR2XF	0.3	9/8	4.1	38.0	2.3	20.1	33.1	178	2,555	55.6	71.1	--	--
NK Seeds	NK05-W3XF	RR2XF	0.5	9/12	3.3	39.4	3.5	19.1	33.6	162	2,796	57.0	78.2	69.6	56.3
NK Seeds	NK06-P2XF	RR2XF	0.6	9/11	3.5	40.8	2.5	20.3	33.2	173	2,621	56.2	72.2	64.4	--
Dairyland Seed	DSR-0220E	E3	0.2	9/12	3.5	30.0	1.8	19.9	33.5	166	2,743	55.5	70.8	--	--
Dairyland Seed	DSR-0585E	E3	0.5	9/16	2.6	34.2	2.5	19.7	33.4	151	3,013	55.7	63.2	--	--
Dairyland Seed	DSR-0757E	E3	0.7	9/17	3.9	33.5	1.0	19.9	32.2	171	2,653	56.7	62.8	56.7	--
LG Seeds	LGS0125XF	RR2XF	0.1	9/4	2.2	35.7	5.3	19.6	33.2	154	2,954	55.7	73.6	--	--
Mean				9/11	3.5	36.6	2.5	19.6	33.2	162	2,817	55.9	68.4	--	--
C.V. (%)				0.0	23.2	9.3	41.4	1.5	1.4	3.5	3.5	0.5	6.5	--	--
LSD (0.05)				2.3	1.1	4.7	1.4	0.4	0.6	7.9	139	0.4	6.2	--	--
LSD (0.10)				1.9	0.9	4.0	1.2	0.3	0.5	6.6	116	0.3	5.2	--	--

Planting Date = May 22; Harvest Date = October 17; Previous Crop = Winter Rye

Soybean - Dryland, Roundup Ready Varieties **Carrington (Page 2 of 3)**

Brand	Variety	Trait	Mat Group	Maturity Date	Pod Ht	Plant Ht	Lodging	Oil	Protein	KWT	Seeds Per Pound	Test Weight	Yield 2023	Yield 2-yr. Avg.	Yield 3-yr. Avg.
					inch	inch	0-9	%	%	g/1000		lb/bu	bu/a	bu/a	bu/a
LG Seeds	LGS0139XF	RR2XF	0.1	9/5	3.7	38.4	3.0	19.6	32.4	169	2,695	55.3	67.4	--	--
LG Seeds	LGS0444XF	RR2XF	0.4	9/11	3.0	38.5	1.8	20.4	32.8	169	2,683	55.2	71.9	--	--
LG Seeds	LGS0701XF	RR2XF	0.7	9/12	4.7	37.2	1.8	19.3	32.9	157	2,898	56.1	71.0	62.6	51.4
Legacy Seeds	LS032-23 E	E3	0.3	9/11	3.1	38.0	3.0	19.5	33.7	159	2,848	55.6	70.8	--	--
Legacy Seeds	LS044-23 XF	RR2XF	0.4	9/11	4.5	40.2	2.0	20.2	33.2	175	2,601	55.4	77.7	--	--
Legacy Seeds	LS052-23 E	E3	0.5	9/11	4.1	35.2	2.8	20.0	32.7	161	2,824	55.7	76.5	--	--
Legacy Seeds	LS064-23 XF	RR2XF	0.6	9/11	3.0	39.3	1.5	19.8	33.2	166	2,734	55.8	77.2	--	--
Legacy Seeds	LS072-21 E	E3	0.7	9/13	3.7	32.9	1.8	18.4	34.9	164	2,772	56.6	76.4	69.0	55.3
Legacy Seeds	LS074-22 XF	RR2XF	0.7	9/13	3.1	37.5	2.0	20.1	32.7	185	2,451	55.4	76.5	67.6	--
Proseed	XF 40-12N	RR2XF	0.1	9/3	4.3	38.6	3.3	19.8	31.7	163	2,792	55.1	66.9	--	--
Proseed	XF 30-42N	RR2XF	0.4	9/10	2.6	38.5	2.3	20.4	32.9	172	2,643	55.5	71.6	65.9	--
Proseed	XF 30-52N	RR2XF	0.5	9/10	3.9	40.6	1.8	20.1	32.2	137	3,315	55.7	71.0	--	--
Thunder Seed Inc.	TX8304N	RR2XF	0.4	9/11	3.9	38.9	2.5	20.1	32.0	133	3,422	55.8	67.8	66.1	--
Thunder Seed Inc.	TEX2305	XF	0.5	9/13	3.9	38.6	2.3	20.2	33.2	163	2,788	55.6	64.3	--	--
Thunder Seed Inc.	TX8305N	RR2XF	0.5	9/15	3.3	35.1	2.3	19.0	34.7	180	2,525	56.3	69.8	63.7	--
Thunder Seed Inc.	TX8307N	RR2XF	0.7	9/18	3.7	38.0	3.3	18.7	33.7	161	2,831	57.6	73.5	--	--
Thunder Seed Inc.	TE7407N	E3	0.7	9/13	3.0	35.4	2.3	18.9	34.3	169	2,683	57.1	68.3	--	--
Dyna-Gro Seed	S03EN94	E3	0.3	9/12	3.3	37.1	2.8	19.5	33.5	152	2,977	55.8	63.6	--	--
Dyna-Gro Seed	S05XF73	RR2XF	0.5	9/11	3.7	44.6	2.3	19.7	33.1	142	3,199	55.9	71.2	66.7	--
Mean				9/11	3.5	36.6	2.5	19.6	33.2	162	2,817	55.9	68.4	--	--
C.V. (%)				0.0	23.2	9.3	41.4	1.5	1.4	3.5	3.5	0.5	6.5	--	--
LSD (0.05)				2.3	1.1	4.7	1.4	0.4	0.6	7.9	139	0.4	6.2	--	--
LSD (0.10)				1.9	0.9	4.0	1.2	0.3	0.5	6.6	116	0.3	5.2	--	--

Planting Date = May 22; Harvest Date = October 17; Previous Crop = Winter Rye

Soybean - Dryland, Roundup Ready Varieties **Carrington (Page 3 of 3)**

Brand	Variety	Trait	Mat Group	Maturity Date	Pod Ht	Plant Ht	Lodging	Oil	Protein	KWT	Seeds Per Pound	Test Weight	Yield 2023	Yield 2-yr. Avg.	Yield 3-yr. Avg.
					inch	inch	0-9	%	%	g/1000		lb/bu	bu/a	bu/a	bu/a
Dyna-Gro Seed	S05EN82	E3	0.5	9/11	4.1	32.7	2.5	19.2	34.9	155	2,929	55.2	69.4	66.7	54.3
Golden Harvest	GH0502XF	RR2XF	0.5	9/13	2.8	39.9	3.5	19.0	33.7	156	2,911	57.0	76.0	--	--
Golden Harvest	GH0384XF	RR2XF	0.3	9/7	2.8	37.5	1.8	20.3	32.6	176	2,573	55.4	74.4	--	--
Champion Seed	0294XL	RR2XF	0.2	9/8	2.8	37.7	1.5	20.7	33.1	181	2,506	56.1	54.6	--	--
Champion Seed	0444XL	RR2XF	0.4	9/12	4.3	37.0	2.0	20.6	31.4	168	2,699	56.0	63.4	--	--
Champion Seed	0563XL	RR2XF	0.5	9/15	2.2	36.6	2.5	19.2	32.7	144	3,155	56.1	66.8	64.5	--
Champion Seed	0624XL	RR2XF	0.6	9/15	3.5	36.6	2.8	19.2	33.7	162	2,807	55.9	66.3	--	--
Champion Seed	0743XL	RR2XF	0.7	9/14	3.0	35.5	1.3	19.4	34.4	180	2,517	56.2	68.1	62.2	--
Paloma	PL2E013	E3	0.1	9/10	3.0	34.9	3.0	19.6	32.9	160	2,843	55.2	69.4	--	--
Paloma	PL2E043	E3	0.4	9/8	3.9	34.4	1.8	19.2	34.3	157	2,886	55.1	66.7	--	--
Paloma	PL2061	E3	0.6	9/12	3.7	34.9	4.3	19.7	33.1	137	3,322	56.1	62.1	--	--
Paloma	PL2E073	E3	0.7	9/19	3.5	34.8	2.5	19.7	32.5	194	2,334	56.2	69.1	--	--
Paloma	PL2E093	E3	0.9	9/18	4.9	38.0	2.8	19.2	32.9	181	2,504	56.2	72.9	--	--
Paloma	PL2E101	E3	1.0	9/20	3.7	35.4	1.5	19.0	32.8	158	2,880	56.7	72.4	--	--
Stine Seed	03EG62	E3	0.3	9/12	3.0	33.1	1.8	19.7	32.9	154	2,948	55.6	69.5	--	--
Stine Seed	05EG26	E3	0.5	9/14	3.1	36.5	2.0	19.7	32.8	159	2,858	55.9	72.9	--	--
Stine Seed	06EG62	E3	0.6	9/15	2.8	34.8	4.0	18.5	32.8	134	3,391	56.4	69.4	--	--
Mean				9/11	3.5	36.6	2.5	19.6	33.2	162	2,817	55.9	68.4	--	--
C.V. (%)				0.0	23.2	9.3	41.4	1.5	1.4	3.5	3.5	0.5	6.5	--	--
LSD (0.05)				2.3	1.1	4.7	1.4	0.4	0.6	7.9	139	0.4	6.2	--	--
LSD (0.10)				1.9	0.9	4.0	1.2	0.3	0.5	6.6	116	0.3	5.2	--	--

Planting Date = May 22; Harvest Date = October 17; Previous Crop = Winter Rye

Soybean - Irrigated, Conventional Varieties — Carrington

Brand	Variety	Mat Group	Maturity Date	Pod Ht	Plant Ht	Lodging	Oil	Protein	KWT	Seeds Per Pound	Test Weight	Yield 2023	Yield 2-yr. Avg.	Yield 3-yr. Avg.
				inch	inch	0-9	%	%	g/1000		lb/bu	bu/a	bu/a	bu/a
NDSU	ND Stutsman	0.7	9/10	2.4	37.0	2.3	19.1	34.3	151	3,009	57.0	76.3	72.8	72.7
NDSU	ND Rolette	00.9	9/2	2.8	35.8	2.0	19.1	36.2	153	2,957	56.9	64.7	67.8	65.5
NDSU	ND Benson	0.4	9/10	2.8	35.2	3.8	18.7	37.8	162	2,794	57.0	61.8	61.4	61.1
NDSU	ND Dickey	0.7	9/13	3.0	32.9	2.8	18.9	35.0	180	2,527	56.1	65.2	63.7	66.5
Richland IFC	MK009	00.9	9/5	2.4	30.7	5.0	18.0	35.2	80	5,668	57.5	49.3	50.3	--
Richland IFC	MK0249	0.2	9/5	2.6	31.1	4.0	18.8	34.2	102	4,426	56.8	54.1	56.2	--
Richland IFC	MK0603	0.6	9/17	4.1	37.6	5.8	18.2	36.1	103	4,399	56.6	69.3	63.4	--
	RR Check 1	0.4	9/12	3.1	36.0	1.5	19.6	34.8	174	2,604	56.3	72.0	--	--
	RR Check 2	0.7	9/17	2.2	38.6	2.5	19.7	34.5	185	2,452	57.0	92.6	--	--
Mean			9/10	2.8	35.0	3.3	18.9	35.4	143	3,432	56.8	67.3	--	--
C.V. (%)			0.7	38.8	9.4	38.5	1.1	1.3	4.6	4.2	0.3	9.4	--	--
LSD (0.05)			2.6	1.6	4.8	1.8	0.3	0.7	9.6	208	0.3	9.2	--	--
LSD (0.10)			2.1	1.3	4.0	1.5	0.3	0.6	8.0	172	0.2	7.6	--	--

Planting Date = May 19; Harvest Date = October 11; Previous Crop = Field Pea

Soybean - Irrigated, Roundup Ready Varieties **Carrington (Page 1 of 2)**

Brand	Variety	Trait	Mat Group	Maturity Date	Pod Ht	Plant Ht	Lodging	Oil	Protein	KWT	Seeds Per Pound	Test Weight	Yield 2023	Yield 2-yr. Avg.	Yield 3-yr. Avg.
					inch	inch	0-9	%	%	g/1000		lb/bu	bu/a	bu/a	bu/a
NDSU	ND21008GT20	GT	00.8	9/5	2.6	35.6	4.3	18.4	35.4	154	2,954	57.2	61.4	61.2	57.8
NDSU	ND2108GT73	GT	0.8	9/17	3.5	37.2	2.0	19.0	35.4	157	2,888	57.0	82.9	72.9	67.3
NDSU	ND17009GT	GT	00.9	9/6	2.4	36.6	3.3	18.9	37.0	164	2,769	59.3	63.1	59.7	56.7
REA Hybrids	R0422XF	RR2XF	0.4	9/15	2.0	37.0	1.3	19.1	35.5	177	2,561	56.4	72.2	69.6	--
REA Hybrids	R0743XF	RR2XF	0.7	9/18	2.6	40.6	2.5	19.1	35.2	185	2,448	57.1	89.7	--	--
Integra Seeds	XF0493	RR2XF	0.4	9/12	2.4	38.0	2.0	19.2	35.6	176	2,577	56.4	83.1	--	--
Integra Seeds	XF0674	RR2XF	0.6	9/15	1.8	37.6	1.8	18.5	35.7	174	2,608	56.7	86.5	--	--
Dairyland Seed	DSR-0220E	E3	0.2	9/13	2.0	31.7	1.5	19.1	35.4	184	2,466	55.9	81.6	--	--
Dairyland Seed	DSR-0585E	E3	0.5	9/17	2.6	36.4	2.0	20.0	34.1	162	2,803	56.3	76.6	--	--
Dairyland Seed	DSR-0757E	E3	0.7	9/19	1.8	34.8	1.8	19.7	33.5	191	2,381	57.2	70.9	68.0	--
LG Seeds	LGS0125XF	RR2XF	0.1	9/8	1.6	38.8	5.8	19.1	34.6	159	2,847	57.4	87.5	--	--
LG Seeds	LGS0139XF	RR2XF	0.1	9/7	1.8	41.9	4.0	18.8	34.6	174	2,602	56.5	78.9	--	--
LG Seeds	LGS0444XF	RR2XF	0.4	9/12	2.2	38.6	1.8	19.0	35.9	177	2,567	56.4	85.0	--	--
LG Seeds	LGS0701XF	RR2XF	0.7	9/13	2.6	40.6	2.8	18.4	34.9	172	2,639	57.1	89.7	79.6	74.7
Legacy Seeds	LS032-23 E	E3	0.3	9/13	2.4	34.1	1.8	19.0	35.2	170	2,674	56.3	83.0	--	--
Legacy Seeds	LS044-23 XF	RR2XF	0.4	9/12	1.8	39.6	1.8	18.8	36.3	187	2,426	56.2	92.2	--	--
Legacy Seeds	LS052-23 E	E3	0.5	9/19	3.3	38.2	3.3	18.9	35.4	190	2,391	57.0	85.9	--	--
Legacy Seeds	LS064-23 XF	RR2XF	0.6	9/13	2.0	37.8	2.5	18.5	35.6	174	2,606	56.7	87.2	--	--
Legacy Seeds	LS072-21 E	E3	0.7	9/19	3.1	37.6	1.8	17.9	36.5	184	2,468	57.0	85.2	76.1	70.1
Mean				9/14	2.4	37.2	2.5	18.9	35.2	173	2,636	56.7	81.1	--	--
C.V. (%)				0.0	38.2	4.5	34.2	1.2	1.3	3.1	3.2	0.4	6.3	--	--
LSD (0.05)				2.5	1.3	2.3	1.2	0.3	0.7	7.4	117	0.3	7.1	--	--
LSD (0.10)				2.1	1.1	2.0	1.0	0.3	0.6	6.2	98	0.3	6.0	--	--

Planting Date = May 22; Harvest Date = October 11; Previous Crop = Field Pea

Soybean - Irrigated, Roundup Ready Varieties																Carrington (Page 2 of 2)
														---------- Yield ----------		
Brand	Variety	Trait	Mat Group	Maturity Date	Pod Ht	Plant Ht	Lodging	Oil	Protein	KWT	Seeds Per Pound	Test Weight	2023	2-yr. Avg.	3-yr. Avg.	
					inch	inch	0-9	%	%	g/1000		lb/bu	---------- bu/a ----------			
Legacy Seeds	LS074-22 XF	RR2XF	0.7	9/17	2.6	38.6	1.8	19.4	34.4	203	2,238	55.7	87.9	79.1	--	
Dyna-Gro Seed	S03EN94	E3	0.3	9/13	2.4	34.1	1.5	19.0	34.8	175	2,596	56.4	78.6	--	--	
Dyna-Gro Seed	S05XF73	RR2XF	0.5	9/11	2.2	43.5	3.0	19.5	34.8	153	2,971	56.7	91.7	77.8	--	
Dyna-Gro Seed	S05EN82	E3	0.5	9/14	2.8	32.3	2.0	18.4	36.3	171	2,655	55.8	82.3	--	--	
Paloma	PL2E013	E3	0.1	9/10	3.0	34.4	2.3	18.8	35.3	167	2,710	55.6	78.2	--	--	
Paloma	PL2E043	E3	0.4	9/12	3.0	38.2	3.5	18.6	36.8	171	2,650	55.9	74.0	--	--	
Paloma	PL2061	E3	0.6	9/17	2.2	31.9	3.0	19.3	34.7	151	3,016	57.3	77.5	--	--	
Paloma	PL2E073	E3	0.7	9/20	2.6	39.4	2.5	18.8	34.8	212	2,139	56.9	85.3	--	--	
Paloma	PL2E093	E3	0.9	9/20	3.1	40.9	2.3	18.9	34.5	192	2,362	57.0	81.6	--	--	
Paloma	PL2E101	E3	1	9/21	3.0	37.0	2.0	18.7	35.0	175	2,594	57.3	82.2	--	--	
Stine Seed	03EG62	E3	0.3	9/12	1.4	34.3	1.8	19.0	34.7	170	2,678	56.2	79.2	--	--	
Stine Seed	05EG26	E3	0.5	9/19	2.8	37.6	3.5	19.0	35.2	178	2,548	56.7	81.2	--	--	
Stine Seed	06EG62	E3	0.6	9/16	2.0	34.1	2.0	18.5	33.8	154	2,943	57.1	89.2	--	--	
Mean				9/14	2.4	37.2	2.5	18.9	35.2	173	2,636	56.7	81.1	--	--	
C.V. (%)				0.0	38.2	4.5	34.2	1.2	1.3	3.1	3.2	0.4	6.3	--	--	
LSD (0.05)				2.5	1.3	2.3	1.2	0.3	0.7	7.4	117	0.3	7.1	--	--	
LSD (0.10)				2.1	1.1	2.0	1.0	0.3	0.6	6.2	97.9	0.3	6.0	--	--	

Planting Date = May 22; Harvest Date = October 11; Previous Crop = Field Pea

Soybean - Conventional Varieties **Barnes County - Dazey**

Brand	Variety	Mat Group	Maturity Date	Pod Ht	Plant Ht	Oil	Protein	KWT	Seeds Per Pound	Test Weight	Yield 2023	Yield 2-yr. Avg.	Yield 3-yr. Avg.
				inch	inch	%	%	g/1000		lb/bu	bu/a	bu/a	bu/a
NDSU	ND Stutsman	0.7	9/11	5.1	36.8	19.1	33.3	137	3,313	55.8	58.1	61.4	54.0
NDSU	ND Rolette	00.9	9/3	4.6	31.1	18.4	34.7	124	3,669	55.1	54.7	58.3	50.3
NDSU	ND Benson	0.4	9/12	4.1	32.2	18.4	35.9	145	3,132	55.8	53.6	57.4	50.0
NDSU	ND Dickey	0.7	9/13	4.1	32.0	18.4	33.8	164	2,776	55.3	59.2	62.2	55.1
Richland IFC	MK009	00.9	9/7	4.2	30.3	17.3	34.1	72	6,324	56.0	46.8	49.2	43.3
Richland IFC	MK0249	0.2	9/6	4.1	31.6	17.6	34.4	93	4,903	55.9	51.2	55.2	48.9
Richland IFC	MK0603	0.6	9/16	4.9	37.8	16.8	36.0	93	4,884	55.9	49.6	51.4	46.6
Richland IFC	MK808CN	0.8	9/10	5.2	36.2	19.4	33.3	140	3,252	56.0	56.1	59.9	51.2
Richland IFC	MK1023	1	9/14	5.1	31.7	17.9	34.4	92	4,939	57.9	49.0	48.0	--
Richland IFC	MK9101	1.1	9/17	9.0	39.4	--	27.6	194	2,343	56.4	49.5	53.8	47.5
Richland IFC	MK9102	1.2	9/17	9.8	47.5	--	27.4	208	2,183	57.1	53.5	--	--
Richland IFC	MK9103	1.2	9/16	8.3	43.3	--	27.5	195	2,323	56.7	54.2	--	--
Richland IFC	Decker	1	9/12	5.7	31.6	--	27.2	143	3,173	54.8	43.0	--	--
Richland IFC	Sable	1.2	9/12	4.9	29.3	--	28.0	143	3,184	54.2	41.3	--	--
Richland IFC	MK41	1.1	9/10	5.5	36.4	16.4	37.7	171	2,672	55.5	62.5	60.9	52.8
Richland IFC	MK146	1.1	9/19	3.9	33.1	17.9	36.2	166	2,782	55.4	67.0	--	--
Legacy Seeds	LS101-23C	1	9/16	8.1	40.4	17.3	36.5	179	2,533	56.1	54.1	--	--
Legacy Seeds	LSX102-23C	1	9/18	6.6	36.0	18.5	35.5	186	2,446	56.2	62.0	--	--
Proseed	PXC05992	0.5	9/13	4.7	34.3	17.6	36.6	204	2,219	55.6	61.7	--	--
Proseed	PXC0899	0.8	9/15	4.9	37.1	17.7	34.3	180	2,517	56.4	72.3	--	--
	RR Check 1	0.4	9/14	3.7	34.4	19.1	34.2	157	2,902	55.0	50.9	62.6	--
	RR Check 2	0.7	9/15	4.9	33.3	18.9	34.1	171	2,662	55.7	72.2	63.4	--
Mean			9/12	5.4	35.0	18.1	33.6	153	3,202	55.9	55.1	--	--
C.V. (%)			0.7	21.8	6.2	2.0	1.6	4.7	4.5	0.8	10.2	--	--
LSD (0.05)			2.6	1.7	3.1	0.5	0.8	10.1	202	0.7	7.9	--	--
LSD (0.10)			2.2	1.4	2.6	0.4	0.6	8.5	169	0.6	6.6	--	--

Plant Date = May 23; Harvest Date = October 12; Previous Crop = Spring Wheat

No significant lodging.

Soybean - Dryland, Roundup Ready Varieties **Barnes County - Dazey (Page 1 of 2)**

Brand	Variety	Trait	Mat Group	Maturity Date	Pod Ht	Plant Ht	Oil	Protein	KWT	Seeds Per Pound	Test Weight	Yield 2023	Yield 2-yr. Avg.	Yield 3-yr. Avg.
					inch	inch	%	%	g/1000		lb/bu	bu/a	bu/a	bu/a
NDSU	ND21008GT20	GT	00.8	9/5	3.7	28.5	18.2	33.7	133	3,414	54.5	40.8	42.2	40.4
NDSU	ND2108GT73	GT	0.8	9/12	3.5	26.6	19.1	32.6	135	3,359	55.8	54.1	53.4	48.0
NDSU	ND17009GT	GT	00.9	9/6	4.1	31.3	19.4	35.0	168	2,710	56.0	45.0	46.0	43.4
REA Hybrids	R0422XF	RR2XF	0.4	9/14	4.9	28.1	19.4	33.3	162	2,795	54.6	45.1	--	--
REA Hybrids	R0743XF	RR2XF	0.7	9/16	3.5	35.4	19.5	33.2	165	2,752	55.6	66.8	--	--
REA Hybrids	R0944XF	RR2XF	0.9	9/16	5.3	39.6	19.4	32.7	168	2,700	55.1	66.1	--	--
NK Seeds	NK03-V5E3	E3	0.3	9/9	3.9	27.4	18.6	34.2	151	3,009	55.1	55.8	56.5	--
NK Seeds	NK05-W3XF	RR2XF	0.5	9/11	3.3	33.9	18.5	33.6	149	3,044	55.6	67.2	62.4	55.4
NK Seeds	NK06-P2XF	RR2XF	0.6	9/11	3.5	32.1	19.6	33.7	167	2,712	55.5	61.3	56.9	--
NK Seeds	NK07-G5E3	E3	0.7	9/11	3.9	29.9	18.7	32.9	149	3,035	55.4	69.3	--	--
Dairyland Seed	DSR-0220E	E3	0.2	9/10	3.1	26.8	19.0	33.9	157	2,888	54.8	55.0	--	--
Dairyland Seed	DSR-0585E	E3	0.5	9/14	3.0	32.1	19.0	33.2	136	3,334	54.2	55.0	--	--
Dairyland Seed	DSR-0757E	E3	0.7	9/15	4.5	32.3	19.2	32.7	168	2,705	55.8	51.8	53.3	--
Dairyland Seed	DSR-0920E	E3	1	9/18	5.5	31.5	19.0	33.3	166	2,728	55.0	61.0	58.6	55.5
Dairyland Seed	DSR-1121E	E3	1.1	9/18	4.1	29.9	20.4	31.7	155	2,929	55.2	59.0	58.4	
Dairyland Seed	DSR-1290E	E3	1.2	9/15	3.5	32.1	20.0	31.1	153	2,959	55.3	69.1	66.6	61.1
Legacy Seeds	LS064-23 XF	RR2XF	0.6	9/10	4.3	31.1	18.7	34.1	154	2,965	55.2	59.5	--	--
Legacy Seeds	LS072-21 E	E3	0.7	9/14	4.3	26.2	18.5	34.2	161	2,817	55.6	67.8	64.4	56.2
Legacy Seeds	LS074-22 XF	RR2XF	0.7	9/15	3.5	33.9	19.4	32.5	181	2,506	54.9	62.0	61.8	--
Legacy Seeds	LS084-22 XF	RR2XF	0.8	9/15	3.5	36.0	19.5	32.5	161	2,811	55.7	65.6	63.3	--
Mean				9/12	4.2	30.6	19.1	33.2	155	2,955	55.3	60.7	--	--
C.V. (%)				0.2	25.2	9.4	1.8	1.8	3.6	4.0	1.0	9.2	--	--
LSD (0.05)				2.0	2.9	4.0	0.5	0.8	7.8	167	0.8	7.8	--	--
LSD (0.10)				1.7	2.5	3.4	0.4	0.7	6.5	140	0.6	6.6	--	--

Planting Date = May 23; Harvest Date = October 12; Previous Crop = Spring Wheat

Soybean - Dryland, Roundup Ready Varieties **Barnes County - Dazey (Page 2 of 2)**

Brand	Variety	Trait	Mat Group	Maturity Date	Pod Ht	Plant Ht	Oil	Protein	KWT	Seeds Per Pound	Test Weight	Yield 2023	Yield 2-yr. Avg.	Yield 3-yr. Avg.
					inch	inch	%	%	g/1000		lb/bu	bu/a	bu/a	bu/a
Legacy Seeds	LS092-22 E	E3	0.9	9/13	4.5	28.0	19.6	32.8	139	3,264	54.8	63.2	65.4	--
Legacy Seeds	LS102-22 E	E3	1	9/19	5.3	29.5	18.7	32.8	155	2,922	55.8	68.2	64.4	--
Legacy Seeds	LS094-20 XF	RR2XF	0.9	9/14	3.7	29.1	19.6	33.1	150	3,027	55.4	61.8	58.8	53.4
Legacy Seeds	LS124-23 XF	RR2XF	1.2	9/18	3.5	31.5	18.8	34.0	175	2,596	55.6	67.9	--	--
Proseed	XF 30-42N	RR2XF	0.4	9/11	3.9	28.5	19.1	34.4	163	2,792	54.7	64.3	--	--
Proseed	XF 30-52N	RR2XF	0.5	9/8	3.9	38.0	19.1	33.1	121	3,801	55.0	62.2	62.1	--
Proseed	XF 30-72N	RR2XF	0.7	9/10	3.3	28.7	18.8	32.9	143	3,179	55.4	55.0	59.3	--
Thunder Seed Inc.	TX8305N	RR2XF	0.5	9/14	5.1	31.5	18.6	34.5	179	2,529	55.2	62.1	--	--
Thunder Seed Inc.	TX8307N	RR2XF	0.7	9/14	4.7	34.4	18.7	33.1	158	2,881	56.4	66.1	62.4	--
Thunder Seed Inc.	TE7407N	E3	0.7	9/13	3.7	29.3	18.4	34.0	162	2,798	56.0	61.9	--	--
Thunder Seed Inc.	TE7309N	E3	0.9	9/15	4.7	29.1	19.2	32.7	167	2,717	55.4	67.3	64.2	--
Thunder Seed Inc.	TX8309N	RR2XF	0.9	9/16	5.7	35.2	18.8	33.1	141	3,218	55.6	64.5	61.7	--
Dyna-Gro Seed	S05XF73	RR2XF	0.5	9/8	3.3	34.8	19.5	32.9	132	3,451	54.9	63.0	--	--
Dyna-Gro Seed	S09EN53	E3	0.9	9/17	4.5	31.1	18.7	32.6	161	2,815	55.9	72.9	65.6	--
Paloma	PL2E013	E3	0.1	9/8	4.3	28.3	19.4	32.5	142	3,191	54.2	56.2	--	--
Paloma	PL2E043	E3	0.4	9/8	4.9	28.9	19.3	33.9	157	2,892	54.6	57.4	--	--
Paloma	PL2061	E3	0.6	9/9	3.9	27.0	19.3	33.4	136	3,330	55.7	63.9	--	--
Paloma	PL2E073	E3	0.7	9/14	4.5	30.3	19.6	32.2	192	2,371	55.0	61.4	--	--
Paloma	PL2E093	E3	0.9	9/15	4.9	32.7	19.1	32.5	179	2,543	55.5	66.5	--	--
Paloma	PL2E101	E3	1	9/18	5.9	26.2	19.2	32.2	161	2,817	55.7	66.9	64.7	--
Stine Seed	05EG26	E3	0.5	9/14	3.7	28.5	19.9	32.0	152	2,991	54.9	61.7	--	--
Stine Seed	06EG62	E3	0.6	9/10	4.1	25.8	18.4	32.4	134	3,378	55.1	62.7	--	--
Mean				9/12	4.2	30.6	19.1	33.2	155	2,955	55.3	60.7	--	--
C.V. (%)				0.2	25.2	9.4	1.8	1.8	3.6	4.0	1.0	9.2	--	--
LSD (0.05)				2.0	2.9	4.0	0.5	0.8	7.8	167	0.8	7.8	--	--
LSD (0.10)				1.7	2.5	3.4	0.4	0.7	6.5	140	0.6	6.6	--	--

Planting Date = May 23; Harvest Date = October 12; Previous Crop = Spring Wheat

No significant lodging.

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

Brand	Variety	Trait	Mat Group	Maturity Date	Pod Ht	Plant Ht	Lodging	Oil	Protein	KWT	Seeds Per Pound	Test Weight	Yield 2023	Yield 2-yr. Avg.	Yield 3-yr. Avg.
					inch	inch	0-9	%	%	g/1000		lb/bu	bu/a	bu/a	bu/a
NDSU	ND21008GT20	GT	00.8	9/10	2.0	30.9	2.5	17.4	35.2	132	3,453	56.2	44.1	--	--
NDSU	ND2108GT73	GT	0.8	9/24	3.0	32.0	2.5	18.8	33.2	138	3,297	56.3	55.2	51.8	46.9
NDSU	ND17009GT	GT	00.9	9/12	2.0	35.2	2.5	18.2	35.7	156	2,913	57.0	45.0	45.6	41.0
REA Hybrids	R0422XF	RR2XF	0.4	9/25	1.6	32.5	1.3	18.7	34.2	177	2,564	55.2	67.5	--	--
REA Hybrids	R0743XF	RR2XF	0.7	9/27	2.8	35.6	1.8	18.8	34.0	175	2,602	55.5	76.8	--	--
REA Hybrids	R0944XF	RR2XF	0.9	9/30	3.3	45.1	2.5	18.4	34.1	192	2,363	55.8	83.3	--	--
NK Seeds	NK05-W3XF	RR2XF	0.5	9/23	3.1	36.2	2.8	17.7	34.8	155	2,952	56.5	68.7	65.8	57.6
NK Seeds	NK06-P2XF	RR2XF	0.6	9/24	2.8	36.8	1.8	18.8	33.2	179	2,536	55.4	72.4	65.4	--
NK Seeds	NK09-B5XF	RR2XF	0.9	9/26	3.0	36.2	2.0	18.0	34.7	191	2,380	56.7	75.8	64.3	--
NK Seeds	NK11-U2XF	RR2XF	1.1	10/1	3.3	37.8	2.0	18.4	34.2	194	2,347	56.5	79.4	--	--
LG Seeds	LGS0444XF	RR2XF	0.4	9/23	2.4	33.5	1.8	18.9	34.1	173	2,621	55.5	68.1	--	--
LG Seeds	LGS0701XF	RR2XF	0.7	9/23	2.4	35.6	1.8	18.3	33.2	162	2,805	55.7	68.6	59.6	53.0
Legacy Seeds	LS084-22 XF	RR2XF	0.8	9/26	3.0	36.0	2.5	18.6	33.2	165	2,750	55.4	66.8	65.4	--
Legacy Seeds	LS092-22 E	E3	0.9	9/27	2.6	31.5	1.8	19.4	33.6	155	2,929	55.2	68.4	63.2	--
Legacy Seeds	LS102-22 E	E3	1.0	10/1	3.3	34.8	2.0	18.1	33.0	170	2,670	55.9	77.6	70.5	--
Legacy Seeds	LS094-20 XF	RR2XF	0.9	9/23	2.8	33.7	2.5	18.2	34.5	155	2,928	55.2	63.1	66.5	--
Legacy Seeds	LS124-23 XF	RR2XF	1.2	9/30	3.1	35.8	1.5	18.8	34.1	175	2,601	56.0	72.7	--	--
Dyna-Gro Seed	S12EN72	E3	1.2	10/1	3.9	36.0	2.8	18.1	35.3	194	2,357	56.5	72.1	67.3	--
Dyna-Gro Seed	S12XF92	RR2XF	1.2	9/29	3.1	31.5	1.5	18.6	33.8	173	2,625	55.6	73.9	65.0	--
Dyna-Gro Seed	S09EN53	E3	0.9	9/29	2.6	32.7	2.0	19.0	32.4	169	2,695	55.8	70.6	66.5	--
Mean				9/25	2.8	34.6	2.0	18.5	34.0	167	2,757	55.9	67.4	--	--
C.V. (%)				0.7	46.0	8.4	30.6	2.6	2.1	3.6	3.9	0.7	10.9	--	--
LSD (0.05)				2.8	1.8	4.1	0.9	0.7	1.1	8.5	153	0.5	10.4	--	--
LSD (0.10)				2.3	1.5	3.4	0.7	0.6	0.9	7.1	127	0.4	8.7	--	--

Planting Date = June 2; Harvest Date = October 20; Previous Crop = Barley/Spring Wheat

Soybean - Irrigated, Conventional Varieties **Dickey County - Oakes**

Brand	Variety	Mat Group	Days to PM	Pod Ht	Plant Ht	Lodging	Seeds/ Pound	Seed Oil	Seed Protein	Test Wt	Seed Yield 2023	Seed Yield 2-yr. Avg.	Seed Yield 3-yr. Avg.
			DAP	inch	inch	0 to 9		%	%	lb/bu	---- bu/a ----		
NDSU	ND Benson	0.4	116	3.3	37.8	1.5	2,199	18.3	37.8	56.4	64.5	--	--
NDSU	ND Dickey	0.7	114	3.8	38.3	0.5	1,954	18.6	35.7	56.1	78.4	73.8	68.0
Legacy Seeds	LS101-23C	1.0	118	4.0	37.5	8.0	1,990	17.8	36.9	55.8	67.0	--	--
Legacy Seeds	LSX102-23C	1.0	119	3.5	36.5	5.5	1,827	18.8	37.8	55.1	82.4	--	--
Mean			116.6	3.7	37.5	3.9	1,992	18.4	37.0	55.9	73.1	--	--
C.V (%)			1.2	26.7	5.1	13.8	3.0	1.2	1.0	1.0	2.9	--	--
LSD 0.05			2.1	1.2	3.1	0.8	96.2	0.4	0.6	0.9	3.4	--	--
LSD 0.10			1.7	0.9	2.5	0.7	78.0	0.3	0.5	0.7	2.8	--	--

Planting Date = May 25; Harvest Date = October 11; Previous Crop = Corn

Soybean - Irrigated, Roundup Ready Varieties | **Dickey County - Oakes (Page 1 of 2)**

Brand	Variety	Mat Group	Days to PM Mat.	Pod Ht	Plant Ht	Lodging	Seeds/ Pound	Seed Oil	Seed Protein	Test Wt	Seed Yield 2023	Seed Yield 2-yr. Avg.	Seed Yield 3-yr. Avg.
			DAP	inch	inch	0 to 9		%	%	lb/bu	-----bu/a-----		
NDSU	ND21008GT20	0.8	99.0	4.2	35.0	7.5	2,407	18.6	35.9	53.8	58.0	--	--
NDSU	ND2108GT73	0.7	117.8	6.2	35.7	1.3	2,257	18.6	36.4	55.7	80.3	76.1	69.7
NDSU	ND17009GT	0.9	99.0	4.0	35.4	5.0	2,093	19.1	37.5	56.0	61.1	57.3	--
REA Hybrids	R0944XF	0.9	118.0	4.2	44.5	3.0	2,028	19.3	35.7	55.4	75.9	--	--
REA Hybrids	R1234XF	1.2	117.8	6.7	38.2	1.0	2,120	18.6	36.0	54.7	83.8	--	--
Dairyland Seed	DSR-0220E	0.2	105.0	4.2	33.7	1.5	2,084	19.2	36.1	56.2	78.6	--	--
Dairyland Seed	DSR-0585E	0.5	112.3	4.0	34.2	1.8	2,157	20.0	33.6	54.9	75.0	--	--
Dairyland Seed	DSR-0757E	0.7	115.3	4.2	35.5	0.8	1,836	19.6	34.5	56.0	73.4	--	--
Dairyland Seed	DSR-0920E	1.0	119.0	5.2	37.7	0.5	2,014	18.5	37.2	55.5	89.5	82.7	82.2
Dairyland Seed	DSR-1121E	1.1	119.0	5.0	32.9	1.3	2,055	20.0	35.0	55.5	89.1	82.8	--
Dairyland Seed	DSR-1290E	1.2	117.0	4.7	39.0	1.3	2,084	20.0	33.7	55.6	92.3	84.7	84.4
LG Seeds	LGS0822E3	0.8	116.8	4.2	35.7	1.0	1,846	18.7	37.0	55.2	83.6	79.5	81.1
LG Seeds	LGS0988XF	0.9	114.8	5.5	39.0	2.8	2,021	18.5	35.6	55.6	88.9	82.4	--
LG Seeds	LGS1043E3	1.0	116.3	4.4	35.0	1.0	2,212	18.6	35.2	55.3	94.3	--	--
LG Seeds	LGS1385XF	1.3	122.3	5.2	43.2	1.8	2,016	18.3	36.6	55.1	91.1	84.1	--
Legacy Seeds	LS084-22 XF	0.8	116.0	4.0	39.7	1.8	2,058	19.5	34.8	55.5	91.6	--	--
Legacy Seeds	LS092-22 E	0.9	115.5	3.7	35.7	1.3	2,218	19.8	35.2	54.5	84.3	79.1	--
Mean			115.7	4.7	37.0	1.7	2,088	19.0	35.8	55.3	84.2765	--	--
C.V (%)			1.2	45.4	2.85t	9.73t	2.3	1.2	1.3	1.4	9.1	--	--
LSD 0.05			1.9	1.1	2.90 - 3.23	1.37 - 1.57	67.6	0.4	0.6	1.3	10.8	--	--
LSD 0.10			1.6	0.9	2.42 - 2.71	1.13 - 1.33	56.5	0.3	0.5	1.1	9.0	--	--

Planting Date = May 25; Harvest Date = October 11; Previous Crop = Corn

t = highly variable data was transformed for statistical analysis and LSDs are reported as a range.

Soybean - Irrigated, Roundup Ready Varieties **Dickey County - Oakes (Page 2 of 2)**

Brand	Variety	Mat Group	Days to PM Mat.	Pod Ht	Plant Ht	Lodging	Seeds/ Pound	Seed Oil	Seed Protein	Test Wt	Seed Yield 2023	Seed Yield 2-yr. Avg.	Seed Yield 3-yr. Avg.
			DAP	inch	inch	0 to 9		%	%	lb/bu	-----bu/a-----		
Legacy Seeds	LS102-22 E	1.0	117.8	4.5	35.5	0.8	2,260	19.0	35.6	55.0	92.2	86.9	--
Legacy Seeds	LS094-20 XF	0.9	113.5	4.4	39.0	0.5	2,126	19.1	35.7	54.7	87.1	81.3	--
Legacy Seeds	LS124-23 XF	1.2	120.0	4.9	37.7	1.3	1,979	18.0	36.7	55.8	85.8	--	--
Dyna-Gro Seed	S12EN72	1.2	122.3	4.2	35.5	2.3	1,820	18.4	37.4	55.3	92.3	84.4	84.2
Dyna-Gro Seed	S12XF92	1.2	119.8	4.4	36.7	1.0	2,101	18.7	36.0	55.1	92.7	86.6	87.7
Dyna-Gro Seed	S09EN53	0.9	117.5	4.0	36.5	0.3	2,158	19.1	35.5	55.0	94.7	86.6	--
Paloma	PL2E093	0.9	119.3	5.2	38.7	2.0	1,843	18.8	35.8	55.4	89.9	--	--
Paloma	PL2E101	1.0	118.5	4.9	36.7	0.8	2,244	18.7	35.7	54.8	88.7	82.0	--
Mean			115.7	4.7	37.0	1.7	2,088	19.0	35.8	55.3	84.2765	--	--
C.V (%)			1.2	45.4	2.85t	9.73t	2.3	1.2	1.3	1.4	9.1	--	--
LSD 0.05			1.9	1.1	2.90 - 3.23	1.37 - 1.57	67.6	0.4	0.6	1.3	10.8	--	--
LSD 0.10			1.6	0.9	2.42 - 2.71	1.13 - 1.33	56.5	0.3	0.5	1.1	9.0	--	--

Planting Date = May 25; Harvest Date = October 11; Previous Crop = Corn

t = highly variable data was transformed for statistical analysis and LSDs are reported as a range.

Soybean - Dryland, Conventional Varieties **Dickey County - Oakes**

								Seed			Seed Yield		
Brand	Variety	Mat. Group	Days to PM Mat.	Pod Ht	Plant Ht	Lodging	Seeds/ Pound	Oil	Protein	Test Wt	2023	2-yr. Avg.	3-yr. Avg.
			DAP	inch	inch	0 to 9		%	%	lb/bu	---- bu/a ----		
NDSU	ND Benson	0.4	116.0	5.8	31.3	2.8	2,511	19.2	35.9	53.5	41.9	--	--
NDSU	ND Dickey	0.7	116.0	6.8	33.5	4.3	2,235	19.1	34.3	52.9	61.7	--	--
Legacy Seeds	LS101-23C	1.0	127.0	8.3	36.0	7.3	2,101	18.0	36.6	53.0	38.8	--	--
Legacy Seeds	LSX102-23C	1.0	127.0	7.5	35.5	6.8	2,113	18.9	37.1	52.9	43.6	--	--
Mean			121.5	7.1	34.1	5.3	2,240	18.8	36.0	53.1	46.5	--	--
C.V (%)			0.0	18.0	5.8	15.7	2.3	1.6	1.9	0.7	14.9	--	--
LSD 0.05			--	1.5	3.2	1.8	84.0	0.5	1.1	0.6	11.1	--	--
LSD 0.10			--	1.2	2.6	1.4	68.1	0.4	0.9	0.5	9.0	--	--

Planting Date = May 21; Harvest Date = November 2; Previous Crop = Corn

Soybean - Dryland, Roundup Ready Varieties **Dickey County - Oakes**

Brand	Variety	Mat Group	Days to PM Mat.	Pod Ht	Plant Ht	Lodging	Seeds/ Pound	Seed Oil	Seed Protein	Test Wt	Seed Yield 2023	Seed Yield 2-yr. Avg.	Seed Yield 3-yr. Avg.
			DAP	inch	inch	0 to 9		%	%	lb/bu	-----bu/a-----		
NDSU	ND21008GT20	0.8	105.3	4.8	29.5	3.5	2,610	18.9	34.9	54.6	41.1	--	--
NDSU	ND2108GT73	0.7	126.8	5.3	32.5	1.2	2,673	18.9	34.8	54.2	59.1	--	--
NDSU	ND17009GT	0.9	110.3	5.8	33.3	1.7	2,329	18.7	36.9	54.9	44.3	--	--
REA Hybrids	R0944XF	0.9	125.5	6.8	46.5	2.1	2,102	19.2	35.2	53.8	75.8	--	--
REA Hybrids	R1234XF	1.2	124.5	7.0	39.3	0.6	2,305	18.6	35.4	53.2	76.1	--	--
Legacy Seeds	LS084-22 XF	0.8	121.0	5.0	39.0	0.5	2,126	19.6	33.7	54.2	75.8	--	--
Legacy Seeds	LS092-22 E	0.9	123.0	5.5	33.0	0.9	2,499	19.8	34.2	53.2	62.9	--	--
Legacy Seeds	LS102-22 E	1.0	127.0	6.8	34.8	0.1	2,443	18.8	34.4	53.9	73.0	--	--
Legacy Seeds	LS094-20 XF	0.9	120.0	5.8	36.3	1.9	2,227	19.1	35.2	54.6	76.1	--	--
Legacy Seeds	LS124-23 XF	1.2	126.8	6.3	38.3	0.1	2,110	18.8	35.7	54.2	78.6	--	--
Paloma	PL2E093	0.9	127.0	6.8	35.8	1.7	2,150	18.7	34.9	54.7	71.0	--	--
Paloma	PL2E101	1.0	128.0	6.0	33.0	0.1	2,497	18.6	34.7	54.0	74.8	--	--
Mean			122.3	6.0	35.8	1.2	2,367	18.9	35.0	54.2	66.6	--	--
C.V (%)			2.6	51.74	4.8	20.1	4.1	2.2	1.7	1.6	12.1	--	--
LSD 0.05			4.5	0.85 -	2.4	1.7	140	0.6	0.8	1.3	11.6	--	--
LSD 0.10			3.8	0.64 -	2.0	1.4	116	0.5	0.7	1.1	9.6	--	--

Planting Date = May 21; Harvest Date = October 22 and November 2; Previous Crop = Corn

t = highly variable data was transformed for statistical analysis and LSDs are reported as a range.

Soybean - Dryland, Conventional	LaMoure County

Brand	Variety	Mat Group	Maturity Date	Lodging	Oil	Protein	Test Weight	Yield
				1-5	%	%	lb/bu	bu/a
NDSU	ND Benson	0.4	9/17	1.0	19.6	33.8	55.2	47.5
NDSU	ND Dickey	0.7	9/20	1.0	19.4	32.3	55.5	59.0
NDSU	ND Rolette	00.9	9/11	1.0	20.0	32.4	55.6	43.1
Richland IFC	MK0603	0.6	9/18	2.0	18.4	32.9	55.7	52.5
Richland IFC	MK808CN	0.8	9/21	1.0	20.5	31.8	57.0	55.9
Richland IFC	MK9101	1.1	9/23	1.0	--	--	56.6	49.8
Richland IFC	MK9102	1.2	9/23	1.0	--	--	56.8	46.5
Richland IFC	MK9103	1.2	9/21	1.0	--	--	57.3	44.9
Richland IFC	Decker	1	9/21	1.0	--	--	56.4	43.3
Richland IFC	Sable	1.2	9/20	1.0	--	--	56.1	42.0
Richland IFC	MK41	1.1	9/17	1.0	18.2	35.3	55.9	54.3
Richland IFC	MK146	1.1	9/24	1.0	18.9	34.5	55.3	59.1
Mean			9/20	1	19.3	33.3	56.0	50.3
C.V. (%)			0.9	26	1.3	1.5	0.5	9.4
LSD (0.05)			1.8	0	0.4	0.9	0.5	8.0
LSD (0.10)			1.5	0	0.4	0.7	0.4	6.6

Planting Date = May 23; Harvest Date = October 4; Previous Crop = Corn

Lodging Score: 1 = upright; 5 = flat.

Dry bean variety trial on Field Day.

Soybean - Dryland, Roundup Ready Varieties — LaMoure County

Brand	Variety	Mat Group	Maturity Date	Oil	Protein	Test Weight	Yield*
				%	%	lb/bu	bu/a
NDSU	ND21008GT20	00.8	9/10	19.7	33.9	55.0	25.5
NDSU	ND17009GT	00.9	9/11	19.6	35.5	57.1	23.0
NDSU	ND2108GT73	0.8	9/21	19.8	33.0	55.6	35.1
NK Seeds	NK09-B5XF	0.9	9/20	19.2	34.0	56.2	44.3
NK Seeds	NK11-U2XF	1.1	9/20	19.6	34.1	56.0	40.4
NK Seeds	NK13-Y4XF	1.2	9/23	19.6	33.2	56.1	46.4
Dairyland Seed	DSR-0220E	0.2	9/15	19.8	33.9	54.5	30.2
Dairyland Seed	DSR-0585E	0.5	9/19	20.1	32.6	54.9	40.8
Dairyland Seed	DSR-0757E	0.7	9/18	20.1	32.6	55.0	40.2
Dairyland Seed	DSR-0920E	1.0	9/23	20.0	33.0	55.7	42.6
Dairyland Seed	DSR-1121E	1.1	9/24	21.1	31.1	55.2	44.1
Dairyland Seed	DSR-1290E	1.2	9/23	20.7	32.4	55.8	44.1
LG Seeds	LGS0822E3	0.8	9/20	19.8	33.4	55.8	38.2
LG Seeds	LGS0988XF	0.9	9/19	19.1	33.3	56.6	43.4
LG Seeds	LGS1043E3	1.0	9/21	18.6	34.2	56.6	38.2
LG Seeds	LGS1385XF	1.3	9/23	19.4	33.4	56.0	42.4
Legacy Seeds	LS084-22 XF	0.8	9/19	20.2	32.3	55.9	46.5
Legacy Seeds	LS092-22 E	0.9	9/20	20.9	31.5	55.5	34.8
Legacy Seeds	LS102-22 E	1.0	9/22	19.2	33.5	56.7	34.7
Legacy Seeds	LS094-20 XF	0.9	9/20	20.1	33.1	55.4	41.7
Legacy Seeds	LS124-23 XF	1.2	9/22	20.1	33.2	55.1	37.8
Proseed	XF 30-72N	0.7	9/18	19.0	33.6	55.4	42.9
Proseed	XF 30-82N	0.8	9/19	18.9	34.7	55.2	35.7
Proseed	XF 30-92N	0.9	9/19	19.2	33.8	55.9	44.8
Mean			9/19	19.8	33.3	55.6	40.1
C.V. (%)			1.2	2.4	2.3	0.9	10.8
LSD (0.05)			17.4	0.8	1.3	0.8	9.7
LSD (0.10)			14.5	0.6	1.0	0.7	3.5

Planting Date = May 23; Harvest Date = October 4; Previous Crop = Corn

No significant lodging.

* Best Linear Unbiased Estimate

Dry Edible Bean - Dryland	**Carrington**

Variety	Class	Days to Maturity	Plant Height	Lodging	Direct Harvest	100 Seed Weight	Seeds/ Pound	Test Weight	------- Yield ------ 2023	3-yr. Avg.[1]
		DAP	inch	0-9	%	g/100		lb/bu	-------- lb/a	-------
Cowboy	Pinto	87.0	23.6	1.0	95.5	32.4	1,401	59.9	3187	2560
La Paz	Pinto	91.8	24.6	2.6	88.8	33.0	1,376	59.6	2330	2360
Monterrey	Pinto	91.5	27.8	2.0	91.3	32.6	1,391	59.8	2655	2430
ND Palomino	Pinto	92.0	25.0	1.3	95.3	33.4	1,359	57.6	2894	2363
Torreon	Pinto	88.5	26.2	0.8	95.8	34.0	1,338	59.5	2809	2477
Vibrant	Pinto	86.3	24.0	0.9	93.8	29.6	1,532	59.3	2689	2295
Windbreaker	Pinto	85.0	20.3	1.8	79.3	33.1	1,372	57.8	2356	2122
Bronco	Pinto	86.5	22.0	0.5	96.3	34.8	1,305	60.6	2684	--
Lariat	Pinto	91.0	27.4	2.6	93.5	32.2	1,413	58.3	2906	2588
ND Falcon	Pinto	91.5	28.3	0.9	97.8	32.3	1,411	55.5	2494	2335
ND Rodeo	Pinto	92.3	27.8	1.9	90.8	30.9	1,472	60.7	2482	--
USDA Diamondback	Pinto	91.3	26.4	1.1	96.0	32.6	1,394	60.3	2700	--
USDA Rattler	Pinto	88.5	24.2	0.9	96.5	30.8	1,473	59.4	2911	--
HMS Medalist	Navy	94.0	25.6	0.1	98.0	15.4	2,953	61.0	2918	2307
T9905	Navy	96.0	25.0	0.1	98.5	18.7	2,434	61.5	2993	2382
Armada	Navy	92.5	24.6	0.0	97.8	17.7	2,565	60.9	2820	--
Blizzard	Navy	93.8	23.6	0.4	97.5	16.7	2,719	61.5	2395	2099
ND Polar	Navy	94.8	25.2	0.8	97.3	17.9	2,538	61.7	2765	2310
Black Tails	Black	92.8	24.0	0.6	98.0	17.9	2,543	62.5	2993	2286
Eclipse	Black	89.3	22.2	0.3	98.5	17.3	2,642	60.6	2651	2166
Zorro	Black	92.0	22.0	0.1	97.0	17.6	2,591	61.6	2869	--
ND Twilight	Black	92.5	22.4	0.6	95.5	18.8	2,413	61.5	2786	2350
Powderhorn	GN	87.5	22.4	0.9	96.3	29.8	1,524	55.5	2689	--
ND Pegasus	GN	92.5	25.4	1.8	96.5	32.1	1,420	59.5	3310	2851
Rosetta	Pink	89.0	22.0	2.4	94.8	27.8	1,640	60.4	1925	--
Merlot	Sm Red	92.3	24.0	2.4	90.8	33.5	1,355	59.3	2253	2119
Ruby	Sm Red	90.5	22.0	7.5	79.3	25.5	1,780	58.8	2380	--
SV6139	Pinto	85.8	21.3	0.3	94.5	28.9	1,576	59.9	2924	--
Cancun	Pinto	87.5	27.8	0.5	96.0	35.1	1,292	58.4	2648	--
B3036381	Black	95.8	22.6	0.5	97.8	18.4	2,473	60.5	2585	--
B3033350	Black	87.8	21.1	0.0	97.5	16.3	2,787	61.0	2220	--
Ace	Black	90.8	19.9	0.4	98.3	18.0	2,518	60.7	2401	--
Mean		90.4	24.0	1.2	93.9	27.0	1,822	59.8	2604	--
C.V. (%)		2.3	8.3	--	3.5	4.4	4.9	0.7	10.0	--
LSD (0.05)		2.9	2.8	--	4.5	1.6	125	0.6	365	--
LSD (0.10)		2.4	2.3	--	3.8	1.4	105	0.5	306	--

Planting Date = May 25; Harvest Date = September 20; Previous Crop = Winter Rye

[1] Three-year average is for 2020, 2022, and 2023 as 2021 trial was lost due to drought.

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

Dry Bean - Irrigated									**Carrington**
								-------- Yield --------	
Variety	Class	Days to Maturity	Plant Height	Direct Harvest	100 Seed Weight	Seeds/ Pound	Test Weight	2023	3-yr. Avg.
		DAP	inch	%	g/100		lb/bu	--------- lb/a ---------	
Cowboy	Pinto	94.8	22.4	95.5	36.0	1,261	57.8	3146	3108
LA Paz	Pinto	100.3	26.6	90.3	36.7	1,237	58.0	2986	2880
Monterrey	Pinto	99.3	23.0	95.3	36.1	1,256	57.7	3188	3102
ND Palomino	Pinto	98.3	23.8	94.0	36.9	1,229	56.1	2866	2834
Torreon	Pinto	96.8	26.2	94.8	38.2	1,189	57.1	2924	2936
Vibrant	Pinto	94.3	25.8	91.3	33.8	1,342	57.9	2657	2822
Windbreaker	Pinto	93.3	21.7	75.8	37.0	1,227	54.0	2743	2798
Bronco	Pinto	94.3	20.3	96.0	40.8	1,112	59.8	3111	--
Lariat	Pinto	99.0	26.4	90.8	38.5	1,180	57.0	3347	3079
ND Falcon	Pinto	101.0	25.4	96.5	40.0	1,136	55.0	2947	2912
ND Rodeo	Pinto	102.0	25.8	91.5	41.0	1,106	59.5	3289	3187
USDA Diamondback	Pinto	99.0	26.0	93.5	37.4	1,213	58.5	2958	--
USDA Rattler	Pinto	99.8	27.6	95.0	39.5	1,149	57.9	3796	--
HMS Medalist	Navy	100.0	27.0	96.0	17.7	2,571	60.5	3698	3240
T9905	Navy	103.8	25.0	94.8	21.4	2,124	60.4	3340	3139
Armada	Navy	101.5	24.4	97.5	20.1	2,257	60.5	3678	--
Blizzard	Navy	104.0	23.8	93.3	19.5	2,331	60.5	3033	2962
ND Polar	Navy	104.0	26.0	95.5	19.0	2,391	60.2	3269	3094
Black Tails	Black	102.5	24.6	95.5	20.8	2,176	60.9	3271	3091
Eclipse	Black	98.5	21.3	96.5	20.0	2,273	58.9	3222	2827
Zorro	Black	99.3	22.0	94.8	19.7	2,306	58.9	2898	2587
ND Twilight	Black	101.5	24.6	95.3	22.5	2,016	59.4	3273	3052
Powderhorn	GN	93.0	20.9	93.8	31.3	1,448	53.6	2551	--
ND Pegasus	GN	100.8	27.6	93.0	36.1	1,256	58.8	3865	3691
Rosetta	Pink	101.0	24.0	84.3	33.8	1,342	58.5	2100	2106
Merlot	Sm Red	99.3	24.8	75.8	37.2	1,219	58.3	2259	2477
Ruby	Sm Red	98.3	22.0	61.3	29.1	1,560	57.2	2330	--
SV6139	Pinto	94.8	25.6	93.8	33.3	1,365	56.8	3377	--
Cancun	Pinto	98.5	28.0	95.0	44.6	1,018	56.1	3393	--
B3036381	Black	110.8	26.4	94.5	21.7	2,096	59.7	3590	--
B3033350	Black	98.5	21.1	96.0	19.6	2,322	60.0	3248	--
Ace	Black	100.5	22.4	96.0	20.2	2,250	59.1	3376	--
Mean		99.0	24.4	91.3	31.0	1,595	58.2	3054	--
C.V. (%)		1.6	11.0	6.0	2.5	2.7	1.2	10.3	--
LSD (0.05)		2.2	3.8	7.7	1.1	60.6	1.0	442	--
LSD (0.10)		1.8	3.2	6.4	0.9	50.7	0.8	370	--

Planting Date = May 25; Harvest Date = October 1; Previous Crop = Field Pea

Dry Bean					Wishek
				---------- Yield ----------	
Variety	100 Seed Weight	Seeds/ Pound	Test Weight	2023	2-yr. Avg.
	g/100		lb/bu	---------- lb/a ----------	
Torreon	38.5	1,182	56.6	3913	2862
Vibrant	35.1	1,295	56.1	3780	2848
ND Falcon	36.3	1,250	53.3	3595	2671
ND Rodeo	38.6	1,177	58.3	3992	--
HMS Medalist	18.4	2,469	59.0	3733	--
ND Polar	17.8	2,555	58.4	3591	2579
Eclipse	19.5	2,332	59.1	3472	2519
ND Twilight	21.9	2,075	59.9	3897	2859
Mean	28.3	1,792	57.6	3747	--
C.V. (%)	4.4	4.3	0.7	10.7	--
LSD (0.05)	1.8	114	0.6	590	--
LSD (0.10)	1.5	95	0.5	488	--

Planting Date = June 5; Harvest Date = September 20; Previous Crop = Soybean

Dr. Osorno reviewing dry bean varieties.

Dry Bean, Misc - Irrigated								Dickey County, Oakes
				100		---------- Seed Yield ----------		
	Market	Days to	Seeds/	Seed	Test		2-yr.	3-yr.
Variety	Class	PM	Pound	Weight	Weight	2023	Avg.	Avg.
		DAP		g/100	lb/bu	---------- lb/a ----------		
Black Tails	Black	99.0	1,707	26.6	60.7	4,058	3,739	3,457
Eclipse	Black	94.3	1,840	24.7	61.3	3,913	3,831	3,623
Zorro	Black	93.5	1,861	24.5	62.3	4,244	3,827	3,506
ND Twilight	Black	93.0	1,797	25.3	63.9	4,123	4,166	3,978
Powderhorn	Great Northern	86.5	1,269	35.9	58.0	3,568	--	--
ND Pegasus	Great Northern	91.8	1,223	37.1	62.1	3,934	4,581	4,170
Rosetta	Pink	96.8	1,111	40.9	57.3	3,932	4,068	3,607
Merlot	Small Red	95.0	1,041	43.6	57.2	4,254	3,996	3,588
Ruby	Small Red	96.0	1,257	36.2	58.9	4,381	--	--
Mean		94.1	1,433	33.4	60.1	4,090	--	--
C.V. (%)		1.5	4.7	4.2	2.3	5.6	--	--
LSD 0.10		1.7	79.9	1.7	1.7	273	--	--
LSD 0.05		2.0	96.0	2.0	2.0	329	--	--

Planting Date = June 1; Harvest Date = September 19, 20, 27 and 28; Previous Crop = Melons and squash

An aerial view of plots at the CREC.

Dry Bean, Navy - Irrigated							Dickey County, Oakes
			100		---------- Seed Yield ----------		
	Days to	Seeds/	Seed	Test		2-yr.	3-yr.
Variety	PM	Pound	Weight	Weight	2023	Avg.	Avg.
	DAP		g/100		---------- lb/a ----------		
HMS Medalist	93.3	1,960	23.2	60.3	4,038	3,926	3,798
T9905	93.0	1,636	27.7	59.6	4,328	4,161	3,895
Armada	92.5	1,684	27.0	61.3	4,250	4,080	--
Blizzard	92.3	1,873	24.2	64.0	4,145	4,069	3,858
ND-Polar	93.0	1,932	23.6	62.1	3,891	4,003	--
Mean	92.8	1,817	25.1	61.5	4,130	--	--
C.V. (%)	0.6	4.2	4.1	2.5	3.8	--	--
LSD 0.10	0.7	95.2	1.3	1.9	3,891	--	--
LSD 0.05	0.9	116	1.6	2.4	240	--	--

Planting Date = June 1; Harvest Date = September 19, 27 and 28; Previous Crop = Melon and squash

Rafters being placed at the Oakes Irrigation Research Site.

Dry Bean, Pinto - Irrigated							Dickey County, Oakes
			100		---------- Seed Yield ----------		
	Days to	Seeds/	Seed	Test		2-yr.	3-yr.
Variety	PM	Pound	Weight	Weight	2023	Avg.	Avg.
	DAP		g/100	lb/bu	---------- lb/a ----------		
Cowboy	87.3	1,037	43.8	60.3	4,206	4,542	4,064
LaPaz	91.3	1,062	42.8	58.6	4,025	4,496	3,960
Monterrey	91.3	1,077	42.2	59.1	3,980	4,391	4,004
ND-Palomino	89.8	1,004	45.2	55.2	4,013	4,404	4,027
Torreon	87.5	988	46.0	58.7	3,983	4,202	3,777
Vibrant	87.0	1,095	41.6	59.8	3,798	4,052	3,759
Windbreaker	86.0	1,071	42.4	58.4	4,196	4,447	4,028
Lariat	91.0	1,024	44.4	58.1	4,024	4,018	3,706
ND-Falcon	92.5	977	46.5	53.6	3,710	3,533	3,312
ND Rodeo	92.0	956	47.5	60.5	4,399	--	--
USDA Diamondback	92.3	980	46.3	59.3	4,152	--	--
USDA Rattler	91.5	1,008	45.2	58.9	4,150	--	--
Mean:	90.2	1,015	44.9	58.4	4,044	--	--
C.V.(%)	1.7	4.1	4.0	3.7	5.2	--	--
LSD 0.10	1.8	49.4	2.2	3.0	253	--	--
LSD 0.05	2.1	59.3	2.6	3.6	303	--	--

Planting Date = June 1; Harvest Date = September 19, 27 and October 1; Previous Crop = Melon and squash

Fungicide spray volume evaluation for white mold control in soybean.

Buckwheat								Carrington
						---------- Yield ----------		
	Days to	Days to	Plant		Test		2-yr.	3-yr.
Variety	Bloom	Maturity	Height	KWT	Weight	2023	Avg.	Avg.
	DAP	DAP	inch	g/1000	lb/bu	---------- lb/a ----------		
Horizon	41.3	91.3	48.2	27.7	47.9	1,562	1,760	1,793
Koma	41.0	92.0	45.1	25.7	50.2	1,459	1,436	1,491
Koto	39.0	91.0	47.2	25.2	49.0	1,659	1,651	1,644
Devyatka	30.0	82.0	39.8	24.6	48.5	1,350	1,224	1,074
DBP2020*	38.0	90.0	51.6	24.9	47.1	1,382	1,554	1,644
Kenmar	37.8	91.0	49.6	25.9	47.3	1,853	--	--
Mean	37.8	89.5	46.9	25.7	48.3	1,544	--	--
C.V. (%)	2.3	1.0	6.6	10.5	1.7	19.0	--	--
LSD (0.05)	1.3	1.4	4.6	4.1	1.2	442	--	--
LSD (0.10)	1.1	1.1	3.8	3.3	1.0	363	--	--
				NS				

Planting Date = June 7; Harvest Date = September 19; Previous Crop = Chickpea

No significant lodging differences were observed.

*DBP2020 is a specialty release yet to be named.

Organic buckwheat variety trial.

Buckwheat - Organic								Carrington
						---------- Yield ----------		
	Days to	Days to	Plant		Test		2-yr.	3-yr.
Variety	Bloom	Maturity	Height	KWT	Weight	2023	Avg.	Avg.
	DAP	DAP	inch	g/1000	lb/bu	---------- lb/a ----------		
Horizon	35.8	91.0	52.0	28.0	48.9	1,595	1,349	1,096
Koma	35.8	90.3	48.4	22.6	51.0	1,367	1,100	947
Koto	32.3	91.8	49.2	28.4	50.6	1,760	1,469	1,229
Devyatka	24.0	82.0	40.6	23.5	47.2	1,932	1,266	1,052
DBP2020*	30.0	89.8	51.8	24.6	49.2	1,655	1,274	1,161
Kenmar	32.8	90.5	52.2	26.9	48.6	1,683	--	--
Mean	31.8	89.2	49.0	25.7	49.3	1,665	--	--
C.V. (%)	3.7	1.3	3.3	3.9	0.8	11.8	--	--
LSD (0.05)	1.7	1.7	2.4	1.5	0.6	296	--	--
LSD (0.10)	1.4	1.4	2.0	1.2	0.5	244	--	--

Planting Date = June 7; Harvest Date = September 19; Previous Crop = Cover Crop

No significant lodging differences were observed.

*DBP2020 is a specialty release yet to be named.

ND Victory field pea.

Field Pea | **Carrington (Page 1 of 2)**

Variety	Brand	Days to Flower	Days to Maturity	Canopy Height At Harvest	--- Harvest Ease --- 2023	3-yr. Avg.	Protein	KWT	Seeds/ Pound	Test Weight	------- Yield ------- 2023	3-yr. Avg.
		DAP	DAP	inch	--------- 0-9	---------	%	gram		lb/bu	-------- bu/a	--------
Yellow Cotyledon Type												
DS Admiral	Pulse USA	41.3	81.5	16.3	5.5	4.0	27.0	280	1,621	63.1	51.8	39.6
Agassiz	Meridian Seeds	43.5	89.3	19.3	3.8	4.6	26.6	283	1,606	64.1	65.2	43.3
CDC Amarillo	Meridian Seeds	45.0	90.3	20.0	2.3	2.9	26.2	260	1,754	64.3	65.6	45.2
ND Dawn	NDSU	43.3	84.8	17.5	6.3	5.2	25.4	281	1,617	62.9	61.9	40.9
AAC Profit	Premier Genetics	45.5	90.0	21.4	4.8	4.8	26.9	267	1,703	64.2	71.9	48.9
EP_6816	Equinom	42.0	87.0	20.7	4.8	--	27.7	250	1,813	63.0	61.2	--
EP_8272	Equinom	43.3	89.3	20.3	5.0	--	29.5	279	1,648	63.6	55.8	--
EP_8971	Equinom	46.0	90.8	18.9	4.5	4.3	31.5	295	1,542	63.6	52.8	33.7
CDC Inca	Meridian Seeds	45.3	89.5	19.7	3.8	3.1	27.4	267	1,697	63.9	70.1	47.2
CDC Spectrum	Meridian Seeds	44.5	90.5	19.7	4.3	3.3	27.3	277	1,640	63.7	61.5	42.2
MS GrowPro	Meridian Seeds	43.0	90.0	23.6	4.3	3.7	30.4	351	1,293	63.5	66.4	45.1
MS Prostar	Meridian Seeds	44.8	86.8	17.6	5.0	--	27.3	305	1,486	63.3	61.5	--
AAC Beyond	Meridian Seeds	43.8	86.0	19.9	5.3	--	26.2	259	1,765	64.3	79.2	--
CP5222Y	CROPLAN	41.5	88.8	19.9	4.0	--	26.9	318	1,430	64.0	66.0	--
CP5244Y	CROPLAN	43.3	90.8	19.1	4.8	--	26.6	265	1,726	64.6	57.9	--
PG 2601	Pulse Genetics	44.0	85.0	19.5	4.5	4.7	27.1	256	1,782	64.3	64.8	42.9
AAC Julius	Valesco Genetics / NDCISA	44.0	83.0	19.9	4.3	--	26.9	253	1,801	63.7	72.4	--
1814	NDCISA	44.0	89.8	20.3	3.5	--	27.2	318	1,426	64.0	66.6	--
Mean		43.5	87.5	19.5	4.6	--	27.3	285.0	1,612	63.7	62.5	--
C.V. (%)		2.8	4.8	17.6	26.9	--	3.0	5.4	6.3	0.8	14.7	--
LSD (0.05)		1.7	5.9	4.8	--	--	1.1	21.4	143	0.7	12.9	--
LSD (0.10)		1.4	4.9	4.0	--	--	1.0	17.9	120	0.6	10.8	--

Planting Date = May 4; Harvest Date = August 9; Previous Crop = Flax

Variety	Brand	Days to Flower	Days to Maturity	Canopy Height At Harvest	--- Harvest Ease --- 2023	3-yr. Avg.	Protein	KWT	Seeds/ Pound	Test Weight	------- Yield ------- 2023	3-yr. Avg.
		DAP	DAP	inch	--------- 0-9 ---------		%	gram		lb/bu	-------- bu/a --------	
Yellow Cotyledon Type												
Orchestra	Premier Genetics	43.3	90.3	17.7	5.5	4.6	29.8	322	1,410	64.0	49.8	34.5
PG Cash	Premier Genetics	43.3	85.8	20.8	4.5	--	27.9	307	1,478	63.4	70.5	--
PSTSPS50	Photosyntech	43.3	90.8	20.8	3.5	--	29.8	370	1,230	62.9	58.8	--
AAC Chrome	Valesco Genetics	44.3	89.0	17.7	5.0	5.3	24.2	292	1,553	64.4	79.5	49.6
5206	Valesco Genetics	43.8	88.5	20.1	4.3	--	26.3	267	1,709	64.5	65.7	--
2822	Valesco Genetics	43.8	90.5	23.5	3.3	--	27.6	295	1,539	63.5	67.3	--
3513	Valesco Genetics	45.8	91.0	20.9	3.3	--	27.3	298	1,525	63.4	65.4	--
Salamanca	Valesco Genetics	43.3	83.5	17.6	4.5	--	28.3	269	1,692	62.7	52.1	--
Hyline	Valesco Genetics	44.5	86.3	19.8	4.0	--	25.1	298	1,523	64.0	66.2	--
Pizzaz	Valesco Genetics	40.0	81.5	15.6	6.5	--	27.1	346	1,312	63.3	50.7	--
Spider	Lafrenz Seed	41.0	83.8	17.5	5.3	--	28.0	291	1,566	63.8	57.8	--
Green Cotyledon Type												
CDC Striker	Pulse USA	44.0	87.3	18.9	5.3	5.3	29.1	268	1,699	64.0	54.4	37.6
Aragorn	Pulse USA	42.8	84.3	17.0	6.8	6.2	27.4	250	1,817	62.5	56.1	37.5
Arcadia	Pulse USA	43.0	85.0	15.1	7.3	6.3	25.3	252	1,801	63.2	51.8	38.5
ND Victory	NDSU	42.7	91.8	25.7	2.0	--	26.4	210	2,057	64.0	65.3	--
PG8318	Premier Genetics	46.0	90.5	24.7	3.8	--	25.7	272	1,667	64.7	72.1	--
Shamrock	Valesco Genetics	45.5	89.3	21.5	2.8	4.2	27.1	280	1,633	64.2	59.4	40.3
Mean		43.5	87.5	19.5	4.6	--	27.3	285.0	1,612	63.7	62.5	--
C.V. (%)		2.8	4.8	17.6	26.9	--	3.0	5.4	6.3	0.8	14.7	--
LSD (0.05)		1.7	5.9	4.8	--	--	1.1	21.4	143	0.7	12.9	--
LSD (0.10)		1.4	4.9	4.0	--	--	1.0	17.9	120	0.6	10.8	--

Planting Date = May 4; Harvest Date = August 9; Previous Crop = Flax

Field Pea - Organic					Carrington
Variety	Days to Flower	Plant Height	Protein	KWT*	Yield*
	DAP	DAP	%	g/1000	bu/a
DS Admiral	40.8	21.1	23.5	205.5	8.9
Agassiz	44.8	22.6	23.8	185.8	2.9
CDC Amarillo	46.3	21.1	25.6	193.0	4.2
ND Dawn	42.5	19.7	23.9	223.0	10.3
AAC Profit	44.3	22.2	24.6	204.8	7.9
CDC Striker	46.3	20.5	26.6	211.3	2.8
Aragorn	43.0	20.1	25.5	195.6	6.0
Arcadia	41.8	18.9	24.4	189.3	7.2
ND Victory	45.3	20.1	25.3	193.9	5.5
Protecta	42.3	21.9	25.4	218.5	7.2
Mean	43.7	20.8	24.8	202.1	6.3
C.V. (%)	3.4	12.5	2.6	8.3	15.1
LSD (0.05)	2.2	3.8	0.9	16.3	1.2
LSD (0.10)	1.8	3.1	0.8	13.5	1.0

Planting Date = May 17; Harvest Date = August 9; Previous Crop = Spring Wheat

A wet spring with delayed planting resulted in high weed pressure.

*Best Linear Unbiased Estimate

Impact of crop rotation interval, planting date and seed treatment on field pea.

Corn - Dryland **Carrington (Page 1 of 2)**

Brand	Hybrid	RM	Trait	Days to Silk	Ear Ht*	Plant Ht	Harvest Moisture	Grain Protein	Grain Starch	Grain Oil	Test Weight	Yield 2023	Yield 2-yr. Avg.	Yield 3-yr. Avg.
				DAP	inch	inch	%	%	%	%	lb/bu	bu/a	bu/a	bu/a
REA Hybrids	83B33	83	RR2	58.3	32.4	90.1	14.4	8.9	69.3	3.6	56.6	178.8	160.0	--
REA Hybrids	86A94	86	RR2Y/LL	61.8	31.5	85.9	14.4	8.1	70.2	3.9	57.1	204.8	176.4	--
REA Hybrids	86B55	86	RR2	61.0	32.8	87.8	14.8	8.5	71.0	4.0	56.7	176.8	--	--
REA Hybrids	88B04	88	RR2	61.5	33.1	87.6	14.7	8.1	71.7	3.8	56.3	190.8	--	--
Integra Seeds	3114 VT2P RIB	81	RR2	58.3	30.6	86.3	14.4	8.8	68.4	3.7	56.5	163.0	--	--
Integra Seeds	3431 VT2P RIB	84	RR2	59.8	29.7	87.9	14.3	8.5	70.4	3.6	57.2	181.4	171.4	138.0
Integra Seeds	3537 VT2P RIB	85	RR2	62.3	29.4	93.7	14.5	8.2	70.6	3.7	56.4	178.2	165.9	133.8
Integra Seeds	3884 VT2P RIB	88	RR2	62.0	31.8	89.7	14.6	8.2	70.7	3.6	55.7	188.0	--	--
Golden Harvest	G82B12-AA	82	GT/LL	60.5	34.6	91.5	14.5	9.2	70.5	3.5	56.9	202.3	--	--
Golden Harvest	G85B04-AA	85	GT/LL	63.5	29.2	94.1	15.0	8.5	71.8	3.7	56.0	210.1	--	--
Golden Harvest	G90B11-AA	90	GT/LL	66.3	31.1	92.6	15.1	9.1	71.4	3.6	56.5	221.3	--	--
Dairyland Seed	DS-2476AM	84	RR2Y/LL	61.0	30.7	88.0	14.1	8.1	70.7	3.7	55.8	192.3	--	--
Dairyland Seed	DS-2612AM	86	RR2Y/LL	62.3	29.1	84.1	14.8	9.0	70.7	3.6	56.1	181.2	--	--
Legacy Seeds	LC354-23	85	Enlist	61.5	30.8	91.0	14.3	8.4	69.3	3.6	54.9	192.2	--	--
Legacy Seeds	LC363-23	85	GT/LL	63.8	38.5	98.7	15.1	8.3	71.9	3.6	55.6	215.4	--	--
Legacy Seeds	LC364-23	86	RR2	60.0	28.4	92.9	14.5	7.7	70.5	4.0	55.8	191.6	--	--
Legacy Seeds	LC-2817	86	RR2	61.5	27.8	90.9	14.5	8.5	69.9	3.7	56.9	182.4	162.7	128.7
Legacy Seeds	LC384-22	88	RR2	62.3	32.7	90.9	14.8	8.2	70.8	3.7	55.7	182.0	--	--
Legacy Seeds	LC-3017	90	RR2	65.5	27.4	96.3	15.5	8.7	70.9	4.0	56.5	203.2	184.8	--
Mean				61.9	29.8	91.3	14.6	8.5	70.7	3.7	56.3	191.5	--	--
C.V. (%)				3.5	8.8	5.3	2.6	3.4	1.0	3.2	1.0	10.9	--	--
LSD (0.05)				3.1	5.3	6.7	0.5	0.4	1.0	0.2	0.8	29.3	--	--
LSD (0.10)				2.6	1.9	5.6	0.5	0.3	0.8	0.1	0.7	24.5	--	--

Planting Date = May 12; Harvest Date = November 20; Previous Crop = Soybean

Corn - Dryland **Carrington (Page 2 of 2)**

Brand	Hybrid	RM	Trait	Days to Silk	Ear Ht*	Plant Ht	Harvest Moisture	Grain Protein	Grain Starch	Grain Oil	Test Weight	Yield 2023	Yield 2-yr. Avg.	Yield 3-yr. Avg.
				DAP	inch	inch	%	%	%	%	lb/bu	bu/a	bu/a	bu/a
Legacy Seeds	LC403-22	90	GT/LL	62.8	30.5	98.0	15.1	8.5	71.6	3.4	55.2	225.4	193.9	--
Legacy Seeds	LC414-21	91	GT/LL	64.8	30.4	91.7	15.0	8.5	70.7	3.9	58.1	218.1	192.7	--
Proseed	1984VT2P	84	RR2	61.0	27.2	90.9	14.3	8.5	70.2	3.6	56.8	174.6	164.7	129.4
Proseed	2486	86	GT	61.8	30.8	96.5	14.8	8.2	71.9	3.6	55.4	210.7	--	--
Thunder Seed Inc.	T6185 VT2P	85	RR2	59.3	24.4	90.7	14.1	8.5	70.1	3.7	55.9	165.6	155.0	126.0
Thunder Seed Inc.	T6485 PC	85	Enlist	62.8	29.2	96.8	14.6	8.6	70.0	3.5	54.4	180.5	--	--
Thunder Seed Inc.	T6389 VT2P	89	RR2	61.5	30.5	90.6	14.3	8.1	71.0	3.6	56.4	203.0	182.5	--
Thunder Seed Inc.	T6490 VT2P	90	RR2	65.3	31.5	97.6	14.8	8.6	70.2	3.7	56.3	191.0	--	--
Dyna-Gro Seed	D20VC24RIB	80	RR2	58.5	27.4	90.7	14.4	8.4	71.2	3.8	55.9	161.7	--	--
Dyna-Gro Seed	D23VC83RIB	83	RR2	60.5	23.6	88.1	14.3	7.9	71.3	3.9	55.9	184.1	171.2	133.7
Dyna-Gro Seed	D26VC64RIB	86	RR2	63.3	23.8	91.3	14.9	8.7	70.6	3.7	56.2	190.9	--	--
Dyna-Gro Seed	D31VC23RIB	91	RR2	65.3	23.9	88.9	14.8	8.8	70.5	3.9	58.8	230.2	197.8	--
Champion Seed	35A24	85	RR2	62.3	28.3	84.9	14.6	8.9	69.8	3.7	58.0	179.3	--	--
Champion Seed	36A24	86	RR2	61.0	30.6	89.6	14.4	8.1	70.6	3.9	56.9	166.8	--	--
Champion Seed	37A24	87	RR2Y/LL	63.0	30.3	97.6	14.8	8.2	71.7	3.7	55.6	216.4	--	--
Champion Seed	40A21	90	RR2	62.3	30.2	93.7	14.9	8.4	71.0	3.7	55.8	186.7	171.5	136.4
Champion Seed	33A20	83	RR2	60.5	29.3	87.4	14.6	8.4	70.8	3.5	57.0	172.5	164.3	127.7
Mean				61.9	29.8	91.3	14.6	8.5	70.7	3.7	56.3	191.5	--	--
C.V. (%)				3.5	8.8	5.3	2.6	3.4	1.0	3.2	1.0	10.9	--	--
LSD (0.05)				3.1	5.3	6.7	0.5	0.4	1.0	0.2	0.8	29.3	--	--
LSD (0.10)				2.6	1.9	5.6	0.5	0.3	0.8	0.1	0.7	24.5	--	--

Planting Date = May 12; Harvest Date = November 20; Previous Crop = Soybean

RM and trait based on data provided by seed company.

* Best Linear Unbiased Estimate

Corn - Irrigated **Carrington**

Brand	Hybrid	RM	Trait	Days to Silk	Ear Ht*	Plant Ht	Harvest Moisture	Grain Protein	Grain Starch	Test Weight	---------- Yield ---------- 2023	2-yr. Avg.	3-yr. Avg.
				DAP	inch	inch	%	%	%	lb/bu	---------- bu/a ----------		
REA Hybrids	83B33	83	RR2	61.8	24.4	96.0	16.4	9.6	70.1	57.9	223.2	194.6	--
REA Hybrids	86A94	86	RR2Y/LL	63.5	24.7	93.0	16.1	9.0	70.7	57.7	211.8	192.5	--
REA Hybrids	86B55	86	RR2	61.3	26.6	91.9	16.3	9.1	70.8	58.3	235.2	--	--
REA Hybrids	88B04	88	RR2	64.5	30.4	94.8	17.2	8.8	72.5	57.4	266.0	--	--
Integra Seeds	3431 VT2P RIB	84	RR2	61.8	20.4	101.5	16.6	8.9	71.5	57.9	236.6	205.6	--
Integra Seeds	3884 VT2P RIB	88	RR2	65.5	21.1	100.6	17.6	9.1	72.8	56.7	253.2	--	--
Dairyland Seed	DS-2612AM	86	RR2Y/LL	62.3	28.1	93.7	16.7	9.3	72.9	56.4	262.7	--	--
Dairyland Seed	DS-2919AM	89	RR2Y/LL	65.3	27.2	97.1	17.0	8.7	72.8	58.2	285.2	237.3	--
Legacy Seeds	LC354-23	85	Enlist	66.0	27.5	104.9	16.2	8.8	70.2	56.3	243.8	--	--
Legacy Seeds	LC363-23	85	GT/LL	65.8	28.0	112.1	17.3	8.4	73.6	56.2	282.8	--	--
Legacy Seeds	LC364-23	86	RR2	61.0	29.8	97.6	16.6	8.7	71.9	57.5	225.8	--	--
Legacy Seeds	LC-2817	86	RR2	64.0	23.6	104.0	17.1	9.1	71.5	57.8	253.0	217.8	217.8
Legacy Seeds	LC384-22	88	RR2	65.0	23.2	99.6	17.9	9.0	72.4	57.0	264.5	--	--
Legacy Seeds	LC-3017	90	RR2	66.3	31.2	103.0	18.5	9.7	72.4	57.5	251.0	212.1	--
Legacy Seeds	LC403-22	90	GT/LL	67.3	31.0	106.3	19.0	9.0	75.5	56.4	322.4	254.9	--
Legacy Seeds	LC414-21	91	GT/LL	68.0	29.7	100.8	17.8	9.4	71.8	59.1	283.8	238.9	--
RENK	RK261VT2P	86	RR2	60.5	23.9	95.5	16.5	8.7	71.1	57.4	212.7	--	--
RENK	RK296AA	89	GT	67.8	30.9	113.0	18.4	8.8	74.5	56.1	321.1	--	--
RENK	RK297VT2P	89	RR2	66.5	27.3	102.0	17.2	8.7	73.5	57.3	279.3	242.0	237.2
RENK	RK300RR	90	RR2	66.3	29.7	96.6	18.5	9.5	73.3	58.0	279.6	229.3	234.7
Dyna-Gro Seed	D20VC24RIB	80	RR2	59.8	27.7	107.3	15.6	8.9	71.6	57.5	223.2	--	--
Dyna-Gro Seed	D23VC83RIB	83	RR2	62.5	28.5	91.9	16.5	8.6	73.1	57.4	231.2	198.1	202.5
Dyna-Gro Seed	D26VC64RIB	86	RR2	64.5	28.8	100.0	17.3	9.2	71.9	56.8	244.7	--	--
Dyna-Gro Seed	D28VC33RIB	88	RR2	65.5	25.4	99.1	17.4	9.4	72.1	57.3	231.4	200.9	--
Mean				64.3	27.0	100.1	17.2	9.0	72.3	57.3	254.9	--	--
C.V. (%)				1.7	15.5	4.4	1.9	2.8	1.0	0.9	7.3	--	--
LSD (0.05)				1.5	9.1	6.2	0.5	0.4	1.0	0.7	26.2	--	--
LSD (0.10)				1.3	3.3	5.2	0.4	0.3	0.9	0.6	21.9	--	--

Planting Date = May 12; Harvest Date = November 6; Previous Crop = Field Pea

* Best Linear Unbiased Estimate

Corn - Dryland, Conventional **Carrington**

Brand	Hybrid	RM	Trait	Days to Silk	Ear Ht*	Plant Ht*	Harvest Moisture	Grain Protein	Grain Starch	Grain Oil	Test Weight	Yield*
				DAP	inch	inch	%	%	%	%	lb/bu	bu/a
Proseed	2388	88	Conv	62.5	34.5	94.4	16.6	8.5	71.9	3.7	56.6	176.5
Proseed	1790	90	Conv	66.0	32.2	92.9	16.7	8.9	71.6	4.1	57.0	199.7
Champion Seed	31A23	81	Conv	62.0	32.1	93.9	14.9	8.3	70.6	3.8	56.4	190.4
Champion Seed	34A23	84	Conv	60.5	32.9	95.3	14.9	8.6	69.8	3.8	56.7	185.0
Champion Seed	36A20	86	Conv	61.5	31.6	99.8	15.2	8.6	70.4	3.9	56.8	189.4
Champion Seed	38A23	88	Conv	62.8	29.4	98.5	16.7	8.8	71.9	3.7	56.9	200.3
Champion Seed	41A20	91	Conv	65.5	33.0	93.5	16.5	8.9	71.5	4.1	56.7	190.7
	RR Check 1			63.5	31.3	89.9	15.4	7.9	71.6	3.7	57.0	199.8
Mean				63.0	33.1	95.5	15.9	8.6	71.2	3.8	56.8	194.2
C.V. (%)				3.1	7.6	2.4	2.4	4.7	1.1	4.3	1.0	4.7
LSD (0.05)				2.9	5.3	4.9	0.6	0.6	1.1	0.2	0.8	22.0
LSD (0.10)				2.4	2.0	1.8	0.5	0.5	0.9	0.2	0.7	8.4

Planting Date = May 12; Harvest Date = November 20; Previous Crop = Soybean

* Best Linear Unbiased Estimate

Corn - Dryland										Fingal
								---------- Yield ----------		
				Harvest	Grain	Grain	Test		2-yr.	3-yr.
Brand	Hybrid	RM	Trait	Moisture	Protein	Starch	Weight	2023*	Avg.	Avg.
				%	%	%	lb/bu	---------- bu/a ----------		
REA Hybrids	88B04	88	RR2	17.9	9.6	71.6	58.4	210.0	--	--
REA Hybrids	92B10	92	RR2	18.5	9.0	73.2	58.8	200.0	192.9	--
REA Hybrids	93F72	93	RR2	18.6	9.4	72.0	57.1	250.3	--	--
REA Hybrids	4B958	95	RR2	18.9	9.5	72.4	59.1	229.4	207.8	206.7
REA Hybrids	95B53	95	RR2	18.3	9.1	72.5	58.2	256.8	--	--
Dairyland Seed	DS-3159AM	91	RR2Y/LL	19.5	9.8	75.1	56.6	249.5	--	--
Dairyland Seed	DS-3477AM	94	RR2Y/LL	18.8	10.0	74.1	57.9	217.2	192.4	--
Dairyland Seed	DS-3599Q	95	RR2Y/LL	19.0	9.5	74.0	57.9	222.0	--	--
Dairyland Seed	DS-3601AM	96	RR2Y/LL	18.7	9.8	74.0	57.8	238.0	207.8	--
Dairyland Seed	DS-3881AM	98	RR2Y/LL	20.3	10.5	75.3	58.3	220.2	--	--
Legacy Seeds	LC384-22	88	RR2	18.1	9.4	72.3	57.8	203.4	--	--
Legacy Seeds	LC-3017	90	RR2	18.6	10.1	71.8	58.7	215.5	185.2	--
Legacy Seeds	LC403-22	90	GT/LL	19.0	9.4	73.6	58.0	233.6	197.9	--
Legacy Seeds	LC414-21	91	GT/LL	17.8	10.0	71.1	60.9	220.7	187.7	--
Legacy Seeds	LC461-21	95	RR2	19.7	9.7	72.6	59.1	220.6	189.0	207.7
Legacy Seeds	LC464-21	96	GT/LL	19.6	9.6	73.4	58.5	225.4	195.8	--
Legacy Seeds	LC465-23	96	Enlist	20.1	10.5	73.4	57.8	230.2	--	--
RENK	RK400VT2P	91	RR2	18.8	10.3	71.9	60.1	212.5	184.5	--
RENK	RK444VT2P	93	RR2	19.0	9.6	73.8	58.4	260.0	217.4	--
RENK	RK485DGVT2P	94	RR2	19.4	9.4	72.7	60.2	223.2	194.1	199.4
RENK	RK561DGVT2P	95	RR2	18.9	10.2	71.2	59.3	227.2	212.3	218.4
RENK	RK571PWE	96	RR2	20.1	10.3	74.1	58.5	236.9	--	--
Proseed	2390 VT2P	90	RR2	18.0	9.2	72.3	57.7	204.6	--	--
Proseed	2392 VT2P	92	RR2	18.4	10.0	71.1	60.3	229.6	189.2	--
Proseed	2496 PCE	96	Enlist	19.6	10.6	74.0	58.2	231.4	--	--
Thunder Seed Inc.	T6390 AA	90	GT/LL	18.6	10.2	72.2	58.1	215.1	--	--
Thunder Seed Inc.	T6490 VT2P	90	RR2	18.2	9.3	72.6	58.4	220.9	--	--
Thunder Seed Inc.	T6992 VT2P	92	RR2	18.6	10.2	70.9	58.9	221.2	206.9	200.8
Thunder Seed Inc.	T6294 VT2P	94	RR2	19.0	9.3	72.3	60.2	238.6	208.4	207.0
Dyna-Gro Seed	D31VC23RIB	91	RR2	18.5	10.1	71.3	61.0	234.8	197.3	--
Dyna-Gro Seed	D34VC93RIB	94	RR2	18.7	9.6	73.3	58.6	242.5	209.1	--
Dyna-Gro Seed	D28VC33RIB	88	RR2	18.0	9.9	72.3	58.5	222.8	194.4	--
Champion Seed	36A24	86	RR2	16.8	8.9	71.6	57.1	206.3	--	--
Champion Seed	37A24	87	RR2Y/LL	18.5	9.5	73.0	58.6	215.8	--	--
Champion Seed	42A24	92	RR2	18.8	9.9	71.6	59.1	222.6	--	--
Champion Seed	46A24	96	RR2	19.7	9.7	72.6	58.8	249.8	--	--
Mean				18.8	9.7	72.7	58.6	219.1	--	--
C.V. (%)				3.5	3.5	1.1	1.3	5.4	--	--
LSD (0.05)				0.9	0.5	1.2	1.1	26.2	--	--
LSD (0.10)				0.8	0.4	1.0	0.9	9.4	--	--

Planting Date = May 24; Harvest Date = November 8; Previous Crop = Soybeans

* Best Linear Unbiased Estimate

Corn - Dryland **Dickey County - Oakes**

Brand	Hybrid	RM	Traits	Days to Silk	Ear Height	Plant Height	Grain Protein	Grain Starch	Harvest Moisture	Test Weight	--Grain Yield-- 2023	2 yr. Avg.
				DAP	inch	inch	%	%	%	lb/bu	bu/a	bu/a
REA Hybrids	92B10	92	RR2	59.0	34.0	86.5	8.2	73.5	18.6	55.5	208.7	200.6
REA Hybrids	93F72	93	RR2	59.8	39.5	93.7	8.4	73.1	19.4	52.8	212.8	--
REA Hybrids	96A79	96	RR2	61.3	34.4	85.5	7.4	74.3	19.6	53.9	164.4	--
Golden Harvest	G90B11-AA	90	GT/LL	60.5	39.0	93.0	8.8	72.8	18.3	55.7	193.2	--
Golden Harvest	G97B68-DV	97	GT/LL	62.5	42.2	89.0	8.4	73.2	19.5	54.4	160.3	--
Dairyland Seed	DS-3599Q	95	RR2Y/LL	58.5	29.7	80.5	8.7	73.9	20.7	53.7	180.9	--
Dairyland Seed	DS-3601AM	96	RR2Y/LL	60.5	37.1	88.2	8.6	73.9	20.8	53.1	204.4	201.2
Legacy Seeds	LC461-21	95	RR2	57.0	43.1	94.2	8.8	73.7	19.9	56.0	223.9	203.5
Legacy Seeds	LC464-21	96	GT/LL	57.0	38.0	98.8	9.3	73.4	20.8	54.7	234.8	204.4
Legacy Seeds	LC465-23	96	Enlist	63.0	34.2	87.5	9.1	74.0	21.1	52.8	204.9	--
Legacy Seeds	LC474-23	97	Enlist	58.8	39.0	89.5	8.5	73.6	20.5	53.1	243.6	--
Legacy Seeds	LC474-20 TRE	97	RR2,VT2P Trecepta	60.0	38.4	92.2	9.2	72.7	20.4	52.7	193.7	--
RENK	RK400VT2P	91	RR2	59.0	38.0	86.2	8.8	72.7	19.1	56.0	193.3	193.1
RENK	RK444VT2P	93	RR2	58.5	39.3	91.6	8.6	72.9	19.2	54.4	214.0	207.5
RENK	RK485DGVT2P	94	RR2	60.0	40.7	92.0	8.4	74.2	20.6	55.1	203.4	190.6
RENK	RK561DGVT2P	95	RR2	59.8	33.2	89.0	9.0	72.8	20.1	53.9	194.3	188.4
RENK	RK571PWE	96	RR2	61.3	35.6	90.3	9.0	74.2	21.0	52.8	165.4	--
Proseed	2496 PCE	96	Enlist	61.3	35.7	90.8	9.5	73.5	21.0	53.0	184.9	--
Proseed	2196 VT2P	96	RR2	60.3	35.7	88.5	8.1	74.1	20.6	53.2	179.0	188.1
Proseed	2398 TRE	98	Enlist	59.3	39.4	96.2	9.2	72.6	20.3	53.3	233.6	208.3
Thunder Seed Inc.	T6294 VT2P	94	RR2	59.0	36.9	87.6	7.8	74.6	19.7	55.5	167.9	--
Thunder Seed Inc.	T6396 VT2P	96	RR2	58.8	37.2	91.0	8.3	73.2	19.3	54.4	214.7	210.6
Thunder Seed Inc.	T6497 TRE	97	RR2	58.8	38.0	89.8	8.7	73.7	20.6	53.6	231.0	--
Thunder Seed Inc.	T6498 PC	98	Enlist	59.5	36.5	95.7	9.2	73.9	21.1	53.3	242.3	--
Dyna-Gro Seed	D33QZ83EZ	93	GT	58.0	37.2	89.0	8.9	73.1	19.6	55.1	214.3	200.2
Dyna-Gro Seed	D34VC93RIB	94	RR2	61.5	34.7	81.9	8.4	73.1	19.3	54.6	157.2	177.8
Dyna-Gro Seed	D38VC80RIB	98	RR2	59.8	35.5	85.5	8.5	73.3	20.3	53.4	210.1	207.0
Mean				59.7	37.1	89.8	8.7	73.5	20.1	54.1	201.1	--
C.V. (%)				4.0	11.1	6.9	9.6	1.0	4.1	1.3	19.1	--
LSD (0.05)				3.4	5.8	9	1.2	1.0	1.2	1.0	54.4	--
LSD (0.10)				2.8	4.8	7.3	1.0	0.8	1.0	0.9	45.6	--

Planting Date = May 21; Harvest Date = November 4; Previous Crop = Corn

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

Brand	Hybrid	RM	Traits	Days to Silk	Ear Height	Plant Height	Grain Protein	Grain Starch	Moisture	Test Weight	--Grain Yield-- 2023	2 yr. Avg.
				DAP	inch	inch	%	%	%	lb/bu	bu/a	bu/a
REA Hybrids	92B10	92	RR2	52.3	43.6	100.6	7.7	73.5	17.0	56.1	257.6	246.6
REA Hybrids	93F72	93	RR2	55.0	46.4	104.5	8.2	73.3	18.6	53.5	297.7	--
REA Hybrids	96A79	96	RR2	55.3	43.7	104.0	8.3	72.8	18.3	55.6	298.9	--
Dairyland Seed	DS-3601AM	96	RR2Y/LL	53.8	48.0	103.8	8.8	73.1	18.9	55.0	306.0	278.5
Legacy Seeds	LC461-21	95	RR2	52.8	48.9	107.4	8.6	73.3	18.7	56.9	310.4	266.5
Legacy Seeds	LC464-21	96	GT/LL	55.0	48.7	110.0	8.7	73.6	20.0	54.9	297.0	272.9
Legacy Seeds	LC465-23	96	Enlist	55.0	45.1	106.5	9.2	73.7	20.1	54.1	314.6	--
Legacy Seeds	LC474-23	97	Enlist	52.5	48.0	103.7	9.0	72.7	19.3	54.6	325.4	--
Legacy Seeds	LC474-20 TRE	97	RR2,VT2P Trecepta	55.5	47.8	110.3	9.0	72.4	19.3	54.4	316.9	--
RENK	RK400VT2P	91	RR2	52.8	46.4	99.4	9.0	72.1	18.3	57.6	293.2	245.9
RENK	RK444VT2P	93	RR2	54.0	49.2	104.3	8.3	73.1	18.7	55.2	289.0	257.2
RENK	RK485DGVT2P	94	RR2	53.0	47.2	104.9	8.6	73.2	19.2	56.5	308.5	272.4
RENK	RK561DGVT2P	95	RR2	53.5	42.8	99.5	8.8	72.6	18.7	55.6	287.5	266.2
RENK	RK571PWE	96	RR2	55.0	48.5	107.2	10.1	72.8	19.9	54.6	329.9	--
Thunder Seed Inc.	T6497 TRE	97	RR2	53.8	42.8	100.2	8.9	72.9	19.6	55.4	296.6	--
Thunder Seed Inc.	T6498 PC	98	Enlist	55.3	48.9	108.9	9.4	73.6	19.9	54.3	322.8	--
Dyna-Gro Seed	D33QZ83EZ	93	GT	52.0	48.3	97.9	8.9	72.4	17.7	56.4	288.3	254.6
Dyna-Gro Seed	D34VC93RIB	94	RR2	53.3	48.8	104.9	8.2	72.9	18.2	55.9	285.7	257.0
Mean				53.8	46.7	103.9	8.8	73.0	19.1	55.3	300.7	--
C.V. (%)				1.7	5.8	3.4	4.8	0.6	3.4	0.8	4.9	--
LSD (0.05)				1.3	3.8	5.0	0.6	0.6	0.9	0.6	20.9	--
LSD (0.10)				1.0	3.2	4.2	0.5	0.5	0.8	0.5	17.5	--

Planting Date = May 23; Harvest Date = November 3; Previous Crop = Soybean

Corn - Irrigated **Dickey County - Oakes (Page 2 of 2)**

Brand	Hybrid	RM	Traits	Days to Silk	Ear Height	Plant Height	Grain Protein	Content Starch	Content Oil	Moisture	Test Weight	--Grain Yield-- 2022	--Grain Yield-- 2 yr. Avg.
				DAP	inch	inch	%	%	%	%	lb/bu	bu/a	bu/a
REA Hybrids	95B53	95	RR2	53.5	46.5	102.1	8.6	72.5	3.8	18.4	55.5	317.6	--
REA Hybrids	98A15	98	RR2Y/LL	54.3	49.8	104.3	9.3	73.1	3.4	20.6	55.0	300.9	--
Dairyland Seed	DS-3881AM	98	RR2Y/LL	53.3	41.2	99.5	9.7	72.8	3.0	20.9	54.0	299.2	--
Dairyland Seed	DS-3900AM	99	RR2Y/LL	52.3	49.5	106.5	8.7	73.5	3.1	20.2	55.4	311.0	--
Thunder Seed Inc.	T6397 AA	97	GT/LL	54.8	48.3	108.6	8.5	74.0	2.9	20.1	54.9	288.9	274.3
Thunder Seed Inc.	T6298 VT2P	98	RR2	54.8	45.6	101.7	8.3	73.3	3.5	20.0	54.4	298.5	264.8
Dyna-Gro Seed	D31VC23RIB	91	RR2	52.8	44.3	96.2	8.9	72.3	3.7	17.9	57.3	274.7	--
MEAN				53.8	46.7	103.9	8.8	73.0	3.3	19.1	55.3	300.7	--
C.V. (%)				1.7	5.8	3.4	4.8	0.6	5.0	3.4	0.8	4.9	--
LSD 0.05				1.3	3.8	5.0	0.6	0.6	0.2	0.9	0.6	20.9	--
LSD 0.10				1.0	3.2	4.2	0.5	0.5	0.2	0.8	0.5	17.5	--

Planting Date = May 23; Harvest Date = November 3; Previous Crop = Soybean

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

Corn Silage - Dryland

Carrington (Page 1 of 2)

Brand	Variety	RM	Traits	Days to Silk	Ear Ht	Plant Ht	Harvest Moisture	DM	Yield 2023	Yield 2-yr. Avg.	Yield 3-yr. Avg.
				DAP	inch	inch	%	%	ton/a (65%)		
REA Hybrids	97P78	97	SmartStax Pro w/RNAi	69.0	27.6	95.3	56.2	43.8	28.2	--	--
Proseed	LFY 101	101	RR	75.3	33.2	114.4	65.9	34.1	28.2	25.2	19.1
Proseed	STS 106	106	GT/CB/LL	73.7	35.2	109.8	68.5	31.5	24.1	21.9	--
Integra	STP4723	97	RR2	70.0	27.4	111.3	59.3	40.7	22.0	--	--
Integra	STP5191	101	RR2	76.0	29.7	118.9	66.4	33.6	29.0	25.3	19.7
Golden Harvest	G95D32	95	V/GT/LL	67.3	25.3	100.9	56.0	44.0	23.2	--	--
Croplan	3200S	92	RR	71.3	29.5	118.0	63.0	37.0	26.4	24.5	--
Croplan	4100S	101	VT2P/RIB	73.0	19.7	105.2	63.7	36.3	24.9	21.7	--
Croplan	4200S	102	RR	75.0	28.3	114.4	66.1	33.9	26.4	--	--
Mean				72.3	28.4	109.8	62.8	37.2	25.8	--	--
C.V. (%)				1.6	21.2	5.0	3.9	6.6	8.3	--	--
LSD (0.05)				2.0	10.5	9.5	4.3	4.3	3.7	--	--
LSD (0.10)				1.7	8.6	7.9	3.5	3.5	3.1	--	--

Planting Date = May 12; Harvest Date = September 12; Previous Crop = Soybean

No significant lodging.

		60 days after ensiling												
Brand	Variety	pH	Crude Protein	ADF*	aNDF*	Starch*	EE*	Ca	P	Mg	K	TDN	NEg	RFV*
			% DM										Mcal/cwt	
REA Hybrids	97P78	4.0	6.7	23.8	42.1	30.3	3.1	0.2	0.2	0.2	0.7	72.5	46.0	159.3
Proseed	LFY 101	3.8	7.9	25.2	43.5	24.4	3.1	0.3	0.2	0.2	1.1	68.9	43.8	147.9
Proseed	STS 106	3.6	7.9	22.7	39.7	28.6	3.5	0.3	0.2	0.2	1.0	70.9	45.3	166.8
Integra	STP4723	4.0	8.3	22.6	40.1	30.3	3.4	0.3	0.2	0.2	1.0	70.9	45.2	168.5
Integra	STP5191	3.9	7.8	25.2	43.4	23.8	2.9	0.3	0.2	0.2	1.1	69.6	44.3	148.0
Golden Harvest	G95D32	3.9	6.6	23.8	41.6	34.9	3.1	0.2	0.2	0.2	0.6	71.7	45.6	158.3
Croplan	3200S	4.0	7.5	31.8	53.7	14.0	2.5	0.3	0.2	0.2	1.0	67.3	42.5	108.2
Croplan	4100S	3.9	7.1	29.8	51.0	18.1	2.6	0.3	0.2	0.2	1.1	68.1	42.9	121.9
Croplan	4200S	3.9	8.0	27.3	47.2	20.9	2.8	0.3	0.2	0.2	1.1	68.1	43.2	133.1
Mean		3.8	7.6	25.9	44.9	24.1	3.0	0.3	0.2	0.2	1.0	69.7	44.3	145.1
C.V. (%)		3.2	5.2	5.7	4.9	12.5	4.0	12.4	5.1	9.4	20.8	3.3	3.8	7.0
LSD (0.05)		0.2	0.7	3.7	5.5	7.6	0.3	0.1	0.0	0.0	0.4	4.0	2.9	24.9
LSD (0.10)		0.2	0.6	1.4	2.1	3.0	0.1	0.0	0.0	0.0	0.3	3.3	2.4	9.7

Planting Date = May 12; Harvest Date = September 12; Previous Crop = Soybean

No significant lodging.

* Best Linear Unbiased Estimate

Corn Silage - Irrigated

Brand	Variety	RM	Traits	Days to Silk	Ear Ht	Plant Ht	Harvest Moisture	DM	Yield 2023	Yield 2-yr. Avg.
				DAP	inch	inch	%	%	ton/a (65%)	
Channel	198-99	98	SSPRIB	71.0	33.3	111	55.2	44.8	37.3	--
Channel	201-07	101	SSPRIB	68.7	37.0	106	56.5	43.5	33.0	--
Channel	201-14	101	VT2PRIB	68.0	35.4	109	54.3	45.7	35.8	--
Channel	203-01	103	VT2PRIB	68.7	35.6	107	55.9	44.1	35.2	--
REA Hybrids	93F72	93	VT4Pro w/RNAi	69.0	32.4	102	52.6	47.4	29.8	--
REA Hybrids	97P78	97	SmartStax Pro w/RNAi	69.0	34.6	107	49.0	51.0	35.3	--
Dairyland Seed	HIDF-3855Q	98	Q	67.7	35.3	113	51.7	48.3	34.7	31.1
Dairyland Seed	HIDF-3802Q	102	Q	70.3	38.8	117	59.8	40.2	36.5	31.9
Legacy Seeds	LC506-22	100	RR2	75.0	30.1	117	57.5	42.5	41.2	--
Legacy Seeds	LC555-21	100	GT/LL	69.3	34.3	103	57.7	42.3	34.1	30.0
Legacy Seeds	LC585-22	103	GT/LL	73.3	38.1	120	62.2	37.8	37.0	--
Integra	STP4723	97	RR2	70.3	43.2	138	51.3	48.7	33.5	--
Integra	STP5191	101	RR2	75.7	32.8	128	58.2	41.8	41.5	--
Croplan	4100S	101	VT2P/RIB	72.3	36.0	118	57.1	42.9	36.0	31.1
Croplan	4200S	102	RR	76.3	38.8	122	58.0	42.0	42.2	--
Mean				71.0	35.7	114	55.8	44.2	36.2	--
C.V. (%)				1.8	16.8	7.4	6.1	7.6	10.4	--
LSD (0.05)				2.1	10.0	14.2	5.6	5.6	6.3	--
LSD (0.10)				1.7	8.3	11.8	4.7	4.7	5.2	--

Planting Date = May 12; Harvest Date = September 25; Previous Crop = Field Pea

No significant lodging.

Corn Silage - Irrigated **Carrington (Page 2 of 2)**

		60 days after ensiling												
Brand	Variety	pH	Crude Protein	ADF	aNDF	Starch	EE	Ca	P*	Mg*	K	TDN	NEg	RFV
			% DM										Mcal/cwt	
Channel	198-99	4.0	7.2	24.2	40.4	31.2	3.2	0.3	0.2	0.2	0.9	70.9	45.8	162.3
Channel	201-07	4.0	7.0	25.4	42.8	27.5	2.9	0.2	0.2	0.2	1.0	70.1	44.9	150.8
Channel	201-14	4.1	7.5	21.8	36.6	37.1	3.1	0.2	0.2	0.1	0.9	72.6	47.2	188.0
Channel	203-01	4.0	7.0	26.0	44.6	26.5	3.1	0.2	0.2	0.2	1.0	69.6	44.2	145.5
REA Hybrids	93F72	4.1	7.5	28.3	47.2	23.1	2.4	0.3	0.2	0.2	1.1	68.0	43.5	132.3
REA Hybrids	97P78	4.1	7.4	24.5	41.2	30.8	3.0	0.3	0.2	0.2	1.0	70.7	45.5	162.2
Dairyland Seed	HIDF-3855Q	4.0	7.1	30.2	48.4	21.3	2.3	0.3	0.2	0.2	1.1	66.7	42.9	128.8
Dairyland Seed	HIDF-3802Q	4.0	7.4	24.4	41.0	29.9	3.2	0.3	0.2	0.2	1.0	70.7	45.6	161.5
Legacy Seeds	LC506-22	4.1	7.7	28.7	48.1	22.4	2.7	0.3	0.2	0.2	1.2	67.7	43.2	132.8
Legacy Seeds	LC555-21	4.0	7.9	27.3	45.5	25.6	2.9	0.3	0.2	0.2	1.3	68.7	44.2	143.7
Legacy Seeds	LC585-22	3.9	7.7	27.1	44.8	22.4	2.7	0.3	0.2	0.2	1.1	68.9	44.4	141.3
Integra	STP4723	4.2	8.1	27.5	45.7	25.4	2.7	0.3	0.2	0.2	1.2	68.6	44.2	139.4
Integra	STP5191	4.0	7.2	31.1	50.7	18.1	2.2	0.3	0.2	0.2	1.2	66.1	42.2	119.7
Croplan	4100S	4.0	6.6	24.4	41.1	32.5	2.7	0.2	0.2	0.2	0.9	70.8	45.4	160.8
Croplan	4200S	4.0	7.8	27.1	44.9	23.6	2.5	0.3	0.2	0.2	1.2	68.8	44.3	143.2
Mean		4.0	7.4	26.5	44.2	26.5	2.8	0.3	0.2	0.2	1.1	69.3	44.5	147.5
C.V. (%)		2.6	5.4	16.1	14.0	27.1	11.1	14.1	3.6	4.6	18.0	4.3	4.9	19.7
LSD (0.05)		0.2	0.7	7.1	10.3	12.0	0.5	0.1	0.0	0.0	0.3	5.0	3.6	48.7
LSD (0.10)		0.1	0.6	5.9	8.6	10.0	0.4	0.1	0.0	0.0	0.3	4.1	3.0	40.5

Planting Date = May 12; Harvest Date = September 25; Previous Crop = Field Pea

No significant lodging.

*Best Linear Unbiased Estimate

Winter Rye Forage — **Carrington**

Variety	Crop Type	Harvest Date	Plant Height	Harvest Moisture	Yield Dry Matter	CP	ADF	NDF	ASH	Ca	P	Mg	K	S	RFV	RFQ
			inch	%	ton/ac	%	%	%	%	%	%	%	%	%		
ND Dylan	Winter Rye	8-Jun	35.4	75.1	1.29	13.0	37.2	59.7	7.6	0.37	0.34	0.22	2.31	0.22	93.5	140.4
Aroostook	Winter Rye	2-Jun	27.6	78.2	0.8	15.5	33.2	54.7	8.6	0.45	0.35	0.25	2.32	0.24	107.3	153.1
Hazlet	Winter Rye	8-Jun	32.8	76.4	1.06	13.9	35.7	59.3	8.0	0.37	0.35	0.23	2.22	0.23	96.0	146.9
ND Gardner	Winter Rye	2-Jun	30.8	76.4	0.98	13.6	36.4	58.4	8.3	0.42	0.34	0.22	2.1	0.21	96.6	147.5
KWS Aviator	Winter Rye	8-Jun	34.3	76.3	1.06	14.5	36.9	58.8	8.7	0.42	0.35	0.23	2.04	0.24	95.3	134.3
KWS Propower	Winter Rye	8-Jun	28.2	75.6	0.9	14.8	36.3	58.3	8.6	0.42	0.35	0.24	2.09	0.25	96.9	134.1
KWS Progas	Winter Rye	8-Jun	30.1	75.2	0.92	15.0	36.0	58.2	8.7	0.41	0.35	0.24	2.14	0.26	97.4	138.5
	Mean		31.3	76.2	1.0	14.3	35.9	58.2	8.4	0.41	0.35	0.23	2.17	0.24	97.6	142.1
	C.V. (%)		6.1	1.1	9.4	6.0	2.9	2.3	8.3	7.8	3.91	5.73	5.6	6.4	3.5	5.3
	LSD 0.05		2.9	1.3	0.14	1.5	1.9	2.4	1.2	0.06	0.02	0.02	0.22	0.03	6.1	13.4

Planting Date = September 16, 2022; Harvest Date = Various; Previous Crop = Durum

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Groundbreaking of new headquarters at Oakes Irrigation Research Site. Photo by Kimberly Cook, Garrison Diversion Conservancy District.

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