North Central Research Extension Center

MINOT, NORTH DAKOTA

2020 Annual Research Report No. 38

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NDSU | EXTENSION

NDSU NORTH DAKOTA AGRICULTURAL EXPERIMENT STATION

North Central Research Extension Center

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Weather Conditions-Minot

	2020 Precipiation	114 Year Average	Departure from Average	2020 Average	114 Year Average	Departure from Average
	----------Inches----------			----------Fahrenheit----------		
December (2019)	0.6	0.6	0.0	16.4	13.5	2.9
January	0.5	0.6	-0.1	12.0	7.6	4.4
February	0.1	0.5	-0.4	18.1	12.1	6.0
March	0.6	0.7	-0.1	28.8	24.5	4.3
April	0.9	1.5	-0.6	36.4	40.5	-4.1
May	1.4	2.3	-0.9	52.5	53.4	-0.9
June	2.9	3.3	-0.4	65.8	62.8	3.0
July	2.8	2.3	0.5	69.7	68.5	1.2
August	1.5	2.0	-0.5	68.6	66.7	1.9
September	0.3	1.6	-1.3	56.9	56.2	0.7
October	0.4	1.1	-0.7	37.9	43.8	-5.9
November	0.3	0.8	-0.5	31.0	27.3	3.7
Total	**12.3**	**17.3**	**-5.0**	**41.2**	**39.7**	**1.5**

	2020	20 Year Average
		----------Fahrenheit----------
Lowest Temp*	-24° (Jan-16)	-26°
Days ≤ 0°	21	42
Highest Temp*	95° (Jun-28 & Aug-20)	97°
Days ≥ 90°	7	9
First Fall Frost	Sep-08	Sep-28
Last Spring Frost	May-11	May-13
Frost Free Days	118	137
GDD** for Corn (May 15-Oct 1)	2073	2015
GDD** for Wheat (May 1-Aug 12)	3137	3167
GDD** for Sunflower (May 31-Oct 28)	2671	2718

**Historic Dates: Coldest Day: Feb 15, 1936 (-49°), Highest Day: July 11, 1936 (109°)*

***Growing Degree Day*

2020 NDSU North Central Research Extension Center Summary

The mission of the North Central Research Extension Center (NCREC) is to conduct applied agricultural research that can help find practical answers to crop production questions, conduct educational programs and demonstrations to address these problems, and to increase foundation grade seed of new and popular crop varieties for this growing region.

Agronomy

The North Central Research Extension Center conducts the majority of its agronomic field research trials at the main research facility south of Minot. The agronomy program also utilized off-station locations to strengthen and enhance its research capabilities. Off-station sites have been established at the Dean Schoenberg Farm west of Mohall, at the Dave Teigen Farm west of Rugby, at the Bendickson Farm east of Garrison and at the Wes Doepke Farm north of Wilton. A few individual trials were also conducted at various locations throughout the region and are noted in individual research reports. The NCREC thanks these farmer-cooperators along with county Extension staff, agricultural crop improvement associations and many others for their dedicated support of these research efforts.

Beginning with the 2013 cropping year, agronomic research studies (with a few exceptions) were conducted utilizing no-till methods in a continuous cropping system. Broadleaf crop trials were typically planted into small grain stubble and small grain trials were typically planted into soybean. Soil samples from each research site were collected and analyzed for macro and micro nutrients. Each research site then received fertilizer applications based on those results. Urea (46-0-0) was the primary source of nitrogen and was "planted" prior to seeding or was applied in a mid-row band at seeding time. Monoammonium phosphate (11-52-0) was the primary source of phosphorous and was applied either directly in the seed row or in a mid-row band at planting. Seeding rates were adjusted for seed size and germination to provide a uniform number of pure live seeds (PLS) per acre for each crop and variety. Small plots were seeded with no-till drills equipped with coulter disc openers set at a 7 or 7 ½ -inch row spacing. Row crops were planted with a SRES small plot planter utilizing Great Plains no-till openers and Monosem singulation seed meters. All small grain crops received an early post-emergence herbicide application for weed control. Broadleaf crops typically received a pre-plant herbicide application to control broadleaf weeds followed by a post-emergence herbicide application to control grassy weeds. Other specific pest problems such as flea beetles in canola and scab on small grain crops were also treated with appropriate pest control measures when possible.

The fall of 2019 was relatively wet, providing for a full soil moisture profile for the 2020 growing season. Very little winter wheat was planted in the North Central region of the state and many late season crops were abandoned or left to harvest the following spring. The winter of 2019/2020 was generally open with little snow and relative mild temperatures. Spring was generally cool with spotty rainfall. Some areas had dry topsoil while other areas were saturated. Planting began in early May for most areas, slightly later than normal. A snow storm on May 9 was the culmination of more than 6 months of "winter" weather. Spring time growing conditions were generally dry and windy. Pre-emergence and early POST emergence herbicide applications were challenging and dry growing conditions often hampered herbicide effectiveness and caused some crop injury. Dry conditions persisted through June but crops were able to utilize stored soil moisture. Timely rainfall during the first part of July provided adequate moisture as crops transitioned into reproductive stages. Summertime temperatures were generally conducive to ideal plant growth. Harvest began in August and was generally uninterrupted for both small grain and row crops. A frost on September 9 caused some lighter test weights in corn and shriveled green seeds in late maturing soybeans. Plant diseases generally were not a big issue but fusarium head blight was reported in localized areas. Cereal leaf beetles and grasshoppers caused some minor defoliation in various crops. This year's cropping season can be summarized as being good with average to above average yields and good seed quality.

Extension Education

The NDSU North Central Research Extension Center's Extension specialists provide information and producer education, working closely with county Extension agents and state Extension specialists. Activities include consultations and presentations delivered through individual contacts and group meetings, workshops, schools, field days and tours. Informal and formal presentations include topics and issues associated with crop production, livestock production, and soil health. Feel free to contact the NCREC at (701) 857-7682 to discuss issues or concerns with NDSU Extension specialists.

Crop Protection: Activities centered on crop protection focused on pest management, beneficial insects, and native pollinators among area crops. During the 2020 season, extension and research activities were focused on pest management and prevention. Research related activities investigated control of red sunflower seed weevil and canola flea beetle. Additionally, evaluations of fungicides and adjuvants were conducted in small grain and dry bean trials. Furthermore, pest and disease pressure were monitored throughout North Dakota and reported with weekly contributed updates released through the publication of NDSU's Crop & Pest Report. Educational activities included producer attended meetings, virtual summer field tours, beneficial insect and native pollinator community meetings, and agent trainings. COVID19 provided some interesting obstacles, however, events were well attended and focused on a variety of crop protection/cropping system topics. Pollinator conservation topics were popular with programs offered throughout the region. Youth education continues to serve as an on-going mission in the area with several presentations centered on area entomology and their relation to agriculture.

Soil Health: Activities at the NCREC focused on soil pH, salinity, fertility, and cover crops. These activities included county-based workshops, soil testing clinics, saline management studies, soil remediation projects, and pipeline reclamation studies.

Foundation Seed Increase
The NCREC Foundation Seed program works closely with the Foundation Seedstocks program and plant breeders at NDSU's Main campus in Fargo. The NCREC's role is to help facilitate the increase of new varieties from Fargo's main campus out to producers in north central North Dakota. The program also maintains inventory of several popular crop varieties grown in the area.

The varieties that will be available for the 2020-2021 cropping season are: ND Genesis barley, Divide, Joppa, ND Grano, ND Riveland durum, ND Hammond, Omega, York flax, Barlow, Bolles, Duclair, MN Torgy, ND Frohberg, ND VitPro HRSW, Hayden, Jury, Souris oat, ND Dawn peas, Ashtabula, ND 170009GT soybean.

Pulse Crops Breeding
While the director of the program (Dr. Nonoy Bandillo) is based out of NDSU main campus, our program spans the entire state of North Dakota. With a research specialist (Hannah Worral) housed at the North Central Research Extension Center (NCREC), where field research trials are conducted, the program benefits from having a strong presence in the heart of the pulse growing region of North Dakota. Collaborative efforts with other NDSU Research Extension Centers (RECs) are also coordinated out of the NCREC and complement research underway on the main campus. Our gene-array and molecular marker laboratory on the main campus is up and running thanks to our new lab manager (Lisa Piche), and our graduate student (Jenna Steffes) continues to make headway in her research focused on the genetic dissection of complex traits in dry pea with an emphasis on protein content. Our new Postdoctoral Research Associate (Md Abdullah Al Bari) is exploring genetic diversity in the USDA pea germplasm collection through the use of GWAS and spearheading our high-throughput phenotyping of dry pea for disease resistance to Fusarium and Aphanomyces root rots. Additional collaborations in 2020 included salinity trials conducted at Minot together with Dr. Qi Zhang (Associate Professor of Turfgrass Stress Physiology at NDSU) and Rhizobia experiments in chickpea conducted at the Williston REC by Dr. Audrey Kalil (Plant Pathologist). In addition to our small green lentil 'ND Eagle' released in 2017, we released a new kabuli chickpea cultivar ('ND Crown') and a new yellow dry pea ('ND Dawn') this year. We are excited to provide producers in the Northern Plains region cultivars tailored to their environment and look forward to releasing more of our promising lines in the future. Single-plant-selections were made for one green dry pea, one large green lentil, and three medium green lentil pre-release lines. Seed for our pre-release green dry pea was sent to New Zealand for breeder seed increase. The lentil pre-release lines will be grown out at Minot for breeder seed increase in 2021. We evaluated 298 dry pea and 91 lentil breeding lines across six different locations in 2020 in addition to screening segregating materials and creating crosses both in the field (Minot) and in the greenhouse (Minot and Fargo).

Weed Science
Weed control studies are conducted in small grains, canola, faba bean, sunflower, flax, dry bean, dry pea, lentil, chickpea, corn, soybean, and others. We evaluate new herbicides/adjuvants or different uses of existing products in various crops. Other experiments involve evaluation of the impact of different cultural practices such as crop rotation and conventional tillage vs no-till on crop yield, seed quality, weed control, and economic feasibility. We conduct IR-4 trials to collect data for registration of pest control products in minor crops. We conduct studies that target specific weeds such as Canada thistle, wild oat, foxtails, kochia, narrowleaf hawksbeard, horseweed, and others.

Interpreting Statistical Analysis

Field research involves the testing of one or more variables such as crop varieties, fertilizers, weed control methods, etc. Field testing of such variables are conducted in order to determine which variety, fertilizer, herbicide, etc. is best for the particular area of production. The main objectives of crop production research are to determine the best means of producing a crop and how to maximize yield and economic return from farming. Agricultural researchers use statistics as a tool to help differentiate production variables so that real and meaningful conclusions can be drawn from a relatively large amount of data gathered from relatively small research plots.

One of these tools is the Coefficient of Variability (C.V.). This statistic gives an indication of the amount of variation in an experimental trial and is an indication of the precision or effectiveness of the trial and the procedures used in conducting it. Attempts are made to control human error and some environmental conditions such as soil variability by replicating the variable in question. For example, there were three plots (replications) of the variety “Faller” grown in the Minot HRSW variety trial. The plots are mixed and dispersed throughout the trial to help eliminate differences that might be a result of soil, chaff rows or other variables. The numbers that you see in the tables are an average of all three replications.

The C.V. for yield in the 2020 Minot HRSW variety trial was 10.3 meaning that there was a 10.3 percent average variation between high and low yields among replications. In summation, a trial with a C.V. of 6 is more precise and more can be concluded from it than a trial with a C.V. of 16.

Another important statistical tool is the Least Significant Difference or LSD. If the yield of variety A exceeds variety B by more than the LSD value, you can conclude that under like environmental conditions, variety A is expected to significantly out-yield variety B. The LSD value allows you to separate varieties, fertilizers, herbicides, or any other variable and determine whether or not they are actually different. An LSD of .05 or 5% is always larger and gives you more precision than an LSD of .1 or 10%. Little confidence can be placed in a variety or treatment unless the results differ by more than the LSD value.

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2020 Hard Red Spring Wheat Variety Trial at Minot

Variety	Days to Head	Plant Height	Lodging	Test Weight	Protein	Grain Yield				
									---- Average ----	
						2018	2019	2020	2 year	3 year
	DAP[1]	inches	0-9*	lbs/bu	%	bu/A				
LCS Trigger	62	29	0	61.0	12.2	97.3	54.9	73.0	64.0	75.1
Faller	59	27	2	59.6	13.6	101.7	58.0	63.8	60.9	74.5
SY Rockford	59	26	0	59.2	13.4	102.0	50.9	64.6	57.8	72.5
CP3530	59	28	2	60.3	14.0	92.3	47.0	67.8	57.4	69.0
SY 611CL2	57	23	0	61.6	14.5	90.8	47.1	68.7	57.9	68.9
MS Barracuda	54	25	2	60.2	15.0	94.6	51.8	59.6	55.7	68.7
Shelly	58	24	0	59.9	13.7	97.7	42.4	64.3	53.3	68.1
TCG Spitfire	59	26	0	60.8	14.0	85.6	49.8	68.9	59.4	68.1
MS Chevelle	56	24	1	60.5	12.7	85.1	49.0	69.0	59.0	67.7
AAC Penhold	58	24	0	60.1	14.4	89.5	48.5	63.4	55.9	67.1
Lanning	56	24	1	59.2	14.3	94.3	47.9	56.4	52.1	66.2
Boost	58	28	0	60.1	14.9	86.1	50.9	58.6	54.7	65.2
Sy Soren	58	24	0	60.5	15.4	84.6	48.6	61.7	55.1	65.0
Elgin ND	56	28	0	59.4	14.7	82.8	50.6	60.9	55.7	64.8
DG Ambush	55	26	0	61.8	14.9	87.7	44.6	59.9	52.3	64.1
SY Longmire**	57	25	0	60.5	14.9	81.0	47.0	63.5	55.3	63.8
AAC Goodwin	57	28	1	61.0	15.2	78.0	49.1	63.8	56.4	63.6
Bolles	57	26	0	59.9	16.7	81.8	45.6	59.1	52.3	62.2
Lang-MN	59	26	0	61.3	14.0	77.6	50.6	58.2	54.4	62.1
SY Valda	57	23	1	60.3	13.5	88.7	44.6	52.1	48.3	61.8
SY McCloud	56	26	0	60.7	14.9	90.8	41.0	53.3	47.2	61.7
LCS Cannon	54	23	0	61.6	13.9	84.5	43.1	56.3	49.7	61.3
Linkert	57	24	0	60.5	15.9	84.5	42.4	56.5	49.5	61.1
LCS Rebel	56	28	1	62.1	14.0	74.5	48.3	60.2	54.3	61.0
MN Washburn	58	23	0	60.1	13.6	80.4	47.3	54.6	51.0	60.8
Mott**	60	30	0	60.8	14.9	76.0	49.2	56.9	53.1	60.7
ND Frohberg	57	29	0	61.5	15.4	80.4	41.2	59.9	50.6	60.5
Barlow	54	25	1	61.4	14.4	82.4	46.2	52.1	49.1	60.2
Glenn	55	27	1	61.0	15.2	82.2	39.2	55.8	47.5	59.1
SY Ingmar	57	25	0	61.2	15.5	82.3	37.0	55.9	46.5	58.4
ND Vitpro	55	26	1	60.8	15.1	77.1	39.1	52.3	45.7	56.2
DG Commander	55	26	0	60.5	14.4	--	55.7	66.7	61.2	--
CP3910	56	25	1	61.0	14.7	--	48.5	70.1	59.3	--
Duclair**	58	29	2	59.8	14.1	--	47.2	66.1	56.7	--
MN Torgy	57	24	0	60.8	13.7	--	49.3	61.3	55.3	--
CP3915	57	24	0	60.6	13.7	--	50.3	55.6	53.0	--
TCG Heartland	56	24	0	61.1	15.0	--	49.5	55.9	52.7	--
Dagmar**	57	24	1	58.3	15.1	--	48.7	51.6	50.2	--
AP Murdock	57	23	0	59.5	14.0	--	40.2	59.7	50.0	--

Continued on next page

2020 Hard Red Spring Wheat Variety Trial at Minot Continued

Variety	Days to Head	Plant Height	Lodging	Test Weight	Protein	Grain Yield 2018	2019	2020	Average 2 year	Average 3 year
	DAP[1]	inches	0-9*	lbs/bu	%	bu/A				
TCG Stalwart**	56	22	1	57.3	15.5	--	48.2	50.8	49.5	--
LCS Buster	61	27	0	59.4	12.2	--	--	75.9	--	--
TCG Wildcat	57	26	0	61.6	14.7	--	--	65.7	--	--
DG Ballistic	58	26	0	59.6	13.9	--	--	65.3	--	--
Driver	58	27	0	61.8	13.8	--	--	65.0	--	--
CP3055	61	25	0	56.4	12.8		--	62.7	--	--
CP3903	55	26	1	59.7	15.3	--	--	60.6	--	--
MS Ranchero	56	23	0	58.9	12.9	--	--	59.6	--	--
Allegent 822	57	23	0	61.0	14.5	--	--	58.5	--	--
DG Velocity	57	25	1	61.2	15.4	--	--	55.0	--	--
Allegent 8432	55	22	0	60.1	15.7	--	--	52.8	--	--
Allegent 834	55	19	0	57.0	15.3	--	--	39.1	--	--
Trial Mean	57	25	0	60.3	14.4	86.1	47.0	59.9	--	--
C.V.%	1.6	5.1	88	1.2	5.5	10.2	13.7	10.3	--	--
LSD 5%	1	2	1	1.2	1.3	14.3	10.4	10	--	--
LSD 10%	1	2	1	1.0	1.0	1.0	8.7	8.4	--	--

[1] DAP = Days after planting. **Lodging: 0 = none, 9 = lying flat on the ground.*

*** Wheat Stem Sawfly tolerant.* *Previous Crop: 2017, 2018 & 2019 = soybean.*

No-till planted on May 1 with a seeding rate of 1.25 million PLS/A and harvested on August 24.

Soil Type: Williams Loam

2020 Hard Red Spring Wheat Variety Trial at Mohall

Cooperators: Dean Schoenberg and the Renville/Bottineau Ag Improvement Association

Variety	Plant Height	Lodging	Test Weight	Protein	Grain Yield 2018	2019	2020	---- Average ---- 2 yr	3 yr
	inches	0-9*	lbs/bu	%	bu/A				
TCG Spitfire	30	0	58.4	14.0	75.9	59.7	52.2	55.9	62.6
Elgin ND	33	0	59.8	15.1	67.2	54.3	54.9	54.6	58.8
Mott	34	0	60.5	14.6	65.0	53.0	55.2	54.1	57.7
SY Valda	29	0	59.8	15.0	67.0	50.6	46.8	48.7	54.8
SY Ingmar	29	0	60.7	15.2	57.4	49.1	50.7	49.9	52.4
Glenn	31	0	60.9	15.4	60.1	50.5	44.7	47.6	51.8
DG Ambush	29	0	60.1	14.9	60.4	52.1	42.5	47.3	51.7
ND Vitpro	29	0	60.9	14.9	58.0	50.6	44.3	47.4	51.0
Bolles	30	0	60.1	15.4	54.3	49.1	44.6	46.8	49.3
SY Soren	27	0	60.1	15.0	52.8	46.4	46.8	46.6	48.7
Linkert	26	0	59.8	15.3	52.0	48.2	39.9	44.1	46.7
LCS Rebel	32	0	60.4	16.2	--	56.0	44.8	50.4	--
SY Longmire	29	0	59.1	14.5	--	51.9	47.9	49.9	--
ND Frohberg	33	0	59.8	15.5	--	56.7	42.0	49.4	--
Lanning	29	0	57.9	16.1	--	52.1	46.4	49.3	--
LCS Cannon	27	0	60.5	14.6	--	50.0	47.1	48.6	--
MN Washburn	28	0	59.9	13.9	--	49.3	45.8	47.6	--
MS Barracuda	26	0	58.8	15.4	--	51.5	42.9	47.2	--
SY McCloud	29	0	60.1	15.4	--	51.2	40.5	45.8	--
TCG Stalwart	29	0	56.3	16.1	--	54.3	35.2	44.8	--
DG Ballistic	32	0	60.1	14.0	--	--	56.4	--	--
MN Torgy	29	0	60.5	14.6	--	--	55.3	--	--
CP3055	30	0	57.3	12.7	--	--	55.0	--	--
Faller	31	0	60.4	13.8		--	53.9	--	--
AP Murdock	26	0	59.2	14.0	--	--	51.2	--	--
Boost	32	0	60.6	15.2	--	--	50.9	--	--
Lang-MN	31	0	61.0	15.2	--	--	48.7	--	--
Dagmar	29	0	57.8	16.0	--	--	46.9	--	--
Shelly	28	0	59.6	14.1	--	--	45.8	--	--
DG Commander	29	0	59.0	14.2	--	--	45.3	--	--
Barlow	30	0	60.3	15.0	--	--	44.3	--	--
Allegent 822	28	0	57.8	14.2	--	--	39.3	--	--
DG Velocity	28	0	60.3	15.3	--	--	37.3	--	--
Allegent 834	22	0	53.7	15.5	--	--	23.5	--	--
Trial Mean	29	0	59.5	14.9	62.7	52.2	46.2	--	--
C.V.%	4.1	0	1.2	3.2	6.7	8.4	7.7	--	--
LSD 5%	2	NS	1.0	0.7	5.9	6.2	5.0	--	--
LSD 10%	1	NS	0.8	0.6	4.9	5.2	4.2	--	--

**Lodging: 0 = none, 9 = lying flat on the ground.*

NS = no statistical difference between varieties.

***Bold** = solid stem sawfly tolerant varieties.*

Planted on May 8 with a seeding rate of 1.25 million PLS/A and harvested on August 26.

Previous Crop: 2017 = durum, 2018 = canola, 2019 = durum.

Tillage: minimum till

Soil Type: Barnes loam

Note: The 2020 trial was infected with moderate levels of Fusarium Head Blight.

2020 Hard Red Spring Wheat Variety Trial at Rugby

Cooperators: Dave Teigen and the Pierce County Crop Improvement Association

Variety	Plant Height	Lodging	Test Weight	Protein	Grain Yield 2018	2019	2020	-- Average -- 2 yr	3 yr
	inches	0-9*	lbs/bu	%	bu/A				
TCG Spitfire	27	0	62.6	12.8	85.4	61.4	59.7	60.5	68.8
SY Valda	25	0	63.5	13.7	73.7	64.8	53.6	59.2	64.0
DG Ambush	26	0	64.7	14.1	77.4	64.8	49.0	56.9	63.7
SY Soren	23	0	62.5	15.1	82.7	60.8	45.9	53.3	63.1
Elgin-ND	30	0	62.1	13.1	71.9	67.7	49.0	58.3	62.9
Glenn	28	0	64.4	13.8	73.6	61.7	46.0	53.8	60.4
SY Ingmar	26	0	63.0	14.6	70.6	59.9	50.2	55.0	60.2
Bolles	27	0	62.8	15.7	69.8	62.3	45.3	53.8	59.1
Linkert	25	0	63.2	15.4	71.0	58.9	45.5	52.2	58.5
ND Vitpro	27	0	64.0	14.2	66.1	61.6	46.0	53.8	57.9
Lanning	28	0	62.0	13.4	--	67.2	49.3	58.3	--
LCS Rebel	30	0	63.9	14.0	--	65.7	50.2	58.0	--
SY Longmire	27	0	62.8	13.7	--	63.1	51.9	57.5	--
MN Washburn	26	0	62.7	13.2	--	62.5	50.0	56.3	--
SY McCloud	27	0	63.9	15.1	--	64.4	47.8	56.1	--
ND Frohberg	27	0	63.2	14.1	--	64.0	46.8	55.4	--
Mott	30	0	64.1	13.5	--	55.5	54.0	54.8	--
TCG Stalwart	26	0	62.1	13.9	--	57.7	48.2	53.0	--
LCS Cannon	23	0	63.3	14.8	--	64.8	26.6	45.7	--
MS Barracuda	23	0	62.5	14.3	--	61.7	28.6	45.1	--
CP 3055	28	0	60.5	11.3	--	--	61.3	--	--
DG Ballistic	29	0	62.7	12.7	--	--	58.6	--	--
Faller	28	0	62.3	13.2	--	--	53.2	--	--
MN Torgy	26	0	63.4	13.3	--	--	53.0	--	--
Boost	30	0	62.8	13.6		--	52.1	--	--
Allegent 822	26	0	64.4	13.0	--	--	51.2	--	--
Lang-MN	29	0	63.5	14.0	--	--	51.1	--	--
Shelly	24	0	63.6	13.3	--	--	50.6	--	--
DG Commander	26	0	62.7	13.4	--	--	50.5	--	--
Dagmar	26	0	62.1	14.1	--	--	48.4	--	--
DG Velocity	26	0	63.3	14.7	--	--	45.6	--	--
Barlow	29	0	63.5	14.0	--	--	45.4	--	--
AP Murdock	24	0	62.3	13.8	--	--	40.1	--	--
Allegent 8432	26	0	64.1	14.0	--	--	36.5	--	--
Trial Mean	27	0	63.1	13.9	76.7	62.9	48.1	--	--
C.V.%	4.7	0	1.2	3.3	6.7	5.7	6.7	--	--
LSD 5%	2	NS	1.1	0.6	7.2	5.1	4.5	--	--
LSD 10%	1	NS	0.9	0.5	6.0	4.2	3.8	--	--

**Lodging: 0 = none, 9 = lying flat on the ground.*

NS = no statistical difference between varieties.

***Bold** = solid stem sawfly tolerant varieties.*

Planted on May 7 with a seeding rate of 1.25 million PLS/A and harvested on August 19.

Previous Crop: 2017 = barley, 2018 = soybean, 2019 = barley

Tillage: minimum till

Soil Type: Gardena silt loam

2020 Hard Red Spring Wheat Variety Trial at Garrison

Cooperators: Brian and Roger Bendickson, Garrison

Variety	Plant Height	Lodging	Test Weight	Protein	Grain Yield 2018	2019	2020	-- Average -- 2 yr	3 yr
	inches	0-9*	lbs/bu	%	bu/A				
TCG Spitfire	22	0	56.6	13.0	68.4	61.2	31.1	46.1	53.6
SY Valda	23	0	58.4	13.4	65.7	61.1	33.0	47.0	53.3
Elgin ND	26	0	56.7	14.0	71.5	57.3	30.4	43.8	53.1
DG Ambush	24	0	59.0	14.6	67.5	57.5	28.3	42.9	51.1
Linkert	22	0	57.8	15.0	60.8	57.6	33.8	45.7	50.7
SY Ingmar	23	0	58.7	14.9	62.5	56.9	30.6	43.7	50.0
SY Soren	23	0	57.0	14.9	57.1	55.8	31.3	43.5	48.1
ND Vitpro	25	0	57.4	14.8	57.1	59.6	27.1	43.3	47.9
Glenn	27	0	58.5	14.5	61.0	54.9	27.3	41.1	47.7
Bolles	24	0	56.4	16.2	62.4	50.9	26.4	38.7	46.6
SY Longmire	23	0	57.7	14.3	--	63.6	33.4	48.5	--
LCS Rebel	26	0	58.8	14.2	--	64.4	30.7	47.5	--
SY McCloud	23	0	58.3	14.5	--	63.0	29.9	46.4	--
MS Barracuda	23	0	58.5	14.9	--	60.0	31.8	45.9	--
MN Washburn	22	0	57.6	13.9	--	60.7	30.5	45.6	--
Lanning	24	0	56.6	14.5	--	58.3	32.2	45.2	--
LCS Cannon	24	0	60.1	14.3	--	56.8	33.1	45.0	--
TCG Stalwart	22	0	55.7	14.7	--	55.5	29.3	42.4	--
ND Frohberg	26	0	57.7	14.2	--	53.3	29.5	41.4	--
Mott	25	0	59.4	13.2	--	49.9	32.6	41.2	--
MN Torgy	23	0	58.8	14.4	--	--	36.1	--	--
Dagmar	25	0	57.4	15.2	--	--	35.3	--	--
CP 3055	22	0	53.8	12.0		--	35.2	--	--
DG Ballistic	25	0	56.6	13.2	--	--	32.9	--	--
Shelly	22	0	56.8	13.9	--	--	32.3	--	--
Allegent 822	22	0	57.2	13.4	--	--	31.8	--	--
AP Murdock	22	0	58.6	14.0	--	--	30.8	--	--
Lang-MN	26	0	58.6	14.7	--	--	30.6	--	--
DG Commander	24	0	57.1	14.0	--	--	30.5	--	--
Faller	24	0	55.5	13.7	--	--	30.2	--	--
Allegent 834	22	0	57.8	14.6	--	--	28.9	--	--
Boost	25	0	57.9	14.3	--	--	28.7	--	--
Barlow	27	0	58.7	14.3	--	--	28.5	--	--
DG Velocity	23	0	58.7	14.9	--	--	28.5	--	--
Trial Mean	24	0	57.7	14.3	65.4	57.9	30.9	--	--
C.V.%	4.9	0	1.1	3.0	6.4	7.9	10.3	--	--
LSD 5%	2	NS	0.9	0.6	5.9	6.5	4.5	--	--
LSD 10%	1	NS	0.8	0.5	5.0	5.4	3.7	--	--

**Lodging: 0 = none, 9 = lying flat on the ground.*

NS = no statistical difference between varieties.

***Bold** = solid stem sawfly tolerant varieties.*

Planted on April 24 with a seeding rate of 1.25 million PLS/A and harvested on August 21.

Previous Crop: 2017 = spring wheat, 2018 = soybean, 2019 = spring wheat.

Tillage: no-till

Soil Type: Williams Bowbells loam

Note: The 2020 trial sustained a moderate infestation of Fusarium Head Blight.

2020 Hard Red Spring Wheat Variety Trial at Wilton
Cooperator: Wes Doepke, Wilton

Variety	Plant Height	Lodging	Test Weight	Protein	Grain Yield 2018	2019	2020	-- Average -- 2 yr	3 yr
	inches	0-9*	lbs/bu	%	bu/A				
TCG Spitfire	26	0	60.6	13.6	84.1	48.7	52.5	50.6	61.8
SY Ingmar	26	1	63.6	14.7	72.2	49.2	54.1	51.6	58.5
SY Soren	25	0	63.5	15.0	71.6	51.0	52.7	51.8	58.4
DG Ambush	27	2	63.5	14.8	74.0	54.6	46.2	50.4	58.3
Glenn	30	1	63.6	15.5	70.3	52.1	52.0	52.1	58.1
Elgin ND	30	0	63.0	14.8	71.8	47.6	53.3	50.5	57.6
Linkert	26	0	64.1	15.4	69.1	52.3	50.9	51.6	57.4
ND Vitpro	28	1	63.9	15.4	69.3	53.8	46.2	50.0	56.4
Bolles	29	1	62.7	17.0	68.3	48.8	51.7	50.3	56.3
SY Valda	25	0	64.0	13.3	64.7	49.0	46.8	47.9	53.5
LCS Rebel	30	2	63.8	15.2	--	51.7	56.8	54.2	--
ND Frohberg	30	0	64.0	14.4	--	51.3	56.0	53.6	--
LCS Cannon	26	1	65.0	14.2	--	53.8	51.0	52.4	--
MS Barracuda	26	1	63.7	15.3	--	49.7	55.2	52.4	--
SY McCloud	26	2	64.1	14.4	--	55.4	48.9	52.2	--
Mott	31	0	62.9	15.0	--	48.8	55.2	52.0	--
SY Longmire	26	0	63.2	14.6	--	47.7	55.2	51.5	--
MN Washburn	25	0	62.4	13.9	--	50.1	51.5	50.8	--
Lanning	27	1	63.2	15.2	--	46.0	53.6	49.8	--
TCG Stalwart	27	2	61.9	15.6	--	45.3	47.5	46.4	--
MN Torgy	26	1	63.6	14.9	--	--	59.8	--	--
Allegent 822	27	0	64.5	14.7	--	--	58.9	--	--
Faller	28	1	62.5	13.6		--	58.8	--	--
Dagmar	29	1	61.5	15.6	--	--	58.2	--	--
CP 3055	25	0	57.9	12.7	--	--	57.3	--	--
Lang-MN	30	1	64.5	14.9	--	--	55.9	--	--
Shelly	26	0	63.8	13.6	--	--	55.7	--	--
DG Ballistic	29	0	62.7	13.5	--	--	54.9	--	--
DG Commander	27	1	63.5	14.4	--	--	53.1	--	--
Allegent 834	23	2	64.2	14.2	--	--	53.0	--	--
Boost	28	1	62.0	14.9	--	--	52.3	--	--
Barlow	30	2	64.3	14.9	--	--	48.4	--	--
DG Velocity	26	0	64.4	15.6	--	--	46.6	--	--
AP Murdock	26	1	63.6	13.4	--	--	45.6	--	--
Trial Mean	27	1	63.3	14.7	72.0	50.1	52.6	--	--
C.V.%	4.5	101	1.2	4.2	5.8	7.9	9.4	--	--
LSD 5%	2	1	1.0	0.9	5.9	5.6	6.9	--	--
LSD 10%	1	1	0.9	0.7	5.0	4.7	5.8	--	--

**Lodging: 0 = none, 9 = lying flat on the ground.*
***Bold** = solid stem sawfly tolerant varieties.*

Planted on April 24 with a seeding rate of 1.25 million PLS/A and harvested on August 6.
Previous Crop: 2017 = soy, 2018 = corn, 2019 = durum
Tillage: minimum till
Soil Type: Mandan silt loam

2020 HRSW Yield Results from the North Central Region **Combined Means**

Variety	Days to Head	Plant Height	Lodging	Test Weight	Protein	Grain Yield 2018	2019	2020	2 Year	3 Year
	DAP[1]	inches	0--9*	lbs/bu	%	----------bu/A----------				
TCG Spitfire	59	26	0	59.8	13.5	79.9	56.2	52.9	54.5	63.0
Elgin ND	56	29	0	60.2	14.3	73.0	55.5	49.7	52.6	59.4
DG Ambush	55	26	0	61.8	14.6	73.4	54.7	45.2	50.0	57.8
SY Valda	57	25	0	61.2	13.8	72.0	54.0	46.4	50.2	57.5
Sy Soren	58	24	0	60.7	15.1	69.8	52.5	47.7	50.1	56.6
SY Ingmar	57	26	0	61.5	15.0	69.0	50.4	48.3	49.4	55.9
Glenn	55	29	0	61.7	14.9	69.4	51.7	45.2	48.4	55.4
Linkert	57	25	0	61.1	15.4	67.5	51.9	45.3	48.6	54.9
Bolles	57	27	0	60.4	16.2	67.3	51.3	45.4	48.4	54.7
ND Vitpro	55	27	0	61.4	14.9	65.5	52.9	43.2	48.1	53.9
LCS Rebel	56	29	1	61.8	14.7	--	57.2	48.5	52.9	--
SY Longmire	57	26	0	60.7	14.4	--	54.7	50.4	52.5	--
Mott	60	30	0	61.5	14.2	--	51.3	50.8	51.0	--
Lanning	56	26	0	59.8	14.7	--	54.3	47.6	50.9	--
MN Washburn	58	25	0	60.5	13.7	--	54.0	46.5	50.2	--
ND Frohberg	57	29	0	61.2	14.7	--	53.3	46.9	50.1	--
SY McCloud	56	26	0	61.4	14.8	--	55.0	44.1	49.5	--
MS Barracuda	54	24	1	60.7	15.0	--	54.9	43.6	49.3	--
LCS Cannon	54	24	0	62.1	14.4	--	53.7	42.8	48.3	--
TCG Stalwart	56	25	0	58.7	15.2	--	52.2	42.2	47.2	--
CP3055	61	26	0	57.2	12.3	--	--	54.3	--	--
DG Ballistic	58	28	0	60.4	13.5	--	--	53.6	--	--
MN Torgy	57	26	0	61.4	14.2	--	--	53.1	--	--
Faller	59	28	1	60.1	13.6	--	--	52.0	--	--
Shelly	58	25	0	60.7	13.7	--	--	49.7	--	--
DG Commander	55	26	0	60.5	14.1	--	--	49.2	--	--
Lang--MN	59	28	0	61.8	14.5	--	--	48.9	--	--
Boost	58	29	0	60.7	14.6	--	--	48.5	--	--
Dagmar	57	26	1	59.4	15.2	--	--	48.1	--	--
Allegent 822	57	25	0	61.0	14.0	--	--	47.9	--	--
AP Murdock	57	24	0	60.6	13.8	--	--	45.5	--	--
Barlow	54	28	1	61.6	14.5	--	--	43.7	--	--
DG Velocity	57	25	0	61.6	15.2	--	--	42.6	--	--
# of Trials	1	5	5	5	5	5	5	5	15	20

[1] *DAP = Days after planting.* **Lodging: 0 = none, 9 = lying flat on the ground.*

Locations: Minot, Garrison, Mohall, Rugby, Wilton

North Dakota Hard Red Spring Wheat Variety Descriptions, Agronomic Traits, 2020

Variety	Agent or Origin[1]	Year Released	Height (inches)	Straw Strength[2]	Days to Head[3]	Reaction to Disease[4] Stem Rust[5]	Leaf Rust	Stripe Rust	Tan Spot	Bact.Leaf Streak	Head Scab
AP Murdock	Syngenta/AgriPro	2019	26	4	53	1	NA	NA	NA	5	6
Ambush	Dyna-Gro	2016	27	5	53	1	4	3	4	6	5
Ballistic	Dyna-Gro	2018	28	3	54	1	5	NA	NA	5	3
Barlow	ND	2009	28	6	52	1	6	4	4	4	4
Bolles	MN	2015	28	4	56	1	3	5	4	6	5
Boost	SD	2016	29	5	56	1	4	3	8	2	5
Commander	Dyna-Gro	2019	27	3	53	1	4	NA	3	4	5
CP3530	Croplan	2015	30	5	56	1	2	8	6	5	5
CP3903	Croplan	2020	27	2	53	1	7	NA	NA	5	4
CP3910	Croplan	2019	26	5	52	1	1	NA	8	8	6
CP3915	Croplan	2019	27	4	54	1	1	NA	7	4	5
Dagmar[6]	MT	2019	27	6	53	1	7	NA	NA	7	7
Driver	SD	2019	28	3	55	1	1	NA	NA	7	3
Elgin-ND	ND	2012	30	5	53	1	6	5	6	6	4
Faller	ND	2007	28	5	56	1	7	8	7	5	4
Glenn	ND	2005	30	4	52	1	6	4	6	4	4
Lang-MN	MN	2017	28	5	55	1	2	1	4	3	3
Lanning	MT	2017	26	4	54	1	7	NA	NA	8	6
LCS Buster	Limagrain	2020	28	6	59	NA	NA	NA	NA	4	5
LCS Cannon	Limagrain	2018	26	4	51	1	7	NA	5	7	6
LCS Rebel	Limagrain	2017	29	6	52	1	7	4	3	4	5
LCS Trigger	Limagrain	2016	29	5	60	1	1	2	6	3	3
Linkert	MN	2013	25	2	54	1	3	1	4	6	5
MN-Torgy	MN	2020	27	3	54	1	4	NA	NA	3	3
MN-Washburn	MN	2019	26	3	56	1	1	NA	6	5	5
MS Barracuda	Meridian Seeds	2018	25	4	51	1	2	NA	7	7	6
MS Chevelle	Meridian Seeds	2014	26	5	53	1	4	3	6	7	6
MS Ranchero	Meridian Seeds	2020	27	5	54	1	4	NA	NA	6	6
ND Frohberg	ND	2020	29	4	54	1	5	NA	NA	4	5
ND VitPro	ND	2016	28	3	53	1	4	3	7	4	4
Shelly	MN	2016	26	4	56	1	6	5	3	7	5
SY 611CL2	Syngenta/AgriPro	2019	25	5	54	1	6	NA	4	6	5
SY Ingmar	Syngenta/AgriPro	2014	27	3	54	1	3	6	6	4	5
SY Longmire[6]	Syngenta/AgriPro	2019	27	4	54	1	7	NA	2	6	7
SY McCloud	Syngenta/AgriPro	2019	27	4	54	1	5	NA	7	8	5
SY Rockford	Syngenta/AgriPro	2017	27	4	55	1	6	NA	2	8	6
SY Soren	Syngenta/AgriPro	2011	25	3	54	1	2	7	2	7	7
SY Valda	Syngenta/AgriPro	2015	26	4	54	1	2	7	6	6	5
TCG-Heartland	21st Century Genetics	2019	26	3	52	1	2	NA	5	7	6
TCG-Spitfire	21st Century Genetics	2015	27	3	57	1	5	4	8	4	6
TCG-Wildcat	21st Century Genetics	2020	27	3	55	1	5	NA	NA	5	NA
Velocity	Dyna-Gro	2019	27	3	54	1	2	NA	NA	6	5

[1] Refers to agent or developer: MN = University of Minnesota; MT = Montana State University; ND = North Dakota State University; SD = South Dakota State University. Bold varieties are those recently released, so data are limited and rating values may change.

[2] Straw Strength = 1 to 9 scale, with 1 the strongest and 9 the weakest. These values are based on recent data and may change as more data become available.

[3] Days to Head = number of days from planting to head emergence from the boot, averaged based on data from several locations in

[4] Disease reaction scores from 1 to 9, with 1 = resistant and 9 = very susceptible, NA = not available.

[5] Fargo stem rust nursery inoculated with Puccinia graminis f. sp. Tritici races TPMK, TMLK, RTQQ, QFCQ and QTHJ.

[6] Solid stemmed or semisolid stem, imparting resistance to sawfly.

-NDSU Publication A574-20 available at www.ag.ndsu.edu.publications

2020 High Yield Spring Wheat Input Trial at Minot

Input	Days to Head	NDVI	Plant Height	Lodging	Test Weight	Grain Protein	Grain Yield
	DAP*	0-1	inches	0-9**	lbs/bu	%	bu/A
Standard treatment[a]	52	0.80	31	0	62.3	13.3	61.3
Standard treatment + Increase seeding rate to 1.6 million PLS/A	52	0.81	32	0	62.6	13.5	64.8
Standard treatment + 10 lbs/A White Table Sugar in furrow at planting	52	0.81	31	0	62.0	13.5	65.4
Standard treatment + 0.5 lb/A Raw Soy Flour / kwt seed treatment	52	0.81	30	0	61.9	13.4	65.6
Standard treatment + 100 lbs/A ContaiN[b] treated urea surface broadcast at planting	53	0.83	32	0	62.6	13.9	72.9
Standard treatment + 75 lbs/A Agrotain[c] treated urea surface broadcast at 3 leaf	54	0.84	32	0	62.4	14.2	72.1
Standard treatment + 60 lbs/A Agrotain treated urea surface broadcast at flag leaf	52	0.81	31	0	62.9	14.1	72.2
Standard treatment + MycoApply[d] seed treatment	52	0.81	31	0	62.4	13.0	63.9
Standard treatment + Nutri-Cycle[e] seed treatment	53	0.82	31	0	62.2	13.5	71.8
Standard treatment + all of the above	54	0.84	31	0	62.6	14.6	81.8
LSD 0.05	NS	0.03	NS	NS	NS	0.8	6.9

**Days After Planting* ***Lodging: 0 = none, 9 = lying flat on ground* *NS = no statistical difference between treatments.*

[a] *Standard treatment: Seeding rate = 1.25 million PLS/A. Intego + Release seed treatment. Residual soil N = 35 lbs/A + 40 lbs/A legume credit. 200 lbs/A urea applied in a mid-row band at planting. 1.7 pt/A Wolverine Advanced herbicide + 1 qt/A Cast Iron Premix foliar micronutrient blend at 4 leaf. 8 oz/A Prosaro fungicide applied at flowering.*

[b] *ContaiN nitrogen stabilizer by AgXplore*

[c] *Agrotain nitrogen stabilizer by Koch Agronomic Services*

[d] *MycoApply mycorrhizal fungi by Valent BioSciences*

[e] *Nutri-Cycle biological seed treatment*

Planting Date: May 8 *Variety: SY Ingmar* *Harvest Date: August 24*
Previous Crop: Soybean
Tillage: No-till
Soil Type: Williams Loam

2020 Nitrogen Fertilizer Additives in Spring Wheat at Minot

TRT	Product	Stand Establishment	Flowering Date	NDVI	Plant Height	Test Weight	Grain Protein	Harvest Moisture	Grain Yield
		%	July	0-1	inches	lbs/bu	%	%	bu/A
1	125 lbs/A ContaiN treated Urea applied in furrow	93	2	0.72	26	60.1	13.9	12.6	65.1
2	125 lbs/A ContaiN MAX treated Urea applied in furrow	92	3	0.72	26	59.8	14.0	12.3	66.3
3	125 lbs/A AGX202019011 treated Urea applied in furrow	93	2	0.71	26	59.8	14.5	12.2	62.5
4	125 lbs/A NZONE Max treated Urea applied in furrow	93	2	0.71	26	60.1	14.2	12.5	64.7
5	125 lbs/A Agrotain Ultra treated Urea applied in furrow	93	2	0.73	26	60.2	14.1	12.1	68.2
6	125 lbs/A Untreated Urea applied in furrow	93	2	0.74	25	60.1	14.0	12.2	65.1
7	No applied N fertilizer	93	2	0.73	25	60.1	14.3	12.2	65.2
Trial Mean		93	2	0.72	26	60.0	14.1	12.3	65.3
C.V. %		1.2	0.1	5.4	4.7	0.7	2.0	2.2	7.0
LSD 0.05		NS	NS	NS	NS	NS	NS	NS	NS

NS = no statistical difference between treatments.

Tillage = No-till. Previous crop = soybean. Soil type = Williams loam.

Summary: The trial was planted on May 8 with SY Valda hard red spring wheat. Fertilizer treatments were applied in the seed furrow at planting. Residual soil nitrogen was 67 lbs per acre at 0-24" plus an additional 40 lbs/A soy credit. This relatively high level of nitrogen probably limited the effectivness of additional nitrogen fertilizer inputs, resulting in no statistical differences between treatments.

2020 AgXplore Foliar Fertilizers in Spring Wheat at Minot

TRT	Product	Heading Date	NDVI	Plant Height	Lodging	Harvest Moisture	Test Weight	Grain Protein	Grain Yield
		DAP*	0-1	inches	0-9**	%	lbs/bu	%	bu/A
1	Untreated	56	0.74	27	0	12.8	61.3	13.3	64.5
2	16 oz/A NutriPak[1] + 16 oz/A SulPak[2] at 4 leaf *fb* 16 oz/A NutriPak + 16 oz/A SulPak at flag leaf	56	0.74	26	0	12.8	61.3	13.7	66.2
3	32 oz/A NitroUltra[3] + 16 oz/A SulPak at 4 leaf *fb* 16 oz/A SulPak at flag leaf	56	0.74	27	0	12.9	61.1	13.2	65.7
4	32 oz/A NitroElite[4] at 4 leaf	56	0.74	27	0	12.7	61.0	13.3	64.2
5	16 oz/A NutriPak at 4 leaf *fb* 16 oz/A NutriPak at flag leaf	56	0.76	26	0	13.1	61.6	13.6	69.4
6	32 oz/A NitroUltra at 4 leaf	56	0.74	26	1	13.1	61.5	13.4	64.6
7	16 oz/A SulPak at 4 leaf *fb* 16 oz/A SulPak at flag leaf	56	0.72	26	0	13.2	61.4	13.0	63.4
8	64 oz/A Octane[5] at 4 leaf	56	0.73	26	0	13.0	61.5	12.6	63.2
Trial Mean		56	0.74	26	0	12.9	61.3	13.3	65.1
C.V. %		1.4	4.4	5.4	112	4.7	1.0	5.4	9.5
LSD 0.05		NS	NS	NS	NS	NS	NS	NS	NS

*Days After Planting **Lodging: 0 = none, 9 = lying flat on ground

[1]AgXplore NutriPak: 8-10-2

[2]AgXplore SulPak 17: 8-0-0-17S

[3]AgXplore NitroUltra: 10-0-0-0.05B-0.2Cu-0.2Fe-0.1Mn-0.1Mg-0.2Zn

[4]AgXplore NitroElite:

[5]AgXplore Octane: blend of complex carbohydrates and biologically derived metabolites

NS = no statistical difference between treatments.

Summary: The primary objective of this trial was to enhance grain protein content and overall plant vitality with various foliar fertilizer treatments. The trial was planted with 6 replications per treatment with SY Valda hard red spring wheat into no-till soybean stubble on May 6. 100 lbs/A urea (46-0-0) was applied in a mid-row band at planting and 50 lbs/A of MAP (11-52-0) was applied in the seed furrow at planting. Residual soil fertility levels at 0 - 24" were 67 lbs/A N (+ 40 lbs/A legume crop N crdit), 38 ppm P and 398 ppm K. Soil is a Williams loam with a pH of 6.1. Foliar treatments were applied to 4 leaf wheat on June 8 and to flag leaf wheat on June 21. Fertilizer treatments were mixed with water and applied at a rate of 20 gallons/A with a CO_2 propelled backpack sprayer. The trial was harvested on August 24. The trial was provided with adequate nutrition at planting. NDVI ratings (leaf greeness) were obtained 5 days after flag leaf treatments, and ratings on all treatments were statistically similar. None of the foliar fertilizer treatments provided any enhancement to grain protein content or grain yield.

Descriptions and agronomic traits of durum wheat varieties grown in North Dakota, 2020

Variety	Agent or Origin[1]	Year Released	Height (inches)[2]	Straw Strength[3]	Days to Head[4]	Reaction to Disease[5]				
						Stem Rust[5]	Leaf Rust	Foliar Disease	Bact.Leaf Streak	Head Scab
AC Commander	Can.	2002	25	5	57	1	1	6	NA	NA
Alkabo	ND	2005	27	2	56	1	1	5	7	6
Alzada	WB	2004	24	6	54	1	1	8	NA	9
Ben	ND	1996	28	4	56	1	1	4	7	8
Carpio	ND	2012	27	5	58	1	1	5	6	5
CDC Verona	Can.	2010	27	5	58	1	1	4	NA	8
Divide	ND	2005	27	5	58	1	1	5	7	5
Grenora	ND	2005	26	5	55	1	1	5	7	6
Joppa	ND	2013	27	5	57	1	1	5	7	5
Lebsock	ND	1999	27	3	55	1	1	5	7	6
Maier	ND	1998	27	5	56	1	1	5	NA	8
Mountrail	ND	1998	27	5	57	1	1	5	7	8
ND Grano[6]	ND	2017	27	5	57	1	1	8	7	6
ND Riveland[6]	ND	2017	29	4	57	1	1	4	7	5
Pierce	ND	2001	28	5	56	1	1	6	7	8
Rugby	ND	1973	29	5	56	1	1	4	NA	8
Strongfield[6]	Can.	2004	26	6	58	1	1	6	NA	8
Tioga	ND	2010	29	4	57	1	1	5	7	6
VT Peak	Viterra	2010	28	6	56	1	NA	NA	NA	NA

[1] Refers to agent or developer: Can. = Agriculture Canada, WB = Westbred, ND = North Dakota State University.

[2] Plant height was obtained from the average of several locations in 2020.

[3] Straw Strength = 1-9 scale, with 1 the strongest and 9 the weakest. Based on recent data. These values may change as more data become available.

[4] Days to Heading = the number of days from planting to head emergence from boot. Averaged from several locations in 2020.

[5] Disease reaction scores from 1-9, with 1 = resistant and 9 = very susceptible. NA = Not adequately tested. Foliar Disease = reaction to tan spot and septoria leaf spot complex.

[6] Low cadmium accumulating variety.

-NDSU Publication A1067-20 available at www.ag.ndsu.edu.publications

2020 Durum Variety Trial at Minot

Variety	Days to Head	Plant Height	Lodging	Test Weight	Protein	Grain Yield 2018	2019	2020	---- Average ---- 2 year	3 year
	DAP[1]	inches	0-9*	lbs/bu	%	----------bu/A----------				
ND Grano	61	31	1	60.7	13.5	86.7	50.9	66.8	58.9	68.1
Montrail	60	31	1	58.9	13.0	78.8	55.3	70.0	62.6	68.0
Joppa	59	29	1	60.3	13.4	86.0	46.0	68.5	57.3	66.8
Carpio	62	28	1	61.4	13.0	82.2	52.4	60.8	56.6	65.1
VT Peak	60	31	1	61.4	13.7	81.9	47.9	64.5	56.2	64.8
Tioga	61	32	1	61.5	14.0	77.1	47.3	66.2	56.8	63.5
Lebsock	59	30	1	60.3	13.8	82.0	41.6	65.2	53.4	62.9
Divide	61	31	1	60.0	14.3	75.9	56.7	54.2	55.4	62.3
ND Riveland	59	32	1	61.4	13.7	80.5	36.5	67.7	52.1	61.6
Pierce	59	33	1	60.7	13.4	72.6	41.7	67.7	54.7	60.7
Grenora	58	29	0	59.2	13.6	67.0	44.2	68.4	56.3	59.9
Ben	59	30	1	59.1	14.4	74.9	49.1	54.0	51.6	59.3
Strongfield	60	31	1	58.7	15.1	65.7	48.5	63.4	56.0	59.2
Maier	58	30	2	59.9	14.7	70.7	43.0	63.1	53.0	58.9
Alkabo	60	30	1	60.4	13.5	70.3	40.3	64.2	52.2	58.3
TCG-Bright	61	32	2	57.1	13.4	70.0	50.2	53.0	51.6	57.7
Rugby	61	31	2	59.4	14.5	78.0	30.4	61.6	46.0	56.7
AC Commander	60	27	1	58.5	14.6	58.9	45.7	65.3	55.5	56.6
CDC Verona	62	27	1	59.5	13.7	67.9	44.5	53.3	48.9	55.2
TCG-Webster	57	26	0	57.8	13.1	71.3	37.0	53.5	45.2	53.9
Normanno	59	25	1	54.7	14.1	59.9	35.7	57.7	46.7	51.1
Alzada	57	25	2	55.3	13.9	58.3	35.3	44.7	40.0	46.1
AAC Cabri	62	34	1	60.7	12.5	--	--	68.9	--	--
AAC Stronghold	60	31	1	59.5	12.9	--	--	64.8	--	--
Trial Mean	61	31	1	60.1	13.7	74.9	44.6	65.6	--	--
C.V.%	1.8	4.7	96	1.8	4.9	4.8	13.2	6.7	--	--
LSD 5%	2	2	NS	1.7	1.1	5.9	9.5	7.1	--	--
LSD 10%	1	2	NS	1.5	0.9	4.9	8.0	6.0	--	--

[1] *DAP = Days after planting.* **Lodging: 0 = none, 9 = lying flat on the ground.*

NS = no statistical difference between varieties.

No-till planted on May 1 with a seeding rate of 1.5 million PLS/A and harvested on August 25.

Previous Crop: 2017, 2018 & 2019 = soybean. *Soil Type: Williams Loam*

2020 Durum Variety Trial at Mohall

Cooperators: Dean Schoenberg and the Renville/Bottineau Ag Improvement Association

					Grain Yield				
	Plant		Test					-- Average --	
Variety	Height	Lodging	Weight	Protein	2018	2019	2020	2 yr	3 yr
	inches	0-9*	lbs/bu	%	----------bu/A----------				
Grenora	30	0	56.1	13.7	54.2	47.5	37.3	42.4	46.3
Carpio	32	0	56.7	13.1	55.1	48.0	31.2	39.6	44.8
Alkabo	30	0	56.3	12.7	56.5	45.6	31.3	38.5	44.5
Tioga	33	0	57.4	13.3	52.2	42.8	37.9	40.3	44.3
Joppa	32	0	54.7	12.8	50.5	48.0	32.5	40.3	43.7
ND Riveland	32	0	58.8	12.5	48.6	45.8	36.3	41.1	43.6
Montrail	32	0	55.8	13.0	47.0	48.6	33.8	41.2	43.1
ND Grano	31	0	54.4	13.6	48.8	46.2	32.7	39.4	42.6
Lebsock	29	0	57.2	13.4	49.0	43.5	33.0	38.3	41.8
Divide	31	0	58.5	14.3	43.3	44.0	35.5	39.8	40.9
Trial Mean	31	0	56.6	13.2	50.8	46.0	34.2	--	--
C.V.%	4.8	0	1.4	4.6	11.5	10.3	14.9	--	--
LSD 0.05	2	NS	1.1	0.9	8.4	NS	NS	--	--
LSD 0.1	2	NS	0.9	0.7	7.0	NS	NS	--	--

**Lodging: 0 = none, 9 = lying flat on the ground.*

NS = no statistical difference between varieties.

Planted on May 8 with a seeding rate of 1.5 million PLS/A and harvested on August 26.

Previous Crop: 2017 = durum, 2018 = canola, 2019 = durum.

Tillage: minimum till

Soil Type: Barnes loam

Note: The 2020 trial was infected with moderate levels of Fusarrium Head Blight.

2020 Durum Variety Trial at Rugby

Cooperators: Dave Teigen and the Pierce County Crop Improvement Association

Variety	Plant Height	Lodging	Test Weight	Protein	Grain Yield 2018	2019	2020	-- Average -- 2 yr	3 yr
	inches	0-9*	lbs/bu	%	bu/A				
Joppa	29	0	62.7	12.0	79.1	53.2	51.1	52.1	61.1
ND Grano	29	0	62.6	12.3	70.1	58.4	52.6	55.5	60.4
ND Riveland	31	0	63.3	11.9	69.6	60.1	50.4	55.3	60.0
Tioga	30	0	63.1	12.6	68.5	58.4	52.5	55.5	59.8
Alkabo	28	0	63.1	12.2	71.0	56.3	49.6	53.0	59.0
Carpio	29	0	63.3	12.0	67.9	55.2	51.7	53.5	58.3
Divide	28	0	62.4	12.6	74.8	53.2	46.5	49.8	58.2
Montrail	28	0	61.8	12.1	72.5	55.6	46.2	50.9	58.1
Grenora	27	0	61.4	12.9	59.9	57.6	50.7	54.2	56.1
Lebsock	28	0	63.2	13.1	63.7	51.6	42.0	46.8	52.4
Trial Mean	29	0	62.7	12.4	70.1	56.0	49.3	--	--
C.V.%	6.2	0	1.0	3.5	6.3	6.4	8.1	--	--
LSD 5%	3	NS	0.9	0.6	6.4	5.2	5.8	--	--
LSD 10%	2	NS	0.8	0.5	5.3	4.3	4.9	--	--

**Lodging: 0 = none, 9 = lying flat on the ground.*

NS = no statistical difference between varieties.

Planted on May 7 with a seeding rate of 1.5 million PLS/A and harvested on August 19.

Previous Crop: 2017 = barley, 2018 = soybean, 2019 = Barley

Tillage: minimum till

Soil Type: Gardena silt loam

2020 Durum Variety Trial at Garrison

Cooperators: Brian and Roger Bendickson, Garrison

Variety	Plant Height	Lodging	Test Weight	Protein	Grain Yield 2018	2019	2020	-- Average -- 2 yr	3 yr
	inches	0-9*	lbs/bu	%	bu/A				
ND Grano	25	0	57.5	13.3	62.4	61.3	29.7	45.5	51.1
Grenora	26	0	56.3	13.2	65.7	54.7	32.7	43.7	51.0
Montrail	26	0	56.4	12.9	63.2	59.8	29.4	44.6	50.8
Joppa	27	0	58.0	12.7	62.8	56.4	30.9	43.7	50.0
Tioga	28	0	56.7	13.4	63.6	54.6	29.0	41.8	49.1
Alkabo	26	0	58.1	12.8	59.8	57.3	29.7	43.5	48.9
Lebsock	26	0	58.4	13.2	62.9	52.9	28.9	40.9	48.2
ND Riveland	27	0	58.7	13.1	57.9	57.0	27.3	42.1	47.4
Carpio	26	0	58.1	12.8	61.3	53.8	24.8	39.3	46.6
Divide	27	0	55.8	13.2	58.3	52.4	27.2	39.8	46.0
Trial Mean	26	0	57.4	13.0	61.8	56.0	29.0	--	--
C.V.%	3.3	0	0.9	1.9	11.3	6.0	7.8	--	--
LSD 5%	1	NS	0.7	0.4	NS	4.9	3.3	--	--
LSD 10%	1	NS	0.6	0.3	NS	4.1	2.7	--	--

**Lodging: 0 = none, 9 = lying flat on the ground.*

NS = no statistical difference between varieties.

Planted on April 24 with a seeding rate of 1.5 million PLS/A and harvested on August 21.

Previous Crop: 2017 = spring wheat, 2018 = soybean, 2019 = spring wheat.

Tillage: no-till

Soil Type: Williams Bowbells loam

Note: The 2020 trial sustained a moderate infestation of fusarrium head blight.

2020 Durum Variety Trial at Wilton

Cooperator: Wes Doepke, Wilton

Variety	Plant Height	Lodging	Test Weight	Protein	Grain Yield 2018	2019	2020	-- Average -- 2 yr	3 yr
	inches	0-9*	lbs/bu	%	bu/A				
Grenora	26	2	61.9	13.7	75.0	40.5	48.6	44.5	54.7
ND Riveland	31	1	61.8	13.9	66.3	39.6	54.9	47.3	53.6
ND Grano	28	1	62.5	13.9	67.2	41.1	45.8	43.4	51.4
Divide	29	2	62.2	14.5	62.2	36.2	48.8	42.5	49.1
Alkabo	28	1	62.5	13.8	57.1	39.9	50.0	44.9	49.0
Montrail	28	2	61.8	13.6	57.9	42.1	45.7	43.9	48.6
Joppa	29	2	62.0	13.0	55.5	38.9	49.7	44.3	48.0
Tioga	29	2	62.7	13.9	55.6	39.9	46.4	43.1	47.3
Carpio	29	2	61.4	13.8	53.5	41.8	43.6	42.7	46.3
Lebsock	29	2	62.9	13.6	53.0	36.4	45.5	41.0	45.0
Trial Mean	29	2	62.2	13.8	60.6	39.6	47.9	--	--
C.V.%	5.2	41	0.5	2.1	6.5	8.1	9.3	--	--
LSD 5%	2	1	0.5	0.4	5.7	4.7	6.4	--	--
LSD 10%	2	1	0.4	0.4	4.7	3.9	5.3	--	--

**Lodging: 0 = none, 9 = lying flat on the ground.*

Planted on April 24 with a seeding rate of 1.5 million PLS/A and harvested on August 6.

Previous Crop: 2017 = soy, 2018 = corn, 2019 = durum.

Tillage: minimum till

Soil Type: Mandan silt loam

2020 Durum Yield Results from the North Central Region **Combined Means**

Variety	Days to Head	Plant Height	Lodging	Test Weight	Protein	Grain Yield 2018	2019	2020	Average 2 Year	3 Year
	DAP*	inches	0-9**	lbs/bu	%	bu/A				
Grenora	58	27	0	59.0	13.4	64.4	48.9	47.5	48.2	53.6
Mountrail	60	29	1	58.9	12.9	63.9	52.3	45.0	48.6	53.7
Joppa	59	29	1	59.5	12.8	66.8	48.5	46.5	47.5	53.9
Tioga	61	30	1	60.3	13.4	63.4	48.6	46.4	47.5	52.8
Alkabo	60	29	0	60.1	13.0	62.9	47.9	45.0	46.4	51.9
Lebsock	59	28	1	60.4	13.4	62.1	**45.2**	**42.9**	44.1	50.1
ND Riveland	59	31	0	60.8	13.0	64.6	47.8	47.3	47.6	53.2
Carpio	62	29	1	60.2	12.9	64.0	50.2	42.4	46.3	52.2
Divide	61	29	1	59.8	13.8	62.9	48.5	42.4	45.5	51.3
ND Grano	61	29	0	59.5	13.3	67.0	51.6	45.5	48.5	54.7
# of Trials	1	4	5	5	5	5	5	5	10	15

**DAP = Days After Planting. **Lodging: 0 = none, 9 = lying flat on the ground.*

Locations: Minot, Garrison, Mohall, Rugby, Wilton

2020 Barley Hay Variety Trial at Minot

Variety	Days to Head	Plant Height	Harvest Moisture	Yield @ 0% moisture 2019	2020	Avg
	DAP[1]	inches	%	tons/A		
Stockford	58	29	62	2.91	8.41	5.66
Hays	59	26	70	2.62	7.90	5.26
Lavina	58	27	63	2.39	7.79	5.09
Haymaker	58	29	66	3.20	6.49	4.85
Tradition	52	29	66	2.19	6.84	4.51
Bestford	56	30	69	1.88	5.01	3.44
Trial Mean	57	28	66	2.53	7.07	--
C.V.%	1.3	7.1	6.1	7.5	11.2	--
LSD 5%	1	NS	NS	0.35	1.44	--
LSD 10%	1	NS	NS	0.28	1.17	--

[1] DAP = days after planting

Planting Date: May 5
Harvest Date: July 22 (soft dough)
Seeding Rate: 90 lbs/A
Tillage: No-till (year 2)
Previous Crop: Soybean
Soil Type: Williams Loam
Note: The 2019 trial sustained severe moisture stress.

North Dakota Barley Variety Descriptions

Variety	Use[1]	Origin[2]	Year Released	Awn Type[3]	Rachilla Hair Length[4]	Aleurone Color	Height (inch)	Days to Head	Straw Stength[5]	Reaction to Disease[6]			
										Stem Rust	Spot form Blotch	Spot Blotch	Net Blotch
Six-rowed													
Tradition	M/F	BARI	2003	S	L	White	23	58	3	8	6	3	7
Two-rowed													
AAC Connect	M/F	Mendia Syngent a	2017	R	L	White	21	62	3	4	5	4	5
AAC Synergy	M/F		2015	R	L	White	21	63	5	4	3	4	4
CDC Bow	M/F	CDC	2016	R	L	White	22	64	3	NA	NA	NA	NA
Conlon7	M/F	ND	1996	S	L	White	23	57	7	8	4	6	3
Explorer	M	Secobr a	NA	R	L	White	20	61	4	NA	NA	8	4
ND Genesis	M/F	ND	2015	S	L	White	24	61	5	8	4	4	6
Pinnacle	M/F	ND	2006	S	L	White	22	60	6	8	8	4	6

Bolded varieties were tested for the first time this year, so some ratings may change as new data become available.

[1] M = malting; F = feed.

[2] BARI = Busch Agricultural Resources Inc.; CDC = Crop Development Centre, University of Saskatchewan. MN = University of

[3] R = rough; S = smooth.

[4] L = long.

[5] Straw Strength scores from 1-9, with 1 = strongest and 9 = weakest.

[6] Disease reaction scores from 1-9, with 1 = resistant and 9 = very susceptible, NA – not available.

[7] Lower DON accumulations than other varieties tested.

-NDSU Publication A1049-20 available at www.ag.ndsu.edu.publications

2020 Barley Variety Trial

Variety	Days to Head	Plant Height	Lodging	% Plump	% Thin	Test Weight	Protein	Grain Yield				
								2018	2019	2020	2 Year	3 Year
	DAP[1]	inches	0-9[2]	>6/64	<5/64	lbs/bu	%	bu/A				
2 Row Types												
ND Genesis	56	30	0	95	1	45.2	10.8	98.0	109.6	119.3	114.5	109.0
AAC Synergy	59	30	2	93	1	46.7	12.5	103.8	106.6	113.3	110.0	107.9
Pinnacle	56	28	2	95	1	45.1	11.5	102.1	110.8	107.5	109.2	106.8
Explorer	58	25	1	90	1	45.5	13.3	103.1	110.1	107.2	108.7	106.8
Conlon	54	27	1	94	1	48.5	13.2	82.2	105.5	83.7	94.6	90.5
AAC Connect	58	28	0	91	1	45.9	13.2		114.7	109.2	111.9	--
CDC Bow	59	28	0	94	1	45.4	12.8	--	--	110.7	--	--
6 Row Types												
Tradition	54	28	0	95	1	46.5	13.9	106.2	98.6	100.4	99.5	101.7
Trial Mean	56	27	1	94	1	45.9	12.1	98.1	105.6	108.9	--	--
C.V.%	1.5	6.6	146	1.7	52	1.5	4.3	5.5	5.5	6.1	--	--
LSD 5%	1	3	NS	3	NS	1.1	0.9	8.9	9.8	11.0	--	--
LSD 10%	1	2	NS	2	NS	0.9	0.7	7.4	8.1	9.2	--	--

[1] DAP = Days after planting. *[2] Lodging: 0 = none, 9 = lying flat on the ground.*

NS = no statistical difference between varieties.

Planted on May 4 with a seeding rate of 800,000 PLS/A and harvested on August 17.

Previous Crop: 2017, 2018 & 2019 = soybean.

Tillage: No-till

Soil Type: Williams Loam

North Dakota Oat Variety Descriptions

							Reaction to Diseases				
Variety	Origin[1]	Year Released	Grain Color	Height	Straw Strength	Maturity[2]	Stem Rust[3]	Crown Rust[3]	Barley Y.Dwf[4]	Test Weight	Protein[5]
AC Pinnacle	AAFC	1999	White	39	Med.	63	8	8	8	V.good	L
Beach	ND	2004	White	35	M.strg.	63	8	4	6	V.good	M
CDC Dancer	Sask.	2000	White	35	Strong	63	8	6	8	V.good	M
CDC Minstrel	Sask.	2006	White	34	M.strg.	64	8	8	8	Good	M
CS Camden	Meridian	2016	White	33	Strong	64	8	6	NA	Good	NA
Deon	MN	2013	Yellow	37	Strong	65	8	1	2	V.good	NA
Hayden	SD	2014	White	36	Med.	62	8	7	NA	V.good	NA
HiFi	ND	2001	White	35	Strong	63	4	8	2	Good	M
Hytest	SD	1986	White	38	M.strg.	62	8	6	8	V.good	H
Jury	ND	2012	White	34	M.strg.	64	1	8	4	V.good	M
Killdeer	ND	2000	White	32	Strong	63	8	6	4	Good	M
Leggett	AAFC	2005	White	33	Strong	63	3	1	8	Good	M
Newburg	ND	2011	White	38	Med.	62	1	8	4	Good	M
Otana	MT	1977	White	36	M.weak	63	8	8	8	V.good	M/L
Paul6	ND	1994	Hull-less	37	Strong	68	1	4	2	Good	H
Rockford	ND	2008	White	38	Strong	65	8	8	4	V.good	M
Souris	ND	2006	White	33	Strong	63	6	8	6	V.good	M
Stallion	SD	2006	White	34	Med.	64	8	3	NA	V.good	M
Warrior	SD	2018	White	32	Strong	62	NA	1	NA	V.good	M

Bolded varieties were tested for the first time this year, so some ratings may change as new data become available.

[1] AAFC = Agriculture & Agri-Food Canada; MN = University of Minnesota; ND = North Dakota State University; SD = South Dakota State University; Sask. = University of Saskatchewan; MT = Montana State University.

[2] Days after planting.

[3] Disease reaction scores from 1-9, with 1 = resistant and 9 = very susceptible.

[4] Disease reaction scores from 1-9, with 1 = resistant and 9 = very susceptible, NA – not available.

[5] H = high; M = medium; L = low; NA = not available.

[6] Hull-less variety.

-NDSU Publication A1049-20 at https://www.ag.ndsu.edu/publications

Oat Variety Trial at Minot

Variety	Days to Head	Plant Height	Lodging	Test Weight	Grain Yield 2018	2019	2020	Average 2 year	Average 3 year
	[1]DAP	inches	[2]0-9	lb/bu	bu/A				
CS Camden	54	36	0	38.4	137.7	126.4	117.5	122.0	127.2
Hayden	53	37	0	42.9	143.7	123.9	96.6	110.2	121.4
CDC Dancer	55	39	0	41.3	134.6	115.1	112.9	114.0	120.9
Rockford	55	38	0	41.2	132.4	121.6	106.6	114.1	120.2
Stallion	56	42	0	41.5	130.9	125.7	103.1	114.4	119.9
Beach	52	37	0	41.8	150.8	118.7	87.6	103.1	119.0
Leggett	53	34	0	42.9	142.1	122.3	84.9	103.6	116.4
CDC Minstrel	54	33	0	41.3	120.3	123.8	102.2	113.0	115.4
Hytest	52	40	0	43.3	133.3	119.4	88.8	104.1	113.8
Deon	57	37	0	42.6	125.6	117.9	96.2	107.1	113.2
ND Heart	51	37	0	41.5	128.0	115.4	94.6	105.0	112.7
HiFi	54	36	0	39.8	117.6	117.6	92.1	104.8	109.1
Killdeer	52	30	0	40.6	115.3	113.1	93.8	103.4	107.4
Otana	55	40	0	41.3	113.4	99.7	107.5	103.6	106.9
Jury	54	38	1	40.3	111.3	114.5	91.2	102.8	105.7
Souris	55	33	0	40.8	112.3	102.9	91.7	97.3	102.3
Newburg	56	33	0	41.2	92.7	116.5	88.6	102.6	99.3
Paul	58	39	0	45.7	103.3	82.4	77.1	79.8	87.6
Warrior	51	35	0	40.4		120.5	99.0	109.8	--
Ore 3542M	53	33	0	40.8	--	--	99.6	--	--
Ore 3541M	52	33	0	42.7	--	--	87.5	--	--
Trial Mean	54	37	0	41.7	125.4	114.3	98.1	--	--
C.V.%	1.6	6.5	355	2.0	11.9	8.0	6.8	--	--
LSD 5%	1	4	NS	1.4	24.1	14.8	10.8	--	--
LSD 10%	1	3	NS	1.1	20.4	12.4	9.0	--	--

[1] DAP = Days after planting. *[2] Lodging: 0 = none, 9 = lying flat on the ground.*

Planted on May 6 with a seeding rate of 1 million PLS/A and harvested on August 11.

Previous Crop: 2017, 2018 & 2019 = soy.

Soil Type: Williams Loam

Tillage: No-till

2019 and 2020 Oat Seeding Rate Trial at Minot

Summary: The main objective of this trial was to document how seeding rates influence agronomic, grain quality and seed yields. Two commonly grown varieties, "Hayden" and "Camden", and the hulless variety "Paul" were grown in this trial. Actual established plant stands were a bit lower than the targeted seeding rates and the two highest seeding rates produced statistically similar stands. Days to flower, plant height, harvest moisture, test weight and kernel weights were statistically similar between seeding rates. Grain yields were statistically similar for 500k and 750k seeding rates and significantly higher for 1 million and 1.25 million seeding rates. This data would suggest that higher seeding rates should be considered for increasing yields without adversely affecting agronomic or other seed quality factors.

Combined Means

Seeding Rate	Plant Stand	Days to Flower	Plant Height	Harvest Moisture	Test Weight	1000 KWT**	Grain Yield
Seeds/A	Plants/A	DAP*	inches	%	lbs/bu	g	bu/A
500k	392,363a	44a	36a	12.7a	36.5a	29a	102.3a
750k	620,811b	44a	34a	13.6a	37.1a	29a	106.6a
1 mill	893,141c	45a	34a	12.2a	37.0a	28a	111.2b
1.25 mill	985,413c	44a	34a	13.3a	37.0a	27a	117.4c

Means followed by the same letter within each column were not statistically different at P≤0.05.

**Days After Planting*

***1000 KWT data from 2019 only*

Planting Date: April 24, 2019 and May 6, 2020
Harvest Date: August 8, 2019 and August 11, 2020
Previous Crop: Soybean
Tillage System: No-till
Soil Type: Williams Loam

Oat Fertility Trial at Minot

2019 and 2020 Combined Means

Summary: The main objective of this trial was to observe and document the effects of applied fertilizers on agronomic factors, seed quality and grain yield. Data from both years was combined and is presented in the table above. Residual soil fertility analysis did not indicate deficiencies in phosphorus, potassium, chloride or sulfur, however, nitrogen levels were relatively low (less than 30 lbs/A). Fertilizer treatments were applied between rows during planting. Growing conditions for both years were fairly similar with mild temperatures and below normal precipitation. Results did not indicate any statistical differences between treatments for any agronomic or seed quality factors. NDVI ratings were collected with a hand held "GreenSeeker" instrument at flag leaf and those ratings were strongly correlated with grain yield. Grain yields tended to increase with increasing rates of nitrogen, however, they tended to peak and level off at the 100 pound per acre rate. The application of UAN during the late boot growth stage did not significantly enhance seed quality or grain yield and therefore would not be a recommended practice. Applications of AMS and potash showed no enhanced effect on agronomic factors, seed quality or grain yield.

Fertility Treatment	Heading Date	Plant Height	NDVI	Test Weight	1000 KWT	Grain Yield
	DAP[1]	inches	0-1[2]	lbs/bu	g	bu/A
75 lbs total N/A* applied in a mid-row band at planting	58	33	0.66	36.3	31.4	105.9
100 lbs total N/A applied in a mid-row band at planting	58	34	0.68	36.1	32.1	110.5
125 lbs total N/A applied in a mid-row band at planting	58	34	0.70	36.4	31.5	112.5
150 lbs total N/A applied in a mid-row band at planting	58	35	0.71	36.1	31.3	113.1
75 lbs total N/A at planting + 20 gal UAN/A late boot	58	33	0.68	36.3	31.5	108.4
50 lbs/A AMS applied in a mid-row band at planting	58	33	0.67	36.1	31.3	103.2
50 lbs/A Potash applied in a mid-row band at planting	58	33	0.64	36.6	32.3	98.1
Trial Mean	58	34	0.68	36.3	31.6	107.4
C.V. %	10.8	10.8	11.1	4.9	7.1	11.0
LSD 0.05	NS	NS	NS	NS	NS	9.6

**Total N = residual soil N + legume N credit + applied N (urea)*

[1] Days After Planting

[2] NDVI: An indication of photosynthetic activity which is strongly associated with yield.

NS = no statistical difference between fertility treatments.

Variety: Hayden
Seeding Rate: 1 million PLS/A
Previous Crop: soybean
Tillage System: no-till
Soil Type: Williams Loam

2020 North Dakota Hard Red Winter Wheat Variety Description and Agronomic Traits

Variety	Agent or Origin[2]	Year	Reaction to Disease[1]					Days to Head	Straw Strength[4]	Height[5] (inches)	Winter[6] Hardiness
			Stripe Rust	Leaf Rust	Stem Rust	Scab	Tan Spot				
AAC Wildfire	**P Genetic**	**2015**	**1**	**5**	**8**	**NA**	**NA**	**1**	**3**	**29**	**3**
AC Emerson	Meridian	2011	1	6	1	3	5	1	2	32	4
Ideal	SD	2011	4	1	3	8	4	-1	4	28	4
Jerry	ND	2001	8	3	1	8	8	0	5	34	3
Keldin	WB	2011	2	3	3	5	3	0	3	29	5
ND Noreen	**ND**	**2020**	**3**	**3**	**1**	**3**	**5**	**0**	**4**	**29**	**3**
Northern	MT	2015	1	8	1	8	6	2	4	29	5
Oahe	SD	2016	2	6	6	4	6	-2	5	29	4
Peregrine	CDC	2008	1	3	1	6	6	1	5	34	2
SY Monument	Agripro	2014	3	3	1	6	5	-2	4	27	3
SY Sunrise	Agripro	2015	3	4	2	6	7	-2	4	23	6
SY Wolf	Agripro	2010	3	3	1	6	1	-2	3	27	6
SY Wolverine	Agripro	2019	4	3	1	4	5	-5	4	25	4
TCG-Boomlock	TCG	2019	NA	NA	NA	NA	NA	-1	4	29	6
Thompson	SD	2017	5	3	3	3	6	-1	3	30	5
WB4462	WB	2016	7	3	NA	8	6	-5	4	28	4
WB4595	WB	2019	4	4	NA	6	6	-1	3	28	6

[1] Disease reaction scores from 1-9, with 1 = resistant and 9 = very susceptible, NA = not available.

[2] CDC=Crop Development Centre, University of Saskatchewan; MT = Montana State University; ND = North Dakota State University; SD = South Dakota State University; TCG = Twenty-first Century Genetics; WB = WestBred.

[3] Days to heading relative to Jerry.

[4] Straw strength: 1 = strongest, 9 = weakest. Based on field observations in limited sites in 2020.

[5] Based on the average of several environments, and should be used for comparing varieties. The environment can impact the height of varieties.

[6] Relative winter hardiness rating: 1 = excellent, 10 = very poor. These values are subject to change as additional information becomes available. Bold varieties are those recently released, so data are limited and rating values may change.

-NDSU Publication A1196-20 at https://www.ag.ndsu.edu/publications

2020 Hard Red Winter Wheat Variety Trial at Minot

Variety	Spring Stand	Heading Date	Plant Height	Lodging	Test Weight	Grain Protein	Grain Yield				
							2018	2019	2020	2 yr avg	3 yr avg
	%	June	inches	0 - 9*	lbs/bu	%	bushels per acre				
Peregrine	99	14	33	1	63.1	12.2	35.4	60.6	81.3	71.0	59.1
Ideal	99	12	30	1	62.9	12.7	31.8	61.5	83.1	72.3	58.8
Keldin	99	13	29	1	62.9	12.8	26.4	61.4	88.1	74.8	58.6
SY Monument	99	11	29	0	59.6	12.4	30.4	65.6	77.6	71.6	57.9
Thompson	99	10	33	0	62.9	12.8	33.1	57.7	81.7	69.7	57.5
Oahe	99	10	31	2	63.5	13.0	31.5	66.1	72.8	69.5	56.8
AC Emerson	99	12	31	0	62.6	13.9	25.0	56.0	76.6	66.3	52.5
Jerry	99	11	30	2	62.1	13.4	25.7	54.3	72.9	63.6	51.0
Northern	99	13	28	1	63.8	13.1	21.6	52.5	70.0	61.2	48.0
SY Wolf	99	11	27	0	64.1	12.6	21.6	49.0	72.6	60.8	47.7
Decade-Fhb1	99	8	27	0	62.2	13.5	28.9	46.6	67.3	57.0	47.6
WB4462	99	6	29	2	61.7	12.3	18.2	49.0	74.3	61.7	47.2
SY Sunrise	99	9	26	1	62.4	11.5	18.8	45.3	68.3	56.8	44.1
ND Noreen	99	11	32	1	64.8	13.8		61.8	79.5	70.7	--
WB4595	99	12	28	1	66.1	11.5	--	65.1	74.9	70.0	--
TCG Boomlock	99	11	29	2	64.1	13.6	--	52.3	76.9	64.6	--
SY Wolverine	98	7	24	0	65.0	13.0	--	46.5	70.2	58.4	--
AAC Wildfire	99	15	31	0	62.6	13.2	--	--	82.9	--	--
CP7017AX	99	7	25	2	61.6	11.5	--	--	76.7	--	--
CP7050AX	98	6	26	2	62.8	13.2	--	--	62.8	--	--
CP7909	99	5	26	2	61.5	12.2	--	--	56.3	--	--
Trial Mean	99	10	29	1	62.8	12.7	26.7	54.6	74.8	--	--
C.V. %	0.8	11.1	5.5	81	1.4	3.4	22.0	9.1	10.2	--	--
LSD 0.05	NS	2	3	1	1.4	0.7	9.6	8.1	12.6	--	--
LSD 0.10	NS	2	2	1	1.2	0.6	8.0	6.8	10.5	--	--

**Lodging: 0 = none, 9 = lying flat on the ground.*

NS = no statistical difference between varieties.

Planting Date: September 17, 2019

Harvest Date: July 31, 2020

Seeding Rate: 1.3 million live seeds / acre

Previous Crop: 2017 = spring wheat, 2018 and 2019 = soy

Tillage: No-till

Soil Type: Williams loam

Note: The 2018 trial sustained dry growing conditions resulting in relatively low yields.

Nitrogen Fertilizer Utilization by Winter Wheat Under Dry Spring Conditions at Minot

Summary: The primary objective of this study was to observe the effects of nitrogen fertilizer applied at various growth stages of winter wheat. The study was conducted during the 2018, 2019 and 2020 growing seasons, and the table below are combined means. The study sustained a lack of early season precipitation all three years which affected infiltration and root absorbsion of surface applied urea treatments, resulting in abnormal overall growing conditions. Nitrogen fertilizer rates and application timing had no statistically significant effect on heading date, NDVI (plant greenness) rating, plant height or grain yield. Significant differences between fertilizer treatments for test weight were detected but there was not an obvious trend. Uncorrected nitrogen deficiencies in this crop are usually expressed (after the fact) in low grain protein content and conversely, excessive N levels are expressed as high grain protein content. Higher protein levels in this study may be explained by a lack of springtime precipitation resulting in limited nitrogen infiltration as stated above. Statistically significant differences for protein content were observed with a trend of higher levels when N fertilizer was applied at jointing or flowering. Although there were no statistically significant yield responses for N applications in this study, it is well known that kernel formation occurs early in springtime plant growth and that plant nutrition is a key component in kernel formation and development. It is truely remarkable to see the yielding ability of this crop with little or no added fertilizer inputs. This observation should be further evaluated.

Applied Nitrogen*				Heading		Plant	Test	Grain	Grain
Planting	E Spg	Jointing	Flowering	Date	NDVI	Height	Weight	Protein	Yield
Pounds				June	0-1	inches	lb/bu	%	bu/A
0	0	0	0	9a	0.54a	24a	59.8abc	14.1d	49.1a
50	0	0	0	11a	0.57a	24a	59.8abc	14.1d	48.7a
100	0	0	0	10a	0.58a	25a	59.9abc	14.1d	52.4a
50	50	0	0	9a	0.60a	25a	60.0ab	14.4cd	52.8a
0	50	50	0	10a	0.62a	24a	59.4bc	14.8abcd	50.3a
50	0	50	0	10a	0.60a	25a	59.2bc	15.1abc	46.0a
50	50	0	25	10a	0.58a	25a	59.5bc	15.4a	48.2a
50	0	0	25	10a	0.57a	24a	60.4a	15.3ab	46.8a
100	0	0	25	10a	0.61a	25a	59.3bc	14.7abcd	49.5a
0	50	0	0	10a	0.61a	25a	59.3bc	14.5bcd	52.0a
0	100	0	0	9a	0.59a	25a	59.7abc	15.4a	50.6a
0	0	50	0	10a	0.56a	25a	59.5bc	14.8abcd	50.0a
0	0	100	0	10a	0.61a	25a	59.6bc	14.7abcd	51.9a
0	0	0	25	9a	0.55a	24a	59.1c	15.0abc	48.2a
0	50	0	25	9a	0.57a	25a	59.2bc	15.1abc	48.5a
0	100	0	25	9a	0.60a	25a	59.3bc	15.0abc	51.4a

Means followed by the same letter within each column were not statistically different.

**Applied N = actual pounds of N applied in a mid-row band at planting or surface applied as urea in the Spring.*

Planting Date: Sept. 21, 2017, Sept. 24, 2018 and Sept. 17, 2019
Planting Rate: 1.3 million PLS/A
Variety: Decade
Harvest Date: July 24, 2018, August 7, 2019 and July 30, 2020
Previous Crop: 2017 and 2018 = Spring Wheat, 2019 = canola
Soil Type: Williams loam
Residual soil N: 2018 = 50 lbs/A, 2019 = 17 lbs/A and 2020 = 46 lbs/A.

North Dakota Winter Rye Variety Descriptions

Variety	Origin[1]	Year Released	Height (inches)	Straw Strength	Days to Flowering	Seed Color	Seed Size	Winter Hardiness
AC Hazlet	Canada	2006	43	Good	152	Bl-grn.	Small	Good
Aroostok	USDA	1981	45	Fair	145	Tan	Small	V.good
Bono[3]	KWS Germany	2013	37	Good	151	Green	Med.	Good
Brasetto[3]	KWS Germany	2008	36	V.good	151	Bl-grn.	Large	Good
Dacold	ND	1989	42	Good	154	Bl-grn.	Med.	Good
Danko	Poland	1976	36	Good	150	Green	Large	Poor
ND Dylan	ND	2016	45	Good	150	Blue	Med.	V.good
ND Gardner	ND	2019	44	Fair	144	Bl-grn.	Small	V.good
Rymin	MN	1973	42	V.good	150	Grn-gray	Large	Fair[4]
Spooner	WI	1993	44	V.good	149	Tan	Large	Good
Wheeler	MI	1971	47	Fair	152	Tan	Large	Fair

[1] ND = North Dakota State University; WI = University of Wisconsin; MN = University of Minnesota; MI = Michigan State University.

[2] NA = not available.

[3] Hybrid.

[4] Varieties with fair winter hardiness should not be seeded in bare soil.

-NDSU Publication A1049-20 at https://www.ag.ndsu.edu/publications

2020 Winter Rye Variety Trial at Minot

Variety	Winter Survival	Heading Date	Plant Height	Lodging	Test Weight	Grain Yield 2018	Grain Yield 2019	Grain Yield 2020	2 yr avg	3 yr avg
	%	June	inches	0-9*	lbs/bu	bushels per acre				
Brasetto	99	7	38	0	52.3	59.1	101.5	130.2	115.9	96.9
Hazlet	99	6	42	4	53.4	57.1	75.1	105.1	90.1	79.1
ND Dylan	99	6	46	4	53.1	45.5	77.3	98.9	88.1	73.9
Dacold	99	8	44	3	51.4	42.6	76.9	93.3	85.1	70.9
Rymin	99	6	38	4	53.9	55.5	75.7	78.1	76.9	69.8
ND Gardner	99	2	43	4	53.2	40.0	65.0	79.0	72.0	61.3
Spooner	99	5	46	4	53.2	35.7	60.5	79.9	70.2	58.7
Aroostok	99	4	46	4	53.8	27.9	59.1	75.1	67.1	54.0
Bono	99	5	36	1	54.3		105.6	132.8	119.2	
Danko	99	4	41	1	53.3			86.4		
Trial Mean	99	5	42	3	53.2	43.2	71.7	95.9	--	--
C.V. %	0.0	18	6.7	47	1.8	7.8	6.4	6.5	--	--
LSD 5%	NS	2	5	2	1.7	5.8	7.8	10.8	--	--
LSD 10%	NS	1	4	2	1.4	4.8	6.5	8.9	--	--

**Lodging: 0 = none, 9 = lying flat on the ground.*

NS = no statistical difference between varieties.

Planting Date: September 24, 2019
Harvest Date: July 30, 2020
Seeding Rate: 1 million live seeds / acre
Previous Crop: 2017 = spring wheat, 2018 and 2019 = soy
Tillage System: No-till
Soil Type: Williams loam
Note: The 2018 trial sustained severe moisture stress.

2020 Silage Corn Variety Trial at Minot

Company	Hybrid	Relative Maturity	Days to Silk	Harvest Moisture	Crude Protein	TDN	Yield 2019	Yield 2020	Yield 2 yr avg
			DAP[1]	%	%	%	tons/A @65% moisture		
INTEGRA	STP4128R	91	72	55	6.7	71	20.22	20.70	20.46
INTEGRA	STP4550R	95	77	60	5.4	67	--	19.93	--
INTEGRA	STP4810R	98	79	62	5.7	65	--	22.11	--
INTEGRA	STP5191R	101	80	65	5.2	65		25.57	--
Dairyland Seed	HiDF-3044Q	91	69	49	5.6	71	--	22.73	--
Dairyland Seed	HiDF-3802Q	102	77	61	5.7	70	20.31	24.46	22.39
Dairyland Seed	DS-4440AMXT	104	75	60	5.8	70	--	22.60	--
Dairyland Seed	HiDF-4545Q	105	79	63	4.9	68	--	21.71	--
Dairyland Seed	HiDF-4999Q	109	81	64	4.8	68	--	19.70	--
Dairyland Seed	DS-3715AM	94	72	54	5.5	68	--	22.19	--
Legacy Seeds	L-3567 RRLFY	95	78	62	5.1	67	20.88	20.06	20.47
Legacy Seeds	L-4545 RRLFY	100	72	60	5.6	67	20.71	22.59	21.65
Legacy Seeds	L-4567 RRLFY	100	80	60	5.0	65	20.50	19.43	19.96
Legacy Seeds	L-5467 RRLFY	104	76	60	5.8	67	21.26	21.51	21.39
	Grain check	85	69	54	5.5	69	--	20.39	--
	Grain check	72	61	35	6.7	75	--	15.68	--
Trial Mean			75	58	5.6	68	21.08	21.33	--
C.V.%			1.6	4.4	--	--	14.10	13.24	--
LSD 5%			2	4	--	--	NS	4.71	--
LSD 10%			2	3	--	--	4.10	3.91	--

[1] *DAP = days after planting* *NS = no statistical difference between hybrids.*

Planting Date: May 19
Harvest Date: September 18
Planting Rate: 30,000 seeds/A
Row Spacing: 30"
Tillage: Strip-till
Previous Crop: 2018 = hrsw, 2019 = soy
Soil Type: Williams Loam

2019 and 2020 Biological Seed Treatments on Grain Corn at Minot **Combined Means**

Product	App. Rate	Days to Silk	Ear Height	Harvest Stand	Harvest Moisture	Test Weight	Grain Yield 2019	Grain Yield 2020	Grain Yield Avg.
		DAP*	inches	plants/A	%	lbs/bu	----- bushels per acre -----		
Untreated		71	38	26,549	21.2	57.7	95.6	103.8	100.6
MA Endoprime	4 g/A	71	37	25,815	21.0	57.3	80.2	106.2	95.8
Nutricycle	1.4 g/A	70	37	26,182	20.9	57.5	93.9	103.2	99.5
MycoApply	3 oz/A	71	38	25,953	21.6	57.6	82.3	105.6	96.3
Saber Infurrow	1 oz/A						81.7	--	--
MA EndoFuse	0.5 g/100 wt						--	100.8	--
LSD 5%		NS	NS	NS	NS	NS	NS	NS	NS

**DAP = Days after planting.* *NS = no statistical difference between products.*

2019 Strip till planted on May 9 into spring wheat stubble and harvested on October 28.
2020 Strip till planted on May 19 into soybean stubble and harvested on October 12.
Planting Rate: 30,000 seeds/A
Row Spacing: 30"
Soil Type: Williams Loam

2020 Grain Corn Variety Trial at Minot

Company	Hybrid	Relative Maturity	Days to Silk	Ear Height	Harvest Moisture	Test Weight	Grain Yield 2018[a]	2019[b]	2020[c]	2 yr	3 yr
		days	DAP*	inches	%	lbs/bu	---------- bushels per acre ----------				
Peterson Farms	22C74	74	63	31	13.9	56.9	--	--	84	--	--
Peterson Farms	21N78	78	66	34	12.8	53.2	--	--	77	--	--
Peterson Farms	71V81	81	66	33	14.3	54.6	78	98	103	101	93
REA Hybrids	1B750	75	65	32	14.2	55.5	--	--	83	--	--
REA Hybrids	1B780	79	65	35	15.2	55.1	68	112	119	115	100
REA Hybrids	1B821	82	67	35	16.9	56.1	--	--	102	--	--
REA Hybrids	2B851	85	66	35	13.7	52.9	--	--	107	--	--
INTEGRA	3009 VT2P RIB	79	65	31	13.5	54.7	--	104	102	103	--
INTEGRA	3282 VT2P RIB	82	69	36	15.8	56.6	64	101	98	99	88
INTEGRA	3431 VT2P RIB	84	69	35	18.7	57.9	--	--	118	--	--
INTEGRA	3537 VT2P RIB	85	69	37	17.3	56.0	75	102	104	103	94
NK Seeds	NK7837-3220 EZ Ref	78	67	40	17.3	57.4		--	91	--	--
NK Seeds	NK8005-3220A EZ Ref	80	68	35	13.8	55.0	--	--	109	--	--
NK Seeds	NK8204-3220 EZ Ref	82	70	43	18.0	57.3	--	--	104	--	--
NK Seeds	NK8519-3220 EZ Ref	85	72	40	16.7	54.9	--	--	108	--	--
Golden Harvest	G78C29-3220 EZ Ref	78	65	38	14.6	56.8	--	--	110	--	--
Dyna-Gro	D22QZ42	82	66	34	15.3	55.6	--	107	114	110	--
Dyna-Gro	D21VC81	81	66	38	14.9	54.8	--	--	115	--	--
Thunder Seed	T4072 RR	72	62	33	12.5	53.7	--	--	89	--	--
Thunder Seed	T6074 VT2P	74	64	33	14.6	57.2	--	91	109	100	--
Thunder Seed	T6079 VT2P	79	64	35	13.9	54.7	--	101	114	107	--
Thunder Seed	T6181 VT2P	81	66	36	15.6	55.6	--	--	113	--	--
Thunder Seed	T6782 VT2P	82	66	31	16.3	57.5	75	94	100	97	90
Proseed	1984 VT2P	84	66	35	17.2	56.6	--	--	119	--	--
Proseed	1882 VT2P	82	66	36	15.2	56.9	--	--	111	--	--
Proseed	2078 GT	78	66	36	13.9	54.0	--	--	87	--	--
Proseed	1980 VT2P	80	64	35	14.0	55.2	--	92	130	111	--
Trial Mean			66	35	15.2	55.7	68	104	104	--	--
C.V.%			1.1	4.6	10.8	2.4	10.7	10.6	5.2	--	--
LSD 5%			1	3	2.7	2.2	12	18	9	--	--
LSD 10%			1	2	2.2	1.8	10	15	8	--	--

**DAP = Days after planting.*

[a] 2018 Strip till twin rows planted on May 15 into wheat stubble and harvested on October 11.

[b] 2019 Strip till planted on May 9 into spring wheat stubble and harvested on October 28.

[c] 2020 Strip till planted on May 19 into soybean stubble and harvested on October 12.

Planting Rate: 30,000 seeds/A *Row Spacing: 30"*

Soil Type: Williams Loam

Note: Test weights and yields are adjusted to 15.5% moisture. The 2018 trial sustained severe drought.

Row Configuration, Planting Rate and RM of Grain Corn at Minot

Summary: The main objective of this trial was to compare single row and twin row planting configurations. Trials were planted during the 2017, 2018 and 2020 growing seasons with a SRES small plot planter using Great Plains no-till openers and Monosem seed singulation meters. The twin row configuration consists of 10 inch paired rows that are planted on 30 inch centers. This configuration is common with some crops such as peanut and with corn in some regions of the country. A twin row configuration allows for more plant to plant growing space within each row compared to traditional single rows. These trials also included 3 planting rates of two hybrids with distinctly different maturities. Comparisons between row configurations showed twin rows producing higher plant stands which translated into 8 more bushels of yield on average than single rows. 30k and 35k planting rates produced statistically similar plant stands and grain yields. As would be expected, there were differences between the hybrids with the later maturing hybrid producing significantly higher yields. In conclusion, these results show benefits of using a twin row configuration, a planting rate of 30k produced optimum yields and the 85 day hybrid was better suited for this environment.

Combined Means - Row Configuration

Row Configuration	Harvest Stand	Days to Silk	Ear Height	Harvest Moisture	Test Weight	Grain Yield
	plants/A	DAP*	inches	%	lbs/bu	bu/A
30" Single	27,066a	69a	35a	20.7a	58.1a	93.5a
30" Twin	31,137b	69a	35a	21.4a	58.6a	101.6b

Means followed by the same letter within each column were not statistically different.

Combined Means - Planting Rate

Planting Rate	Harvest Stand	Days to Silk	Ear Height	Harvest Moisture	Test Weight	Grain Yield
Seeds/A	plants/A	DAP*	inches	%	lbs/bu	bu/A
25k	23,735a	69a	35a	21.2a	58.8a	88.6a
30k	30,549b	69a	36a	20.6a	57.9a	101.9b
35k	33,020b	69a	35a	21.4a	58.3a	102.0b

Means followed by the same letter within each column were not statistically different.

Combined Means - Hybrid

Hybrid	Harvest Stand	Days to Silk	Ear Height	Harvest Moisture	Test Weight	Grain Yield
RM	plants/A	DAP*	inches	%	lbs/bu	bu/A
76 day	28,942a	67a	35a	20.5a	59.4a	85.4a
85 day	29,261a	71b	36a	21.6a	57.2b	109.6b

Means followed by the same letter within each column were not statistically different.
**Days after planting.*

Planting Date: May 15, 2017, May 14, 2018 and May 19, 2020
Harvest Date: Oct. 21, 2017, Oct. 11, 2018 and Oct. 12, 2020
Previous Crop: 2016 = Barley, 2017 = Soybean and 2019 = wheat
Tillage System: Minimum Till *Soil Type: Williams Loam*
Test Weight and Yield are adjusted to 15.5% moisture

Predicting Corn Dry Down with a Web Based Tool

Hybrids of the recommended relative maturity, which were planted in the first part of May are now approaching maturity.

Hybrids of the recommended relative maturity, which were planted in the first part of May are now approaching maturity. Once the corn reaches physiological maturity a black layer is formed at the base of the kernel and no additional weight will be added. Black layer usually occurs when the grain moisture content reaches 30 to 32% moisture, but can vary from 25 to 40% moisture depending on the hybrid and the season. A freezing event, like that experience on Monday night in some parts of the state, might cause the death of the leaves and affect further grain filling. A short duration frost when temperatures are at or just below freezing can kill leaves but not the stalk. If the leaves are killed, but not the stalk, carbohydrates can still move from the stalk to the ear.

Figure 1. Predicted grain moisture content of an 89-day relative maturity corn hybrid, planted on May 12 at Prosper, ND, 2020. The Corn Drydown Calculator was developed by Iowa State, 2019.

The Corn Growing Degree Day Decision Support Tool, (https://mrcc.illinois.edu/U2U/gdd/) can help to determine how close your corn crop is to maturity. This tool tracked the development of the corn we planted May 14 quite well, with an 89 RM hybrid we sampled today (Tuesday September 8th) coming in at 34% moisture, very close to the moisture we would expect at physiological maturity. The decision support tool predicted that this hybrid would reach blacklayer on September 9th.

Reaching maturity is important as it means that the crop has maximized the amount of weight that it has packed into its kernels. The grain then needs to dry in the field to the point that it can be harvested and be economically dried for storage and marketing. Predicting the rate of drying in the field is more complex than predicting corn development. Factors that affect the rate of field drying include: the initial moisture content of the grain, air temperature, relative humidity, rainfall, dew, wind speed and kernel characteristics. I have found the web-based tool developed by Iowa State University called the Corn Dry Down Calculator to be very helping in predicting how quickly the corn will dry. Using this tool, I found that the hybrid described above, will reach 18% moisture by the first part of October (Figure 1). The moisture decline in September is very rapid, demonstrating the value growing a hybrid that matures by the middle of September when temperatures are still high enough to drive high rates of field drying.

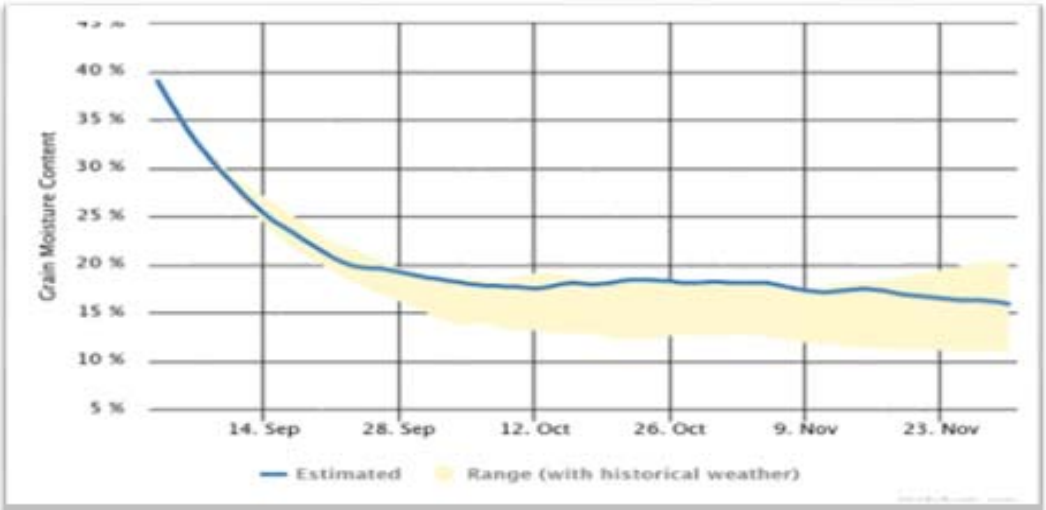

Figure 1. Predicted grain moisture content of an 89-day relative maturity corn hybrid, planted on May 12 at Prosper, ND, 2020. The Corn Drydown Calculator

-NDSU Publication: www.ag.ndsu.edu/cpr/plant-science/predicting-corn-dry-down-with-a-web-based-tool-09-10-20
Joel Ransom, NDSU Extension Agronomist, Cereal Crops

2020 Liberty Link Canola Variety Trial at Minot

Company	Variety	Days to Bloom	Bloom Duration	Days to Maturity	Plant Height	Oil Content	Yield
		DAP*	Days	DAP*	inches	%	lbs/A
DEKALB	DKLL82SC	42	21	79	37	44.1	1838
DEKALB	DKTFLL21SC	40	22	78	34	44.1	2304
BASF	InVigor L233P	42	20	79	39	44.9	2172
BASF	InVigor L234PC	41	21	79	37	43.0	2109
BASF	InVigor L345PC	44	19	80	40	44.7	1911
BASF	InVigor L255PC	45	19	83	37	46.8	1538
Trial Mean		42	20	80	38	44.5	2061
C.V.%		2.4	4.0	1.1	5.7	1.7	4.6
LSD 0.05		2	1	1	4	1.3	162
LSD 0.1		1	1	1	3	1.1	134

**DAP = Days after planting.*

Trial was planted on May 15 with a seeding rate of 8 lbs/A and harvested on August 21.

Previous Crop: soybean

Soil Type: Williams Loam

Tillage: No-till

Oil content and seed yields are adjusted to 8.5% moisture.

Safflower Variety Descriptions

Variety	Origin[1]	PVP[2]	Hull Type[3]	Oil Type[4]	Irrigated Yield[5]	Dryland Yield[5]	Test Weight[5]	Oil[5]	Maturity	Tolerance[6] Alt	Tolerance[6] BB
Cardinal	MSU/NDSU	yes	N	high lino	v good	v good	high	fair	med	T	MT
Finch	MSU/NDSU	no	N	lino	good	v good	v high	fair	m early	MS	T
Hybrid 1601	STI	yes	STP	high oleic	v good	v good	med	good	m late	MT	MT
Hybrid 9049	STI	yes	N	high oleic	v good	v good	v high	fair	med	MT	MT
MonDak	MSU/NDSU	yes	N	high oleic	good	v good	high	fair	m early	T	MT
Montola 2000	MSU/NDSU	yes	N	high oleic	m good	good	med	good	early	MS	MS
Montola 2001	MSU/NDSU	yes	STP	high oleic	good	fair	med	good	med	MT	MT
Montola 2003	MSU/NDSU	yes	N	high oleic	v good	v good	m high	good	m early	MT	MT
Montola 2004	MSU/NDSU	yes	N	high oleic	good	good	m high	good	m early	MS	MT
Morlin	MSU/NDSU	yes	STP	high lino	v good	good	med	good	m late	T	T
Nutrasaff	MSU/NDSU	yes	RED	lino	good	good	med	high	med	T	MT

[1] *MSU = Montana State University, NDSU = North Dakota State University, STI = Safflower Technologies International*

[2] *PVP = Plant Variety Protection. "yes" indicates the variety is protected and the seed may be sold for planting purposes only as a class of certified seed (Title V option).*

[3] *STP = striped, N = normal, RED = reduced.*

[4] *Lino = linoleic.*

[5] *Relative ratings of yield, test weight and oil will vary under conditions of moderate-severe disease infestation.*

[6] *Alt = Alternaria leaf spot disease, BB = bacterial blight, S = susceptible, MS = moderately susceptible, MT = moderately tolerant, T = tolerant.*

-NDSU Publication A1105-16 at https://www.ag.ndsu.edu/publications

2020 Safflower Variety Trial at Minot

Variety	Days to Bloom	Plant Height	Test Weight	Oil Content	Seed Yield 2018	2019	2020	2 yr Avg.	3 yr Avg.
	DAP[1]	inches	lbs/bu	%	pounds per acre				
Linoleic Types									
Cardinal	71	24	40.7	42.0	1671	2277	2058	2168	2002
Finch	71	23	40.7	37.5	1391	2111	2058	2085	1853
NutraSaff	71	24	34.9	50.1	1541	2055	1681	1868	1759
Rubis Red	70	23	42.9	37.9	1518	2117	1635	1876	1757
Oleic Types									
Hybrid 200	68	25	39.9	31.9	2054	2083	2044	2063	2060
Chickadee	72	21	41.2	39.0	1706	2310	2126	2218	2047
Hybrid 1601	69	23	40.7	42.8	1894	2144	1761	1952	1933
MonDak	70	25	40.3	32.5	1622	2016	2046	2031	1895
Hybrid 446	70	22	42.7	39.4	1480	2162	1943	2053	1862
Montola 2003	69	27	33.5	39.4	1544	2075	1815	1945	1811
Trial Mean	70	24	39.7	39.3	1642	2135	1917	--	--
C.V.%	0.6	5.9	1.7	2.0	11.6	5.8	8.4	--	--
LSD 5%	1	2	1.1	1.4	326	214	277	--	--
LSD 10%	1	2	0.9	1.1	269	177	229	--	--

[1] *Days after Planting*

Planting Date: May 14
Harvest Date: October 7
Seeding Rate: Hybrids = 18 lbs/A, non-hybrids = 25 lbs/A
Previous Crop: 2017, 2018 & 2019 = hrsw
Tillage System: Minimum till *Soil Type: Williams Loam*

Flax Variety Descriptions Tested in 2020 in North Dakota

Variety[1]	Origin[2]	Year Released	Days to Flower Avg.[3]	Seed Color	Plant Height	Plant Height inch Avg.[3]	Fusarium Wilt[4]
AAC Bright	Can.	2017	46	Yellow	Tall	24	MS/S[5]
Aquarius	Pulse USA[6]	--	41	Brown	Med.short	17	MR
Bison	ND	1926	47	Brown	Med.tall	22	MR
Carter	ND	2004	47	Yellow	Med.tall	19	MS/S[5]
CDC Buryu	Can.	2016	47	Brown	Med.tall	22	MR
CDC Dorado	Can.	2017	42	Yellow	Med.tall	19	MS[5]
CDC Glas	Can.	2012	49	Brown	Tall	23	MS[5]
CDC Neela	Can.	2013	47	Brown	Med.tall	20	MR
CDC Plava	Can.	2015	46	Brown	Med.tall	20	MR
CDC Rowland	Can.	2018	46	Brown	Med.tall	22	MR
Gold ND	ND	2014	48	Yellow	Med.tall	22	MR/R
Lion	Pulse USA[6]	--	44	Brown	Med.short	17	MR
ND Hammond	ND	2018	46	Brown	Med.	19	MS
Omega	ND	1989	47	Yellow	Med.	18	MS[5]
Prairie Thunder	Can.	2006	48	Brown	Med.tall	22	MR
Webster	SD	1998	48	Brown	Med.tall	21	MR
York	ND	2002	45	Brown	Med.tall	21	MR/R

[1] All varieties have resistance to prevalent races of rust; all have good oil yield and oil quality.

[2] Can. = Canada; ND = North Dakota State University; SD = South Dakota State University.

[3] Based on Carrigton in 2020.

[4] R = resistant; MR = moderately resistant; MS = moderately susceptible: S = susceptible.

[5] This variety had fusarium wilt within the 2020 CREC flax variety trial, and rating has been adjusted to a lower rating.

[6] Company entering variety into the trial at Carrington.

-NDSU Publication A1105-20 at https://www.ag.ndsu.edu/publications

2020 Flax Variety Trial at Minot

Variety	10% Bloom	Plant Height	Test Weight	Oil Content	Seed Yield 2017	2018	2020	2 yr Avg.	3 yr Avg.
	DAP[1]	inches	lbs/bu	%	bushels per acre				
CDC Neela	46	23	53.9	45.2	23.5	30.7	25.1	27.9	26.4
CDC Glas	45	20	53.4	42.8	23.6	25.9	23.4	24.7	24.3
Bison	46	23	54.0	44.0	18.9	24.9	22.5	23.7	22.1
Gold ND	45	19	52.4	43.8	16.3	25.0	23.8	24.4	21.7
Prairie Thunder	44	23	53.2	44.6	17.8	25.7	21.6	23.7	21.7
Carter	46	22	53.9	44.1	20.3	20.7	22.5	21.6	21.2
ND Hammond	46	25	53.3	43.1	17.9	22.0	23.6	22.8	21.2
Webster	45	20	53.3	44.4	20.5	21.3	20.0	20.7	20.6
Omega	47	25	53.7	44.4	16.1	24.6	20.2	22.4	20.3
York	46	24	53.7	46.9	18.7	20.1	19.1	19.6	19.3
CDC Durado	45	20	53.4	44.2	--	--	26.0	--	--
AAC Bright	44	22	53.4	43.6	--	--	22.9	--	--
CDC Rowland	46	23	54.2	44.7		--	22.6	--	--
CDC Plava	44	20	53.6	42.3	--	--	22.3	--	--
CDC Buryu	43	19	52.5	45.7	--	--	18.3	--	--
Trial Mean	45	22	53.5	44.3	18.4	21.2	22.9	--	--
C.V.%	1.2	7.7	2.2	1.4	15.3	21.7	14.0	--	--
LSD 5%	1	3	NS	1.0	4.6	7.5	NS	--	--
LSD 10%	1	2	NS	0.8	3.8	6.3	NS	--	--

[1] Days after Planting *NS = no statistical difference between varieties.*

Planting Date: May 14 *Harvest Date: August 29*
Seeding Rate: 2.5 million PLS/A
Previous Crop: 2016 = soybean, 2017 & 2019 = spring wheat
Soil Type: Williams Loam *Tillage: minimum-till*
Note: The 2018 trial sustained herbicide (sulfentrazone) injury resulting in inconsistent yields.
The 2019 trial sustained severe drought and seed shatter prior to harvest. Data not reported.

2020 Oil Type Sunflower Variety Trial at Minot

Company	Hybrid	Days to Bloom	Days to Mature	Plant Height	Oil	Test Weight	Yield 2018	Average 2019	Average 2020	Average 2 yr	Average 3 yr
		DAP*	DAP*	inches	%	lbs/bu	lbs/A				
Nuseed	Badger DMR	65	98	59	37.7	29.6	--	--	1690	--	--
Nuseed	N5LM307	64	97	58	38.1	29.4	1650	2004	1959	1981	1871
Nuseed	Hornet	72	100	55	46.8	31.3	2649	2215	2295	2255	2386
Nuseed	N4H422 CL	69	102	64	44.5	32.8	--	--	2004	--	--
Nuseed	N4H470 CL PLus	72	101	58	46.5	33.9	3106	2518	1758	2138	2461
Nuseed	N4HM354	66	100	58	44.2	30.6	1883	1916	2268	2092	2022
Nuseed	Camaro II	69	99	61	45.8	31.6	2322	2283	1905	2094	2170
Nuseed	N4H302 E	69	101	59	45.5	27.6	2642	2012	1388	1700	2014
Nuseed	Falcon	68	102	55	45.1	32.1	2387	1752	1805	1779	1981
CROPLAN	CP545CL	70	100	52	44.1	32.3	2270	2088	2081	2085	2146
CROPLAN	CP432E	64	98	58	41.3	30.1	2096	1993	1784	1888	1958
CROPLAN	CP450E	68	103	57	42.9	31.8	2371	1895	1565	1730	1944
CROPLAN	CP455E	68	104	59	44.4	30.4	3124	2965	1637	2301	2575
CROPLAN	CP4909E	69	100	60	45.6	31.2	--	2033	1734	1884	--
CHS Sunflower	8D310CL	67	103	63	38.6	28.8	--	--	2218	--	--
Proseed	E-93 E	69	100	68	40.1	27.3	--	--	1392	--	--
Proseed	E-91 E	69	100	66	39.4	31.2	--	1767	1409	1588	--
Proseed	E-31	69	101	66	39.1	26.8	2319	1345	1587	1466	1750
DAIRYLAND SEED	D643HO	66	99	68	45.8	30.6	--	--	2351	--	--
DAIRYLAND SEED	D684HO	69	104	69	43.3	34.2	--	--	1525	--	--
DAIRYLAND SEED	D683MO	67	104	61	41.6	31.5	--	--	1453	--	--
DAIRYLAND SEED	D690MO	69	103	66	44.5	30.9		--	1884	--	--
Sunopta	4415HO/CLP	69	99	62	42.9	30.7	2185	1647	1978	1812	1937
Sunopta	4425CL	66	104	65	42.4	30.9	2249	1874	1954	1914	2026
Caussade Semences	Kaledonia	68	103	60	31.3	26.6	--	--	1014	--	--
Dyna-Gro	H45HO10EX	67	103	57	43.5	28.0	--	2128	1402	1765	--
Dyna-Gro	H49HO19CL	72	101	54	45.9	30.4	2547	1601	1872	1737	2007
Dyna-Gro	H45NS16CL	64	98	54	46.5	30.4	2507	1499	1954	1727	1987
Dyna-Gro	H44HO12CL	66	100	54	45.7	31.1	2246	1764	1349	1556	1786
Dyna-Gro	H42HO18CL	65	97	52	44.3	30.1	2015	1625	2075	1850	1905
Dyna-Gro	XH01H56 CL	59	96	45	38.9	28.1	--	--	1297	--	--
Dyna-Gro	XH93H79CL	71	99	56	46.5	29.7	--	--	1865	--	--
Dyna-Gro	XH82H63EX	70	104	66	42.1	33.9	--	--	1540	--	--
Dyna-Gro	XH82H65EX	65	100	63	44.0	29.6	--	--	2272	--	--
Long term check	Hybrid 894	66	102	54	43.5	29.6	1995	1640	1736	1688	1790
Early maturing check	Honeycomb NS	60	96	52	39.9	27.6	--	--	635	--	--
Med maturing check	8N270CLDM	63	100	47	40.0	27.9	--	--	939	--	--
Late maturing check	559CL	68	104	65	47.8	31.7	2219	2072	2051	2062	2114
Trial Mean		67	101	59	42.9	30.4	2178	1889	1761	--	--
C.V.%		1.6	2.0	6.6	2.5	4.2	11.8	14.4	16.8	--	--
LSD 5%		2	3	6	1.7	2.1	308	442	481	--	--
LSD 10%		1	3	5	1.5	1.8	258	370	402	--	--

**DAP = Days after planting.*

Planting Date: May 29 *Harvest Date: October 19* *Row Spracing: 30"*

Planting Population: 21,000 plants/A *Tillage: Minimum Till* *Soil Type: Williams loam*

Previous Crop: 2017 = soybean, 2018 and 2019 = spring wheat

2020 Non-Oil Type Sunflower Variety Trial at Minot

Company/Brand	Hybrid	Date of 50% Bloom	Maturity Date	Plant Height	Test Weight	Seed Over Screen >22/64	>20/64	>18/64	Yield
		August	Sept	inches	lbs/bu	----------%----------			lbs/A
Royal Hybrid	RH208EX	1	6	61	23.2	97	7	3	1616
Long term check	Hybrid 924	4	9	59	26.9	91	26	8	1540
Trial Mean		3	7	61	24.8	95	13	4	1665
C.V.%		30.6	30.6	3.7	5.1	3	61	50	12
LSD 5%		2	NS	NS	2.9	NS	NS	NS	NS
LSD 10%		2	NS	NS	2.2	NS	14	4	NS

Planting Date: May 29
Planting Rate: 21,000 seeds/A
Row Spacing: 30"
Harvest Date: October 19
Previous Crop: spring wheat
Tillage: Minimum till
Soil Type: Williams Loam

Row Configurations and Planting Rates of Sunflower at Minot

Summary: The main objective of this trial was to compare 15 inch, 30 inch and 30 inch twin row planting configurations along with four planting rates within each row configuration. Trials were planted during the 2018, 2019 and 2020 growing seasons with a SRES small plot planter using Great Plains no-till openers and Monosem seed singulation meters. The twin row configuration consists of 10 inch paired rows that are planted on 30 inch centers. A twin row configuration allows for more plant to plant growing space within each row compared to traditional single rows. Two hybrids with distinctly different genetic backgrounds were also used in each comparison. Comparisons between row configurations showed 15 inch rows and twin rows produced more productive plants which translated into significantly higher yields along with higher oil content than the traditional 30 inch row spacing. On average, 15 inch rows produced 179 pounds per acre more and the twin rows produced 251 pounds per acre more than the 30 inch rows. Actual harvested plant stands did not match with the 15k and 20k planting rates and are believed to be a result of inaccurate seed metering. The harvested stand for the 15k and 20k planting rates were almost identical and produced almost identical results. 25k and 30k planting rates also produced statistically similar results to each other, but were statistically higher in oil content and yield than the 15k and 20k planting rates. In conclusion, this crop is known for its ability to adjust head size according to micro-environmental growing conditions. This study shows merit in growing this crop in 15 inch rows or in a twin row configuration with a planting rate of 25,000 seeds per acre. Other considerations include the cost of twin row planting equipment and combine headers for narrow rows. Sunflower stalks are relatively brittle at harvest and twin rows have a tendency to break over with a 30" combine header. Plants in narrow rows canopy over more quickly, providing for better weed competition.

Combined Means - Row Configuration

Row Configuration	Harvest Stand	Days to Bloom	Days to Mature	Plant Height	Test Weight	Oil Content	Yield
	plants/A	DAP*	DAP*	inches	lbs/bu	%	lbs/A
15"	25,512a	70a	113a	50a	30.1a	44.6a	2062a
30"	21,691b	70a	113a	48b	30.0a	43.4b	1883b
30" Twin	26,607a	70a	113a	50a	30.2a	44.8a	2134a

Means followed by the same letter within each column were not statistically different.
**Days After Planting*

Combined Means - Planting Rate

Planting Rate	Harvest Stand	Days to Bloom	Days to Mature	Plant Height	Test Weight	Oil Content	Yield
	plants/A	DAP*	DAP*	inches	lbs/bu	%	lbs/A
15k	20,515a	70a	113a	48a	29.8a	43.6ab	1916a
20k	20,192a	70a	113a	48a	30.0a	43.3a	1829a
25k	27,783b	70a	113a	51b	30.1a	44.7bc	2131b
30k	29,923b	70a	114a	51b	30.4a	45.5c	2230b

Means followed by the same letter within each column were not statistically different.
**Days After Planting*

Planting Date: May 25, 2018, May 20, 2019 and May 29, 2020
Harvest Date: Oct. 23, 2018, Nov. 4, 2019 and Oct. 19, 2020
Previous Crop: Spring wheat
Tillage System: Minimum Till
Soil Type: Williams Loam

2020 Conventional Soybean Variety Trial at Minot

Variety	Maturity Group	IDC Rating	Maturity Date	Plant Height	Test Weight	Yield 2018	Yield 2019	Yield 2020	Yield 2 yr	Yield 3 yr
		1-5[a]	Sept	inches	lbs/bu	bushels / acre				
ND Rolette	00.9	1.9	6	31	53.2	28.6	45.3	41.3	43.3	38.4
ND Benson	0.4	2.0	10	34	52.7	19.5	48.6	33.9	41.2	34.0
Ashtabula	0.4		9	33	52.9	--	--	36.7		--
ND Dickey	0.7	1.9	14	31	52.9	--	--	43.3	--	--
Trial Mean		2.4	9	32	53.8	22.0	45.8	39.5	--	--
C.V.%		17.2	11.3	6.4	3.7	17.1	8.3	9.2	--	--
LSD 5%		0.3	2	3	NS	6.3	6.2	6.0	--	--
LSD 10%		0.2	1	3	NS	5.2	5.2	5.0	--	--

[a] *IDC rating = Iron deficiency chlorosis rating: 1 - green, 3 - yellow, 5 - dead*

NS = no statistical difference between varieties.

Planting Date: May 22
Planting Rate: 150,000 PLS/A
Row Spacing: Solid Seeded (7" rows)
Tillage: Minimum Till
Previous Crop: 2017 = corn, 2018 = wheat, 2019 = soybean
Harvest Date: October 1
Soil Type: Williams Loam
Notes: The 2018 trial sustained moderate drought. Light frost on Sept. 8, 2020.

2020 RR, GT, Extend and Enlist Soybean Variety Trial at Minot

Company/Brand	Variety	Herbicide System	Maturity Group	IDC Rating	Maturity Date	Plant Height	Test Weight	Yield 2018	Yield 2019	Yield 2020	Yield 2 yr	Yield 3 yr
				1-5[a]	Sept	inches	lbs/bu	bushels / acre				
Integra	40129N	Enlist E3	0.1	2.1	10	23	57.3	--	--	29.0	--	--
Integra	20215	RR2	0.2	2.5	5	25	56.8	43.8	51.2	28.5	39.8	41.2
Integra	40201N	Enlist E3	0.2	2.9	13	23	57.8	--	--	34.4	--	--
Integra	50309N	Xtend	0.3	1.8	7	27	58.0	28.2	48.6	33.1	40.9	36.6
Integra	40300N	Enlist E3	0.3	2.3	7	25	57.2	--	--	30.0	--	--
LG Seeds	LGS00899RX	Xtend	00.8	2.7	3	26	57.8	--	47.9	32.1	40.0	--
LG Seeds	LGS0111RX	Xtend	0.1	2.3	7	29	57.3	43.1	52.8	35.1	43.9	43.7
LG Seeds	LGS0355RX	Xtend	0.3	2.1	8	28	57.2	--	--	34.9	--	--
LG Seeds	LGS0400RX	Xtend	0.4	2.5	11	30	57.0	--	--	37.3	--	--
Peterson Farms Seed	21X007	Xtend	00.7	3.0	1	25	57.3	--	--	28.1	--	--
Peterson Farms Seed	19EN008	Enlist E3	00.8	2.1	6	25	58.1	--	54.7	33.8	44.2	--
Peterson Farms Seed	19X03N	Xtend	0.3	2.1	9	28	58.1	--	--	37.4	--	--
P3 Genetics	2002E	Enlist E3	0.2	2.5	9	22	57.4	--	47.4	28.3	37.9	--
NK Seeds	S006-R7X	Xtend	00.6	2.8	8/31	22	57.5	--	--	33.5	--	--
NK Seeds	S01-C4X	Xtend	0.1	2.3	7	28	58.7	--	--	36.3	--	--
NK Seeds	S02-F9X	Xtend	0.2	3.1	5	24	57.9	--	--	36.4	--	--
NK Seeds	S03-S6X	Xtend	0.3	2.6	9	30	57.9	--	--	39.1	--	--
NK Seeds	S05-N5X	Xtend	0.5	2.8	13	28	58.0	--	--	37.5	--	--
NK Seeds	S04-Q7X	Xtend	0.4	2.0	13	25	57.8	--		32.6	--	--
Golden Harvest	GH00629X	Xtend	00.6	2.2	8/30	22	57.5	--	--	34.5	--	--
Golden Harvest	GH00833E3	Enlist E3	00.8	2.2	6	24	57.3	--	--	34.2	--	--
Golden Harvest	GH0443X	Xtend	0.4	1.9	12	25	58.5	--	--	35.1	--	--
Dairyland Seed	EXP E8-201E	Enlist E3	00.8	2.2	5	26	58.0	--	--	35.6	--	--
Dairyland Seed	EXP E9-201E	Enlist E3	00.9	1.6	7	26	58.0	--	--	32.6	--	--
Dairyland Seed	DSR-0119E	Enlist E3	0.1	2.6	7	22	57.7	--	--	39.7	--	--
Proseed	XT70-09	Xtend	00.9	2.6	6	29	58.1	--	--	36.2	--	--
Proseed	EL80-093	Enlist E3	00.9	2.1	6	26	58.5	--	57.0	35.5	46.2	--
Proseed	XT20-07	Xtend	00.7	2.4	8/31	26	57.7	--	--	32.1	--	--
Dyna-Gro	S009XT68	Xtend	00.9	2.2	7	29	57.7	32.8	50.3	36.9	43.6	40.0
Dyna-Gro	S02EN71	Enlist E3	0.2	3.0	12	22	57.8	--	--	34.2	--	--
Dyna-Gro	S03XT29	Xtend	0.3	1.9	10	29	58.0	30.6	52.9	37.0	44.9	40.2
Legacy Seeds	LS-00639N RR2X	Xtend	00.6	2.4	2	27	57.9	--	43.2	32.1	37.6	--
Legacy Seeds	LS-00930 RR2X	Xtend	00.9	2.5	8	23	57.5	--	46.9	34.1	40.5	--
Legacy Seeds	LS 012-20	Enlist E3	0.1	2.6	10	26	57.5	--	--	31.2	--	--
Legacy Seeds	LS-0239N RR2X	Xtend	0.2	2.0	7	26	58.2	--	48.2	32.0	40.1	--
Legacy Seeds	LS-0319 LLGT27	LL, GT	0.3	2.5	12	27	57.8	--	--	35.1	--	--
Thunder Seed	SB81006	Xtend	00.6	2.7	2	27	57.4	--	--	32.4	--	--
Thunder Seed	TE71008N	Enlist E3	00.8	2.1	5	24	57.9	--	--	35.6	--	--
Thunder Seed	SB8001	Xtend	0.1	2.5	7	25	57.9	--	--	33.9	--	--
Thunder Seed	TE7101N	Enlist E3	0.1	3.1	11	21	57.4	--	--	30.8	--	--
NDSU	ND17009GT	GT	00.9	3.1	7	29	59.1	36.1	49.6	27.1	38.4	37.6
Norcan Seed	NOR004	GT	00.4	--	8/30	23	56.7	29.3	41.1	25.4	33.3	31.9
Norcan Seed	NOR005	GT	00.5	--	8/29	23	57.2	33.1	44.2	25.1	34.7	34.1
Norcan Seed	NOR04	GT	0.4	--	6	22	57.7	--	38.2	23.3	30.7	--
Trial Mean				2.4	6	26	57.7	30.5	48.1	33.2	--	--
C.V.%				14.7	0.2	9.5	1.1	12.1	7.0	8.1	--	--
LSD 5%				0.2	3	4	1.0	5.9	5.5	4.4	--	--
LSD 10%				0.2	3	3	0.8	5.0	4.6	3.6	--	--

[a] *IDC rating = Iron deficiency chlorosis rating: 1 - green, 3 - yellow, 5 - dead*

Planting Date: May 22
Planting Rate: 150,000 PLS/A
Row Spacing: solid seeded (7")
Tillage: Minimum Till
Previous Crop: 2017 = corn, 2018 = wheat, 2019 = soy
Harvest Date: October 1
Soil Type: Williams Loam
Note: Light frost on September 9.

2020 Soybean Variety Trial at Mohall

Cooperators: Dean Schoenberg and the Renville/Bottineau Ag Improvement Assoc.

Company/Brand	Variety	Herbicide System	Maturity Group	IDC Rating	Plant Height	Test Weight	Yield 2018	Yield 2019	Yield 2020	Yield 2 yr	Yield 3 yr
				1-5[a]	inches	lbs/bu	bushels/acre	bushels/acre	bushels/acre	bushels/acre	bushels/acre
Integra	50060N	Xtend	00.6	2.1	37	58.7	--	47.4	37.4	42.4	--
Integra	40089N	Enlist E3	00.8	2.1	37	57.9	--	39.1	41.2	40.1	--
Integra	50081N	Xtend	00.8	2.6	32	58.3	--	--	45.2	--	--
Integra	20097	RR2	00.9	2.8	39	58.0	28.7	43.7	39.7	41.7	37.4
LG Seeds	LGS00899RX	Xtend	00.8	2.7	37	57.6	--	45.3	41.3	43.3	--
LG Seeds	LGS0111RX	Xtend	0.1	2.3	39	57.8	31.4	56.7	36.7	46.7	41.6
LG Seeds	LGS0355RX	Xtend	0.3	2.1	37	57.4	--	--	35.5	--	--
NK Seeds	S006-R7X	Xtend	00.6	2.8	33	58.3		--	50.3	--	--
NK Seeds	S01-C4X	Xtend	0.1	2.3	37	58.8	--	--	33.8	--	--
NK Seeds	S02-F9X	Xtend	0.2	3.1	32	58.1	--	--	38.8	--	--
NK Seeds	S03-S6X	Xtend	0.3	2.6	32	58.3	--	--	31.0	--	--
NK Seeds	S05-N5X	Xtend	0.5	2.8	32	58.5	--	--	35.8	--	--
NK Seeds	S04-Q7X	Xtend	0.4	2.0	37	57.9	--	--	31.7	--	--
Dairyland Seed	EXP E8-201E	Enlist E3	00.8	2.2	38	57.9	--	--	41.6	--	--
Dairyland Seed	EXP E9-201E	Enlist E3	00.9	1.6	37	58.1	--	--	33.8	--	--
Dairyland Seed	DSR-0119E	Enlist E3	0.1	2.6	36	56.1	--	--	35.3	--	--
Proseed	XT70-09	Xtend	00.9	2.6	36	57.9	--	--	39.3	--	--
Proseed	XT60-09	Xtend	00.9	2.0	39	58.5	--	44.1	38.5	41.3	--
Proseed	EL80-093	Enlist E3	00.9	2.1	37	57.6	--	45.7	38.3	42.0	--
Proseed	XT20-07	Xtend	00.7	2.4	37	58.0	--	--	38.6	--	--
Dyna-Gro	S005XT38	Xtend	00.5	2.3	37	57.7	29.3	39.8	41.5	40.6	36.9
Dyna-Gro	S007XT27	Xtend	00.7	2.4	32	58.0	29.7	39.5	37.5	38.5	35.6
NDSU	ND17009GT	GT	00.9	3.1	34	59.0	25.8	33.7	36.9	35.3	32.1
Trial Mean				2.4	36	58.0	27.5	40.1	38.1	--	--
C.V.%				14.7	4.7	0.7	11.4	14.0	5.5	--	--
LSD 5%				0.2	2	0.6	4.4	7.9	3.0	--	--
LSD 10%				0.2	2	0.5	3.7	6.6	2.5	--	--

[a] *IDC rating = Iron deficiency chlorosis rating: 1 - green, 3 - yellow, 5 - dead*

Planting Date: May 26
Harvest Date: October 6
Planting Rate: 150,000 PLS/A
Row Spacing: Solid Seeded (7" rows)
Soil Type: Barnes loam
Tillage: Minimum Till
Previous Crop: 2017 = durum, 2018 = canola, 2019 = durum
Note: Frost on September 9.

2020 Soybean Variety Trial at Rugby

Cooperators: Dave Teigen and the Pierce County Crop Improvement Assoc.

Company/Brand	Variety	Herbicide System	Maturity Group	IDC Rating	Plant Height	Test Weight	Yield 2018	Yield 2019	Yield 2020	Yield 2 yr	Yield 3 yr
				1-5[a]	inches	lbs/bu	bushels/acre	bushels/acre	bushels/acre	bushels/acre	bushels/acre
Integra	40129N	Enlist E3	0.1	2.1	30	58.2	--	34.6	31.8	33.2	--
Integra	20215	RR2	0.2	2.5	29	58.3	54.8	41.9	36.6	39.3	44.4
Integra	40201N	Enlist E3	0.2	2.9	24	57.6	--	--	38.9	--	--
Integra	50309N	Xtend	0.3	1.8	31	57.7	66.3	40.7	34.3	37.5	47.1
REA Hybrids	RX0411	Xtend	0.4	2.3	37	58.4	--	--	32.4	--	--
LG Seeds	LGS00899RX	Xtend	00.8	2.7	30	58.3	--	38.6	37.6	38.1	--
LG Seeds	LGS0111RX	Xtend	0.1	2.3	31	58.2	--	45.7	36.2	41.0	--
LG Seeds	LGS0355RX	Xtend	0.3	2.1	33	57.7	--	--	36.2	--	--
LG Seeds	LGS0400RX	Xtend	0.4	2.5	30	58.0	--	--	37.3	--	--
NK Seeds	S006-R7X	Xtend	00.6	2.8	25	57.9	--	--	39.2	--	--
NK Seeds	S01-C4X	Xtend	0.1	2.3	30	59.0	--	--	34.9	--	--
NK Seeds	S02-F9X	Xtend	0.2	3.1	26	58.6	--	--	36.8	--	--
NK Seeds	S03-S6X	Xtend	0.3	2.6	26	58.5	--	--	34.2	--	--
NK Seeds	S04-Q7X	Xtend	0.4	2.0	27	58.5	--	--	33.5	--	--
NK Seeds	S05-N5X	Xtend	0.5	2.8	27	58.3	--	--	33.2	--	--
Proseed	XT70-09	Xtend	00.9	2.6	29	58.5		--	35.9	--	--
Proseed	EL80-093	Enlist E3	00.9	2.1	29	58.9	--	38.9	37.1	38.0	--
Proseed	XT20-07	Xtend	00.7	2.4	31	58.0	--	--	38.2	--	--
Legacy Seeds	LS-0239N RR2X	Xtend	0.2	2.0	30	57.8	53.8	40.5	35.1	37.8	43.1
Legacy Seeds	LS-0319 LLGT27	LL,GT	0.3	2.5	26	58.0	--	--	32.3	--	--
Legacy Seeds	LS-0320N E3	Enlist E3	0.3	2.4	24	58.1	--	--	36.8	--	--
Legacy Seeds	LS-0429 E3	Enlist E3	0.4	1.9	29	58.1	--	40.9	30.9	35.9	--
Legacy Seeds	LS-0438	Xtend	0.4	2.7	28	58.1	--	41.0	31.0	36.0	--
Thunder Seed	SB81006	Xtend	00.6	2.7	28	57.7	--	--	37.5	--	--
Thunder Seed	TE71008N	Enlist E3	00.8	2.1	29	58.8	--	--	36.0	--	--
Thunder Seed	SB8001	Xtend	0.1	2.5	27	57.8	--	--	36.5	--	--
Thunder Seed	TE7101N	Enlist E3	0.1	3.1	24	57.8	--	--	35.9	--	--
NDSU	ND17009GT	GT	00.9	3.1	29	59.6	57.4	35.3	29.8	32.5	40.8
Trial Mean				2.4	28	58.3	58.6	39.4	35.1	--	--
C.V.%				14.7	7.6	0.6	6.4	9.1	7.8	--	--
LSD 5%				0.2	3	0.5	5.2	5.0	3.9	--	--
LSD 10%				0.2	3	0.4	4.4	4.2	3.2	--	--

[a] *IDC rating = Iron deficiency chlorosis rating: 1 - green, 3 - yellow, 5 - dead*

Planting Date: May 28
Harvest Date: October 6

Row Spacing: Solid Seeded (7" rows)
Soil Type: Gardena silt loam
Tillage: Minimum Till
Previous Crop: 2017 = barley, 2018 = soybean, 2019 = barley

2020 Soybean Variety Trial at Garrison

Cooperators: Brian and Roger Bendickson, Garrison

Company/Bran	Variety	Herbicide System	Maturity Group	IDC Rating	Plant Height	Lodging	Test Weight	Yield 2018	Yield 2019	Yield 2020	Yield 2 yr	Yield 3 yr
				1-5[a]	inches	0-9*	lbs/bu			bu/A		
Integra	40129N	Enlist E3	0.1	2.1	20	0	55.5		--	32.8	--	--
Integra	20215	RR	0.2	2.5	22	0	56.1	37.0	55.2	37.9	46.6	43.4
Integra	40201N	Enlist E3	0.2	2.9	17	0	55.6	--	--	37.2	--	--
Integra	50309N	Xtend	0.3	1.8	23	0	56.0	36.6	51.0	32.3	41.6	40.0
REA Hybrids	RX0411	Xtend	0.4	2.3	26	0	55.5	--	--	33.7	--	--
REA Hybrids	RX0520	Xtend	0.5	2.3	23	0	56.2	--	41.1	30.9	36.0	--
LG Seeds	LGS0111RX	Xtend	0.1	2.3	25	0	55.4	36.3	53.2	37.9	45.5	42.5
LG Seeds	LGS0355RX	Xtend	0.3	2.1	22	0	56.2	45.8	53.7	35.4	44.5	45.0
LG Seeds	LGS0400RX	Xtend	0.4	2.5	23	0	55.8	--	--	34.9	--	--
NK Seeds	S006-R7X	Xtend	00.6	2.8	20	0	55.7	--	--	36.4	--	--
NK Seeds	S01-C4X	Xtend	0.1	2.3	22	0	56.5	--	--	35.0	--	--
NK Seeds	S02-F9X	Xtend	0.2	3.1	21	0	56.6	--	--	38.4	--	--
NK Seeds	S03-S6X	Xtend	0.3	2.6	22	0	56.6	--	--	32.3	--	--
NK Seeds	S05-N5X	Xtend	0.5	2.8	20	0	55.8	--	--	37.1	--	--
NK Seeds	S04-Q7X	Xtend	0.4	2.0	21	0	55.4	--	--	29.1	--	--
Proseed	XT60-09	Xtend	00.9	2.0	22	0	56.4	--	44.8	34.7	39.7	--
Proseed	EL80-093	Enlist E3	00.9	2.1	20	0	56.0	--	49.2	34.2	41.7	--
Proseed	XT80-20N	Xtend	0.2	2.0	24	0	56.2	--	53.7	32.7	43.2	--
Proseed	XT60-40N	Xtend	0.4	2.2	22	0	55.5	--	--	33.3	--	--
Dyna-Gro	S02EN71	Enlist E3	0.2	3.0	20	0	56.5	--	--	35.0	--	--
Dyna-Gro	S03XT29	Xtend	0.3	1.9	22	0	56.2	40.6	51.3	35.9	43.6	42.6
Dyna-Gro	S04XT77	Xtend	0.4	2.3	19	0	56.1	37.5	49.8	35.6	42.7	41.0
Legacy Seeds	LS-0239N RR2X	Xtend	0.2	2.0	21	0	56.3	--	--	35.7	--	--
Legacy Seeds	LS-0319 LLGT27	GT, LL	0.3	2.5	19	0	56.3	--	--	34.7	--	--
Legacy Seeds	LS-0320N E3	Enlist E3	0.3	2.4	21	0	55.6	--	--	38.9	--	--
Legacy Seeds	LS-0429 E3	Enlist E3	0.4	1.9	23	0	55.6	--	--	35.8	--	--
Legacy Seeds	LS-0438	Xtend	0.4	2.7	21	0	55.4	--	--	33.3	--	--
NDSU	ND17009GT	GT	00.9	3.1	22	0	57.0	30.0	33.4	33.5	33.4	32.3
Trial Mean				2.4	21	0	56.0	37.2	46.5	34.8	--	--
C.V.%				14.7	7.3	0.0	0.9	8.8	9.5	10.9	--	--
LSD 5%				0.2	2	NS	0.7	4.6	6.2	NS	--	--
LSD 10%				0.2	2	NS	0.6	3.9	5.2	4.4	--	--

[a]*IDC rating = Iron deficiency chlorosis rating: 1 - green, 3 - yellow, 5 - dead*

**Lodging: 0 = none, 9 = lying flat on the ground.*

NS = no statistical difference between varieties.

Planting Date: May 27

Harvest Date: October 5

Planting Rate: 150,000 PLS/A

Row Spacing: Solid Seeded (7" rows)

Soil Type: Williams Bowbells loam

Tillage: No-till

Previous Crop: 2017 = spring wheat, 2018 = soybean, 2019 = spring wheat

2020 Soybean Variety Trial at Wilton

Cooperator: Wes Doepke, Wilton

Company/Brand	Variety	Herbicide System	Maturity Group	IDC Rating	Plant Height	Lodging	Test Weight	Yield				
								2018	2019	2020	2 yr	3 yr
				1-5[a]	inchs	0-9*	lbs/bu	bushels/acre				
Integra	40129N	Enlist E3	0.1	2.1	28	0	56.8	--	--	23.2	--	--
Integra	20215	RR	0.2	2.5	25	0	57.6	--	--	28.5	--	--
Integra	40201N	Enlist E3	0.2	2.9	22	0	57.8	--	--	24.7	--	--
Integra	50309N	Xtend	0.3	1.8	30	0	57.5	33.6	48.6	29.5	39.1	37.2
REA Hybrids	RX0411	Xtend	0.4	2.3	33	0	56.8	--	--	25.7	--	--
REA Hybrids	RX0520	Xtend	0.5	2.3	27	0	57.7	--	44.1	23.9	34.0	--
LG Seeds	LGS0111RX	Xtend	0.1	2.3	31	0	57.3	32.6	47.1	26.2	36.7	35.3
LG Seeds	LGS0355RX	Xtend	0.3	2.1	28	0	57.0	33.1	46.5	24.2	35.4	34.6
LG Seeds	LGS0400RX	Xtend	0.4	2.5	30	0	57.4	--	45.2	26.5	35.8	--
LG Seeds	LGS0595RX	Xtend	0.5	2.1	26	0	57.6	--	--	24.2	--	--
NK Seeds	S006-R7X	Xtend	00.6	2.8	27	0	55.9	--	--	32.6	--	--
NK Seeds	S01-C4X	Xtend	0.1	2.3	30	0	58.1		--	25.7	--	--
NK Seeds	S02-F9X	Xtend	0.2	3.1	28	0	57.9	--	--	30.6	--	--
NK Seeds	S03-S6X	Xtend	0.3	2.6	30	0	58.0	--	--	24.2	--	--
NK Seeds	S05-N5X	Xtend	0.5	2.8	26	0	57.6	--	--	27.8	--	--
NK Seeds	S04-Q7X	Xtend	0.4	2.0	29	0	58.6	--	--	25.2	--	--
Golden Harvest	GH0443X	Xtend	0.4	1.9	27	0	57.0	--	--	32.9	--	--
Golden Harvest	GH0543X	Xtend	0.5	2.7	26	0	57.5	--	--	27.3	--	--
Proseed	XT60-09	Xtend	00.9	2.0	31	0	57.6	--	45.2	27.8	36.5	--
Proseed	EL80-093	Enlist E3	00.9	2.1	31	0	57.5	--	47.3	31.3	39.3	--
Proseed	XT80-20N	Xtend	0.2	2.0	29	0	57.5	--	41.4	22.2	31.8	--
Proseed	XT60-40N	Xtend	0.4	2.2	27	0	56.8	--	--	24.5	--	--
Dyna-Gro	S03XT29	Xtend	0.3	1.9	29	0	57.6	34.0	47.1	34.9	41.0	38.7
Dyna-Gro	S04EN21	Enlist E3	0.4	2.3	27	0	57.3	--	--	25.7	--	--
Dyna-Gro	S04XT91	Xtend	0.4	2.4	24	0	58.0	--	--	27.5	--	--
Legacy Seeds	LS-0429 E3	Enlist E3	0.4	1.9	29	0	57.2	--	49.0	30.6	39.8	--
Legacy Seeds	LS-0438	Xtend	0.4	2.7	26	0	57.5	35.7	46.1	26.5	36.3	36.1
Legacy Seeds	LS 061-20	GT	0.6	2.3	28	0	58.2	--	--	29.0	--	--
Legacy Seeds	LS-0638N RR2X	Xtend	0.6	2.9	30	0	57.8	--	--	27.3	--	--
Croplan	RX0500	Xtend	0.5	--	24	0	57.2	--	43.4	28.5	36.0	--
Croplan	RX0426	Xtend	0.4	--	25	0	57.4	--	43.5	27.8	35.6	--
NDSU	ND17009GT	GT	00.9	3.1	28	0	58.2	24.7	43.8	28.8	36.3	32.4
Trial Mean				2.4	28	0	57.5	31.9	45.1	27.3	--	--
C.V.%				14.7	8.3	0.0	0.8	8.5	8.5	11.8	--	--
LSD 5%				0.2	3	NS	0.6	3.8	5.4	4.5	--	--
LSD 10%				0.2	2	NS	0.5	3.2	4.5	3.8	--	--

[a] *IDC rating = Iron deficiency chlorosis rating: 1 - green, 3 - yellow, 5 - dead*

Lodging: 0 = none, 9 = lying flat on the ground

NS = no statistical difference between varieties

Planting Date: May 27

Harvest Date: October 5

Planting Rate: 150,000 PLS/A

Row Spacing: Solid Seeded (7" rows)

Soil Type: Mandan silt loam

Tillage: No-till

Previous Crop: 2017 = soybean, 2018 = corn, 2019 = durum

2020 RR Soybean Yield Results from the North Central Region

Company	Variety	Maturity Group	IDC Rating	Seed Yield				
			1-5[a]	Garrison	Minot	Mohall	Rugby	Wilton
				bushels/acre				
Dairyland Seed	DSR-0119E	0.1	2.6	--	39.7	35.3	--	--
Dairyland Seed	EXP E8-201E	00.8	2.2	--	35.6	41.6	--	--
Dairyland Seed	EXP E9-201E	00.9	1.6	--	32.6	33.8	--	--
Dyna-Gro	S02EN71	0.2	3.0	35.0	34.2	--	--	--
Dyna-Gro	S03XT29	0.3	1.9	35.9	37.0	--	--	34.9
Golden Harvest	GH0443X	0.4	1.9	--	35.1	--	--	32.9
Integra	20215	0.2	2.5	37.9	28.5	--	36.6	28.5
Integra	40129N	0.1	2.1	32.8	29.0	--	31.8	23.2
Integra	40201N	0.2	2.9	37.2	34.4	--	38.9	24.7
Integra	50309N	0.3	1.8	32.3	33.1	--	34.3	29.5
Legacy Seeds	LS-0239N RR2X	0.2	2.0	35.7	32.0	--	35.1	--
Legacy Seeds	LS-0319 LLGT27	0.3	2.5	34.7	35.1	--	32.3	--
Legacy Seeds	LS-0320N E3	0.3	2.3	38.9	--	--	36.8	--
Legacy Seeds	LS-0429 E3	0.4	2.1	35.8	--	--	30.9	30.6
Legacy Seeds	LS-0438	0.4	2.5	33.3	--	--	31.0	26.5
LG Seeds	LGS00899RX	00.8	2.7	--	32.1	41.3	37.6	--
LG Seeds	LGS0111RX	0.1	2.3	37.9	35.1	36.7	36.2	26.2
LG Seeds	LGS0355RX	0.3	2.1	35.4	34.9	35.5	36.2	24.2
LG Seeds	LGS0400RX	0.4	2.5	34.9	37.3	--	37.3	26.5
NDSU	ND17009GT	00.9	3.1	33.5	27.1	36.9	29.8	28.8
NK Seeds	S006-R7X	00.6	2.8	36.4	33.5	50.3	39.2	32.6
NK Seeds	S01-C4X	0.1	2.3	35.0	36.3	33.8	34.9	25.7
NK Seeds	S02-F9X	0.2	3.1	38.4	36.4	38.8	36.8	30.6
NK Seeds	S03-S6X	0.3	2.6	32.3	39.1	31.0	34.2	24.2
NK Seeds	S04-Q7X	0.4	2.0	29.1	32.6	31.7	33.5	25.2
NK Seeds	S05-N5X	0.5	2.8	37.1	37.5	35.8	33.2	27.8
Proseed	EL80-093	00.9	2.1	34.2	35.5	38.3	37.1	31.3
Proseed	XT20-07	00.7	2.4	--	32.1	38.6	38.2	--
Proseed	XT60-09	00.9	2.9	34.7	--	38.5	--	27.8
Proseed	XT60-40N	0.4	2.3	33.3	--	--	--	24.5
Proseed	XT70-09	00.9	2.6	--	36.2	39.3	35.9	--
Proseed	XT80-20N	0.2	1.8	32.7	--	--	--	22.2
REA Hybrids	RX0411	0.4	2.1	33.7	--	--	32.4	25.7
REA Hybrids	RX0520	0.5	2.5	30.9	--	--	--	23.9
Thunder Seed	SB8001	0.1	2.5	--	33.9	--	36.5	--
Thunder Seed	SB81006	00.6	2.7	--	32.4	--	37.5	--
Thunder Seed	TE71008N	00.8	2.1	--	35.6	--	36.0	--
Thunder Seed	TE7101N	0.1	3.1	--	30.8	--	35.9	--
Trial Mean			2.4	34.8	33.2	38.1	35.1	27.3
C.V.%			14.7	10.9	8.1	5.5	7.8	11.8
LSD 5%			0.2	NS	4.4	3.0	3.9	4.5
LSD 10%			0.2	4.4	3.6	2.5	3.2	3.8

[a] *IDC rating = Iron deficiency chlorosis rating: 1 = green, 3 = yellow, 5 = dead*

Iron Deficiency Chlorosis Rating in Soybean

1

2

3

4

5

A color illustration can be found at https://www.ag.ndsu.edu/NorthCentralREC/variety-trial

Management of Frost Damaged Immature Soybeans

Soybeans killed at growth stages of full seed development (R6) and beginning maturity (R7) should be left out in the field to dry and harvested along with mature soybeans (R8).

Soybeans killed at growth stages of full seed development (R6) and beginning maturity (R7) should be left out in the field to dry and harvested along with mature soybeans (R8). Weather conditions during the field-drying period, after plants are frozen, influence the color of harvested soybeans. NDSU research during 2019 found for R6 soybeans, field dried during nice weather, there was significant change in the color of the seed coat with a golden yellow tone approaching that of mature soybean (R8-control) after field drying. However, R6 soybeans, field dried during freezing temperatures, snow and rain, and lack of sun after desiccation, had a green tone to the golden color. Despite the bean yellow/green tone observed after field drying, little green color was observed in the extracted oil from the seeds during a 2019 study and close to that of the mature R8-control. Despite the snow and rain encountered prior to harvesting of the desiccated seeds, leaving the seeds out in the field likely aided the natural ripening causing degradation of chlorophyll pigments in the seeds.

Early freezing temperatures have been reported to result in low oil yield. According to a Wisconsin study in 1998, soybeans on frost-damaged plants showed quicker maturity and color change than those on undamaged plants.

Effect of storage on the quality of stored beans after field drying

There was only a slight change in color during six months of storage of soybeans that had been field dried. A green tone still existed in the visual observation of stored soybeans at the end of the sixth month. There also was a very small change in chlorophyll content in the oil. However, the chlorophyll level was low after field drying, so little change was expected.

During the first year of the research, soybeans were stored at 40 and 75 degrees F, with and without light, and with and without aeration for four months. There was a marginal increase in the yellow color and dissipation of the green in all the soybeans during storage. However, the only parameter that significantly influenced the color change in the soybeans during storage was exposure to light. Of course, the beans cannot be exposed to light in a storage, so research during the second year examined color change leaving the soybeans in the field after a killing frost.

There was a reduction in chlorophyll in all the soybeans during the 4 months of storage during the first year. However, the chlorophyll content of immature soybeans exceeded the level in mature soybeans.

-NDSU Publication: www.ag.ndsu.edu/cpr/stored-grain/management-of-frost-damaged-immature-soybeans-09-24-20
Kenneth Hellevang, Extension Agricultural Engineer & Professor

2020 Public Field Pea Variety Trial at Minot

Variety	Days to Flower	Days to Maturity	Vine Length	Pod Height	Seed Protein	1000 Seed Weight	Seeds/ Pound	Test Weight	Seed Yield	Significant Difference [4]
	DAP[1]	DAP[1]	cm	cm	%[2]	g	#	lb/bu	bu/A[3]	
Yellow Cotyledon										
AAC Asher	50	81	39	35	26.1	312	1456	66.7	28.6	A
AAC Carver	48	77	50	44	25.0	287	1580	66.4	27.4	A
Agassiz	46	78	51	46	24.6	262	1734	66.3	27.3	A
CDC Spectrum	49	80	50	45	26.0	268	1695	66.5	26.4	A
CDC Saffron	49	78	43	41	25.8	262	1728	67.1	26.3	A
AAC Chrome	50	80	43	37	25.3	297	1527	66.7	26.3	B
CDC Amarillo	51	80	51	45	26.6	263	1727	66.5	26.1	B
CDC Inca	50	78	50	44	24.8	260	1747	66.7	25.5	B
AAC Profit	50	78	49	44	26.0	271	1674	66.6	25.4	B
Jetset	47	75	46	42	25.2	257	1764	66.5	24.8	B
Durwood	47	78	51	45	26.6	266	1709	66.9	24.3	B
Mystique	48	77	47	43	26.1	291	1563	66.1	24.1	B
DS Admiral	47	77	44	42	25.6	281	1612	67.2	23.9	C
Salamanca	47	76	48	44	27.2	288	1572	66.0	23.5	C
Majestic	47	77	49	44	26.7	289	1573	65.9	23.1	C
Hyline	47	78	43	38	25.2	265	1712	66.9	23.1	C
Orchestra	46	77	46	42	27.1	304	1492	66.5	22.8	C
DL Apollo	47	76	50	47	25.4	247	1842	67.1	22.6	C
LG Equator	45	76	45	40	25.4	251	1806	67.1	22.3	C
CDC Dakota	52	78	49	46	28.9	227	1997	66.9	22.3	C
Peregrine	43	76	38	35	25.3	265	1713	67.0	22.1	C
LG Stunner[5]	48	79	46	42	26.0	276	1644	67.2	21.6	D
ND Dawn	47	77	44	41	24.0	259	1753	65.5	21.4	D
Cronos	44	75	45	42	27.5	321	1410	65.7	20.7	D
LG Sunrise	45	76	47	40	24.4	260	1744	67.3	19.8	D
Korando	43	74	45	39	27.7	294	1542	66.0	19.8	D
Nette 2010	47	77	41	39	25.7	272	1670	66.7	19.6	D
Kite	45	77	36	31	25.9	269	1691	66.2	18.7	D
Trial Mean	47	77	46	42	25.8	268	1706	66.5	23.2	
C.V. %	4.6	2.4	10.8	10.4	4.37	9.2	9.2	0.85	12.72	
LSD 5%	0.8	1.3	3.4	2.6	0.34	4.6	30.7	0.34	2.29	

[1] Days after planting

[2] Protein adjusted to 0% moisture

[3] Yield adjusted to 13.5% moisture

[4] Seed yields within a market class with different letters are significantly ($p<0.05$) different

[5] LG Stunner, variety name pending. Was tested as LGPN 4915

Planting date: 5/8/2020
Harvest date: 8/3/2020
Previous Crop: Flax
Tillage: Minimal Tillage

Continued on next page

2020 Public Field Pea Variety Trial at Minot Continued

Variety	Days to Flower	Days to Maturity	Vine Length	Pod Height	Seed Protein	1000 Seed Weight	Seeds/ Pound	Test Weight	Seed Yield	Significant Difference[4]
	DAP[1]	DAP[1]	cm	cm	%[2]	g	#	lb/bu	bu/A[3]	
Green Cotyledon										
ND-G1[6]	51	79	52	47	24.6	230	1974	66.7	25.8	A
Shamrock	50	78	47	43	25.6	278	1633	66.8	25.6	A
Arcadia	47	77	43	38	24.5	243	1872	66.5	25.4	A
AAC Comfort	52	81	43	39	25.8	305	1493	65.9	25.0	A
CDC Greenwater	49	80	48	42	25.6	272	1669	66.0	23.7	A
Empire	49	78	62	54	25.3	256	1772	67.7	23.1	B
Daytona	48	77	50	46	26.9	317	1428	65.9	23.0	B
Hampton	47	78	37	34	28.2	265	1712	65.6	22.0	B
CDC Striker	49	77	44	40	27.7	267	1697	67.3	21.3	B
Greenwood	46	75	40	37	25.5	220	2076	66.7	20.5	C
Bluemoon	48	78	41	39	26.3	284	1601	66.0	20.4	C
Viper	44	75	46	43	26.3	270	1684	65.9	19.4	C
Aragorn	45	75	41	36	26.1	231	1962	65.4	18.5	D
Trial Mean	47	77	46	42	25.8	268	1706	66.5	23.2	
C.V. %	4.6	2.4	10.8	10.4	4.37	9.2	9.2	0.85	12.72	
LSD 5%	0.8	1.3	3.4	2.6	0.34	4.6	30.7	0.34	2.29	

[1] Days after planting

[2] Protein adjusted to 0% moisture

[3] Yield adjusted to 13.5% moisture

[4] Seed yields within a market class with different letters are significantly ($p<0.05$) different

[6] NDSU advanced breeding line

Planting date: 5/8/2020
Harvest date: 8/3/2020
Previous Crop: Flax
Tillage: Minimal Tillage

Note : No significant differences observed for lodging. All plots maintained upright habit throughout the season.

2020 Evaluation and Enhancement of Dry Pea Protein Content

Treatment	Timing	Rate	NDVI 23-Jun	NDVI 15-Jul	Test Weight	Yield	Protein
					lbs/bu	bu/A	%
PROFIT							
Untreated			52	68	64.2	52.6	25.5
UAN[ł]	First flower	20 gal/A	50	67	63.7	52.2	25.7
UAN	90% flower	20 gal/A	51	67	64.3	50.5	25.5
Double Inoculation[ŧ]	At planting	5 lb/A + 5 oz/cwt	52	68	64.3	51.8	25.8
Urea	At planting	200 lb/A	52	70	63.7	58.6	26.8
Miravis Top Fungicide	First flower	13.7 oz/A	52	68	64.5	54.3	25.6
Boost 10	At planting	10 oz/A	51	68	64.1	52.6	25.6
Nutricycle	At planting	8 oz/cwt	53	66	64.3	48.1	25.3
AAC CARVER							
Untreated			52	67	64.9	48.3	24.6
UAN	First flower	20 gal/A	51	67	64.8	48.6	24.3
UAN	90% flower	20 gal/A	52	72	64.9	51.1	24.8
Double Inoculation	At planting	5 lb/A + 5 oz/cwt	51	72	64.8	50.3	24.6
Urea	At planting	200 lb/A	54	70	64.3	60.0	25.0
Miravis Top Fungicide	First flower	13.7 oz/A	47	66	64.8	50.5	24.3
Boost 10	At planting	10 oz/A	54	67	64.8	48.1	24.8
Nutricycle	At planting	8 oz/cwt	50	68	64.5	49.2	24.5
Trial Mean			51.5	68.2	64.4	51.7	25.2
C.V.%			3	6	0.8	6.8	1.8
LSD 10%			3	NS	0.5	3.4	0.4

NDVI=Normalized Difference Vegetation Index

NS = no statistical difference between varieties.

ł UAN Application of 20 gal/A with a 50:50 mixture of UAN and water applied with at hand held boom on June 26 and July 3 correspond to 1st flower and 90% flower, respectively

ŧ Double Inoculation of Tag Team granular and N-Charge peat for Field Pea

Planted on April 30 with a seeding rate of 350,000 PLS/A and harvested on August 3.

Previous Crop: 2017 = barley, 2018 = soybean, 2019 = HRSW

Tillage: minimum till

2020 Public Lentil Variety Trial at Minot

Variety	Market Class	Days to Flower	Days to Maturity	Vine Length	Pod Height	Seed Protein	1000 Seed Weight	Seeds/ Pound	Test Weight	Seed Yield	Significant Difference[4]
		DAP[1]	DAP[1]	cm	cm	%[2]	g	#	lb/bu	bu/A[3]	
CDC Richlea	MG	45	73	32	19	23.9	47	10199	62.4	18.4	A
CDC Greenland	LG	45	76	39	23	24.5	51	9494	60.1	18.2	A
CDC Imvincible-C	SG	46	73	34	19	27.2	39	11830	63.9	18.1	A
CDC Kermit	SG	46	73	35	21	25.1	37	12619	64.7	18.1	A
CDD Impala-CL	ESR	46	74	31	16	25.4	45	11459	65.0	18.1	A
CDC Greenstar	LG	45	73	36	25	23.3	61	7908	60.3	17.9	A
CDC Maxim-CL	SR	45	73	36	21	23.7	44	10482	64.5	17.9	A
ND Eagle	SG	46	74	26	13	25.6	45	10432	64.1	17.9	A
Avondale	MG	44	71	36	19	23.7	49	9547	62.3	17.8	A
Trial Mean		45	73	34	19	24.7	47	10441	63.0	18.0	
C.V. %		1.3	1.7	11.3	17.8	5.07	15.2	13.5	2.94	0.99	
LSD 5%		1.2	0.8	2.6	2.6	0.45	16.8	3504.6	0.60	NS	

[1] Days after planting
[2] Protein adjusted to 0% moisture
[3] Yield adjusted to 13.5% moisture
[4] Seed yields within a market class with different letters are significantly (p<0.05) different

Planting date: 5/11/2020
Harvest date: 8/17/2020
Previous Crop: Flax
Tillage: Minimal Tillage

Note: No significant differences were observed for lodging. All plots maintained upright habit throughout the season.

2020 Public Chickpea Variety Trial at Minot

Variety	Days to Flower	Days to Maturity	Vine Length	1000 Seed Weight	Seeds/ Pound	Test Weight	Seed Yield	Significant Difference[3]
	DAP[1]	DAP[1]	cm	g	#	lb/bu	bu/A[2]	
CDC Frontier	44	99	45	334	1306	63.3	26.9	A
ND Crown	44	98	44	374	1148	62.7	23.7	A
CDC Palmer	44	94	44	395	1222	62.6	21.3	A
CDC Leader	44	99	43	364	1270	61.8	15.9	B
CDC Orion	42	105	43	342	1311	60.6	9.1	C*
Sawyer	43	104	43	432	1078	60.8	8.6	C*
Royal	46	101	44	478	956	61.2	8.1	C*
Sierra	43	103	43	422	1119	61.3	6.9	C*
Trial Mean	44	101	44	393	1176	61.8	15.0	
C.V. %	2.8	3.5	1.5	12.5	10.6	1.59	53.18	
LSD 5%	2.2	3.2	6.8	60.3	178.7	1.53	7.84	

**Yields were severely impacted by Ascochyta Blight*
[1] Days after planting
[2] Yield adjusted to 13.5% moisture
[3] Seed yields within a market class with different letters are significantly (p<0.05) different

Planting date: 5/11/2020
Harvest date: 9/4/2020
Previous Crop: Flax
Tillage: Minimal Tillage

Note: No significant differences were observed for lodging or seed size. All varieties met the RMA requirement for large kabuli types that at least 51% stayed above a 22/64" round hole screen.

2020 Dry Edible Bean Variety Trial at Minot

Variety	Market Class	Visual Stand at Harvest	Plant Height	Test Weight	100 Seed wt.	Seed Yield				
						2018	2019	2020	2 year	3 year
		%	inches	lbs/bu	grams	pounds per acre				
Lariat	Pinto	96	18	63.4	29.1	1723	2007	1952	1980	1894
Monterrey	Pinto	98	18	65.2	29.9	1155	1534	2443	1989	1711
La Paz	Pinto	97	18	64.5	28.5	1498	1619	1867	1743	1661
ND-Palomino	Pinto	95	18	62.6	30.0	1679	1499	1766	1632	1648
Windbreaker	Pinto	93	14	62.5	32.6	1064	1243	2090	1666	1466
Stampede	Pinto	96	16	63.1	28.3	976	1603	1761	1682	1447
Torreon	Pinto	90	19	64.9	30.6	--	1916	1823	1870	--
Vibrant	Pinto	97	18	65.0	27.5	--	1544	1945	1744	--
ND-Falcon	Pinto	95	18	61.9	29.3	--	1443	1513	1478	--
DR Wood	Pinto	97	18	64.5	29.3		--	1833	--	--
Longs Peak	Pinto	85**	17	63.4	29.7	--	--	1455	--	--
Croissant	Pinto	96	16	64.3	28.9	--	--	1403	--	--
Centennial	Pinto	96	18	64.9	29.1	--	--	1223	--	--
HMS Medalist	Navy	96	18	67.2	15.3	898	1544	1675	1609	1372
T9905	Navy	60**	18	67.8	17.2	964	1424	1366	1395	1251
Blizzard	Navy	93	19	67.8	16.8	--	1544	1803	1674	--
Eclipse	Black	96	19	66.8	16.9	713	1685	1936	1810	1445
Black Tails	Black	88	18	67.2	16.4	--	1672	1752	1712	--
ND-Twilight	Black	70**	17	67.7	16.7	--	--	1392	--	--
Merlot	Small Red	67**	19	65.5	28.0	887	1399	1210	1304	1165
Viper	Small Red	97	19	65.8	24.1	--	2043	2170	2107	--
ND-Pegasus	Great Northern	77**	20	64.1	29.6	--	2113	1546	1829	--
Trial Mean		89	18	65.1	25.0	1135	1599	1698	--	--
C.V. %		9.4	10.0	0.9	4.8	14.6	11.6	12.6	--	--
LSD 5%		14	NS	0.9	2.0	278	304	351	--	--
LSD 10%		11	2	0.8	1.7	231	253	292	--	--

*** These varieties had reduced stands at harvest which affected yields.*

NS = no statistical difference between varieties.

Planting Date: May 28

Harvest: Direct harvested on September 17

Seeding Rate: 90,000 live seeds / Acre

Row Spacing: 15"

Previous Crop: 2017 = corn, 2018 and 2019 = spring wheat.

Tillage System: Minimum till

Soil Type: Williams Loam

Note: The 2018 trial sustained moderate drought.

2020 CBD Hemp Variety Trial at Minot

Strain	Plant Height	Moisture Content at Harvest	Total THC	Total CBD	Total Cannabinoids	Dry Biomass Yield	Dry Biomass
	inches	%	%	%	%	lbs/A	lbs/plant
Super T1	49	72	0.29	9.02	11.05	2437	1.40
Super Rich1	51	72	0.29	8.93	11.06	1996	1.15
Suzy Q Bx	51	73	0.35	11.28	13.74	2830	1.62
Jamaican Lion	57	72	0.30	9.08	11.19	2496	1.43
Nueve Bcx	51	70	0.65	6.87	8.89	3801	2.18
B20	61	68	0.29	9.25	11.26	1820	1.04
Bubba x Sweetgrass	53	71	0.25	7.97	9.67	3572	2.05
Early Susy	48	71	0.32	10.00	12.17	4020	2.31
Trial Mean	53	71	--	--	--	2909	1.67
C.V. %	7.0	2.5	--	--	--	29.9	29.9
LSD 0.05	3	3	--	--	--	NS	NS
LSD 0.1	2	2	--	--	--	1257	0.72

NS = No statistical difference between strains.

Planting Date: June 12
Planting Stock: 6" transplants propagated from feminized seed.
Planting Rate: 5' rows and 5' between plants (1742 plants/A)
Production System: Outdoor. No supplemental irrigation.
Weed Control: Clipping (lawn mower)
Harvest Date: October 13

General Observations

Super T1 - Fairly uniform in size and shape. Tall height. Medium flowering.
Super Rich1 - Fairly diverse in size and shape. Medium height. Medium to late flowering.
Suzy Q Bx - Very diverse in size and shape. Short to tall height. Medium to late flowering.
Jamaican Lion - Uniform in size and shape. Tall height. Medium flowering.
Nueve Bcx - Diverse in size and shape. Medium height. Late flowering. Compact canopy.
B20 - Fairly uniform in size and shape. Medium Height. Open canopy with heavy budding.
Bubba x Sweetgrass - Fairly uniform. Medium height. Late flowering. Dense canopy.
Early Susy - Fairly uniform. Short height. Medium flowering. Broad compact canopy.

2020 CBD Hemp Planting Date at Minot

Summary: The trial was set up as a randomized complete block design with 3 replications and planted with two experimental CBD hemp strains that were propagated from feminized seed and planted as 6 inch transplants or propagated as clones from a single mother plant. Clones were 1 to 4 inches tall when planted and many of these did not survive. Planting dates were staggered approximately 10 days apart. Growing conditions were generally mild (avg 64F) and dry (6.6") from June 1 through September 30. The trial was harvested on October 15. Individual plants were weighed for yield and approximately 10 inches of the terminal bud was collected and dried at 80F for 5 days to determine moisture content. *A sub-sample of this biomass was collected and will be analyzed for THC, CBD and total cannabinoid content when funds become available.* There was a lot of phenotypic variability within the feminized seed transplants as far as plant height and shape. This variability also resulted in inconsistent yields between plants within plots, however, combined analysis showed a consistent decrease in dry plant weight with each delayed planting date. The data for transplant production would indicate significant advantages in biomass production with early planting dates vs. later planting dates. For clonal production, combined data analysis showed a trend, although not statistically significant, for biomass yields to incrementally increase with the first three planting dates followed by significant decreases on subsequent planting dates. In conclusion, it is logical, within reason, for a plant to accumulate biomass the longer it is allowed to grow and that is

Transplant Production

Planting Date	Plant Height	Total THC	Total CBD	Total Cannabinoids	Harvest Moisture	Dry Plant Weight	Dry Biomass
	inches	%	%	%	%	lbs/plant	lbs/A
May 12	66	--	--	--	59.6	4.65	8095
May 22	52	--	--	--	51.8	3.61	6281
June 2	73		--	--	66.0	2.99	5202
June 10	71	--	--	--	68.7	2.73	4761
June 22	68	--	--	--	66.0	1.72	3004
July 2	58	--	--	--	67.9	1.00	1749
Trial Mean	65	--	--	--	63.3	2.78	4849
C.V. %	19.0	--	--	--	14.7	34.6	34.6
LSD 0.05	15	--	--	--	11.1	1.15	1997

Clonal Production

Planting Date	Plant Height	Total THC	Total CBD	Total Cannabinoids	Harvest Moisture	Dry Plant Weight	Dry Biomass
	inches	%	%	%	%	lbs/plant	lbs/A
May 12	52	--	--	--	69.7	3.39	5910
May 22	67	--	--	--	55.3	3.92	6831
June 2	67	--	--	--	52.9	4.23	7375
June 10	53	--	--	--	64.6	1.69	2953
June 22	45		--	--	63.0	1.46	2542
July 2	32	--	--	--	70.3	0.49	858
Trial Mean	55	--	--	--	62.1	2.90	5048
C.V. %	14.1	--	--	--	11.6	29.7	29.7
LSD 0.05	10	--	--	--	8.9	1.06	1841

Planting Rate: 5' rows and 5' between plants (1742 plants/A)
Production System: Outdoor. No supplemental irrigation.
Weed Control: Clipping (lawn mower)

2020 CBD Hemp Harvest Timing at Minot

Summary: The trial was set up as a randomized complete block design with 3 replications and planted on June 12 with two experimental CBD hemp strains that were propagated from feminized seed and planted as 6 inch transplants or propagated as clones from a single mother plant. Clones were 1 to 4 inches tall when planted and many of these did not survive. Growing conditions were generally mild (avg 64F) and dry (6.6") from June 1 through September 30. Harvest intervals were approximately 11 days apart and consisted of hand harvesting individual plants, drying at 80F for 5 days and collecting dry foliage / bud biomass*. A sub-sample of this biomass will be analyzed for THC, CBD and total cannabinoid content when funds become available.* There was a lot of phenotypic variability within the feminized seed transplants as far as plant height and shape. This variability carried through harvest, resulting in no obvious trend or statistical differences for biomass yield between harvest dates. Data from the clonal production is shown, however, there were not enough harvested plants to perform a good statistical analysis on. In conclusion, this data would suggest that delaying harvest does not increase biomass yield, however, this may very well be related to a lack of late season precipitation. This data should be viewed with caution until additional information can be generated.

Transplant Production

Harvest Date	N	Plant Height	Total THC	Total CBD	Total Cannabinoids	Dry Plant Weight	Dry Biomass**
	*	inches	%	%	%	lbs/plant	lbs/plant
September 3	6	66	--	--	--	2.02	0.94
September 14	6	68	--	--	--	2.47	1.11
September 25	6	69	--	--	--	2.09	1.06
October 6	6	60	--	--	--	1.78	1.02
October 16	6	67	--	--	--	1.60	0.96
October 27	5	71	--	--	--	2.41	1.34
Trial Mean		67	--	--	--	2.05	1.06
C.V. %		17	--	--	--	35	31
LSD 0.05		NS	--	--	--	NS	NS

**Total number of harvested plants used in this analysis.*

***Dry Biomass = average per plant weight of dried foliage with stems removed.*

NS = No statistical difference between harvest dates.

Clonal Production

Harvest Date	N	Plant Height	Total THC	Total CBD	Total Cannabinoids	Dry Plant Weight	Dry Biomass**
	*	inches	%	%	%	lbs/plant	lbs/plant
September 3	6	50	--	--	--	1.39	0.75
September 14	3	52	--	--	--	0.95	0.55
September 25	3	44		--	--	0.87	0.61
October 6	2	34	--	--	--	0.33	0.25
October 16	2	34	--	--	--	0.46	0.33
October 27	1	25	--	--	--	0.28	0.19

**Total number of harvested plants used in this analysis.*

***Dry Biomass = average per plant weight of dried foliage with stems removed.*

Planting Rate: 5' rows and 5' between plants (1742 plants/A)

Production System: Outdoor. No supplemental irrigation.

Weed Control: Clipping (lawn mower)

2020 CBD Hemp Fertility Trial at Minot

Summary: The trial was set up as a randomized complete block design with 3 replications. An experimental CBD hemp strain was propagated from feminized seed and planted as 6 inch transplants on June 2 or propagated as clones from a single mother plant and planted on June 15. Clones were 1 to 4 inches tall when planted and many of these did not survive. Residual soil fertility levels were 17 lbs/A N, 16 PPM P and 458 lbs/A K. Fertilizer treatments consisted of urea (46-0-0) as the nitrogen fertilizer, MAP (11-52-0) as the phosphorus fertilizer, potash (0-0-60) as the potassium fertilizer and AMS (21-0-0-24S) as the sulfur fertilizer. Treatments were surface applied in a one foot band over the top of the row on June 5. Growing conditions were generally mild (avg 64F) and dry (6.6") from June 1 through September 30. Due to dry conditions, fertilizer treatments were not effectively translocated into the root zone until rainfall during the first week of July. The trial was harvested on October 9. Individual plants were weighed for yield and approximately 10 inches of the terminal bud was collected and dried at 80F for 5 days to determine moisture content. *A sub-sample of this biomass was collected and will be analyzed for THC, CBD and total cannabinoid content when funds become available.* There was a lot of phenotypic variability within the feminized seed transplants as far as plant height and shape. This variability carried through harvest, resulting in no obvious trend or statistical differences for plant height or dry plant weight between fertility treatments. Data from the clonal production is shown, however, there were not enough harvested plants to perform a good statistical analysis on. In conclusion, this data would suggest that we don't understand the nutritional needs of this crop and therefore more research should be conducted in order to optimize fertilizer use.

Transplant Production Fertilizer Treatment	Harvested Plants	Plant Height	Harvest Moisture	Total THC	Total CBD	Total Cannabinoids	Dry Plant Weight
	**	inches	%	%	%	%	lbs/plant
50 lbs/A N*	8	68	65.0	--	--	--	2.38
100 lbs/A N*	8	70	65.3	--	--	--	2.85
150 lbs/A N*	10	69	68.7	--	--	--	2.69
100 lbs/A N* + 25 lbs/A MAP	8	75	67.3	--	--	--	2.97
100 lbs/A N + 50 lbs/A MAP	8	62	66.3	--	--	--	2.71
100 lbs/A N* + 25 lbs/A potash	6	75	62.0	--	--	--	2.55
100 lbs/A N* + 50 lbs/A potash	7	76	61.3	--	--	--	2.10
100 lbs/A N* + 25 lbs/A AMS	9	66	58.7	--	--	--	1.81
100 lbs/A N* + 50 lbs/A AMS	8	63	64.7	--	--	--	2.32
100 lbs/A N* + 25 lbs/A MAP + 25 lbs/A potash + 25 lbs/A AMS	6	71	59.7	--	--	--	2.74
100 lbs/A N* + 50 lbs/A MAP + 50 lbs/A potash + 50 lbs/A AMS	5	72	62.0	--	--	--	2.36
100 lbs/A N* + 25 lbs/A MAP + 25 lbs/A potash + 25 lbs/A AMS + 50 lbs/A urea applied on Sept. 4	10	67	62.7	--	--	--	2.55
Trial Mean		69	63.7	--	--	--	2.50
C.V. %		12.2	6.7	--	--	--	26.8
LSD 0.05		NS	NS	--	--	--	NS

**Total lbs/A N (residual N + urea)* ***Total number of harvested plants used in this analysis.*

NS = No statistical difference between fertilizer treatments.

Continued on next page

2020 CBD Hemp Fertility Trial at Minot Continued

Clonal Production

Fertilizer Treatment	Harvested Plants	Plant Height	Harvest Moisture	Total THC	Total CBD	Total Cannabinoids	Dry Plant Weight
	**	inches	%	%	%	%	lbs/plant
50 lbs/A N*	3	49	53	--	--	--	1.03
100 lbs/A N*	2	38	53	--	--	--	0.97
150 lbs/A N*	5	57	59	--	--	--	2.14
100 lbs/A N* + 25 lbs/A MAP	1	56	54	--	--	--	0.73
100 lbs/A N + 50 lbs/A MAP	3	52	70		--	--	1.32
100 lbs/A N* + 25 lbs/A potash	1	50	61	--	--	--	1.13
100 lbs/A N* + 50 lbs/A potash	0	--	--	--	--	--	--
100 lbs/A N* + 25 lbs/A AMS	1	57	69	--	--	--	2.46
100 lbs/A N* + 50 lbs/A AMS	0	--	--	--	--	--	--
100 lbs/A N* + 25 lbs/A MAP + 25 lbs/A potash + 25 lbs/A AMS	4	54	60	--	--	--	1.34
100 lbs/A N* + 50 lbs/A MAP + 50 lbs/A potash + 50 lbs/A AMS	2	38	48	--	--	--	0.86
100 lbs/A N* + 25 lbs/A MAP + 25 lbs/A potash + 25 lbs/A AMS fb 50 lbs/A urea applied on Sept. 4	4	52	67	--	--	--	1.08

**Total lbs/A N (residual N + urea)* ***Total number of harvested plants used in this analysis.*

Planting Rate: 5' rows and 5' between plants (1742 plants/A)

Production System: Outdoor. No supplemental irrigation.

Weed Control: Clipping (lawn mower)

***Disclaimer**: This data should be viewed with caution until additional information can be generated.*

2020 CBD Hemp Row Spacing and Planting Rate Trial at Minot

Summary: The trial was set up as a randomized complete block design with 3 replications. An experimental CBD hemp strain was propagated from feminized seed and planted as 6 inch transplants or propagated as clones from a single mother plant. Plants were planted into 30 inch and 60 inch rows with 24, 48 and 72 inch spacing between plants within the row. Growing conditions were generally mild (avg 64F) and dry (6.6") from June 1 through September 30. The trial was harvested on October 14. Plants were weighed for yield and a bulk sample of approximately 10 inches of each terminal bud was collected and dried at 80F for 5 days to determine moisture content. *A sub-sample of this biomass was collected and will be analyzed for THC, CBD and total cannabinoid content when funds become available.* There was a lot of phenotypic variability within the feminized seed transplants as far as plant height and shape. This variability carried through harvest, resulting in no obvious trend or statistical differences for plant height, moisture content at harvest or individual dry plant weight between row spacing or plant spacing treatments. Results from the clonal production were very similar to the transplant production with the exception of the 30 inch row with 48 inches between plants which showed a twofold increase in biomass yield. The assumption is that this was a random occurrence due to genetic variability with the feminized seed transplants. As would be expected, higher plant populations on a per acre basis produced higher biomass yields. In conclusion, this data would suggest that row spacing and spacing between plants had little effect on individual plant biomass production and that overall plant density may be more important to maximizing space efficiency. Plant genetics are also an important consideration, as plant shape and size affects sunlight interception, air movement and weed competition. High plant density may enhance weed competition, however, higher plant densities may hinder air movement, creating an environment more conducive to diseases and molds.

Transplant Production

Row Spacing	Plant Spacing	Planting Rate	Plant Height	Harvest Moisture	Total THC	Total CBD	Total Cannabinoids	Dry Plant Weight	Dry Biomass
inches	inches	plants/A	inches	%	%	%	%	lbs/plant	lbs/A
30	24	8712	65	69.4		--	--	1.38	12,052
30	48	4356	66	65.1	--	--	--	2.18	9,511
30	72	2904	60	64.1	--	--	--	1.85	5,382
60	24	4356	59	67.3	--	--	--	1.27	5,547
60	48	2178	60	63.6	--	--	--	1.43	3,115
60	72	1452	67	68.7	--	--	--	1.92	2,783
C.V. %			9.8	7.1	--	--	--	22.4	25.4
LSD 0.05			NS	NS	--	--	--	NS	1,784

NS = No statistical difference between fertilizer treatments.

Clonal Production

Row Spacing	Plant Spacing	Planting Rate	Plant Height	Harvest Moisture	Total THC	Total CBD	Total Cannabinoids	Dry Plant Weight	Dry Biomass
inches	inches	plants/A	inches	%	%	%	%	lbs/plant	lbs/A
30	24	8712	56	68.7	--	--	--	1.18	10,251
30	48	4356	59	70.9	--	--	--	1.10	4,770
30	72	2904	57	60.5		--	--	1.64	4,748
60	24	4356	57	68.1	--	--	--	1.36	5,939
60	48	2178	66	60.0	--	--	--	1.43	3,115
60	72	1452	55	69.9	--	--	--	1.91	2,768
C.V. %			12.9	7.1	--	--	--	32.9	33.5
LSD 0.05			NS	NS	--	--	--	NS	2,317

NS = No statistical difference between fertilizer treatments.

Production System: Outdoor. No supplemental irrigation. Weed control: clipping (lawn mower).

Sugar Beet Waste Lime Impacts on Canola, Soybeans, and Soil

Dr. Chris Augustin, Extension Specialist/Soil Health, Dr. Brian Jenks, Weed Scientist, Tiffany Walter, Research Specialist, Gary Willoughby, Research Specialist

Introduction

Soil pH is the activity of the hydrogen ion (H^+) and measure by the negative log concentration of H^+. That is why as pH decreases, acidity increases. North Dakota soil pH has historically been alkaline. However, several fields west of highway 83 now have a soil pH less than 5.5. The cause of the soil acidification is believed to be caused by nitrogen fertilizers. As nitrogen fertilizers convert into plant available nitrate, H^+ is released and acidifies the soil. Over time, H^+ accumulates and can turn the soil acidic which reduces yields. Soil acidity is rarely found throughout an entire field. Soil acidity tends to be found in depressional or summit areas. Precision agriculture can help pinpoint acidic areas.

Acidic soils reduce yields because of reduced soil microbial activity, aluminum toxicity that stunts root growth, and reduced nutrient availability such as phosphorus tie-up. Acidic soils can be managed by the application of lime. Lime is calcium-carbonate. Lime raises soil pH because carbonates react with H^+. This produces free calcium, carbon-dioxide, and water. Many states have developed lime recommendations based on their clay type, parent materials, and climate. Acidic soils in North Dakota are a new issue and consequently, lime recommendations have not been developed here. Commercial ag lime is not readily available in North Dakota. However, sugarbeet waste lime (beet lime) is readily available from sugarbeet processing factories. Beet lime is a by-product of the sugar refining process. Beet lime was used as the liming agent for this project.

Materials and Methods

Experimental plots were treated with 0 (check), two, four, and eight tons of sugarbeet waste lime (beet lime) by hand application in 2018. Beet lime was soil incorporated shortly after the application with a field cultivator. Beet lime is made up of more than just the acid neutralizing carbonates and has nitrogen, phosphorus, various micro-nutrients, and organic matter. The beet lime used for this project contained 73% calcium carbonate, 3% nitrate, 3% phosphorus, and trace amounts of zinc, copper, and manganese. The actual amount of calcium carbonate applied was 0, 1.5, 2.9, and 5.8 tons/ac.

Results

Each beet lime treatment increased soil pH (Figure 1) and decreased extractable aluminum (Figure 2). Aluminum toxicity becomes an issue when the soil pH is less than 5.5 and extractable aluminum is greater than 25 ppm. Aluminum toxic plant root growth tends to be malformed and reduced.

Aluminum toxicity was possible with the beet lime applications of zero and two tons/ac. However, aluminum toxic symptoms were not observed. The beet lime applications of four and eight tons reduced soil extractable levels to less than two ppm (Figure 2). Soil pH was greater at the eight tons/ac beet lime treatment than the four tons/ac beet lime (Figure 1). However, the data suggests that beet lime applications of four and eight tons/ac reduced soil extractable aluminum to similar levels.

The average soil calcium carbonate content was 0.29% and similar across all lime treatments (p-value 0.556). This indicates that within two years, the lime treatments reacted with the soil acidity. Future use of nitrogen fertilizer will likely re-acidify the lime applied soil. This study site will be monitored annually to gather important information on the frequency of re-liming.

Sugar Beet Waste Lime Impacts on Canola, Soybeans, and Soil Continued

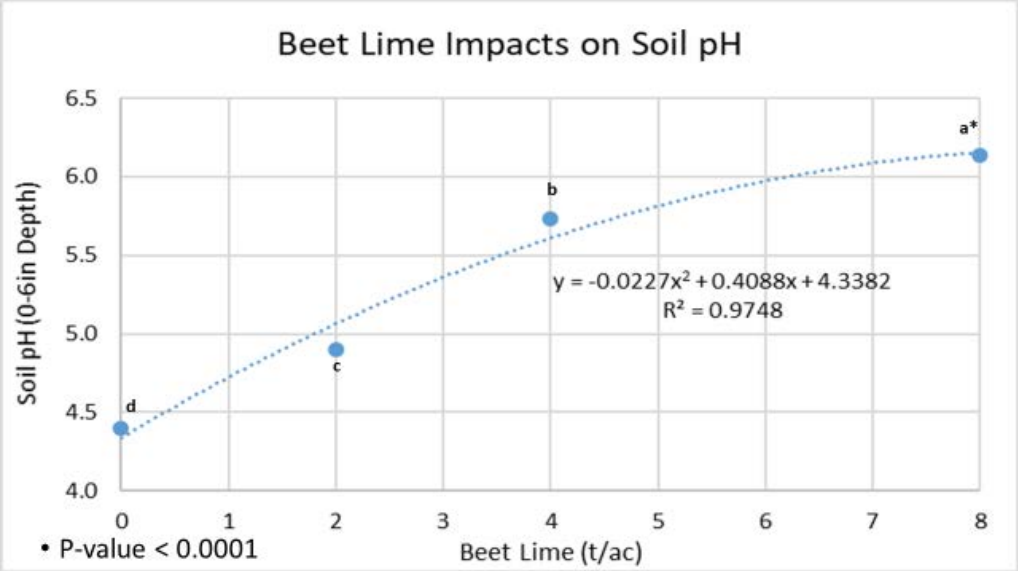

Figure 1. The relationship of hand applied and incorporated beet lime on soil pH at the 0-6 inch depth. *Different letters indicate statistical differences at the 0.05 level.

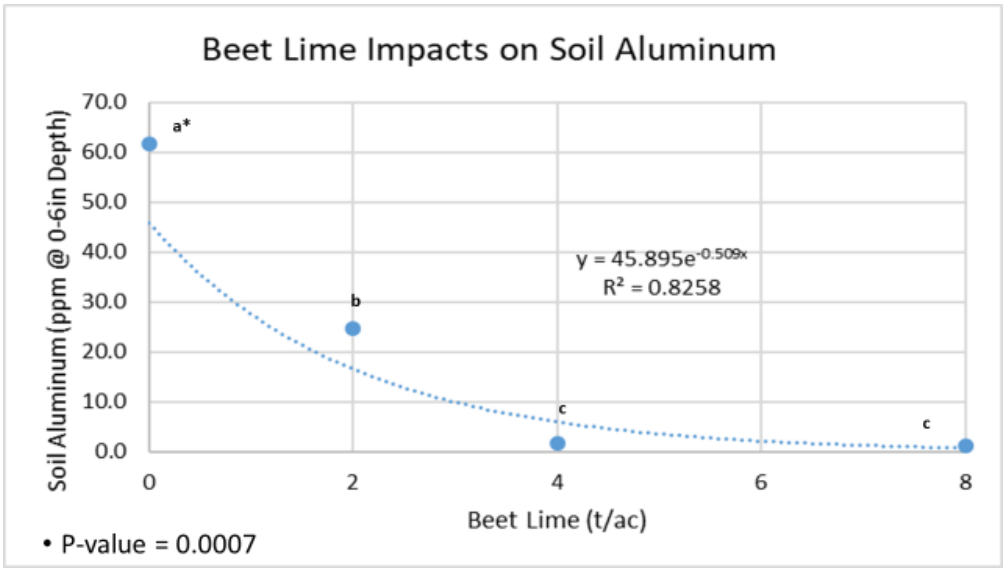

Figure 2. The relationship of hand applied and incorporated beet lime on soil extrable aluminum at the 0-6 inch depth. *Different letters indicate statistical differences at the 0.05 level.

Beet lime applications improved soil pH and soil extractable aluminum. However, lime did not impact yield or quality of canola and soybean grain. The analysis of variance determined that the average soybean yield was 23 bu/ac with a variance of 87.5 and a p-value of 0.586. Beet lime treatments did not impact soybean oil or protein content at the 0.05 level.

Sugar Beet Waste Lime Impacts on Canola, Soybeans, and Soil Continued

Canola is susceptible to manganese toxicity when soil pH is less than 5.5. Manganese toxicity symptoms were observed early in the growing season (Figure 3), but it appeared that the canola "grew" out of the symptoms. The manganese toxic canola growth was slowed and germination was reduced. Manganese toxic leaf margins were chlorotic (indicated by red arrow). The manganese toxic canola contained 1,595 ppm of manganese. The normal canola manganese range is less than 100 ppm. However, manganese toxicity did not impact canola yield or quality. The average canola yield was 1,870 lbs/ac with a variance of 349.8 and p-value of 0.515. Canola oil content was not impacted by beet lime at the 0.05 level. The average protein content of lime was 40.2%.

Figure 3. Manganese toxic canola. The Red arrows are pointing to the leaf margin chlorosis that is commonly expressed by manganese toxicity.

Conclusions

All beet lime treatments increased soil pH, and decreased soil extractable aluminum. This data suggests that four tons beet lime/ac (2.9 tons calcium carbonate/ac) is an effective rate to improve soil pH and soil extractable aluminum. Yield and quality of canola and soybeans were not impacted by beet lime treatments. However, young canola plant health was better from the beet lime applications.

Kochia control with fall-applied Valor and Spartan

The objective of this study was to evaluate kochia control with fall-applied Valor and Spartan. We have learned from previous studies and from grower experience that Valor applied late in the fall will provide suppression of early spring-emerging kochia. Fall treatments were applied October 8, 2019. About 0.10 inches of rain fell on October 9. Spring treatments were applied May 6, 2020. About 0.40 inches of rain fell on May 9. At the fall application, about 60% of the ground was covered with old kochia plant residue. At the spring application, kochia was 0.25-0.75 inches tall. No Roundup was applied with any of the Valor/Spartan treatments.

By May 22, none of the fall treatments provided good kochia control. We speculate that the old kochia residue present at the fall application may have tied up some of the herbicide. In the spring, the only effective treatments were those that contained metribuzin (Authority MTZ=Spartan + Metribuzin). Authority MTZ applied in the spring provided good-excellent kochia control through early June. Very dry conditions from April-June likely hindered Valor and Spartan soil activity. Note that in a separate study on 3-inch kochia applied May 29, the metribuzin treatments were not as effective.

Table. Kochia control with fall-applied Valor and Spartan. (2001)

			Weed Control			
			Kochia			
Treatment	Rate	Timing	May-6	May-22	May-29	Jun-11
			----------%			----------
Untreated			0	0	0	0
Valor	3 oz	Oct	52	23	20	10
Valor + Spartan	3 oz + 4 oz	Oct	61	33	25	15
Spartan / Spartan[a]	2.5 oz / 2.5 oz	Oct / May	27	63	42	23
Spartan	5 oz	Oct	48	22	13	8
Spartan[a]	4 oz	May	0	75	59	43
Valor / Authority MTZ[a]	3 oz / 11 oz	Oct / May	61	99	98	95
Authority MTZ[a]	11 oz	May	0	97	94	89
Valor / Spartan + Sharpen[a]	3 oz / 4 oz + 1 oz	Oct / May	54	77	63	38
Spartan + Sharpen[a]	4 oz + 1 oz	May	0	73	58	37
Valor + Metribuzin + 2,4-D ester	3 oz + 0.33 lb + 0.5 pt	Oct	85	65	58	42
Glyphosate + AMS	32 oz + 2.5 gal	May	0	56	42	25
LSD (0.05)			15.7	9.7	12.1	13.4

[a] *Applied with MSO (1%) + AMS (2.5 gal)*

Kochia control with fall-applied Valor vs spring-applied Reglone

The objective of this study was to evaluate kochia control with fall-applied Valor compared to spring-applied Reglone tank mixes. Fall treatments were applied October 8, 2019. About 0.10 inches of rain fell on October 9. Spring treatments were applied May 6, 2020. About 0.40 inches of rain fell on May 9. At the fall application, about 60% of the ground was covered with old kochia plant residue. At the spring application, kochia was 0.25-0.75 inches tall. No Roundup was applied with any of the treatments.

By May 22, the most effective treatment was Reglone + Metribuzin, which provided good-excellent control through early June. None of the other treatments provided good kochia control. We speculate that the old kochia residue present at the fall application may have tied up some of the Valor herbicide. Also, very dry conditions from April-June likely hindered Valor and Spartan soil activity. Note that in a separate study on 3-inch kochia applied May 29, the metribuzin treatments were not as effective.

Table. Kochia control with fall-applied Valor vs spring-applied Reglone. (2002)

			Weed Control			
			Kochia			
Treatment	Rate	Timing	May-6	May-22	May-29	Jun-11
			----------%----------			
Untreated			0	0	0	0
Valor / Spartan[a]	3 oz / 4 oz	Oct / May	7	62	40	27
Reglone + NIS	1.5 pt + 0.25%	May	0	80	62	32
Reglone + Spartan Charge[a]	1.5 pt + 5 oz	May	0	74	60	33
Reglone + Metribuzin + NIS	1.5 pt + 0.25 lb + 0.25%	May	0	97	95	89
Reglone + Aim[a]	1.5 pt + 1 oz	May	0	66	50	23
Reglone + Sharpen[a]	1.5 pt + 1 oz	May	0	74	53	27
LSD (0.05)			7.8	3.2	2.6	4.5

[a] *Treatments applied with MSO (1%) + AMS (2.5 gal)*

Kochia control with Roundup, Liberty, and Enlist in a burndown

The objective of this study was to evaluate kochia control in a burndown situation with Roundup, Liberty, and Enlist. Herbicide treatments were applied May 29 when kochia was 0.25-2 inches tall, air temperature was 65° F, and relative humidity was about 37%.

About two weeks after application, all Liberty treatments provided excellent kochia control (97-99%). Roundup PowerMax provided 73-81% control. Enlist Duo provided 93% control, while Enlist One provided only 61% control.

Table. Kochia control with Roundup and Liberty in a burndown. (2022)

		Weed Control	
		Kochia	
Treatment[a]	Rate	Jun-13	Jun-26
		-------%-------	
Check		0	0
Liberty	32 oz	99	98
RoundUp Powermax	28 oz	81	79
Liberty + RoundUp Powermax	32 oz + 28 oz	99	99
Liberty + RoundUp Powermax	32 oz + 21 oz	99	98
Liberty + RoundUp Powermax	43 oz + 21 oz	99	99
Liberty + Enlist Duo	32 oz + 4.75 pt	99	98
Liberty + Enlist One	32 oz + 2 pt	97	95
Enlist Duo	4.75 pt	93	94
Enlist One	2 pt	61	58
Liberty	43 oz	98	97
RoundUp Powermax	21 oz	73	70
LSD (0.05)		4.1	4.5

[a] *All treatments applied with AMS (8.8 gal/100 gal)*

Kochia control in wheat with Huskie FX

The objective of this study was to evaluate kochia control with Huskie FX compared to commercial standards. Herbicide treatments were applied June 15 to 4-5 leaf wheat and 0.5-4 inch kochia.

None of the treatments caused visible wheat injury. Huskie FX + Luxxur provided good control throughout the season. Huskie FX applied alone was not as effective early, but control improved as the wheat canopy developed. WideMatch, Talinor, and Bromac provided only fair kochia control.

Table. Kochia control with Huskie FX. (2025)

		Injury	Weed Control			
		HRSW[b]	Kochia			
Treatment[a]	Rate	Jun-23	Jul-1	Jul-9	Jul-21	Jul-29
		--%--	----------%----------			
Untreated		0	0	0	0	0
Huskie FX	15.5 oz	0	75	78	92	92
Huskie FX	18 oz	0	82	87	97	97
WideMatch + MCPA Ester	1 pt + 0.5 pt	0	57	62	69	67
Talinor + CoAct+	13.7 oz + 2.75 oz	0	70	67	67	65
Bromac	1 pt	0	65	60	53	50
Luxxur B + Luxxur A + Huskie FX	6.85 oz + 0.21 oz + 15.5 oz	0	90	87	92	94
Luxxur B + Luxxur A + Huskie FX	6.85 oz + 0.21 oz + 18 oz	0	90	88	95	95
LSD (0.05)		NS	8.2	8.0	12.1	13.6

[a] *Applied to 0.5-4" weeds*

[b] *HRSW= Hard Red Spring Wheat*

Effect of metribuzin on emerged kochia control

We initiated this study on May 29 after observing excellent kochia control in separate study where metribuzin was applied with Spartan or Reglone on May 6 to small kochia (< 1 inch). We wanted to determine if the "metribuzin effect" would be consistent on larger kochia (~3 inches tall). Air temperature was 63 F and humidity was 37% at application.

Results: The same treatments that had provided excellent control (Spartan + Metribuzin and Reglone + metribuzin) of small kochia in a previous study, provided only fair control of larger kochia in this study. Thus, these results indicate growers should target smaller kochia for burndown applications.

Table. Effect of metribuzin on emerged kochia control. (2045)

		Weed Control	
		Kochia	
Treatment[a]	Rate	Jun-8	Jun-19
		-------%-------	
Untreated		0	0
Spartan[b]	4 oz	64	58
Spartan + Roundup[b]	4 oz + 22 oz	71	70
Spartan + Roundup + Metribuzin[b]	4 oz + 22 oz + 0.25 lb[b]	84	80
Spartan + Metribuzin[b]	4 oz + 0.25 lb	73	65
Sharpen[b]	1 oz	48	42
Sharpen + Roundup[b]	1 oz + 22 oz	79	75
Sharpen + Roundup + Metribuzin[b]	1 oz + 22 oz + 0.25 lb[b]	87	84
Sharpen + Metribuzin[b]	1 oz + 0.25 lb[b]	75	65
Reglone + NIS	1.5 pt + 0.25%	40	35
Reglone + Metribuzin + NIS	1.5 pt + 0.25 lb + 0.25%	77	71
Roundup + AMS	22 oz + 2.5 gal	76	72
Metribuzin[b]	0.25 lb	20	17
LSD (0.05)		13.8	11.5

[a] *All treatments applied as a burndown*

[b] *Applied with AMS + MSO (2.5% + 1%)*

Weed control in corn with Balance Flexx, Capreno, Laudis, and Harness

The objective of this study was to evaluate weed control in corn with preemergence (PRE) and postemergence (POST) herbicides. PRE treatments were applied May 15. The first significant rainfall after the PRE occurred on May 23 and 24 with 0.13 and 0.41 inches, respectively. The next significant rain fell on June 6 with 0.61 inches. The POST treatments were applied June 5 at the V3-V4 corn stage with weeds generally 2-4 inches tall.

All treatments containing POST applications generally provided good to excellent control of all weeds. Grass control was better with Capreno than Laudis. The PRE treatment containing Harness was more effective than with just Balance + Atrazine alone. Acuron Flexi did not provide effective weed control.

Table. Weed control with Balance Flexx, Capreno, Laudis and Harness in Corn. (2035)

			Weed Control[d]									
			Kochia		Wibw		Colq		Rrpw		Grft	
Treatment[c]	Rate	Timing	Jun-13	Jul-24	Jun-13	Jul-24	Jun-13	Jul-24	Jun-13	Jul-24	Jun-13	Jul-24
			----------%----------									
Untreated			0	0	0	0	0	0	0	0	0	0
Balance + Atrazine	5.5 oz + 1 pt	PRE	30	27	23	7	27	23	30	23	42	13
Balance + Harness + Atrazine	5.5 oz + 2.5 pt + 1 pt	PRE	87	73	60	23	79	47	95	82	85	40
Balance + Capreno + Harness + Atr + Sup[ab]	4 oz + 3 oz + 2 pt + 16 oz + 0.25%	V3-4	95	99	95	98	95	99	95	99	89	95
Balance / Laudis + Harness + Atr + Dest[ab]	4 oz / 3 oz + 2 pt + 12 oz + 0.5%	PRE/V3-V4	95	99	95	99	95	99	95	99	88	89
Capreno + Harness + Atr + Sub[ab]	3 oz + 2 pt + 16 oz + 0.25%	V3-4	95	99	95	98	95	99	95	99	88	95
Laudis + Harness + Atr + Dest[ab]	3 oz + 2 pt + 12 oz + 0.5%	V3-4	95	99	95	94	95	99	95	98	89	84
Capreno + DiFlexx + Atr + Sub + CAR[b]	3 oz + 7.5 oz + 16 oz + 0.5% + 0.5%	V3-4	95	99	95	99	95	98	95	98	88	87
Laudis + DiFlexx + Atr + Dest + CAR[b]	3 oz + 7.5 oz + 16 oz + 0.5% + 0.5%	V3-4	95	99	95	95	95	99	95	99	88	71
Acuron Flexi + Atr	56 oz + 16 oz	PRE	43	33	20	10	47	23	50	40	46	13
LSD (0.05)			10.3	15.9	3.1	9.3	12.5	18.7	10.4	18.8	13.4	6.6

[a] *Applied with N-PAK AMS Liquid (2.5 %)*

[b] *Applied with Roundup PowerMax (32 oz)*

[c] *Sup=Superb HC; Dest=Destiny HC; CAR= Class Act Ridion; Balance=Balance Flexx; Atr=Atrazine;*

[d] Wibw=Wild buckwheat; Colq=Common lambsquarters; Rrpw=Redroot pigweed; Grft=Green foxtail

Dry pea tolerance to Group 14 herbicide tank mixes

The objective of this study was to determine if tank mixing more than one Group 14 herbicide will cause greater dry pea injury. Spartan, Sharpen, and Aim are all in the Group 14 chemical family. These herbicides were applied at two rates in various tank mixes. Herbicide treatments were applied May 15 with three replications. The first significant rainfall after the PRE occurred on May 23 and 24 with 0.13 and 0.41 inches, respectively. The next significant rain fell on June 6 with 0.61 inches.

Crop injury varied by where each treatment was located within the study area. Part of the study area was on a hilltop where soil pH tends to be higher and organic matter lower. We expect to see more crop injury from herbicides such as Spartan on hilltops. As much as 40% crop injury occurred in some replications, but significantly less injury in other reps. For example, in the Spartan + Sharpen treatment (6 + 2 oz), one rep on the hilltop had 40% injury while another rep in a lower area showed only 15% injury. Dry pea injury appeared to be influenced more by soil characteristics (higher pH on a hilltop) than by combining multiple Group 14 herbicides.

Table. Dry pea tolerance to Group 14 tank mixes. (2039)

		Injury				Density	Height	
		Dry pea				Plants/m row	cm	
Treatment[a]	Rate	Jun-2	Jun-13	Jun-24	Jul-11	Jun-12	Jun-24	Jul-22
		----------%----------				---%---	--------%-------	
Untreated		0	0	0	0	3.8	27.9	48.4
Spartan	3 oz	7	6	4	2	5.5	30.8	65.3
Spartan	6 oz	16	18	11	5	4.7	31.1	64.4
Spartan Charge	3.8 oz	8	8	7	0	4.0	28.8	63.8
Spartan Charge	7.6 oz	25	24	16	9	6.9	29.1	59.2
Sharpen	1 oz	0	0	0	0	3.9	29.4	58.6
Sharpen	2 oz	0	0	0	0	5.6	29.0	49.4
Spartan + Sharpen	3 oz + 1 oz	12	13	7	3	6.1	29.5	60.2
Spartan + Sharpen	6 oz + 2 oz	24	32	21	11	5.4	28.0	60.4
Spartan Charge + Sharpen	3.8 oz + 1 oz	14	12	7	1	5.6	29.3	60.2
Spartan Charge + Sharpen	7.6 oz + 2 oz	20	19	14	11	4.8	28.6	60.7
LSD (0.05)		10.5	13.1	7.9	8.3	1.6	NS	10.0

[a] *All treatments applied preemergence*

Dry pea and sunflower tolerance to fall- and spring-applied Valor and Spartan

Previous studies and grower experience have shown that fall-applied Valor may provide control of winter annual weeds as well as early spring-emerging kochia. However, fall-applied Valor does not provide season long weed control. Thus, a spring herbicide application (such as Spartan) is necessary to help control weeds that emerge in the spring and summer. The objective of this study was to determine if applying Valor in the fall followed by Spartan in the spring would be safe to dry pea and sunflower. Valor and Spartan are in the same chemical family (Group 14 PPO inhibitors). Growers have asked if crops can tolerate two PPO inhibitors applied fall and spring. In this study, we applied Valor in the fall followed by Spartan, Sharpen, or Authority MTZ in the spring. Note that Authority MTZ and Sharpen are not labeled for sunflower.

None of the labeled herbicides caused dry pea or sunflower injury. The only injury occurred from metribuzin and Sharpen, which are not labeled for sunflower.

Table 1. Sunflower tolerance to fall- and spring-applied Valor and Spartan. (2003)

			Sunflower								
			Injury			Density	Height		Yield	Test wt.	Oil
Treatment[a]	Rate	Timing[b]	13-Jun	29-Jun	23-Jul	9-Jun	7-Jul	22-Jul	22-Sep	22-Sep	22-Sep
	(oz)		----------%----------			#/m row	-------cm-------		lb/A	lb/bu	%
Untreated			0	0	0	4.4	62	135	2298	28.9	40.0
Valor	3	Fall	0	0	0	4.8	60	139	1975	28.2	39.2
Valor / Spartan[a]	3 / 4	Fall / PRE	0	0	0	4.6	63	139	1955	29.6	40.8
Spartan[a]	4	PRE	1	0	0	5.2	69	138	2369	28.8	40.6
Valor / Auth MTZ[a]	3 / 11	Fall / PRE	4	3	0	4.8	60	135	2089	29.7	41.4
Authority MTZ[a]	11	PRE	6	5	2	5.8	68	138	1624	29.8	40.9
Valor / Spartan + Sharpen[a]	3 / 4+1	Fall / PRE	6	11	7	4.7	55	125	1755	27.8	39.6
Spartan + Sharpen[a]	4 + 1	PRE	5	6	7	4.6	53	120	1746	28.8	39.2
LSD (0.05)			NS	NS	NS	NS	NS	NS	NS	NS	NS

[a] *Applied with AMS + MSO (2.5% + 1%)*

[b] *Fall treatments applied October 8, 2019. Spring treatments applied preplant May 6, 2020.*

Table 2. Dry pea tolerance to fall- and spring-applied Valor and Spartan. (2003)

			Dry pea								
			Injury			Density	Height		Yield	Test wt.	Protein
Treatment[a]	Rate	Timing[a]	10-Jun	29-Jun	23-Jul	9-Jun	7-Jul	22-Jul	24-Aug	24-Aug	24-Aug
	(oz)		----------%----------			#/m row	-------cm-------		lb/A	lb/bu	%
Untreated			0	0	0	8.0	32	71	2488	65.3	28.5
Valor	3	Fall	0	0	0	6.9	32	70	2305	65.3	28.3
Valor / Spartan[a]	3 / 4	Fall / PRE	0	0	0	7.4	31	69	2404	65.2	28.6
Spartan[a]	4	PRE	0	0	0	8.3	32	69	2436	65.4	29.2
Valor / Auth MTZ[a]	3 / 11	Fall / PRE	0	0	0	6.8	31	70	2502	65.2	28.6
Authority MTZ[a]	11	PRE	0	0	0	7.3	32	71	2439	65.0	28.7
Valor / Spartan + Sharpen[a]	3 / 4+1	Fall / PRE	0	0	0	7.6	33	70	2474	65.1	28.8
Spartan + Sharpen[a]	4 + 1	PRE	0	0	0	7.3	33	71	2456	65.0	28.4
LSD (0.05)			NS	NS	NS	NS	NS	NS	NS	NS	NS

[a] *Applied with AMS + MSO (2.5% + 1%)*

[b] *Fall treatments applied October 8, 2019. Spring treatments applied preplant May 6, 2020.*

Weed control in sunflower with Authority Supreme and Express

The objective of this study was to evaluate broadleaf weed control in Express-tolerant sunflower with Authority Supreme, Authority Elite, Spartan Charge, and Anthem Flex applied preemergence (PRE). In addition, these treatments were compared with and without POST-applied Express. The PRE treatments were applied May 29, while the POST treatments were applied June 23. All PRE treatments were tank mixed with glyphosate. The first significant rain after the PRE treatments fell on June 6 (0.61 inches).

All PRE treatments containing Spartan provided fair to good control of redroot pigweed, common lambsquarters, and kochia. However, all treatments containing Spartan followed by POST-applied Express provided good-excellent control of all weeds.

Table. Weed Control in sunflower with Authority Supreme and Express. (2040)

			Weed Control[d]					
			Rrpw		Colq		Kochia	
Treatment[ad]	Rate	Timing	Jun-26	Jul-23	Jun-26	Jul-23	Jun-26	Jul-23
			----------%----------					
Untreated			0	0	0	0	0	0
Gly + AMS	22 oz + 2.5%	PRE	0	0	0	0	0	20
Auth Sup + Aim + Gly[c]	8 oz + 1 oz + 22 oz	PRE	89	84	81	82	89	85
Auth Sup + Aim + Gly[c] / Express[b]	8 oz + 1 oz + 22 oz / 0.5 oz	PRE / POST	95	99	93	99	96	96
Auth Elite + Aim + Gly[c]	24 oz + 1 oz + 22 oz	PRE	81	72	74	67	88	86
Auth Elite + Aim + Gly[c] / Express[b]	24 oz + 1 oz + 22 oz / 0.5 oz	PRE / POST	89	99	82	99	93	89
Spartan Charge + Gly[c]	5.1 oz + 22 oz	PRE	78	71	72	70	79	74
Spartan Charge + Gly[c] / Express[b]	5.1 oz + 22 oz / 0.05 oz	PRE / POST	89	97	82	99	97	92
Anthem Flex + Aim + Gly[c]	4.5 oz + 0.4 oz + 22 oz	PRE	83	72	47	45	40	37
Anthem Flex + Aim + Gly[c] / Express[b]	4.5 oz + 0.4 oz + 22 oz / 0.5 oz	PRE / POST	87	97	57	99	78	76
Gly + AMS / Express[b]	22 oz + 2.5% / 0.5 oz	PRE / POST	7	98	0	99	0	33
LSD (0.05)			12.6	9.9	29.1	20.6	20.4	17.5

[a] *Treatments applied preemergence or postemergence (4-leaf)*

[b] *Express applied with MSO (1%)*

[c] *Applied with AMS (2.5%) and MSO (1%)*

[d] *Gly=Roundup PowerMax; Auth Sup=Authority Supreme; Auth Elite=Authority Elite; Rrpw=Redroot pigweed; Colq=Common lambsquarters*

False chamomile control with Talinor

The objective of this greenhouse study was to evaluate false chamomile control with Talinor. False chamomile can emerge in the fall or spring. Fall-emerging plants are more difficult to control in the spring. A 2019 field study showed that POST-applied Talinor and Huskie provided poor control of fall-emerging false chamomile in wheat. In this study, we wanted to determine if Talinor would control newly emerged seedlings. This study was conducted in the greenhouse. Treatments were applied when false chamomile plants were 2-3 inches tall.

At 14 days after treatment (DAT), Talinor provided 100% control of small seedlings, while Affinity BS and Huskie provided 97 and 78% control, respectively.

Table. False chamomile control with Talinor. (Greenhouse study - 2020)

			Weed Control		
			False chamomile		
Treatment	Rate	Timing	7 DAT	11 DAT	14 DAT
			----------%----------		
Untreated			0	0	0
Talinor + Coact + COC	13.7 fl oz + 2.75 fl oz + 1%	POST	100	100	100
Talinor + Coact + COC	18.2 fl oz + 3.6 fl oz + 1%	POST	100	100	100
Experimental + COC + AMS	18 fl oz + 1% + 2.5%	POST	99	100	100
Huskie + NIS + AMS	11 fl oz + 0.25% + 2.5%	POST	84	78	78
Affinity BS + 2,4-De + NIS	0.6 oz + 0.5 pt + 0.25%	POST	92	96	97
LSD (0.05)			11.2	15.0	14.9

Canada thistle control with Luxxur tank mix

The objective of this study was to evaluate Canada thistle control with Luxxur herbicide applied alone or in a tank mix. Herbicide treatments were applied June 17 to 2- to 24-inch Canada thistle (average 10”). By about three weeks after treatment, most treatments provided fair to good thistle control/suppression (68-84%). Only Luxxur + Bromac and Huskie Complete provided poor thistle control. By about six weeks after treatment, the best treatments provided 52-76% control.

Table. Canada Thistle Control with Luxxur Tank Mix. (2026)

		Weed Control		
		Canada Thistle		
Treatment[a]	Rate	Jun-26	Jul-11	Jul-28
		----------%----------		
Untreated		0	0	0
Luxxur B + Luxxur A	6.85 oz + 0.21 oz	18	68	52
Luxxur B + Luxxur A + Starane Flex	6.85 oz + 0.21 oz + 13.5 oz	20	84	76
Luxxur B + Luxxur A + 2,4-D ester	6.85 oz + 0.21 oz + 0.5 pt	30	79	63
Luxxur B + Luxxur A + Starane Flex + 2,4-D ester	6.85 oz + 0.21 oz + 13.5 oz + 0.5 pt	30	83	64
Luxxur B + Luxxur A + Sentrallas	6.85 oz + 0.21 oz + 10 oz	20	83	73
Luxxur B + Luxxur A + Sentrallas + 2,4-D ester	6.85 oz + 0.21 oz + 10 oz + 0.5 pt	33	84	69
Luxxur B + Luxxur A + Bromac	6.85 oz + 0.21 oz + 1 pt	40	37	28
Luxxur B + Luxxur A + Pixxaro	6.85 oz + 0.21 oz + 6 oz	23	80	68
Huskie Complete	13.7 oz	50	17	15
LSD (0.05)		3.7	7.3	15.3

[a] *Applied at 2-24 inch Canada Thistle (average 10-12")*


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