North Dakota State University

Hettinger Research Extension Center

2018 Annual Report

NDSU | HETTINGER RESEARCH EXTENSION CENTER

NORTH DAKOTA **AGRICULTURE EXPERIMENT STATION**

Hettinger Research Extension Center

Hettinger REC Research in Brief

- Integrated crops, livestock, and range research and extension
- Variety, herbicide, and crop production research
- Lamb and beef feedlot nutrition and management
- Reproductive management of fall, winter, and spring lambing ewes
- Multiple-land use management including cropping systems, livestock, and wildlife as potential outputs
- Livestock Extension and applied calf backgrounding

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The Hettinger Research Extension Center (HREC) was established from a gift of 160 acres by the residents of Adams County and the city of Hettinger in 1909. Original work at the HREC involved converting native prairie to farm land for the purpose of agronomic research. In 1912, through cooperation with the United States Department of Agriculture, a dry land farming trial began. In 1913 a herd of Guernsey and Jersey cows and bulls was purchased to aid local producers in the production of replacement dairy cattle. Following a brief closure during the Depression, the HREC continued to grow the research programs, focusing on agronomy and sheep breeding. In 1947, an option was secured for the purchase of an extra quarter of land to continue and expand sheep and agronomy research. In the 1980's the research programs were solidified with the addition of land bringing the total owned land to 1130 acres, and the hiring of an agronomist.

The HREC is a semi-arid site located in southwest North Dakota, providing the most southerly NDSU location in the non-glaciated portion of North Dakota as a site for its agronomy research program. The HREC also is located at the center of the North Dakota sheep industry, the focus of one of its animal research programs. Furthermore, the HREC is located in an area of rapidly growing livestock feeding ventures, another focus of animal research at the HREC. Additionally, the HREC is located in a region where much of the land base is in the Conservation Reserve Program and Forest Service lands, which has resulted in additional research evaluating potential changes in the CRP program and how these changes may affect upland native and game bird populations. A new research program evaluating low-cost rangeland monitoring strategies on U.S. Forest Service lands has resulted in a significant increase in the quantity of rangeland, livestock, and wildlife interaction research conducted at the HREC throughout the western Dakotas. Research at HREC involves the disciplines of animal science, range and wildlife science agronomy, and weed science. Collaboration is with Main Station scientists, Branch Station scientists, U.S. Forest Service, grazing associations, university scientists from WY, SD, and MT, and USDA research entities in these research disciplines to improve the productivity of livestock and cropping systems and economic development of the region. Through these efforts, the center's research program has gained a national reputation for its involvement with sheep production systems as well as a strong regional and state reputation for its research in agronomy, multiple-land use, and calf backgrounding.

AGRONOMY

- Conducted crop variety and hybrid yield trials for 21 different crops at Hettinger along with off-station small grains trials at 4 locations.
- 12 preliminary yield trials/nurseries for wheat, pulse and canola breeding programs.
- Evaluation of carinata, an oilseed mustard like canola, for adaptation to western ND for use biofuel production. This crop looks promising with yields of carinata being competitive with hybrid canola and having fewer problems with seed shatter.
- 10 agronomic studies, including seed treatments, soybean & duram planting dates, spring wheat nitrogen timing, and spring wheat seeding rate.

WEED SCIENCE

- Evaluation of pre-emergence an post-emergence herbicides for weed control and crop tolerance for SW ND.
- Evaluation of fall-applied herbicides for weed control and crop tolerance.
- Options for post-harvest weed control.
- Management of noxious and troublesome weeds in pasture and rangelands.
- Cover crop tolerance to carryover of herbicides applied to spring wheat.
- Contributed to NDSU Weed Control Guide.
- Publish Crops Day report.

HREC Crops, Weeds, Livestock, and Range

RANGE and LIVESTOCK SCIENCE

- Using annual forages to provide forage for grazers and resources for pollinators and a state-wide assessment of pollinator populations.
- Evaluate the ecological effects of integrating livestock herbivory and annual forages into a winter wheat cropping system.
- Patch-burn and sheep/cattle grazing on post Conservation Reserve Program land.

- Evaluated supplementation strategies during pregnancy and their effect on embryonic death loss, fetal development, and potential feedlot and reproductive performance of offspring.
- Continued research in “Value Added Animal Production”; evaluated mineral injection during receiving of freshly weaned calves.
- Evaluation of feeding and supplementation strategies that impact ram fertility.
- Conduct the Dakota Fall Performance Ram Test; a 140 day Rambouillet Certificate of Merit program, one of three Rambouillet Ram Tests in the nation.

OUTREACH and EXTENSION

- Conduct annually the HREC Beef Day, Sheep School, Shearing School, Wool Classing School, Carcass Ultrasound School, Crops Tours, Crops Day, and Soil Health and Wildlife Workshops.
- Analyze wool samples for fiber diameter using an OFDA Fiber Analyzer
- Bi-weekly radio updates during the growing season.
- Implemented Nitrate QuikTest certification program in 41 ND County Extension Offices.
- Delivered over 30 presentation to 800 livestock producers since January 1.

HREC Research Faculty

Dr. Christopher Schauer, Director & Animal Scientist
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2018 Agronomy

Weather Summary - Hettinger

Frost Free Days

	28ºF	32ºF	50% Probability 32ºF
Date of Last Frost	April 28	May 11	May 20
Date of First Frost	September 28	September 28	September 16
Frost Free Days	**153**	**140**	**119**

Precipitation (inches)

Month	2013-14	2014-15	2015-16	2016-17	2017-18	63 Year Average
October	4.4	0.1	2.0	0.9	0.0	1.1
November	0.2	1.0	0.0	0.4	0.2	0.5
December	0.5	0.0	0.5	0.1	0.2	0.3
January	0.1	0.1	0.2	0.6	0.3	0.4
February	0.3	0.0	0.4	0.2	0.6	0.4
March	0.6	0.2	0.2	0.9	0.3	0.7
April	1.6	1.0	3.7	1.2	1.6	1.6
May	1.6	4.0	1.0	0.6	1.7	2.7
June	5.1	5.2	0.9	0.3	3.7	3.3
July	0.9	1.0	1.5	1.7	2.7	2.0
August	5.2	1.9	1.7	1.8	0.9	1.8
September	1.3	0.9	2.3	1.9	1.7	1.4
April-Sept.	**14.3**	**13.1**	**8.9**	**5.6**	**10.6**	**11.4**
Total	**21.7**	**15.4**	**14.4**	**10.6**	**13.9**	**16.2**

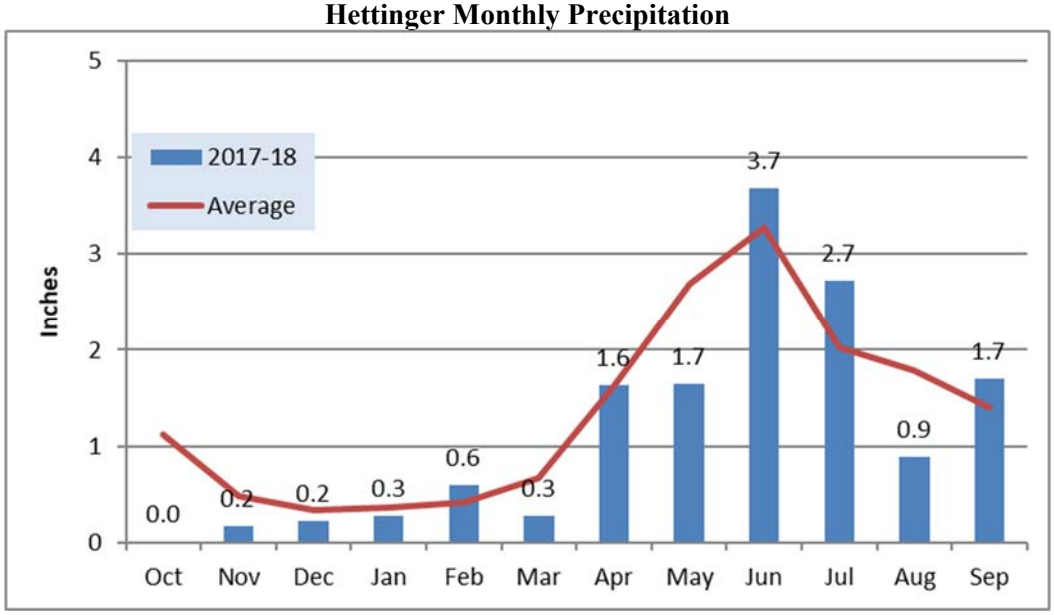
Air Temperature (ºF)

Month	2013-14	2014-15	2015-16	2016-17	2017-18	63 Year Average
October	39.7	46.6	48.5	48.1	44.9	45.5
November	28.8	21.3	32.4	39.5	32.4	29.9
December	12.9	23.4	23.9	10.1	19.0	19.7
January	16.6	21.6	20.1	11.8	17.1	15.5
February	10.1	19.1	32.0	24.6	6.0	20.0
March	26.5	38.0	38.8	34.1	27.4	29.1
April	39.1	43.2	44.2	43.6	35.1	42.5
May	52.8	50.2	54.2	55.2	58.7	53.6
June	59.5	64.6	68.7	66.1	65.4	63.1
July	66.4	70.4	72.0	76.3	69.1	70.1
August	66.0	69.3	69.0	66.8	67.8	68.7
September	56.4	64.1	60.7	58.2	56.3	58.0
Average	**39.6**	**44.3**	**47.0**	**44.5**	**41.6**	**43.0**

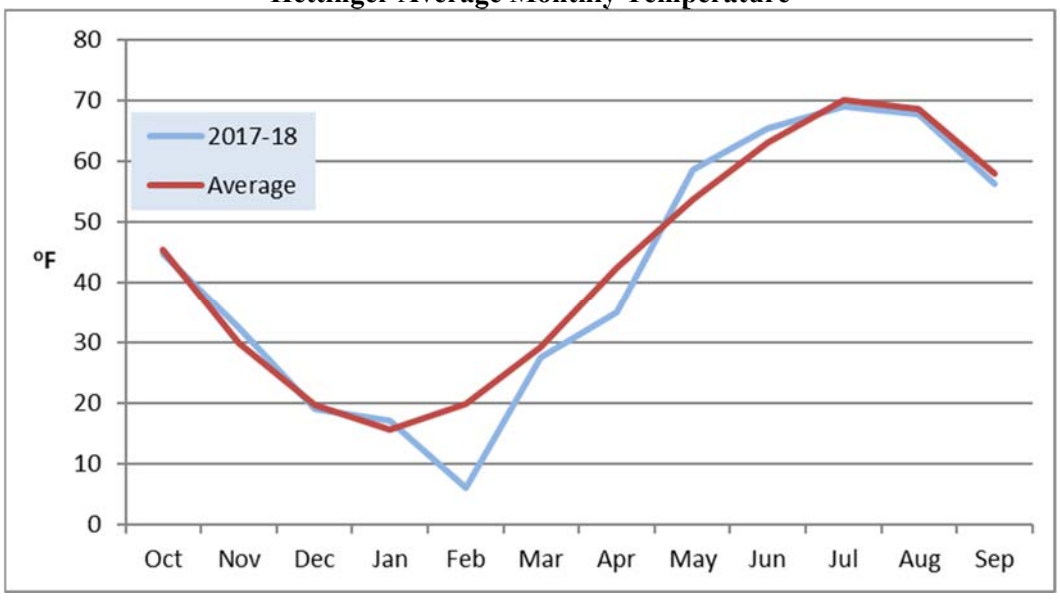
Corn Growing Degree Days (GDD)

Month	2014	2015	2016	2017	2018	46 Year Average
May	245	185	298	297	371	262
June	330	444	545	519	467	423
July	526	595	626	699	579	588
August	504	578	568	520	511	537
September	313	462	380	339	321	325
Total	**1918**	**2264**	**2417**	**2374**	**2249**	**2134**

Hettinger Monthly Precipitation



Hettinger Average Monthly Temperature



Trials Not Published

The following trials were not published in this report because of very poor yields and significant plot variation. Trial average yields are reported below.

Trial	Average Yield
Hettinger Carinata Planting Date	48 lb/ac
Hettinger Carinata Seeding Rate	83 lb/ac
Mandan Barley VT	Not harvested due to wildlife damage

Hard Red Spring Wheat - 2018 **Hettinger, ND**

Variety	Days to Head	Plant Height	Plant Lodge	Test Weight	Grain Protein	----- Grain Yield ----- 2016	2017	2018	Average Yield 2 yr	3 yr
	DAP[1]	inches	0-9[2]	lbs/bu	%	---------- Bushels per acre ----------				
AAC Brandon	53	26	0	57.6	17.3	--	--	55.5	--	--
AAC Goodwin	53	26	0	57.8	16.6	--	--	54.5	--	--
AAC Penhold	54	21	0	57.6	17.0	--	--	49.0	--	--
Barlow	50	24	0	58.4	16	48.4	40.1	55.6	47.9	48.0
Bolles	54	26	0	54.4	19.0	44.0	32.8	36.0	34.4	37.6
Boost	54	25	0	56.8	17.3	50.6	31.2	38.3	34.8	40.0
Dyna-Gro Ambush	51	27	0	57.5	16.4	--	36.3	55.0	45.7	--
Dyna-Gro Caliber	53	20	0	55.9	17.1	--	32.5	44.4	38.5	--
Elgin ND	54	28	0	57.8	16.8	48.5	38.4	60.8	49.6	49.2
Faller	54	25	0	56.7	15.8	43.4	41.5	53.0	47.3	46.0
Glenn	51	23	0	57.8	16.6	49.1	32.1	54.0	43.1	45.1
HRS 3100	52	23	0	55.8	17.3	--	36.3	39.9	38.1	--
HRS 3419	55	22	0	54.1	17.3	54.7	41.2	34.8	38.0	43.6
HRS 3504	53	22	0	57.7	16.3	48.3	32.7	52.9	42.8	44.6
HRS 3530	54	26	0	56.9	17.1	43.7	35.9	52.4	44.2	44.0
HRS 3616	52	25	0	56.1	17.2	48.6	38.7	51.0	44.9	46.1
HRS 3888	53	23	0	56.5	16.9	--	--	50.0	--	--
Lang MN	54	25	0	57.2	17.0	49.9	36.3	53.3	44.8	46.5
Lanning	53	24	0	56.7	16.6	--	--	63.5	--	--
LCS Breakaway	50	22	0	57.5	17.9	48.4	34.8	41.6	38.2	41.6
LCS Cannon	49	24	0	58.7	17.1	--	--	51.3	--	--
LCS Rebel	51	25	0	57.8	16.7	--	36.8	55.5	46.2	--
LCS Trigger	57	25	0	58.6	14.9	55.7	44.5	69.9	57.2	56.7
Linkert	51	21	0	57.2	17.2	43.6	34.0	42.0	38.0	39.9
Mott	53	25	0	56.6	17.2	46.4	36.6	43.8	40.2	42.3
MS Camaro	51	20	0	55.1	17.5	--	31.4	33.4	32.4	--
MS Chevelle	51	21	0	57.7	15.4	47.8	37.5	59.1	48.3	48.1
MS Barracuda	49	22	0	55.8	17.5	--	--	48.6		
ND VitPro	52	25	0	56.9	16.8	48.1	31.9	52.6	42.3	44.2
Prestige	50	24	0	55.7	16.2	45.8	32.6	55.6	44.1	44.7
Prosper	55	26	0	56.7	15.9	36.0	39.5	53.0	46.3	42.8
Redstone	56	25	0	56.1	16.9	47.0	38.3	46.8	42.6	44.0
Rollag	51	23	0	57.5	17.3	47.3	31.6	46.3	39.0	41.7
Shelly	55	24	0	57.6	16.8	50.9	43.9	53.1	48.5	49.3
Surpass	51	20	0	56.6	16.9	49.7	36.7	40.4	38.6	42.3
SY Ingmar	54	22	0	57.1	17.6	48.1	39.9	40.3	40.1	42.8

Table continued on next page

Hard Red Spring Wheat - 2018 **Hettinger, ND**

Variety	Days to Head	Plant Height	Plant Lodge	Test Weight	Grain Protein	----- Grain Yield ----- 2016	2017	2018	Average Yield 2 yr	3 yr
	DAP[1]	inches	0-9[2]	lbs/bu	%	---------- Bushels per acre ----------				
Table continues from previous page										
SY Rockford	53	25	0	55.5	16.9	48.7	39.3	54.0	46.7	47.3
SY Soren	53	22	0	56.9	17.6	50.1	36.5	43.7	40.1	43.4
SY Valda	52	22	0	56.8	16.6	49.6	35.1	51.0	43.1	45.2
TCG Climax	56	22	0	57.7	18.3	--	34.5	52.7	43.6	--
TCG Glenville	52	19	0	55.7	17.5	--	--	35.9	--	--
TCG Spitfire	55	25	0	57.0	16.4	52.0	37.6	54.0	45.8	47.9
WB9479	52	21	0	56.9	17.2	--	34.4	51.4	42.9	--
WB9590	52	20	0	56.6	17.2	--	37.6	50.7	44.2	--
WB9653	52	20	0	57.1	16.5	45.8	39.4	50.2	44.8	45.1
WB9719	53	24	0	57.5	16.7	--	43.4	52.2	47.8	--
Trial Mean	53	24	0	57.0	17.0	47.3	35.8	49.4	43.0	44.8
C.V. %	1.2	9.6	--	1.2	2.1	7.1	11.4	12.2	--	--
LSD 5%	0.9	3.2	NS	0.9	0.5	4.7	5.7	8.4	--	--
LSD 10%	0.7	2.7	NS	0.8	0.4	4.0	4.8	7.1	--	--

[1] Days to Head = the number of days from planting to head emergence from the boot.

[2] 0 = no lodging, 9 = 100% lodged.

Planting Date: April 27

Harvest Date: August 22

Previous Crop: Carinata

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Hard Red Spring Wheat - 2018 **Scranton, ND**

Variety	Plant Height	Plant Lodge	Test Weight	Grain Protein	----- Grain Yield ----- 2016	2017	2018	Average Yield 2 yr	3 yr
	inches	0-9*	lbs/bu	%	---------- Bushels per acre ----------				
Barlow	29	0	59.4	15.0	41.1	15.2	33.0	24.1	29.8
Bolles	30	0	56.7	17.3	--	12.5	34.4	23.5	--
DynaGro Ambush	28	0	57.7	15.7	--	--	36.3	--	--
Elgin-ND	31	0	58.9	15.4	41.7	16.4	44.0	30.2	34.0
Glenn	28	0	58.0	14.7	42.4	16.1	33.7	24.9	30.7
HRS 3419	33	0	57.6	15.1	48.5	16.2	54.1	35.2	39.6
HRS 3530	30	0	57.1	15.7	42.8	14.8	37.0	25.9	31.5
HRS 3616	28	0	57.4	16.1	--	--	35.4	--	--
Lang-MN	33	0	58.7	15.9	--	16.4	44.0	30.2	--
LCS Rebel	28	0	58.5	15.6			33.9	33.9	33.9
LCS Trigger	31	0	59.3	13.1	--	13.8	57.0	35.4	--
Linkert	27	0	58.6	17.1			36.1	36.1	36.1
Mott	32	0	57.4	16.0	36.6	15.4	37.2	26.3	29.7
MS Chevelle	28	0	57.8	14.8	--	13.5	37.1	25.3	--
ND-VitPro	29	0	58.1	16.0	--	13.7	35.4	24.6	--
Redstone	33	0	57.9	14.5	--	13.9	53.7	33.8	--
Shelly	29	0	58.8	14.8	--	18.9	44.2	31.6	--
Surpass	28	0	58.0	15.4	--	17.9	29.8	23.9	--
SY Ingmar	29	0	59.3	16.6	38.2	14.1	37.0	25.6	29.8
SY Rockford	31	0	57.0	15.6	--	--	41.1	--	--
SY Soren	25	0	59.3	15.7	38.3	18.1	37.2	27.7	31.2
SY Valda	27	0	58.5	15.7	--	13.8	35.5	24.7	--
TCG Climax	32	0	60.4	17.4			45.1	45.1	45.1
TCG Spitfire	30	0	58.9	15.5	--	17.8	46.7	32.3	--
WB9653	27	0	58.3	15.1	41.2	16.9	43.3	30.1	33.8
WB9719	28	0	59.6	15.9			38.6	38.6	38.6
Trial Mean	29	0	58.3	15.6	40.7	15.6	39.9	29.5	33.8
C.V. %	4.9	--	0.8	2.6	9.7	16.5	5.3	--	--
LSD 5%	2.0	NS	0.7	0.6	5.6	3.6	3.0	--	--
LSD 10%	1.7	NS	0.6	0.5	4.6	3.0	2.5	--	--

* 0 = no lodging, 9 = 100% lodged.

Planting Date: May 7

Harvest Date: September 1

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Hard Red Spring Wheat - 2018 **Regent, ND**

Variety	Plant Height	Plant Lodge	Test Weight	Grain Protein	----- Grain Yield ----- 2016	2017	2018	Average Yield 2 yr	3 yr
	inches	0-9*	lbs/bu	%	---------- Bushels per acre ----------				
Barlow	33	0	60.3	14.9	31.5	17.7	45.1	31.4	31.4
Bolles	32	0	58.8	15.4	--	15.5	45.2	30.4	--
DynaGro Ambush	32	0	59.7	15.3	--	--	45.4	--	--
Elgin-ND	36	0	58.7	14.2	35.3	18.8	48.6	33.7	34.2
Glenn	36	0	60.9	14.4	29.0	17.2	46.3	31.8	30.8
HRS 3419	33	0	57.8	14.7	24.2	15.9	50.0	33.0	30.0
HRS 3530	33	0	58.6	14.6	36.9	14.5	49.9	32.2	33.8
HRS 3616	31	0	58.4	15.1	--	--	49.2	--	--
Lang-MN	36	0	60.9	14.6	--	19.4	53.4	36.4	--
LCS Rebel	35	0	60.2	15.6	--	--	48.8	--	--
LCS Trigger	34	0	58.1	13.6	--	20.7	52.9	36.8	--
Linkert	31	0	59.1	15.5	--	--	44.0	--	--
Mott	38	0	59.1	15.1	32.7	16.7	46.8	31.8	32.1
MS Chevelle	32	0	58.7	13.4	--	21.3	46.3	33.8	--
ND-VitPro	33	0	58.9	14.9	--	16.9	48.3	32.6	--
Redstone	33	0	58.8	14.2	--	15.4	48.4	31.9	--
Shelly	33	0	60.3	13.9	--	18.9	51.6	35.3	--
Surpass	33	4	59.7	14.4	--	19.0	45.9	32.5	--
SY Ingmar	30	0	59.8	15.0	35.2	19.8	44.3	32.1	33.1
SY Rockford	32	0	58.7	14.3	--	--	51.3	--	--
SY Soren	30	0	60.1	15.2	32.9	15.4	47.3	31.4	31.9
SY Valda	30	0	59.4	14.5	--	18.7	51.4	35.1	--
TCG Climax	33	0	62.0	15.6	--	--	44.8	--	--
TCG-Spitfire	32	0	58.6	14.9	--	16.7	48.9	32.8	--
WB9653	30	0	56.5	14.5	38.1	20.1	49.2	34.7	35.8
WB9719	32	0	60.8	14.9	--	--	47.4	--	--
Trial Mean	33	0	59.4	14.7	32.3	17.7	48.1	33.1	32.6
C.V. %	6.5	69.2	1.4	4.2	7.6	13.5	6.3	--	--
LSD 5%	3.0	0.1	1.2	0.9	3.5	3.4	4.3	--	--
LSD 10%	2.5	0.1	1.0	0.7	2.9	2.8	3.6	--	--

* 0 = no lodging, 9 = 100% lodged.

Planting Date: May 7

Harvest Date: August 17

Hard Red Spring Wheat - 2018 **Mandan, ND**

Variety	Plant Height	Plant Lodge	Test Weight	Grain Protein	----- Grain Yield ----- 2016	2017	2018	Average Yield 2 yr	3 yr
	inches	0-9*	lbs/bu	%	---------- Bushels per acre ----------				
AAC Brandon	28	0	54.4	12.4	--	--	41.7	--	--
AAC Goodwin	31	0	55.4	12.6	--	--	50.9	--	--
AAC Penhold	30	0	54.6	12.4	--	--	49.0	--	--
Barlow	28	0	54.7	13.1	60.9	16	46.2	31.1	41.0
Bolles	27	0	55.3	13.2	--	7.5	48.6	28.1	--
Boost	28	0	54.5	12.8	--	16.0	50.5	33.3	--
DynaGro Ambush	26	0	56.1	12.1	--	--	50.5	--	--
DynaGro Caliber	29	0	55.9	14.2	--	--	52.7	--	--
Elgin-ND	27	0	55.8	12.7	65.3	17.4	48.9	33.2	43.9
Faller	29	0	55.6	11.3	--	--	45.6	--	--
Glenn	30	0	54.9	13.1	62.6	11.1	56.0	33.6	43.2
HRS 3100	29	0	54.5	12.5	--	--	52.4	--	--
HRS 3419	30	0	54.9	10.5	73.5	18.3	51.2	34.75	47.7
HRS 3504	27	0	53.4	11.7	--	--	46.2	--	--
HRS 3530	25	0	55.3	12.9	70.6	18.3	48.2	33.3	45.7
HRS 3616	27	0	55.9	13.0	--	--	46.5	--	--
HRS 3888	30	0	54.5	12.5	--	--	51.5	--	--
Lang-MN	28	0	55.3	12.0	--	21.1	51.3	36.2	--
Lanning	28	0	55.1	12.8	--	--	46.3	--	--
LCS Breakaway	28	0	54.3	13.1	--	--	49.6	--	--
LCS Cannon	30	0	54.1	13.1	--	--	50.0	--	--
LCS Rebel	27	0	55.4	12.9	--	--	52.0	--	--
LCS Trigger	29	0	54.0	10.2	--	28.7	43.5	36.1	--
Linkert	29	0	54.9	13.1	--	--	45.9	--	--
Mott	28	0	54.1	12.9	61.3	18.2	45.1	31.65	41.5
MS Camaro	26	0	55.0	13.7	--	--	51.6	--	--
MS Chevelle	29	0	54.0	12.0	--	22.6	49.8	36.2	--
MS Barracuda	29	0	55.3	12.3	--	--	50.2	--	--
ND VitPro	29	0	55.2	13.7	--	16.2	47.1	31.7	--
Prestige	29	0	55.5	12.6	--	--	46.5	--	--
Prosper	31	0	54.3	11.2	--	--	53.0	--	--
Redstone	26	0	55.4	10.9	--	22.3	44.7	33.5	--
Rollag	29	0	54.6	13.7	--	--	48.6	--	--
Shelly	28	0	54.7	11.0	--	15	51.8	33.4	--
Surpass	30	0	54.8	11.8	--	17.4	51.4	34.4	--
SY Ingmar	29	0	55.2	12.5	58.8	20.5	55.4	38.0	44.9

Table continued on next page

Hard Red Spring Wheat - 2018 **Mandan, ND**

Variety	Plant Height	Plant Lodge	Test Weight	Grain Protein	----- Grain Yield ----- 2016	2017	2018	Average Yield 2 yr	3 yr
	inches	0-9*	lbs/bu	%	---------- Bushels per acre ----------				
Table continues from previous page									
SY Rockford	27	0	54.6	11.9	--	--	46.0	--	--
SY Soren	30	0	54.6	12.7	59.4	18.3	48.0	33.2	41.9
SY Valda	31	0	56.0	11.6	--	19.1	46.0	32.6	--
TCG Climax	29	0	54.6	12.7	--	--	54.8	--	--
TCG Glenville	30	0	55.2	13.6	--	--	53.3	--	--
TCG Sptifire	29	0	55.2	11.4	--	23.2	49.2	36.2	--
WB9479	30	0	55.8	13.1	--	--	51.9	--	--
WB9590	27	0	54.1	12.8	--	--	52.2	--	--
WB9653	29	0	54.2	11.1	70.1	23.7	45.3	34.5	46.4
WB9719	31	0	54.7	11.3	--	--	49.9	--	--
Trial Mean	29	0	54.9	12.5	64.2	18.5	49.3	33.1	43.8
C.V. %	7.6	--	2.2	6.0	7.6	15.7	12.2	--	--
LSD 5%	3.0	NS	1.7	1.0	6.9	4.1	8.4	--	--
LSD 10%	2.6	NS	1.4	0.9	5.7	3.4	7.0	--	--

* 0 = no lodging, 9 = 100% lodged.

Planting Date: May 9

Harvest Date: September 6

Previous Crop: Spring Wheat

Hard Red Winter Wheat - 2018 **Hettinger, ND**

Variety	Heading Date	Plant Height	Plant Lodge	Test Weight	Grain Protein	---- Grain Yield ---- 2016	2017	2018	Average Yield 2 yr	3 yr
	Julian	inches	0-9[1]	lbs/bu	%	---------- Bushels per acre ----------				
AAC Goldrush	164	25	0	57.7	17.0	--	--	32.7	--	--
AAC Wildfire	164	21	0	58.9	15.6	--	--	40.2	--	--
AC Broadview	163	24	0	58.6	15.4	58.4	81.6	36.7	59.2	58.9
AC Emerson	164	21	0	57.6	18.4	63.0	70.6	30.6	50.6	54.7
AC Gateway	164	24	0	59.2	16.3	64.1	76.5	35.9	56.2	58.8
Accipiter	164	23	0	59.9	15.0	56.1	72.4	35.2	53.8	54.6
CDC Chase	164	22	0	58.9	15.9	56.3	81.3	33.9	57.6	57.2
Decade	162	23	0	55.6	17.7	58.0	76.2	19.5	47.9	51.2
Ideal	163	29	0	57.5	16.7	57.3	88.2	26.6	57.4	57.4
Jerry	163	24	0	56.8	16.9	51.9	76.1	29.7	52.9	52.6
Keldin	164	25	0	57.4	15.5	--	101.2	37.2	69.2	--
Loma	165	24	0	58.3	15.9	69.7	71.5	36.5	54.0	59.2
Lyman	162	24	0	56.6	17.0	64.9	84.2	27.3	55.8	58.8
Moats	164	27	0	57.0	16.5	60.7	80.2	29.5	54.9	56.8
Northern	165	22	0	58.8	16.1	68.3	78.9	33.7	56.3	60.3
Oahe	162	26	0	54.9	16.6	--	83.1	28.2	55.7	--
Overland	162	21	0	57.5	16.8	72.4	91.7	29.5	60.6	64.5
Overland-FHB1	160	23	0	56.7	16.8	--	90.9	26.9	58.9	--
Peregrine	164	21	0	59.4	14.9	63.1	81.1	38.0	59.6	60.7
Redfield	162	21	0	58.1	16.6	60.2	79.2	24.7	52.0	54.7
SY Monument	160	19	0	56.9	15.6	69.1	99.6	27.6	63.6	65.4
SY Sunrise	162	22	0	57.3	15.9	80.2	85.6	20.4	53.0	62.1
SY Wolf	160	22	0	54.6	16.1	69.0	93.9	24.3	59.1	62.4
Thompson	163	25	0	55.2	16.6	--	--	33.0	--	--
WB Matlock	163	22	0	58.8	16.3	55.7	71.1	33.8	52.5	53.5
WB4462	159	23	0	55.8	16.1	--	--	20.1	--	--
Trial Mean	162	23	0.0	57.4	16.3	61.2	82.2	30.3	56.4	58.1
C.V. %	0.5	8.8	--	2.3	2.4	4.3	9.4	18.3	--	--
LSD 0.05	1.2	2.9	NS	1.9	0.5	4.8	10.8	7.8	--	--
LSD 0.10	1.0	2.4	NS	1.5	0.5	4.0	9.1	6.5	--	--

[1] 0 = no lodging, 9 = 100% lodged.

Planting Date: September 29

Harvest Date: August 3

Previous Crop: Oats

Winter Rye - 2018 **Hettinger, ND**

Variety	Heading Date	Plant Height	Plant Lodge	Test Weight	----- Grain Yield ----- 2016	2017	2018	Average Yield 2 yr	3 yr
		inches	0-9[1]	lbs/bu	---------- Bushels per acre ----------				
Aroostok	5/28	38	0	48.1	45.6	53.2	27.6	40.4	42.1
Brasetto	6/2	31	0	50.3	--	97.8	58.6	78.2	--
Dacold	6/4	33	0	45.1	72.9	76.6	37.6	57.1	62.4
ND Dylan	6/2	37	0	45.8	64.6	74.5	21.6	48.1	53.6
Hancock	6/1	35	0	44.6	59.9	66.1	29.7	47.9	51.9
Hazlet	6/3	33	0	47.7	--	84.9	40.2	62.6	--
Rymin	6/3	33	0	48.4	62.1	85.4	39.6	62.5	62.4
Spooner	6/2	35	0	46.7	57.3	61.4	32.6	47.0	50.4
Wheeler	6/3	37	0	47.8	--	50.8	25.6	38.2	--
Trial Mean	6/1	34	0	47.1	60.5	70.0	34.2	53.5	53.8
C.V. %	0.4	6.5	--	3.2	9.0	6.7	15.3	--	--
LSD 0.05	0.9	3.3	--	1.8	8.0	6.8	7.6	--	--
LSD 0.10	0.8	2.7	--	1.5	6.7	5.6	6.3	--	--

[1] 0 = no lodging, 9 = 100% lodged.

Planting Date: September 29

Harvest Date: August 6

Previous Crop: Oats

Durum Wheat - 2018 **Hettinger, ND**

Variety	Days to Head	Plant Height	Plant Lodge	Test Weight	Grain Protein	----- Grain Yield ----- 2016	2017	2018	Average Yield 2 yr	3 yr
	DAP[1]	inches	0-9[2]	lbs/bu	%	---------- Bushels per acre ----------				
AC Commander	55	26	0	55.3	16.1	35.0	38.0	37.3	37.7	36.8
AC Navigator	56	27	0	56.0	15.7	36.3	37.3	35.2	36.3	36.3
Alkabo	56	29	0	56.0	15.5	33.3	32.6	38.1	35.4	34.7
Alzada	53	29	0	54.4	16.0	34.4	34.0	35.6	34.8	34.7
Ben	54	30	0	55.3	16.2	31.6	35.1	31.9	33.5	32.9
Carpio	56	29	0	55.6	15.0	32.2	36.5	41.9	39.2	36.9
CDC Verona	56	28	0	55.5	16.8	33.7	36.0	36.2	36.1	35.3
Divide	56	28	0	55.1	16.3	33.4	33.5	34.1	33.8	33.7
Grenora	54	28	0	56.0	15.6	33.4	33.3	38.3	35.8	35.0
Joppa	56	27	0	54.9	15.6	41.1	35.7	34.6	35.2	37.1
Lebsock	54	29	0	56.1	16.4	35.6	37.8	33.2	35.5	35.5
Maier	55	29	0	56.0	17.0	30.4	33.5	35.9	34.7	33.3
Mountrail	55	29	0	56.1	16.0	31.8	38.9	37.7	38.3	36.1
ND Grano	56	28	0	56.1	15.7	33.8	35.7	34.6	35.2	34.7
ND Riveland	56	31	0	54.9	15.6	37.4	37.3	36.3	36.8	37.0
Pierce	54	29	0	56.0	15.7	35.1	34.7	32.2	33.5	34.0
Rugby	54	31	0	55.8	16.3	25.5	34.1	31.5	32.8	30.4
Strongfield	56	29	0	54.7	16.9	35.5	38.9	38.8	38.9	37.7
Tioga	56	29	0	55.4	16.7	34.3	33.8	32.1	33.0	33.4
VT Peak	54	28	0	56.7	16.1	35.1	37.2	39.5	38.4	37.3
Trial Mean	56	29	0	55.7	16.0	35.1	36.1	36.7	35.7	35.1
C.V. %	0.9	6.1	--	1.0	2.4	17.2	9.7	8.1	--	--
LSD 5%	0.7	2.5	NS	0.8	0.5	8.4	4.9	4.1	--	--
LSD 10%	0.6	2.1	NS	0.7	0.4	7.1	4.1	3.5	--	--

[1] Days to Head = the number of days from planting to head emergence from the boot.

[2] 0 = no lodging, 9 = 100% lodged.

Planting Date: April 27

Harvest Date: August 22

Previous Crop: Carinata

Durum Wheat - 2018 **Scranton, ND**

Variety	Plant Height	Plant Lodge	Test Weight	Grain Protein	----- Grain Yield ----- 2016	2017	2018	Average Yield 2 yr	3 yr
	inches	0-9*	lbs/bu	%	---------- Bushels per acre ----------				
Alkabo	27	0	57.9	12.8	62.5	20.2	33.6	26.9	38.8
Carpio	31	0	57.2	11.6	70.2	21.6	36.4	29.0	42.7
Joppa	31	0	57.8	12.2	69.8	24.9	34.9	29.9	43.2
ND Grano	31	0	58.1	11.3	--	23.7	32.1	27.9	--
ND Riveland	32	0	58.6	11.0	--	18.8	36.4	27.6	--
Tioga	34	0	58.2	12.0	72.9	19.9	34.0	27.0	42.3
Trial Mean	31	0	57.9	11.8	70.0	21.3	34.6	28.0	41.7
C.V. %	8.0	--	1.1	7.0	4.8	12.3	7.7	--	--
LSD 5%	2.7	NS	0.9	1.2	5.1	3.9	4.0	--	--
LSD 10%	2.3	NS	0.8	1.0	4.2	3.2	3.3	--	--

* 0 = no lodging, 9 = 100% lodged.

Planting Date: May 7

Harvest Date: September 1

Durum Wheat - 2018 **Regent, ND**

Variety	Plant Height	Plant Lodge	Test Weight	Grain Protein	----- Grain Yield ----- 2016	2017	2018	Average Yield 2 yr	3 yr
	inches	0-9*	lbs/bu	%	---------- Bushels per acre ----------				
Alkabo	36	0	59.7	13.7	26.6	9.8	52.4	31.1	29.6
Carpio	38	0	58.6	14.0	29.3	12.3	49.3	30.8	30.3
Joppa	38	0	57.7	13.5	29.9	12.9	53.8	33.4	32.2
ND Grano	38	0	59.3	14.3	--	14.0	50.2	32.1	--
ND Riveland	38	0	58.9	14.5	--	14.2	52.0	33.1	--
Tioga	37	0	59.5	13.8	31.1	13.1	52.3	32.7	32.2
Trial Mean	37	0	59.0	14.0	86.3	13.3	51.7	32.2	31.1
C.V. %	2.7	--	1.7	4.9	2.6	16.5	5.4	--	--
LSD 5%	1.5	NS	1.5	1.0	3.4	3.2	4.2	--	--
LSD 10%	1.2	NS	1.2	0.9	2.8	2.7	3.4	--	--

* 0 = no lodging, 9 = 100% lodged.

Planting Date: May 7

Harvest Date: August 17

Durum Wheat - 2018 **Mandan, ND**

Variety	Plant Height	Plant Lodge	Test Weight	Grain Protein	----- Grain Yield ----- 2016	2017	2018	Average Yield 2 yr	3 yr
	inches	0-9*	lbs/bu	%	---------- Bushels per acre ----------				
Alkabo	27	0	57.9	12.8	62.5	20.2	33.6	26.9	38.8
Carpio	31	0	57.2	11.6	70.2	21.6	36.4	29.0	42.7
Joppa	31	0	57.8	12.2	69.8	24.9	34.9	29.9	43.2
ND Grano	31	0	58.1	11.3	--	23.7	32.1	27.9	--
ND Riveland	32	0	58.6	11.0	--	18.8	36.4	27.6	--
Tioga	34	0	58.2	12.0	72.9	19.9	34.0	27.0	42.3
Trial Mean	31	0	57.9	11.8	70.0	21.3	34.6	28.0	41.7
C.V. %	8.0	--	1.1	7.0	4.8	12.3	7.7	--	--
LSD 5%	2.7	NS	0.9	1.2	5.1	3.9	4.0	--	--
LSD 10%	2.3	NS	0.8	1.0	4.2	3.2	3.3	--	--

* 0 = no lodging, 9 = 100% lodged.

Planting Date: May 9

Harvest Date: September 6

NDSU Hettinger Research Extension Center

Barley - 2018 **Hettinger, ND**

Variety	Days to Head	Plant Height	Plant Lodge	Plump	Test Weight	Grain Protein	----- Grain Yield ----- 2016	2017	2018	Average Yield 2 yr	3 yr
	DAP[1]	inches	0-9[2]	%	lbs/bu	%	---------- Bushels per acre ----------				
TWO ROW											
AAC Synergy	54	25	0	92	47.1	14.0	75.7	41.8	88.6	65.2	68.7
ABI Balster	54	23	0	88	46.9	14.2	73.2	53.0	85.1	69.1	70.4
ABI Growler	52	22	0	88	45.8	14.6	68.0	34.7	85.4	60.1	62.7
Conlon	48	23	0	93	46.8	13.9	60.4	24.2	75.5	49.9	53.4
Explorer	53	20	0	89	46.6	13.7	--	57.8	95.5	76.7	--
LCS Genie	56	23	0	87	47.3	13.2	67.0	53.7	89.0	71.4	69.9
ND Genesis	52	24	0	92	46.2	12.5	69.0	40.0	90.3	65.2	66.4
Pinnacle	51	24	0	93	47.7	12.0	64.6	49.4	90.4	69.9	68.1
Sirish	54	20	0	91	47.8	13.2	71.4	48.6	88.6	68.6	69.5
SIX ROW											
Celebration	52	24	0	87	43.8	16.4	61.4	47.9	77.0	62.5	62.1
Innovation	50	22	0	89	44.8	15.5	62.1	40.4	76.4	58.4	59.6
Lacey	49	22	0	87	44.3	15.0	59.5	49.9	70.3	60.1	59.9
Quest	51	25	0	86	43.5	15.2	64.4	52.1	70.4	61.3	62.3
Stellar-ND	50	22	0	90	43.3	15.1	62.5	47.5	66.7	57.1	58.9
Tradition	52	22	0	88	44.8	14.8	63.3	46.3	76.4	61.4	62.0
Trial Mean	51	23	0	89	45.6	14.0	67.7	45.4	82.9	64.8	64.9
C.V. %	1.7	7.3	--	1.8	1.1	3.6	7.5	15.0	5.7	--	--
LSD 5%	1.2	2.4	NS	2.3	0.7	0.7	7.2	9.6	6.7	--	--
LSD 10%	1.0	2.0	NS	1.9	0.6	0.6	6.0	8.0	5.6	--	--

[1] Days to Head = the number of days from planting to head emergence from the boot.

[2] 0 = no lodging, 9 = 100% lodged.

Planting Date: May 2

Harvest Date: August 24

Previous Crop: Soybean

Barley - 2018 **Scranton, ND**

Variety	Plant Height	Plant Lodge	Plump	Test Weight	Grain Protein	----- Grain Yield ----- 2016	2017	2018	Average Yield 2 yr	3 yr
	inches	0-9*	%	lbs/bu	%	---------- Bushels per acre ----------				
TWO ROW										
ND Genesis	27	0	89	46.0	12.7	66.5	11.3	52.7	32.0	43.5
Pinnacle	25	0	93	48.1	12.4	56.7	11.0	73.0	42.0	46.9
CDC Meredith	29	0	93	48.1	11.9	57.5	9.5	62.3	35.9	43.1
SIX ROW										
Innovation	23	0	82	43.6	14.7	60.8	12.1	32.7	22.4	35.2
Tradition	25	0	85	44.4	15.3	59.8	12.1	32.9	22.5	34.9
Trial Mean	26	0	89	46.0	13.4	60.3	11.2	50.7	35.7	51.3
C.V. %	8.7	--	5.5	1.2	4.3	10.2	23.1	6.8	--	--
LSD 5%	3.5	NS	7.4	0.8	0.9	9.4	4.0	10.5	--	--
LSD 10%	2.8	NS	6.0	0.7	0.7	7.7	3.3	8.6	--	--

* 0 = no lodging, 9 = 100% lodged.

Planting Date: April 27

Harvest Date: August 11

Barley - 2018 **Regent, ND**

Variety	Plant Height	Plant Lodge	Plump	Test Weight	Grain Protein	----- Grain Yield ----- 2016	2017	2018	Average Yield 2 yr	3 yr
	inches	0-9*	%	lbs/bu	%	---------- Bushels per acre ----------				
TWO ROW										
ND Genesis	33	0	87	48.0	12.8	39.7	19.3	87.0	53.2	48.7
Pinnacle	27	0	80	45.3	14.2	24.5	17.4	82.2	49.8	41.4
CDC Meredith	33	0	83	46.9	13.5	44.1	19.1	82.5	50.8	48.6
SIX ROW										
Innovation	32	0	72	45.6	15.6	27.4	19.5	81.6	50.6	42.8
Tradition	33	0	81	46.7	14.3	30.8	21.1	85.4	53.3	45.8
Trial Mean	32	0	81	46.5	14.1	33.3	19.3	83.7	26.3	50.1
C.V. %	7.1	--	9.1	2.1	4.7	18.8	27.4	6.7	--	--
LSD 5%	3.5	NS	11.2	1.5	1.0	9.6	8.1	8.6	--	--
LSD 10%	2.8	NS	9.2	1.2	0.8	7.9	6.6	7.0	--	--

* 0 = no lodging, 9 = 100% lodged.

Planting Date: April 27

Harvest Date: August 11

Mandan location was abandoned due to wildlife damage.

NDSU Hettinger Research Extension Center

Oat - 2018 **Hettinger, ND**

Variety	Days to Head	Plant Height	Plant Lodge	Test Weight	----- Grain Yield ----- 2016	2017	2018	Average Yield 2 yr	3 yr
	DAP[1]	inches	0-9[2]	lbs/bu	---------- Bushels per acre ----------				
Beach	54	32	0	37.3	59.6	50.9	90.9	70.9	67.1
CS Camden	55	30	0	34.3	--	73.3	114.1	93.7	--
CDC Dancer	55	33	0	34.6	62.4	72.4	98.9	85.7	77.9
Deon	56	31	0	35.6	64.0	70.9	89.8	80.4	74.9
Hayden	54	30	0	36.0	68.9	75.4	105.2	90.3	83.2
HiFi	55	31	0	35.3	61.6	57.5	94.1	75.8	71.1
Hytest	51	33	0	37.1	53.7	63.5	84.3	73.9	67.2
Jury	53	33	0	36.2	55.5	58.0	92.3	75.2	68.6
Killdeer	52	30	0	36.0	61.6	58.2	108.3	83.3	76.0
Leggett	55	30	0	34.3	61.5	65.6	99.7	82.7	75.6
CDC Minstrel	54	30	0	34.9	65.9	66.6	99.6	83.1	77.4
Newburg	54	33	0	34.1	63.9	57.5	95.6	76.6	72.3
Otana	55	34	0	36.6	63.8	67.2	97.1	82.2	76.0
AC Pinnacle	56	31	0	34.6	77.4	79.5	95.5	87.5	84.1
Rockford	56	32	0	37.1	65.3	76.2	112.3	94.3	84.6
Souris	54	30	0	36.2	64.0	74.2	103.6	88.9	80.6
Stallion	54	32	0	37.3	59.6	58.2	96.5	77.4	71.4
Paul (hull-less)	57	32	0	40.7	46.2	39.3	72.7	56.0	52.7
Trial Mean	54	31	0	35.8	62.8	62.3	97.3	81.0	74.2
C.V. %	1.0	5.4	--	1.2	9.1	26.0	6.0	--	--
LSD 5%	0.8	2.4	NS	0.6	8.0	22.7	8.2	--	--
LSD 10%	0.6	2.0	NS	0.5	6.7	19.0	6.9	--	--

[1] Days to Head = the number of days from planting to head emergence from the boot.

[2] 0 = no lodging, 9 = 100% lodged.

Planting Date: May 2

Harvest Date: August 14

Previous Crop: Oat No-till Green Fallow

NDSU Hettinger Research Extension Center

Safflower - 2018 **Hettinger, ND**

Variety	Days to Flower	Plant Height	Test Weight	Oil Content	-------Grain Yield-------- 2015	2016	2018	Average Yield 2-Yr	3-Yr
	DAP[1]	inches	lbs/bu	%	---------- lbs per acre ----------				
Linoleic Types									
Cardinal	71	24	40.5	33.4	2497	1805	1825	1815	2042
Chickadee	72	23	38.9	34.5	--	--	1497	--	--
Finch	72	24	41.1	33.8	2672	1669	1335	1502	1892
NutraSaff	69	25	33.3	43.8	2162	1223	1425	1324	1603
Rubis Red	70	24	43.0	29.0	--	--	1393	--	--
Oleic Types									
Hybrid 200	72	25	40.4	29.9	3412	1723	1397	1560	2177
Hybrid 446	72	25	41.2	29.5	--	--	1297	--	--
Hybrid 1601	71	24	37.7	33.7	3750	2095	1929	2012	2591
MonDak	72	25	37.8	33.8	3050	1559	1680	1620	2096
Montola 2003	70	25	37.5	35.4	3346	1555	1830	1693	2244
Trial Mean	71	24	39.1	33.7	3011	1661	1561	1646	2092
C.V. %	2.2	4.0	1.6	1.5	7.7	13.6	9.5	--	--
LSD 5%	2.3	1.4	0.9	0.8	337	333	215	--	--
LSD 10%	1.9	1.2	0.8	0.6	279	276	179	--	--

[1] Days after planting.

Planting Date: May 16

Harvest Date: October 2

Previous Crop: Oats

Safflower Trial was not harvested in 2017

NDSU Hettinger Research Extension Center

Oil Type Sunflower - 2018 **Hettinger, ND**

Company/ Brand	Hybrid	Oil Type & Traits[1]	Days to Bloom[2]	Plant Height	Lodging	Test Weight	Oil Content	Grain Yield 2018	Grain Yield 2-Year	Grain Yield 3-Year
				inches	%	lbs/bu	%	--------lbs/ac--------		
Croplan	3732	NS	67	57	0	28.2	37.1	3410	2496	--
Croplan	3845 HO	HO	66	61	0	28.7	37.5	3421	2683	--
Croplan	432 E	NS, EX, DM	64	65	0	26.4	33.4	2370	2132	2124
Croplan	455 E HO	HO, EX, DM	66	65	0	27.9	37.2	3715	2639	2284
Croplan	545 CL	NS, CL, DM	68	62	0	25.9	36.2	3172	2525	2460
Croplan	549 CL	HO, CL, DM	63	69	0	28.4	37.5	2892	2384	2278
Croplan	557 CL HO	HO, CL, DM	69	66	0	25.7	36.9	3407	--	--
Croplan	568 CL HO	HO, CL, DM	70	64	0	26.5	36.6	3466	2643	--
Mycogen	8H449CLDM	HO, CL, DM	67	61	0	29.6	39.1	3571	2791	2558
Mycogen	MY8H456CL	HO, CL, DM	69	69	0	26.2	38.3	3617	2875	--
Mycogen	MY8H460CP	HO, CLP	68	73	0	27.0	36.8	3246	--	--
Nuseed	Badger DMR	NS, CL, DM	64	70	0	25.8	36.1	2899	2536	2269
Nuseed	Camaro II	NS, CL, DM	67	71	0	29.0	37.2	2905	2485	2321
Nuseed	Falcon	NS, EX	67	61	0	27.8	35.5	3014	2505	2264
Nuseed	Hornet	HO, CL, DM	68	68	0	26.1	37.0	3417	2839	2789
Nuseed	N4H302 E	HO, EX	66	63	0	25.8	37.7	2539	--	--
Nuseed	N4HM354	NS, CL, DM	64	57	0	28.0	36.2	2769	2440	2367
Nuseed	N4H521 CL	NS, CL, DM	69	65	0	25.6	35.9	3359	--	--
Nuseed	N4H470 CL Plus	HO, CLP, DM	68	63	0	28.1	39.1	3566	3051	--
Nuseed	N5LM307	NS, CL	64	64	0	24.8	34.4	2514	2159	2058
NuTech	63C4 CL	NS, CL	64	59	0	27.6	38.1	2769	--	--
NuTech	64H6	H0, EX	66	70	0	26.9	36.1	3444	--	--
NuTech	68H7	HO, EX	68	71	0	27.6	35.4	2862	--	--
NuTech	68M5	NS, EX	68	66	0	27.2	36.1	2851	--	--
NuTech	69M2	NS, EX	68	74	0	27.4	36.5	3617	--	--
Proseed	E-21 CL	NS, CL, DM	67	74	0	25.7	36.1	2105	1854	--
Proseed	E-31 CL	NS, CL, DM	67	72	0	25.0	34.9	2551	2259	2207
Proseed	E-362436	NS, CL, DM	66	73	0	28.5	35.1	2638	2279	--
Proseed	E 50016 CL	NS, CL	68	65	0	26.0	36.1	2973	2260	--
Proseed	E-71 CL	NS, CL, DM	68	70	0	24.0	34.5	2582	2084	--
Proseed	E-72	NS	69	72	0	27.2	35.9	3138	2510	--
Proseed	E-73 CL	NS, CL, DM	69	70	0	23.7	35.2	2519	2141	--
SunOpta	4415 HO/CLP/DM	HO, CLP, DM	67	71	0	25.8	36.0	2990	--	--
SunOpta	4425 CL	NS, CL	67	74	0	26.7	35.4	3007	--	--
SunOpta	EX721	HO, CL	67	68	0	24.7	35.6	2994	--	--
SunOpta	EX725	NS, CL	67	72	0	25.1	35.6	2950	--	--
SunOpta	EX72468	NS, CL	70	68	0	25.8	36.9	3582	--	--

Table continued on next page

NDSU Hettinger Research Extension Center

Oil Type Sunflower - 2018 **Hettinger, ND**

Company/ Brand	Hybrid	Oil Type & Traits[1]	Days to Bloom[2]	Plant Height	Lodging	Test Weight	Oil Content	Grain Yield 2018	Grain Yield 2-Year	Grain Yield 3-Year
Table continues from previous page										
Limagrain	LCSADVX18-001HO	HO	69	72	0	25.4	37.1	2951	--	--
Limagrain	LCSADVX18-002HO	HO	67	73	0	27.5	35.5	2966	--	--
Limagrain	LCSADVX18-003HOCL	HO, CLP	69	72	0	24.6	35.2	2830	--	--
Limagrain	LCSADVX18-004HO	HO	67	75	0	26.2	34.0	3009	--	--
Limagrain	LCSADVX18-005LN	Conv	72	76	0	28.6	36.6	2697	--	--
Limagrain	LCSADVX18-006HO	HO	67	72	0	25.1	34.5	2393	--	--
Limagrain	LCSADVX18-007LN	Conv	67	75	0	25.4	34.6	2833	--	--
Limagrain	LCSADVX18-008HOCL	HO, CL	67	71	0	25.6	34.4	2384	--	--
Limagrain	LCSADVX18-009LN	Conv	65	74	0	27.7	35.8	2923	--	--
Limagrain	LCSADVX18-010LNCL	Conv, CLP	68	74	0	29.5	37.0	3212	--	--
Limagrain	LCSADVX18-011LN	Conv	65	73	0	26.6	35.5	2825	--	--
Limagrain	LCSADVX18-012LNCL	Conv, CLP	67	68	0	25.4	36.7	2675	--	--
Limagrain	LCSADVX18-013LN	Conv	67	72	0	29.1	37.2	2793	--	--
Mycogen (C	8N270CLDM	NS, CL, DM	62	62	0	27.8	38.3	2260	1960	1925
USDA (CK	Honeycomb NS	NS	60	61	0	22.1	32.3	958	875	1061
USDA (CK	894	TR	65	67	0	27.9	37.1	2808	2353	2173
USDA (CK	Hybird 924	TR	67	67	0	26.4	35.9	2931	--	--
Trial Mean			67	68	0	26.6	36.2	2931	2373	2209
C.V. %			1.0	5.5	--	3.2	3.5	9.7	--	--
LSD 5%			1.0	5.3	NS	1.2	1.8	397	--	--
LSD 10%			0.9	4.4	NS	1.0	1.5	333	--	--

[1] Type: TR-Traditonal, NS-NuSun, HO-High Oleic, CL=Clearfield, EX=ExpressSun, DM=Downy Mildew Resistan

[2] Days after planting.

Planting Date: May 31

Harvest Date: November 1

Previous Crop: Wheat

NDSU Hettinger Reserch Extension Center

Canola - Conventional - 2018 **Hettinger, ND**

Brand	Variety	Oil Type[1]	Days to Bloom	Bloom Duration	Days to Mature	Plant Height	Lodging	Oil Content	Seed Yield
			DAP[2]	days	DAP[2]	inches	0 - 9[3]	%	lbs/a
Photosyntech	NCC101S		43	16	76	29	0	32.8	188
Photosyntech	NCC1825/8-S		43	17	77	32	0	36.3	359
Rubisco Seeds	Atomic		45	16	79	27	0	32.9	54
Rubisco Seeds	Trapper		43	17	78	32	0	36.0	240
BrettYoung	6090 RR (RR Check)		47	17	82	34	0	37.6	399
Croplan	HyClass 930 (RR Check)		42	17	77	31	0	39.3	436
Trial Mean			44	16	78	32	0	35.8	248
C.V. %			2.7	3.2	1.7	9.7	--	3.0	17.3
LSD 5%			1.7	0.8	1.9	4.5	--	1.6	62
LSD 10%			1.4	0.6	1.6	3.7	--	1.3	51

[1] Type: TR-Traditional Oil Type, HO-High Oleic Oil Type.

[2] Days after planting.

[3] Lodging: 0 = none, 9 = lying flat on ground.

Planting Date: May 16

Harvest Date: August 23

This trial has a high coeffient of variation (CV) due dry conditions and hail in June. Therefore yield comparisons should not be made.

NDSU Hettinger Reserch Extension Center

Canola - Roundup Ready - 2018 **Hettinger, ND**

Brand	Variety	Oil Type[1]	Days to Bloom	Bloom Duration	Days to Mature	Plant Height	Lodging	Oil Content	Seed Yield	
									2018	2-Yr. Avg.
			DAP[2]	days	DAP[2]	inches	0 - 9[3]	%	----------lbs/a----------	
BrettYoung	4187 RR	TR	44	18	80	40	0	40.8	749	--
BrettYoung	6074 RR	TR	43	18	79	34	0	39.2	627	740
BrettYoung	6090 RR	TR	44	18	80	43	0	38.9	503	--
Canterra Seeds	CS2100	TR	43	18	79	38	0	38.0	522	716
Canterra Seeds	CS2300	TR	43	18	79	36	0	39.6	685	--
Cargill Inc.	11H430	TR	41	18	77	32	0	37.7	588	--
Croplan	HyCLASS 730	TR	41	18	77	34	0	40.3	530	--
Croplan	HyCLASS 930	TR	42	19	78	35	0	40.4	546	793
Croplan	HyCLASS 955	TR	42	19	78	33	0	39.8	513	703
Proseed	300 MAG	TR	43	18	79	37	0	41.4	701	751
Proseed	PS 5000	TR	43	18	79	37	0	38.2	415	604
Star Specialty Seed	Star 402	TR	43	18	79	33	0	41.6	416	628
Trial Mean			43	18	79	36	0	39.4	550	705
C.V. %			1.0	3.4	0.7	9.6	--	3.2	**26.2**	--
LSD 5%			0.6	0.9	0.8	4.9	--	1.8	206	--
LSD 10%			0.5	0.7	0.7	4.0	--	1.5	171	--

[1] Type: TR-Traditional Oil Type, HO-High Oleic Oil Type.

[2] Days after planting.

[3] Lodging: 0 = none, 9 = lying flat on ground.

Planting Date: May 16

Harvest Date: August 23

This trial has a high coeffient of variation (CV) due dry conditions and hail in June. Therefore yield comparisons should not be made.

NDSU Hettinger Research Extension Center

Flax - 2018 **Hettinger, ND**

Variety	Days to Bloom	Plant Height	Test Weight	Oil Content	-------Grain Yield--------			Average Yield	
					2015	2016	2018	2-Yr	3-Yr
	DAP[1]	inches	lbs/bu	%	---------- bu per acre ----------				
Bison	44	26	55.9	44.2	--	18.7	21.6	20.2	--
Carter*	45	25	55.2	44.1	35.5	18.2	24.5	21.4	26.1
CDC Bethume	45	28	56.1	43.9	32.5	19.1	23.6	21.4	25.1
CDC Glas	47	25	54.7	44.7	35.4	21.1	24.1	22.6	26.9
CDC Neela	45	26	55.6	44.1	36.2	21.6	25.1	23.4	27.6
CDC Sanctuary	45	25	55.5	44.4	35.1	22.5	23.0	22.8	26.9
CDC Sorel	47	29	56.1	44.5	32.8	21.4	24.3	22.9	26.2
Gold ND*	47	30	55.8	44.4	33.1	19.4	22.0	20.7	24.8
ND Hammond	45	28	53.4	42.5	--	--	22.0	--	--
Nekoma	46	27	55.5	44.0	--	19.3	20.6	20.0	--
Omega*	46	25	56.1	43.6	27.2	19.4	18.9	19.2	21.8
Pembina	44	27	55.4	44.3	30.5	17.6	23.5	20.6	23.9
Prairie Blue	45	26	56.3	44.6	33.8	19.2	21.7	20.5	24.9
Prairie Sapphire	45	26	54.8	45.6	30.5	19.9	22.0	21.0	24.1
Prairie Thunder	45	28	55.7	44.5	28.2	18.9	27.0	23.0	24.7
Rahab 94	46	24	55.0	44.3	33.1	17.8	23.1	20.5	24.7
Webster	46	29	56.4	44.4	30.8	20.1	23.9	22.0	24.9
York	44	28	55.5	43.9	33.8	19.4	24.0	21.7	25.7
Trial Mean	45	27	55.5	44.6	32.4	19.5	23.0	22.1	26.2
C.V. %	2.6	5.9	1.3	1.5	6.9	9.6	11.6	--	--
LSD 5%	1.6	2.2	1.0	0.9	3.2	2.7	3.7	--	--
LSD 10%	1.4	1.8	0.9	0.8	2.6	2.2	3.1	--	--

* Yellow seed type.

[1] Days after planting.

Lodging notes were taken at harvest, however no lodging was observed.

Planting Date: May 16

Harvest Date: September 26

Previous Crop: Oats

Dry Bean - 2018 **Hettinger, ND**

Variety	Type	Plant Height	Plant Lodge	Test Weight	Grain Yield 2016	Grain Yield 2017	Grain Yield 2018	Average Yield 2 yr	Average Yield 3 yr
		inches	0-9[1]	lbs/bu	lbs per acre	lbs per acre	lbs per acre	lbs per acre	lbs per acre
LaPaz	Pinto	18	5	56.8	1318	1507	1691	1599	1505
Lariat	Pinto	17	7	52.9	1252	1140	1375	1258	1256
Monterrey	Pinto	21	4	56.5	1454	1496	1653	1575	1534
Palomino	Pinto	18	5	55.0	1099	1282	1536	1409	1306
Stampede	Pinto	19	5	54.0	1382	1415	1609	1512	1469
Windbreaker	Pinto	16	5	53.0	1069	1110	1534	1322	1238
HMS Medalist	Navy	18	2	56.2	1282	1466	937	1202	1228
Ensign	Navy	17	3	56.3	--	--	1130	--	--
T9905	Navy	18	3	56.7	1438	1652	1243	1448	1444
Merlot	Sm Red	19	4	50.4	1230	1449	1011	1230	1230
Rosetta	Pink	18	3	51.9	1261	1597	1060	1329	1306
Eclipse	Black	17	2	53.0	1429	1451	1162	1307	1347
Loreto	Black	18	3	57.8	1284	1298	1006	1152	1196
Zorro	Black	18	2	53.6	1333	1391	1071	1231	1265
Powderhorn	Great Northern	20	2	51.1	--	1900	1303	1602	--
Trial Mean		18	4	54.4	1226	1427	1288	1369	1333
C.V. %		7.4	19.8	3.8	9.8	13.1	13.0	--	--
LSD 5%		1.9	2.0	2.9	170	266	240	--	--
LSD 10%		1.6	1.7	2.4	142	222	200	--	--

[1] 0 = no lodging, 9 = lying flat on ground.

Planting Date: May 23

Harvest Date: September 18

Previous Crop: HRSW

NDSU Hettinger Research Extension Center

Chickpea - 2018 **Hettinger, ND**

Variety	Days to Flower	Height	Lodging	-----Seed Size (mm)----- <8	8-9	9-10	>10	Test Weight	Grain Yield ---- 2015	2016	2018	Average Yield 2 yr	3 yr
	DAP[1]	inches	0 - 9[2]	----------%----------				lb/bu	----------lbs/ac----------				
Kabuli Type													
CDC Frontier	47	15	0	7	43	17	1	56.0	3891	2119	1802	1961	2604
CDC Luna	47	14	0	8	36	15	2	55.0	3761	2054	1589	1822	2468
Sawyer	47	17	0	5	37	25	10	60.0	3107	1387	1439	1413	1978
Sierra	49	14	0	3	15	21	12	56.0	3021	879	1066	973	1655
CDC Orion	43	13	0	4	31	25	8	56.0	--	--	1456	--	--
Desi Type													
CDC Anna	47	15	0	36	4	0	0	56.0	3378	2136	1687	1912	2400
Mean	47	15	0	10	28	17	6	56.0	3032	1736	1507	1616	2221
C.V. %	2.0	7.4	--	19.1	16.4	25.2	44.2	1.5	8.2	12.7	11.1	--	--
LSD 5%	1.4	1.7	NS	3.0	6.9	6.5	3.7	1.2	351	324	253	--	--
LSD 10%	1.1	1.4	NS	2.5	5.6	5.3	3.1	1.0	294	268	208	--	--

[1] Days after planting.

[2] Lodging: 0 = none, 9 = lying flat on ground.

Planting Date: May 3

Harvest Date: september 18

Previous Crop: Oats

NDSU Hettinger Research Extension Center

Field Pea - 2018 **Hettinger, ND**

Variety	Days to Flower	Days to Mature	Canopy Height	Lodging	Seed Protein	1,000 Seed Wt.	Seeds Lb	Test Weight	Seed Yield 2018	Seed Yield 2-Yr. Avg.	Seed Yield 3-Yr. Avg.
	DAP[1]	DAP[1]	inches	0 - 9[2]	%	gm	seeds	lb/bu	bu/a		
Yellow Cotyledon Type											
DS Admiral	46	82	13	7		239	1898	*	19.6	16.3	17.2
Agassiz	46	82	15	7		226	2013		25.2	18.7	19.3
LG Amigo	46	82	14	5		221	2057		17.8	15.8	--
Bridger	44	82	13	5		217	2103		12.9	12.8	14.7
Durwood	47	82	17	7		208	2191		21.2	17.6	19.1
Hyline	47	83	12	6		236	1923		15.4	13.7	14.9
LGPN4249	46	82	14	6		274	1660		20.4	--	--
LGPN4906	44	82	14	6		260	1750		19.0	15.9	16.8
LGPN4908	41	80	11	4		251	1809		11.1	11.4	--
LGPN4909	42	81	10	5		257	1769		14.2	14.1	--
LGPN4912	46	81	11	5		231	1966		13.3	--	--
LGPN4913	45	82	12	7		233	1954		15.8	--	--
LGPN4915	44	82	16	7		229	1987		24.4	--	--
SW Midas	46	82	13	5		211	2156		12.0	13.3	14.1
Navarro	41	76	11	5		264	1719		11.6	13.1	15.4
Nette 2010	46	82	14	6		220	2069		18.1	16.3	17.4
Pro 133-6243	42	81	11	4		267	1700		12.3	--	--
AAC Profit	48	83	17	8		237	1919		30.0	--	--
Salamanca	46	81	15	7		226	2012		20.1	17.4	18.5
Spider	47	82	16	8		237	1917		26.7	18.7	17.9
LG Sunrise	46	81	15	6		241	1883		19.1	--	--
Green Cotyledon Type											
Arcadia	46	82	12	1		202	2255		5.7	9.1	11.9
Banner	42	76	10	2		230	1973		7.0	--	--
Cruiser	44	81	13	4		192	2363		13.6	13.4	13.9
Ginny	46	81	13	5		207	2197		12.6	11.6	--
Greenwood	45	81	11	4		218	2082		11.6	11.8	--
LG Koda	48	82	12	6		235	1937		20.4	16.6	--
LGPN1125	47	82	14	7		271	1675		22.8	17.6	--
LGPN1131	46	81	14	5		246	1844		18.7	--	--
Pro 121-7126	46	81	15	6		212	2146		19.3	--	--
Shamrock	49	83	15	7		222	2049		18.6	15.0	--
CDC Striker	46	82	10	3		194	2345		9.3	11.2	12.8
Viper	44	82	14	6		229	1986		12.6	12.9	14.5
Trial Mean	45	81	13	5		231	1979		16.7	14.5	15.9
C.V. %	1.4	0.9	17.4	20.4		3.3	3.5		25.9	--	--
LSD 5%	0.9	1.1	3	2		11	98		6.1	--	--
LSD 10%	0.7	0.9	3	1		9	82		5.1	--	--

[1] Days after planting.

[2] Lodging: 0 = none, 9 = lying flat on ground.

* Not enough sample for a test weight.

Planting Date: May 3

Harvest Date: August 7

Previous Crop: Oats

NDSU Hettinger Reserach Extension Center

Lentil - 2018 **Hettinger, ND**

Variety	Days to Flower	Height	Lodging	1,000 Seed Wt.	Seeds Lb	Test Weight	Grain Yield 2015	Grain Yield 2016	Grain Yield 2018	Average Yield 2 yr	Average Yield 3 yr
	DAP[1]	inches	0 - 9[2]	gm	seeds	lb/bu	lbs/acre	lbs/acre	lbs/acre	lbs/acre	lbs/acre
Large Green Type											
CDC Greenland	48	13	2	66	6921	*	2823	1219	1028	1124	1690
Pennell	47	13	1	65	6955		2527	1079	1268	1174	1625
Riveland	46	15	2	72	6330		2374	1118	951	1034	1481
Medium Green Type											
CDC Richlea	48	13	1	53	8542		2804	1299	1233	1266	1779
Small Green Type											
CDC Viceroy	47	12	0	38	11899		2951	1352	1634	1493	1979
ND Eagle	46	13	1	42	10974		3409	890	1455	1172	1918
French Green Type											
CDC Lemay	55	12	1	35	12999		3005	598	1334	966	1646
Small Red Type											
CDC Red Rider	50	14	1	48	9465		2974	1359	1466	1413	1933
CDC Redberry	51	15	0	45	10103		3295	902	1258	1080	1818
CDC Rosetown	56	13	0	34	13442		2768	1304	1557	1431	1876
CDC Rouleau	54	13	0	41	11150		3154	1157	1180	1169	1830
Trial Mean	50	13	1	49	9889		2687	1043	1306	1932	2128
C.V. %	2.4	8.5	105.5	5.1	5.5		7.0	11.8	18.9	--	--
LSD 5%	1.7	1.6	1.3	3.6	780		264	174	357	--	--
LSD 10%	1.4	1.4	1.1	3.0	648		221	145	297	--	--

[1] Days after planting.

[2] Lodging: 0 = none, 9 = lying flat on ground.

* Not enough sample for weigh system to obtain a test weight.

Planting Date: May 3

Harvest Date: August 13

2017 results not used for milti-year averages because of very low yields.

Soybean - Roundup Ready - 2018 **Hettinger, ND**

Company/Brand	Variety	Maturity	Mature Date	Plant Height	Test Weight	Seed Oil	Seed Protein	Seed Yield	Average Yield 2-Yr	Average Yield 3-Yr
				inches	lbs/bu	%	%	------ Bushels per acre ------		
NDSU	17009GT	00.9	9/17	23	55.1	15.6	34.6	26.2	--	--
Proseed	30-20	0.2	9/20	23	52.8	16.2	33.8	31.0	28.7	28.1
Legacy Seeds	LS-0334 RR2	0.3	9/28	22	53.5	15.4	34.0	30.1	--	--
Legend Seeds	LS 03X852N	0.3	9/27	22	54.3	15.1	33.0	28.9	--	--
Legacy Seeds	LS-0438 RR2X	0.4	9/28	21	53.3	15.7	34.1	28.9	--	--
Legend Seeds	LS 05X865N	0.5	9/29	21	52.8	15.7	34.3	29.2	--	--
REA Hybrids	RX0516	0.5	9/29	23	53.9	15.2	33.3	30.5	--	--
REA Hybrids	RX0628	0.6	10/2	20	53.4	15.5	33.5	29.0	26.2	--
Legacy Seeds	LS-0738N RR2X	0.7	10/2	21	53.7	15.2	34.5	30.6	--	--
REA Hybrids	RX0719	0.7	10/2	20	53.6	15.5	34.1	29.8	--	--
Legend Seeds	LS 09R23N	0.9	10/3	21	54.3	15.3	33.7	31.7	--	--
Legend Seeds	LS 09X960N	0.9	10/4	20	53.8	14.9	35.4	30.3	--	--
REA Hybrids	RX0929	0.9	10/3	21	53.4	14.7	35.3	31.0		
Trial Mean			9/29	21	53.7	15.4	34.1	29.8	27.4	28.1
C.V. %			1.2	8.5	1.1	2.0	1.4	11.0	--	--
LSD 5%			2.2	2.6	0.8	0.4	0.7	4.7	--	--
LSD 10%			1.8	2.2	0.7	0.4	0.6	3.9	--	--

Planting Date: May 23
Harvest Date: October 15
Previous Crop: Barley

Soybean - Conventional - 2018 **Hettinger, ND**

Company/Brand	Variety	Maturity	Mature Date	Plant Height	Test Weight	Seed Oil	Seed Protein	Seed Yield	Average Yield 2-Yr	Average Yield 3-Yr
				inches	lbs/bu	%	%	------ Bushels per acre ------		
NDSU	ND Benson	0.4	9/30	24	13.2	15.4	35.4	30.3	28	--
NDSU	ND Bison	0.7	10/5	24	13.1	15.7	33.5	33.9	30.6	34.3
NDSU	ND Stutsman	0.7	9/27	27	12.3	15.6	33.6	36.8	32.4	--
RR Check		0.8	10/6	26	13.4	15.8	33.0	36.6	--	--
Trial Mean			10/2	25	13.0	15.6	33.9	34.0	30.3	34.3
C.V. %			0.3	5.4	0.7	3.0	3.4	12.2	4.1	12.2
LSD 5%			0.7	2.2	0.6	0.7	1.9	6.7	1.7	6.7
LSD 10%			0.5	1.8	0.5	0.6	1.5	5.5	1.4	5.5

Planting Date: May 23
Harvest Date: October 16
Previous Crop: HRSW

NDSU Hettinger Research Extension Center

Corn - 2018 **Hettinger, ND**

Company	Hybrid	Traits[1]	Relavtive Maturity[1]	Plant Height	Ear Height	Stalk Lodge	Moisture Content	Test Weight	Grain Yield 2018	Grain Yield 2-Yr
			days	inches	inches	%	%	lbs/bu	------bu/ac------	
Integra	3282	RR2, VT2P	83	105	46	0	17.7	53.1	111.4	--
Integra	3325	RR2, AV-3010A	84	91	36	0	18.7	54.0	110.9	84.8
Integra	3537	RR2, VT2P	86	105	43	0	17.7	52.1	110.8	83.4
Integra	3718	RR2, VT2P	90	104	46	0	20.9	52.6	113.4	--
Legend Seeds	LR 9583	RR2, VT2P	83	100	43	0	17.3	51.9	110.8	--
Legend Seeds	40J684	RR2	87	108	43	1	20.8	55.0	114.5	--
Legend Seeds	LR 9986	RR2, VT2P	85	99	39	1	18.0	52.0	90.1	--
Legend Seeds	LR 9990	RR2, VT2P	83	110	46	0	22.6	50.7	114.0	--
Legacy	L-2516	RR2, VT2P	82	99	39	0	17.2	51.9	97.9	81.7
Legacy	L-2847	RR2, VT2P	83	105	45	1	19.0	51.8	112.6	85.1
Legacy Seeds	L-2546	RR2	85	109	43	2	20.0	56.3	116.8	--
Legacy Seeds	L-2314	RR2, VT2P	87	102	45	1	17.2	53.6	110.9	--
Proseed	1480	RR2, VT2P	80	103	43	0	17.1	54.1	112.5	79.8
Proseed	1483	RR2, VT2P	83	102	42	1	16.4	53.4	117.5	88.2
Proseed	1384	RR2, VT2P	84	103	40	1	18.2	54.8	89.5	71.6
Proseed	1787	RR2, VT2P	87	107	42	0	17.6	53.4	115.4	--
Proseed	1487	RR2, VT2P	87	107	44	0	18.3	53.1	114.0	--
Trial Mean				104	42	0	18.5	53.2	109.6	82.1
C.V. %				3.8	8.3	265.1	7.8	2.2	12.1	--
LSD 5%				5.6	5.0	1.8	2.1	1.9	19.1	--
LSD 10%				4.6	4.2	1.5	1.7	1.6	15.9	--

[1] Traits and relavtive maturity provided by company.

Planting Date: May 22

Harvest Date: October 30

Previous Crop: Spring Wheat

Nitrogen Relationships in Soybean in Southwest North Dakota

Best management practices are needed to achieve optimal crop yields. Soybean has the ability to form a symbiotic relationship with nitrogen (N)-fixing bacteria; however, it may be possible to increase yield through addition of synthetic N fertilizer, however addition of N reduces the plants need to form a relationship with N-fixing bacteria. It may be possible that with a dryer environment in southwest North Dakota that the N-fixing bacteria are less productive. The Dickinson Research Extension Center worked with the Hettinger Research Extension Center to observe the effects of different agronomic management strategies on soybean growth and yield. Objectives of the research were to evaluate yield and growth differences between five N management strategies applied to two soybean cultivars with different maturities grown at two populations. The research was conducted at two locations in 2017 and 2018, however only data from the Hettinger location was recorded due to herbicide damage in 2017 in Dickinson. In 2018 we dealt with early frost in the region. The Dickinson site was a little further behind the Hettinger site in maturity at first frost and there was frost damage during pod fill that caused issues with maturity. Due to this issue only data from Hettinger is included in 2018 as well.

In 2017 even with drought conditions throughout most of the season rainfall in August aligned with reproductive growth of soybeans allowing the plants to attain decent average yields considering the poor conditions during vegetative growth. Although there were no significant differences among N treatments alone, there were differences in yield with the interaction between populations of 80,000 and 160,000 plants per acre and the N treatments (Table 1), this interaction needs to be further investigated before making any conclusions. In 2017, no significant yield differences were found between populations, 80,000 plants/acre averaged 23.3 bu/ac while 160,000 plants/acre averaged 24.2 bu/ac. In 2018, 160,000 plants/ acre yielded significantly higher at 27.1 bu/ac compared to 25.4 bu/ac in 80,000 plants/acre however depending on seed input costs and soybean price this may not necessarily result in higher profits.

Table 1. 2017 and 2018 soybean yields in Hettinger, ND across plants per acre and nitrogen treatments. Soybeans were planted May 18th 2017 and May 24th 2018.

Nitrogen Management	Yield bu/acre			
	2017		2018	
	80,000	160,000	80,000	160,000
No inoculant/no N added	24.0ab	20.9b	25.0	27.1
No inoculant/30 lbs N added	21.3b	26.8a	24.7	25.5
Inoculant/no N added	23.4ab	24.5ab	24.9	28.4
Inoculant/30 lbs N added	24.4ab	24.5ab	26.6	26.9
Double inoculant	NA	NA	26.0	27.8
LSD (0.05)	3.9		ns	

A yield difference was found among the two maturities with the 0.3 maturity out yielding the 0.6 maturity (Table 2). This is consistent with the recommended maturity for the region.

Table 2. 2018 soybean yields in Hettinger, ND across maturities.

	Yield (bu/ac)
0.3	27.8a
0.6	24.8b
LSD (0.05)	1.4

Drought conditions in 2017 reduced yield capacity for soybeans. Under drought conditions a plant population half of the recommended seeding rate was able to yield just as well as the full rate. While it may be possible that with higher rainfall a larger yield is possible, more work should be conducted before changing recommendations. Under drought conditions with a reduced yield potential, it could be possible to reduce seed input costs without losing bushels and depending on the economic environment it may still be profitable to decrease plant population.

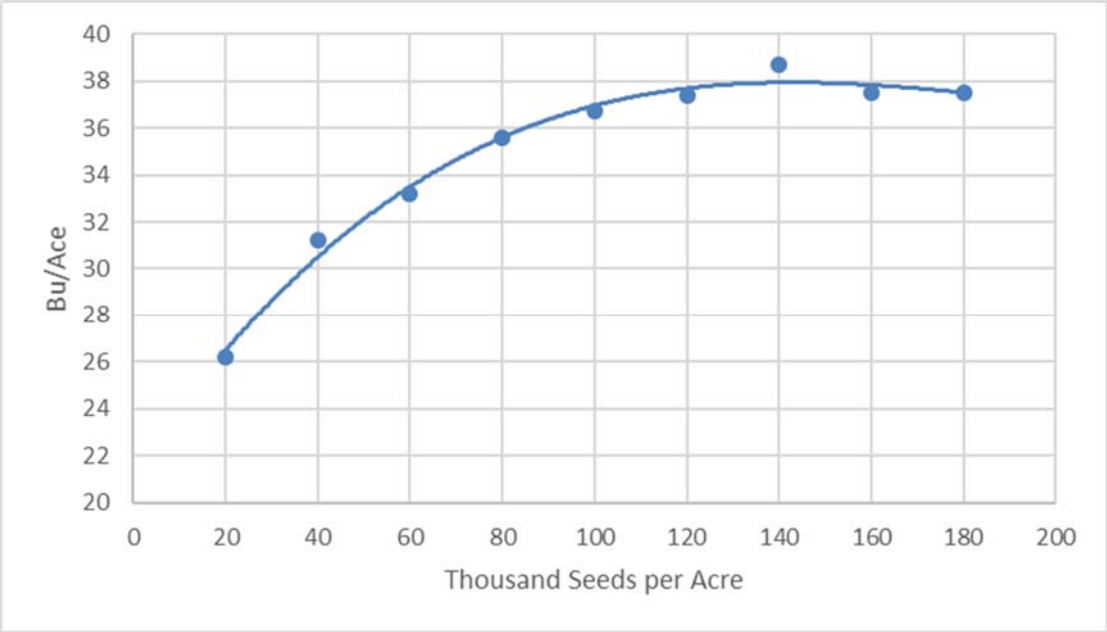
Hettinger Soybean Seeding Rate Study

Over the past decade soybean seeding rate recommendations in the corn-soybean belt have been reduced from 180,00 - 240,000 seeds per acre to 125,000 - 170,000. Much of this is due to increasing cost of soybean seed and soybeans tremendous ability to compensate for lower densities with increased branching and pod number. Yield per acre for soybeans remains relatively constant across population. This is because the number of seeds produced per plant is inversely related to the number of plants per acre. In general, numerous studies in the Midwest have shown 100,000 relatively uniformly spaced plants at harvest will produce the maximum economic return under most conditions. There have been many studies on soybean seeding rates in the Midwest, but there is little information on seeding rates for dryland soybeans in the semi-arid high plains.

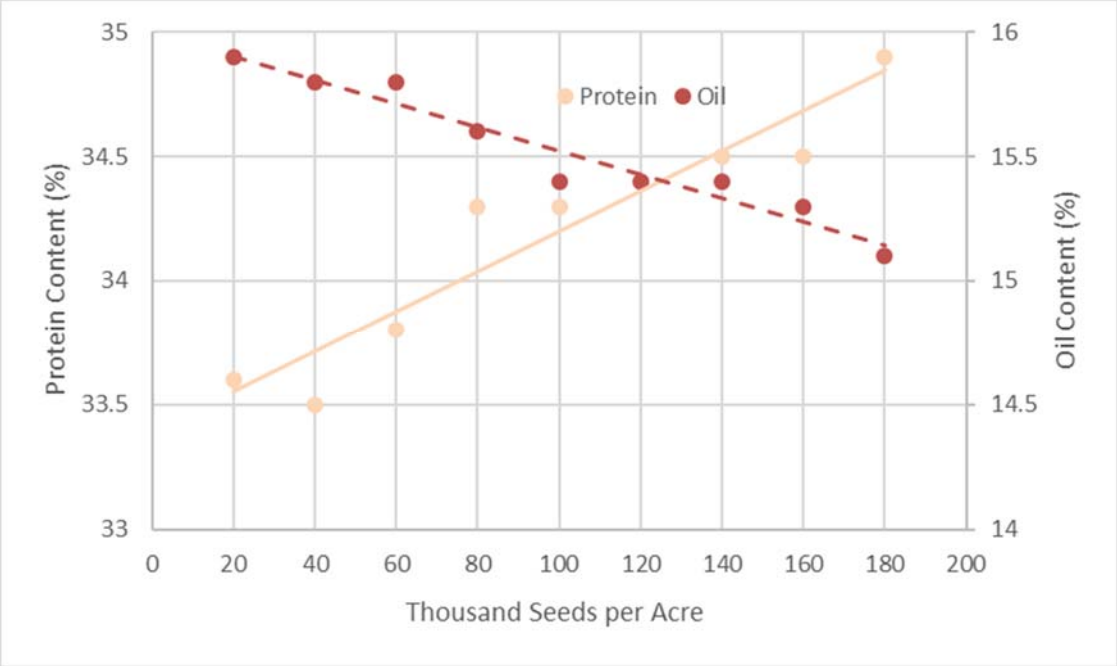
A study was initiated at Hettinger, ND in 2018 with nine seeding rates, 20,000 to 180,000 in 20,000 increments in both drilled (7”) and row (30”) configuration. The soybean variety Proseed 30-20 was no-till planted on May, 23 with a 7 row plot drill equipped with Acra Plant ADU double disk openers and a two row planter equipped with John Deere 1700 row units. Weed control was obtained by a pre-emergence herbicide application of BroadAxe and post-emergence application of glyphosate. The trial was harvested on October 16 with a Kincaid 8XP small plot combine. Data was recorded on flowering, height, maturity date, yield, test weight, seed size, seed protein and seed oil content.

The results in the following graphs and table show that seeding rates of 100,000 – 180,000 were not significantly different in yield and even the extremely low rate of 20,000 yielded 70% of the 100,000 - 180,000 seeding rates. For seed protein and oil content, as seeding rate increased, oil content decreased and protein increased. At the very lowest population, seed size increased and test weight decreased, but there was no significant difference in the 40,000 to 180,000 rates for seed size or test weight. Plant height was not significantly different among any of the treatments. Row spacing showed no difference in yield, test weight or height, but 7” rows had slightly smaller seed size and slightly lower oil content than 30” rows.

Soybean Seeding Rate Study Yields by Seeding Rate.



Soybean Seeding Rate Study Protein and Oil Content by Seeding Rate.



Soybean Seeding Rate Study - 2018 **Hettinger, ND**

Treatment	Mature Date	Plant Height	Seeds Lb	Test Weight	Seed Oil	Seed Protein	Grain Yield
		inches	seeds	lbs/bu	%	%	bu/ac
Row Spacing							
7" Rows	9/30	26	3727	54.4	15.4	34.2	34.6
30" Rows	9/30	25	3535	54.3	15.7	34.1	35.2
LSD 5%	NS	NS	53	NS	0.1	NS	NS
Population							
20,000	10/2	25	3497	53.4	15.9	33.6	26.2
40,000	10/1	25	3603	54.2	15.8	33.5	31.2
60,000	9/30	26	3607	54.1	15.8	33.8	33.2
80,000	9/30	26	3608	54.6	15.6	34.3	35.6
100,000	9/30	26	3757	54.4	15.4	34.3	36.7
120,000	9/30	25	3676	54.4	15.4	34.4	37.4
140,000	9/30	26	3685	54.7	15.4	34.5	38.7
160,000	9/30	26	3655	54.5	15.3	34.5	37.5
180,000	9/30	26	3589	54.6	15.1	34.9	37.5
LSD 5%	0.3	NS	112	0.4	0.3	0.5	3.7
Row Spacing X Population							
7" - 20,000	10/2	25	3470	53.1	15.6	33.6	25.3
7" - 40,000	10/2	26	3742	54.2	15.7	33.7	31.0
7" - 60,000	9/30	27	3743	54.2	15.7	33.8	32.2
7" - 80,000	9/30	27	3705	54.7	15.5	34.3	35.8
7" - 100,000	9/30	26	3919	54.6	15.1	34.5	37.9
7" - 120,000	9/30	25	3758	54.7	15.2	34.5	37.0
7" - 140,000	9/30	26	3751	55.0	15.2	34.5	38.9
7" - 160,000	9/30	26	3797	54.5	15.3	34.4	37.2
7" - 180,000	9/30	26	3656	54.8	14.9	35.0	36.0
30" - 20,000	10/2	25	3524	53.8	16.1	33.5	27.2
30" - 40,000	10/1	25	3463	54.3	15.9	33.4	31.3
30" - 60,000	9/30	25	3471	54.0	15.9	33.8	34.2
30" - 80,000	9/30	25	3511	54.5	15.7	34.3	35.5
30" - 100,000	9/30	26	3595	54.2	15.7	34.1	35.5
30" - 120,000	9/30	25	3594	54.2	15.6	34.2	37.8
30" - 140,000	9/30	26	3619	54.5	15.6	34.4	38.6
30" - 160,000	9/30	27	3512	54.5	15.4	34.6	37.9
30" - 180,000	9/30	26	3522	54.4	15.3	34.8	38.9
Trial Mean	9/30	26	3631	54.3	15.5	34.2	34.9
LSD 5%	0.3	NS	158	0.5	NS	NS	NS
C.V. %	0.1	4.9	3.1	0.7	1.8	1.3	10.6

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Evaluation of Herbicide Options for Kochia Control in Western North Dakota. Daniel Guimaraes Abe*, Caleb Dalley; North Dakota State University, Hettinger, ND (042)

Late-emerging kochia that is not controlled during the cropping season can become problematic following harvest of small grains. Seed produced by these late flushes of kochia increase the weed seedbank and can spread infestation to neighboring farms and fields. Identification of herbicides that could be used to control kochia post-harvest, especially large kochia is needed. Trials were conducted to evaluate herbicides for kochia control post-harvest at three locations. In these trials, kochia was beyond typically recommended ideal heights for control ranging from 23 cm (9 in) at Location One to 61 cm (24 in) at Location Three. All treatments were applied using a tractor-mounted research sprayer at 94 L/ha (10 gal/A). At Location One, glyphosate (1680 g ae/ha) was ineffective at controlling kochia with only 28% control at 30 DAT. The addition of fluroxypyr (196 g ae/ha) to glyphosate (840 g/ha) increased kochia control to 53% at 30 DAT, which was better than either glyphosate alone of fluroxypyr alone. The addition of 2,4-D LV6 (392 g ae/ha) or dicamba (140 g ae/ha) to fluroxypyr treatments resulted in 45 and 55% control. The premix of fluroxypyr and clopyralid resulted in 78% control 30 DAT. Paraquat (840 g/ha) provided the greatest control of kochia with 90% control 20 DAT; however, by 30 DAT, control fell to 85% at 30 DAT due to regrowth. At Location Two, glyphosate was much more effective, resulting in 85% kochia control 30 DAT. Fluroxypyr (275 g/ha) tank mixed with glyphosate (840 g/ha), 2,4-D (785 g/ha), or dicamba (280 g/ha) controlled kochia 80, 79, and 79%, respectively 30 DAT, which was better than fluroxypyr alone (68%). Again, paraquat (840 g/ha) provided the greatest control of kochia with 98% control 7 DAT, which fell to 95% at 30 DAT. At Location Three, glyphosate was very effective at controlling kochia (99% at 30 DAT). Fluroxypyr tank-mixed with glyphosate resulted in similar control to that of glyphosate alone. Fluroxypyr alone or tank-mixed with 2,4-D, dicamba, or fluroxypyr resulted in around 70% control. Paraquat again provided excellent control (98% at 30 DAT). The differential response of kochia to glyphosate is worrisome as resistance to glyphosate is an increasing problem. The less than satisfactory response of kochia to fluroxypyr was likely related to the large size of kochia at time of application. This shows the need for following recommendations for applying fluroxypyr when kochia is less than 10 cm (4 in) in height. Paraquat was the most consistent treatment for controlling large kochia plants in this trial, although there is some concern with regrowth following treatment, especially if coverage is less than ideal.

Evaluation of Herbicide Options for Kochia Control in Western North Dakota

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INTRODUCTION

Kochia (*Bassia scopia)* is an annual broadleaf C4 plant. Its C4 metabolism allows for its aggressive growth habit under high temperatures and low soil moisture conditions common in western North Dakota. Kochia is tolerant to saline and alkaline soils and is a prolific seed producer, having one of the highest ratio of seed biomass per unit plant biomass. Seeds are weakly attached to light, buoyant plants that roll and tumble across fields with the wind dispersing seed. Kochia seed have weak or low dormancy and lose viability after one to two years. Kochia has high genetic and phenotypic variation, which has lead to development of herbicide resistant biotypes to Group 2, 4, 5, and 9 herbicides in North Dakota. Late-emerging kochia that is not controlled during the cropping season can become problematic following harvest of small grains. Seed produced by these late flushes of kochia increase the weed seedbank and can spread infestation to neighboring farms and fields. Identification of herbicides that could be used to control kochia post-harvest, especially large kochia is needed.

OBJECTIVES

Evaluate herbicides for postharvest control of Kochia

MATERIAL AND METHODS

- Experiments were conducted at three locations near Hettinger, ND.
- Experimental sites were crop fields naturally infested with kochia that had become established over years of small grains production.
- Treatments (Table 1) were arranged in a randomized complete block with four replications each.
- Plot size was 3 by 15 m.
- Kochia average height was 23, 53, and 61 cm, at Locations One, Two, and Three, respectively.
- Treatments were applied with a tractor mounted research sprayer equipped with TeeJet® 8001XR flat fan nozzles calibrated to deliver 94 L/ha at 262 kPa using compressed CO_2 as a propellant.
- Treatments (Table 1) were applied on July 26 at Location One, on August 18 at Location Two, and on August 22 at Location Three.
- Kochia control was visually evaluated at 1, 3, and 4 weeks after treatment (WAT) at Location One and at 1, 2, 3, and 4 WAT at Locations Two and Three.
- Data were subjected to ANOVA using Proc Mixed in SAS 9.4. Sites were analyzed separately after initial analysis showed a treatment by location interaction.
- Visual control ratings were transformed by arcsine square root percent prior to analysis, but actual values are presented for clarification.
- Means separation was performed using Tukey-Kramer multiple comparison procedure at P=0.05.

Table 1. Herbicides treatments and rates utilized for kochia control at three locations. Treatments 2 and 3 included AMS at 10 g/L.

Trt #	Herbicide	Location 1	2 and 3
		-----Rate (g ae/ha)-----	
1	Untreated	-	-
2	Glyphosate	1,680	1,680
3	Glyphosate+fluroxypyr	840+196	840+275
4	Fluroxypyr	196	275
5	Fluroxypyr+2,4-D LV6	196+392	275+785
6	Fluroxypyr+dicamba	196+140	275+280
7	Clopyralid+fluroxypyr	140+140	140+140
8	Paraquat	840	840

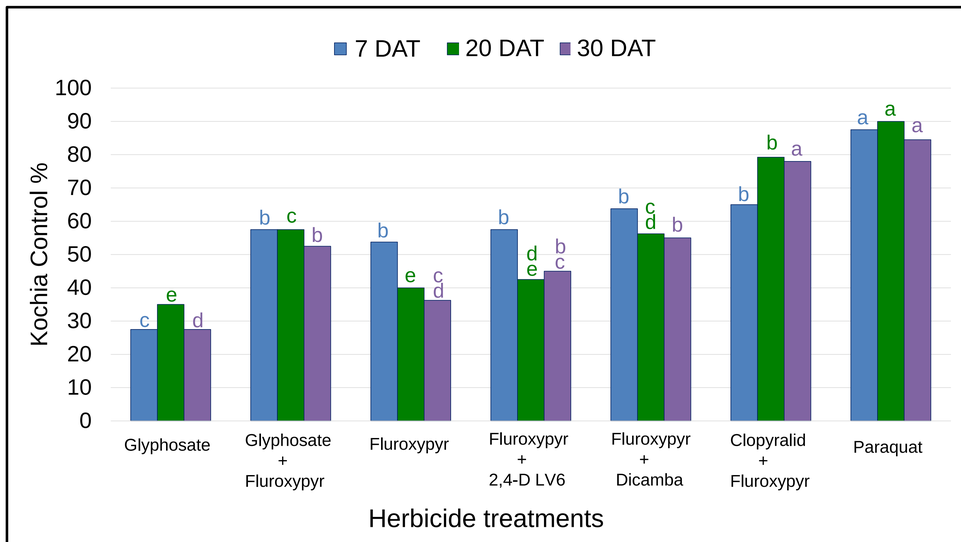


Figure 1. Kochia control with herbicide treatments at Location One. Treatment means, within evaluation dates, with different letters above the bar are significantly different (0.05). Herbicides rates are shown on Table 1.

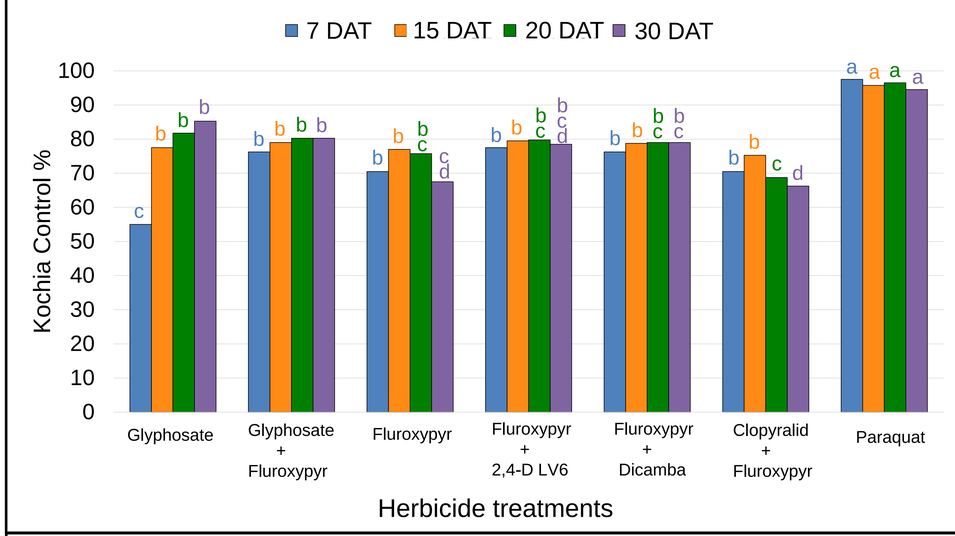


Figure 2. Kochia control with herbicide treatments at Location Two. Treatment means, within evaluation dates, with different letters above the bar are significantly different (0.05). Herbicides rates are shown on Table 1.

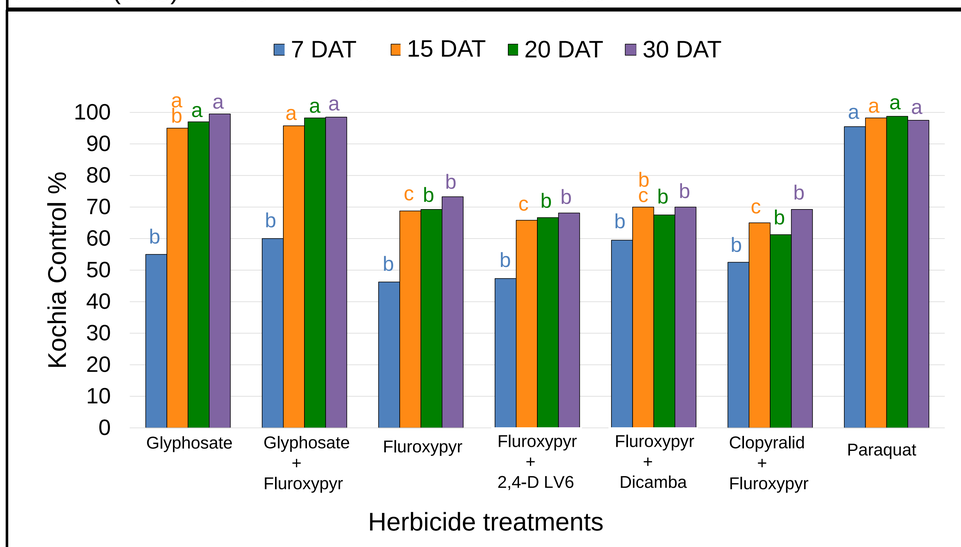
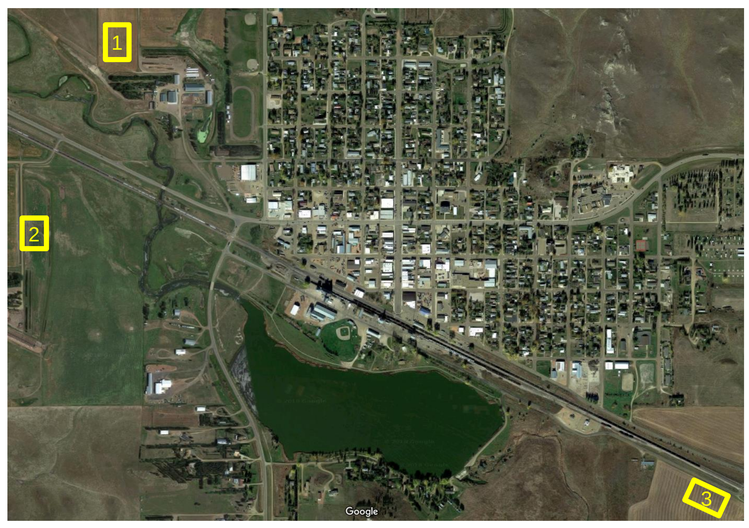
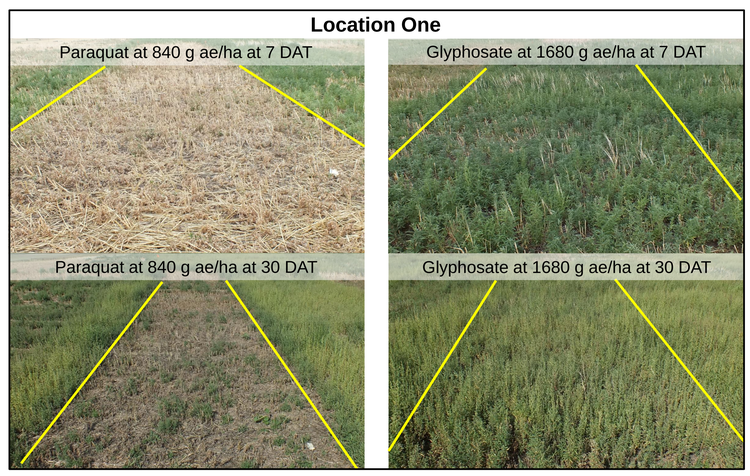


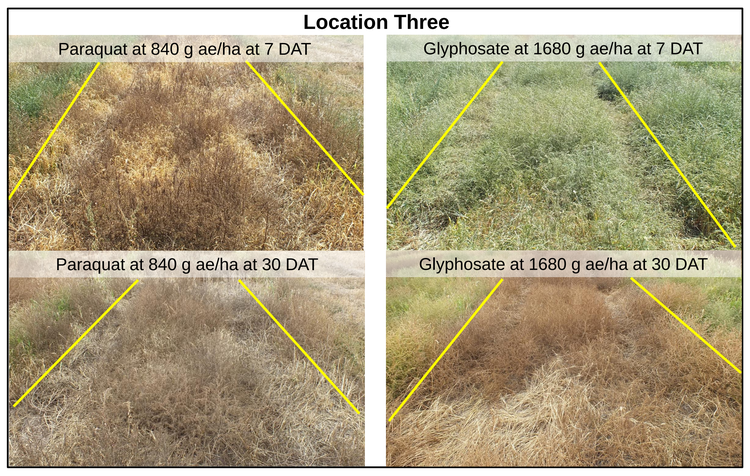
Figure 3. Kochia control with herbicide treatments at Location Three. Treatment means, within evaluation dates, with different letters above the bar are significantly different (0.05). Herbicides rates are shown on Table 1.

RESULTS

- At Location One, kochia control was fair to poor with all treatments except paraquat where kochia control reached 90% 20 DAT, but digressed to 85% 30 DAT. Clopyralid+fluroxypyr controlled kochia 79% 20 DAT.
- At Location One, glyphosate alone (1680 g/ha) controlled kochia poorly with a maximum control of 35% 20 DAT.
- A tank-mix of fluroxypyr (196 g/ha) with glyphosate (840 g/ha) or dicamba (140 g/ha) improved kochia control, compared to only glyphosate alone, however control never exceeded 60%.
- Kochia control with glyphosate at Location Two was 85% 30 DAT, but was less than with paraquat (95%). Fluroxypyr tank-mixed with glyphosate, dicamba, or 2,4-D generally provided similar kochia control as glyphosate alone. Kochia control when fluroxypyr was applied alone or when premixed with clopyralid was less than glyphosate.
- At Location Three, kochia control was 98% or better 30 DAT with glyphosate alone or when tank-mixed with fluroxypyr and also with paraquat. Other treatments provided only fair control (68-73%) of kochia.
- Independent of location, paraquat provided the most consistent kochia control. Addition of surfactants (NIS, MSO, and HSCO) to paraquat treatments did not impact kochia control (data not shown).







DISCUSSION AND IMPLICATIONS

Although kochia at Location One was smaller than at other locations, most treatments, including glyphosate, provided poor kochia control compared to control at the other two locations. This indicates a possible development of resistance to glyphosate and possibly fluroxypyr in this kochia population. Glyphosate-resistant kochia biotypes in Kansas and Montana required > 2 kg/ha glyphosate for 50% reduction in plant dry biomass (Godar et al. 2015; Kumar et al. 2014). However, kochia at Location One were taller than in these studies. At Location Three, kochia plants were taller than at other locations which may be responsible for reduced control with fluroxypyr. Paraquat provided the most consistent kochia control, however long-term control may be an issue as regrowth was occurring at 30 DAT at all locations. Kumar and Jha (2015) had similar results when using paraquat for kochia control resulted in declining control 3 and 5 WAT due to recovery and survival of late-emerging kochia, especially when compared with tank-mixes including residual herbicides. Further research is necessary to evaluate and monitor possible resistant kochia populations and to develop alterative control methods.

REFERENCES

Godar, AS, Stahlman, PW, Jugulam, M, Dille, JA (2015) Glyphosate-resistant kochia (*Kochia scoparia*) in Kansas: EPSPS gene copy number in relation to resistance levels. Weed Sci 63:587-595.

Kumar, V, Jha P, Reichard, N (2014) Occurrence and characterization of kochia (*Kochia scoparia*) accessions with resistance to glyphosate in Montana. Weed Tech 28:122-130.

Kumar, V, and Jha, P (2015) Effective preemergence and postemergence herbicide programs for kochia. Weed Tech 29:24-34.

Spring wheat response to the herbicide pyroxasulfone at Hettinger, ND

A trial was established to evaluate spring wheat response to the herbicide pyroxasulfone (Zidua SC) when applied PRE (after planting), DPRE (after wheat germination, but before emergence), and EPOST (soon after wheat has emerged). Wheat 'Elgin' was planted on May 21, 2018 at 100 lb/A at a depth of 1.5 inches using a John Deere 1590 no-till drill. Starter fertilizer (18-46-0) was applied in furrow at planting at a rate of 40 lb/A. Prior to planting, urea fertilizer (46-0-0) was broadcast applied at a rate of 150 lb/A (69 lb nitrogen per acre). The field was treated with glyphosate (Cornerstone 5 Plus @ 32 oz/A plus AMS @ 17 lb/100 gal) prior to planting to control emerged annual weeds. Plots were maintained weed free for the entire growing season. Herbicide treatments were applied using a research plot sprayer at an application volume of 10 gallons per acre. PRE treatments were applied the day after wheat was planted. The DPRE treatments were applied on May 24, three days after planting when wheat coleoptiles were 0.5 inches in length and had not yet emerged. Wheat emerged on May 27. EPOST treatments were applied on June 4 to wheat in the 1-leaf growth stage. In between planting and wheat emergence, 0.19 inches of rainfall occurred. An additional 0.4 inches of rainfall occurred after crop emergence, but prior to the EPOST application. Wheat was evaluated for injury on June 21 and no injury was observed for any herbicide treatment regardless of application timing. Wheat height (the longest extended leaf) was measured on June 28 and no differences in wheat height were found regardless of herbicide treatment or treatment timing. Wheat was harvest on August 30. No differences in wheat yield were found regardless of herbicide treatment or treatment timing. The herbicide Zidua is currently registered for use at rates of 1.25 to 4 oz/A when applied DPRE or EPOST to spring wheat in North Dakota.

Table. Spring wheat response to pyroxasulfone (Zidua SC) applied preemergence, delayed preemergence, and early-postemergence at Hettinger, ND

	Rate		injury 31 DAP	height 37 DAP	Yield	Test
Treatment	—oz/A—	Timing	%	cm	bu/A	lb/bu
1Zidua SC	1.75	PRE	0	44	26.6	55
2Zidua SC	2.5	PRE	0	46	28.8	55
3Zidua SC	3.25	PRE	0	46	29.8	55
4Zidua SC	4.0	PRE	0	45	28.7	55
5Zidua SC	1.75	DPRE	0	46	28.8	55
6Zidua SC	2.5	DPRE	0	45	28.3	55
7Zidua SC	3.25	DPRE	0	46	25.2	54
8Zidua SC	4.0	DPRE	0	44	26.8	55
9Zidua SC	1.75	EPOST	0	45	26.2	54
10Zidua SC	2.5	EPOST	0	46	28.9	55
11Zidua SC	3.25	EPOST	0	44	25.2	55
12Zidua SC	4.0	EPOST	0	44	26.1	54
13Untreated			0	46	26.0	55
LSD P=.05			.	2.5	4.64	1.5
Treatment F			0.000	0.836	0.956	0.622
Treatment Prob(F)			1.0000	0.6144	0.5057	0.8092

Abbreviations: DAP, days after planting; PRE, preemergence treatments were applied on May 22 (the day after planting); DPRE, delayed preemergence treatments were applied on May 24 (3 days after planting),;EPOST, early-postemergence treatments were applied on June 4 (14 days after planting).

Broadleaf weed control using pyridate (Tough) herbicide in chickpea

Chickpea 'Leader,' a medium-sized Kabuli-type, was planted at a rate of 150 lb/A at a depth of 3 inches on May 9, 2018 using a John Deere 1590 no-till drill. Chickpea inoculant was applied in-furrow during planting. Prior to planting, the entire field was treated with glyphosate (32 oz/A, 1.0 lb ai/A) to control winter annual weeds. Chickpea emerged on May 23. Herbicide treatments were applied on June 5 using a tractor-mounted research plot sprayer at a spray volume of 20 gallons per acre. This trial was designed to evaluate pyridate application rate without adjuvant and to compare methylated seed oil (MSO) verses crop oil concentrate (COC) adjuvants for broadleaf weed control. Additionally, treatments were included to determine if clethodim (Select) could be safely tank-mixed with pyridate. Also, we evaluated a single versus sequential applications of pyridate. Weeds present at time of application included kochia (2 to 5 inches), common lambsquarters (2 to 4 inches), Russian thistle (1 to 3 inches), and green foxtail (1 to 2 inches). Chickpea were evaluated for injury 8 days after treatment and no injury was observed for any of the herbicide treatments applied. The sequential treatments were applied on June 14, 9 days after the initial application. Chickpea were again evaluated for injury 7 days after the sequential application and no injury was observed for any herbicide treatment. At this same time, kochia, common lambsquarters, and green foxtail were visually evaluated for control (0-100 with 0 being no control, similar to the untreated and 100 being complete control or death of plants). At two weeks after the initial treatment application, kochia control increased from 44 to 59 to 68% when Tough herbicide was applied at 0.75, 1, and 1.5 pt/A, respectively. When Tough was applied at 1.5 pt/A with MSO or COC adjuvants, kochia control increased to 75 and81%, respectively. Tank-mixing Tough with Select did not antagonize kochia control. When Tough was applied sequentially using 1.5 pt/A twice, kochia control increased to 89%, this was similar to sequential applications of 1.5 pt/A followed by 0.75 pt/A that resulted in 90% control of kochia. Sequential applications of 0.75 pt/A resulted in only 73% kochia control and was similar to a single application at 1.5 pt/A. Control of common lambsquarters followed similar trends to that of kochia with the best control occurring with sequential applications of either 1.5 pt/A twice or 1.5 pt/A followed by 0.75 pt/A that resulted in 95% control of common lambsquarters. When Select was tank-mixed with Tough, green foxtail was controlled 94 to 98% 16 days after treatment, indicating that there was no antagonism for this tank-mix. Tough alone did not control green foxtail. At 30 days after the first application, similar trends occurred for weed control with one exceptions. There was no apparent advantage to use of either MSO or COC adjuvants as control of both kochia and common lambsquarters was similar with and without these adjuvants. This was also true for Russian thistle that was evaluated at this timing. Results from this trial indicate that pyridate (Tough herbicide) has potential use for broadleaf weed control in chickpea. Pyridate is a contact herbicide with no residual effect on weed control that will only control weeds present at time of application and with smaller weeds being controlled better than larger ones. It will best be utilized with other management options, such as following PRE herbicide application or possibly being tank-mixed with other PRE herbicides labelled for use in chickpea. Pyridate does offer potential POST control of broadleaf weeds in chickpea with is not currently an option with current registered herbicides. Further evaluations of PRE/POST combinations with pyridate as well as tank-mixes need to be considered.

Table. Chickpea response and weed control following application of pyridate (Tough) herbicide treatments at Hettinger, ND.

			chickpea			kochia			common lambsquarters			Russian thistle	
			8 DAT	16 DAT	30 DAT	16 DAT	30 DAT	49 DAT	16 DAT	30 DAT	49 DAT	30 DAT	49 DAT
Treatment	Rate	Timing	————% injury————			——————————————————— % control ———————————————————							
1Untreated	—	—	0	0	0	0	0	0	0	0	0	0	0
2Tough	0.75pt/a	A	0	0	0	44g	42f	54d	34e	41d	50e	49f	53e
3Tough	1pt/a	A	0	0	0	59f	58e	66c	58d	76bc	78cd	66e	76d
4Tough	1.5pt/a	A	0	0	0	68e	71cd	75b	77c	90a	89ab	80cd	81cd
5Tough	1.5pt/a	A	0	0	0	81c	79bc	79b	85b	88ab	81bcd	78cde	80cd
COC	2pt/a	A											
6Tough	1.5pt/a	A	0	0	0	75cd	79bc	81b	88ab	89a	91a	85bc	90b
MSO	2pt/a	A											
7Tough	1.5pt/a	A	0	0	0	81bc	75c	80b	86b	87ab	85abc	82bcd	85bc
Select	6oz/a	A											
COC	2pt/a	A											
8Tough	1.5pt/a	A	0	0	0	77cd	77bc	76b	84b	87ab	89ab	81cd	84c
Select	6oz/a	A											
MSO	2pt/a	A											
9Tough	1.5pt/a	A	0	0	0	89ab	88a	91a	95a	95a	92a	98a	100a
Select	6oz/a	A											
COC	2pt/a	A											
Tough	1.5pt/a	B											
COC	2pt/a	B											
10Tough	0.75pt/a	A	0	0	0	73de	66d	79b	72c	70c	72d	71de	81cd
Select	6oz/a	A											
COC	2pt/a	A											
Tough	0.75pt/a	B											
COC	2pt/a	B											
11Tough	1.5pt/a	A	0	0	0	90a	85ab	92a	95a	89a	94a	93a	100a
Select	6oz/a	A											
COC	2pt/a	A											
Tough	0.75pt/a	B											
COC	2pt/a	B											
LSD P=.05			.	.	.	7.27	8.14	7.88	7.12	12.72	9.46	3.90	5.52
Treatment F			0.000	0.000	0.000	31.249	23.794	16.725	58.371	13.033	16.394	1418.604	50.055
Treatment Prob(F)			1.0000	1.0000	1.0000	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001

Means followed by same letter or symbol do not significantly differ (P=.05, LSD)

Treatment timing ‘A’ was applied on June 5, 2018; timing ‘B’ was applied on June 14, 2018

Comparison of spray volume and adjuvant use for broadleaf weed control using pyridate (Tough) herbicide in chickpea

Chickpea 'Leader,' a medium-sized Kabuli-type, were planted at a rate of 150 lb/A at a depth of 3 inches on May 9, 2018 using a John Deere 1590 no-till drill. Chickpea inoculant was applied in-furrow during planting. Prior to planting, the entire field was treated with glyphosate (32 oz/A, 1.0 lb ai/A) to control winter annual weeds. Chickpea emerged on May 23. Herbicide treatments were applied on June 5 using a tractor-mounted research plot sprayer. Spray volumes of 10, 20, and 30 gallons per acre were compared with and without crop oil concentrate (COC) adjuvant. Weeds present at time of application included kochia (2 to 5 inches) and Russian thistle (1 to 3 inches). Chickpea was evaluated for injury 8, 16, and 31 days after treatment (DAT) and there was no injury observed with any treatment. At 16 DAT, kochia control was less (69%) when Tough plus COC was applied at a spray volume of 10 gallons per acre compared with spray volumes of 20 and 30 gallons per acre, 81 and 88% control, respectively. However, when evaluated at 31 and 49 DAT, no differences in kochia control was observed when comparing spray volumes, although there appeared to be a small advantage when using COC adjuvant verses no adjuvant. Russian thistle was controlled equally well regardless of spray volume or COC adjuvant. While initially it appear that a higher spray volume may increase weed control, the impact did not carry through at later evaluations.

Table. Chickpea response and weed control following application of pyridate (Tough) herbicide treatments at spray volumes of 10, 20, and 30 gallons per acre.

			chickpea			kochia			Russian thistle		
			8 DAT	16 DAT	31 DAT	16 DAT	31 DAT	49 DAT	8 DAT	31 DAT	49 DAT
Treatment	Rate	Volume	———% injury———			——————————— % control ———————————					
1Untreated	—	—	0	0	0	0	0	0	0	0	0
2Tough	1.5pt/a	10	0	0	0	69bc	73bc	77	84	85	88
3Tough	1.5pt/a	10	0	0	0	69bc	75abc	79	95	83	92
COC	1.25pt/a		0	0	0						
4Tough	1.5pt/a	20	0	0	0	65c	64bc	74	79	81	85
5Tough	1.5pt/a	20				81ab	77ab	78	90	81	92
COC	1.25pt/a		0	0	0						
6Tough	1.5pt/a	30				64c	63c	73	90	86	93
7Tough	1.5pt/a	30	0	0	0	74abc	71bc	76	86	87	70
COC	1.25pt/a										
8Tough	1.5pt/a	30				88a	87a	85	100	89	90
COC	2.5pt/a		0	0	0						
LSD P=.05			.	.	.	14.05	13.27	9.67	16.45	12.95	24.72
Treatment F			0.000	0.000	0.000	3.364	3.344	1.588	1.622	0.494	0.926
Treatment Prob(F)			1.0000	1.0000	1.0000	0.0211	0.0216	0.2076	0.1984	0.8048	0.4998

Means followed by same letter or symbol do not significantly differ (P=.05, LSD)

Response of Oats to Preemergence and Postemergence applied Herbicides at Hettinger, ND

A trial was conducted to evaluate herbicide with potential use in oats for preemergence and postemergence applications. Oats 'Hytest' were planted on May 23, 2018 at a rate of 60 lbs/A at a depth of 2 inches using a John Deere 1590 no-till drill. Starter fertilizer (18-46-0) was applied in furrow during planting at a rate of 40 lb/A (7 lb N and 18 lb P2O5/A). Immediately after planting paraquat (Gramoxone @ 32 oz/A) was applied to control emerged weeds. Prior to planting, urea fertilizer (46-0-0) was applied at a rate of 150 lbs/A (69 lb N/A) and glyphosate was applied (Cornerstone 5 Plus @ 32 oz/A) to control winter annual weeds. Preemergence herbicide treatments were applied on May 24 using a tractor-mounted research plot sprayer at a spray volume of 10 gallons per acre. Oats emerged on May 30. Early postemergence treatments were applied on June 4 (at the 1-leaf oat stage) and late postemergence treatments were applied on June 14 (at the 4-leaf oat stage). Oats were evaluated for injury at 18, 26, 36, and 50 days after the PRE application timing. The only injury observed to oats was with the postemergence application of Armezon, with bleaching injury being greater at the late POST application timing. Oats were harvested on August 31. Even with significant injury, there were no significant differences in oat yield or test weight. Oat yield ranged from 67 to 83 bushel per acre. The numerically lowest yield occurred following the late POST application of Armezon and the POST application of Zidua. Further evaluation of these herbicides is needed to verify safety for use in oats, but there appears to be potential for additional herbicides that could be utilized in oats.

Table. Oat response to preemergence and postemergence herbicide application at Hettinger, ND

			18 DAT	26 DAT	36 DAT	50 DAT	Yield	Test
Treatment	Rate	Timing	% control				Bu/A	Lb/Bu
1Untreated			0b	0c	0b	0b	74	36
2Zidua	3oz/a	PRE	0b	0c	0b	0b	82	35
3Warrant	1.5qt/a	PRE	0b	0c	0b	0b	82	37
4Dual II Magnum	1.67pt/a	PRE	0b	0c	0b	0b	78	35
5Prowl	3pt/a	PRE	0b	0c	0b	0b	76	37
6Outlook	18oz/a	PRE	0b	0c	3b	0b	78	35
7Zidua	3oz/a	EPOST	0b	0c	0b	0b	67	35
8Warrant	1.5qt/a	EPOST	0b	0c	0b	0b	76	34
9Dual II Magnum	1.67pt/a	EPOST	0b	0c	0b	0b	83	35
10Prowl	3pt/a	EPOST	0b	0c	0b	0b	83	35
11Outlook	18oz/a	EPOST	0b	0c	0b	0b	79	36
12Armezon COC	1oz/a 1% v/v	EPOST	14a	9b	0b	3b	77	37
13Armezon COC	1oz/a 1% v/v	LPOST	—	28a	46a	30a	67-	36
LSD P=.05			0.60	1.24	2.89	3.46	16.6	2.359
Treatment F			361.000	329.379	160.611	47.254	0.852	1.248
Treatment Prob(F)			0.0001	0.0001	0.0001	0.0001	0.5995	0.2903

Means followed by same letter or symbol do not significantly differ (P=.05, LSD)
Oats were planted on May 23, 2018 at Hettinger, ND.
Abbreviations: PRE, preemergence; EPOST, early postemergence; LPOST, late postemergence
Herbicides were applied on May 24 (PRE), June 4 (EPOST, 1-leaf oats), and June 14 (LPOST, 4-leaf oats)

Fall and Spring Applications of Sulfentrazone and Metolachlor for Weed Control in Dry Field Peas.

A trial was conducted to evaluate fall and spring applications of sulfentrazone and metolachlor for weed control in dry field peas. Fall treatments were applied on October 17, 2017 to a no-till field site previously planted to spring wheat. Treatments were applied using a tractor-mounted research plot spray at a spray volume of 10 gallons per acre. Downy brome had emerged prior to this application timing and was mostly in the 1-leaf stage. Winter weather prevented evaluation of plots until spring. In the spring, prior to planting, fall applications were 100% effective in controlling downy brome shepherd's purse and prickly lettuce. Field peas 'Nettes' were planted on May 3, 2018 using a John Deere 1590 no-till drill. On May 5, spring preemergence treatments were applied using the same equipment as fall treatments. All preemergence treatments included glyphosate plus AMS to control emerged weeds. Spring treatments were also nearly 100% effective at controlling downy brome and shepherd's purse. Residual control of green foxtail was generally better with spring application than fall, but control of kochia and common lambsquarters was very similar for both application timings. Evaluations taken on June 26th, 250 days after fall application of sulfentrazone resulted in 88 to 95% control of common lambsquarters and 87 to 91% control of kochia. Unfortunately, a severe hailstorm on the night of June 26 resulted in total defoliation of the peas and weeds making further evaluation of weed control impossible and prevented collection of yield data as well. It was impressive how well spring weeds were controlled with fall preemergence applications. Further research looking at fall herbicide applications for weed control prior to planting peas should be pursued.

Table. Effect of fall and spring preemergence herbicide treatments for weed control in field peas at Hettinger, ND

Treatment	Rate oz/A	Timing	Pea	Downy brome		Shepherd's purse		Kochia			Green foxtail		Common lambsquarters	
			18 DAE	-11 DAE	7 DAE	-11 DAE	7 DAE	7 DAE	18 DAE	43 DAE	18 DAE	43 DAE	18 DAE	43 DAE
			% injury	% control										
1Untreated		Fall	0	0b	0c	0c	0d	0c	0.0d	0f	0g	0c	0c	0e
2Glyphosate Broadaxe XC	32 25	Fall	0	100a	100a	100a	99a	100a	91.3a	91ab	70e	63a	94a	92a
3Glyphosate Broadaxe XC	32 19	Fall	0	100a	100a	100a	100a	95a	80.0c	90ab	58f	36b	86b	93a
4Glyphosate Broadaxe XC Dual II	32 19 10	Fall	0	100a	100a	100a	100a	98a	85.0bc	88b	78cd	73a	90ab	95a
5Glyphosate Broadaxe XC Dual II	32 19 16	Fall	0	100a	100a	100a	100a	96a	85.0bc	91ab	80bcd	74a	93a	88a
6Glyphosate Dual II	32 32	Fall	0	100a	100a	100a	100a	44b	0.0d	13e	75de	66a	0c	0e
7Glyphosate	32	Fall	0	100a	96b	97ab	90bc	0c	0.0d	0f	0g	0c	0c	0e
8Glyphosate	32	Fall + Spring	0	100a	100a	95b	99a	95a	0.0d	0f	0g	0c	0c	0e
9Glyphosate Broadaxe XC	32 25	Spring	0	0b	100a	0c	98a	100a	91.0a	93ab	85a	78a	94a	87ab
10Glyphosate Broadaxe XC	32 19	Spring	0	0b	100a	0c	96ab	100a	89.1ab	96a	83abc	74a	90ab	90a
11Glyphosate Broadaxe XC Dual II	32 10 16	Spring	0	0b	100a	0c	99a	98a	86.3ab	80c	77d	75a	86b	75c
12Glyphosate Broadaxe XC Dual II	32 10 23	Spring	0	0b	100a	0c	94abc	96a	90.0ab	93ab	83ab	78a	86b	78bc
13Glyphosate Dual II	32 32	Spring	0	0b	99a	0c	98a	95a	0.0d	25d	79bcd	76a	0c	0e
14Glyphosate	32	Spring	0	0b	100a	0c	89c	98a	0.0d	0f	0g	0c	0c	0e
LSD P=.05			.	.	2.13	3.25	6.69	8.32	5.8	6.7	5.0	17.4	4.0	9.4
Treatment F			0.000	0.000	1283.6	2036.3	125.2	157.6	475.7	340.1	425.1	31.0	1053.4	161.9
Treatment Prob(F)			1.0000	1.0000	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001

Means followed by same letter or symbol do not significantly differ (P=.05, LSD)

Fall treatments were applied on October 19. Spring treatments were applied on May 5. Peas were planted on May 3

All treatments included AMS at 8.5 lbs/100 gallons

Flax Tolerance to Preemergence Herbicides at Hettinger, ND

Flax 'York' was planted on May 15, 2018 at 38 lb/A at a depth of 1.5 inches using a John Deere 1590 no-till drill. Prior to planting, on May 4, the entire field was treated with glyphosate (Cornerstone 5 Plus @ 32 oz/A) to control winter annual weeds. Urea fertilizer (46-0-0) was applied on May 2 at a rate of 45 lb/A. Preemergence herbicide treatments were applied on May 16 using a tractor mounted research spray using a spray volume of 10 gallons per acre. Flax emerged on May 24. Flax was evaluated for injury on June 12 (27 days after treatment (DAT)) and Jul 13 (58 DAT). The only treatment causing visual injury was the herbicide acetochlor (Warrant) resulting in 8% and 19% injury at 27 and 58 DAT, respectively. Stand and height counts were measured on June 19 and while there were no significant differences in stand or height, flax height following acetochlor was lowest of all treatments. Common mallow control 27 DAT was greatest (81%) following application of sulfentrazone plus metolachlor (Broadaxe plus Dual II Magnum), and similar to sulfentrazone plus pyroxasulfone (Spartan plus Zidua), flumioxazin plus pyroxasulfone (Fierce) and pendimethalin (Prowl H2O) with control ranging from 74 to 76%. All other treatments resulted in poor control of common mallow. Baryard control was best following application of metolachlor (Dual II Magnum) sulfentrazone plus metolachlor, pendimethalin, and dimethenamid (Outlook). Control of barnyardgrass with these treatments was only fair (74 to 79%). All other treatments provided poor control of barnyardgrass. Plots were impacted by a severe hailstorm on the night of June 26 resulting in nearly complete defoliation. Further evaluations were not taken do to the damage to the plots. However, plot yields were measured on September 28. While yields showed no statistically significant differences, yields were lowest following application of acetochlor and second lowest in the untreated control. Yields ranged from 787 to 1015 LB/A. Test weight of flax was lowest following application of acetochlor. From these results, it appears that there are several options that could be pursued for preemergence weed control in flax. Although, the herbicide acetochlor may be too injurious to flax.

Table. Flax response and weed control following preemergence herbicide application.

		Flax			Common mallow	Barnyardgrass	Kochia	Flax	
		Injury	Stand	height	27 DAT	27 DAT	27 DAT	Yield	Test
Treatment	Rate	%	plants/m	cm	——————% control——————			LB/A	LB/BU
1 Untreated		0b	187	20	0c	0f	0e	836-	53c
2 Zidua	3oz/a	0b	216	21	0c	71bcd	70b	1012-	56abc
3 Spartan Zidua	4oz/a 1.5oz/a	0b	221	21	76a	68cd	78ab	1016-	58a
4 Warrant	1.5qt/a	8a	213	19	5c	63d	66b	787-	49d
5 Dual II Magnum	1.5pt/a	0b	196	20	0c	75abc	74ab	873-	55abc
6 BroadAxe Dual II Magnum	22.8oz/a 5.2oz/a	0b	206	21	81a	78ab	84a	908-	57ab
7 Fierce	3oz/a	0b	195	21	74a	74abc	74ab	870-	56abc
8 Prowl H2O	3pt/a	0b	221	20	76a	79a	67b	967-	55abc
9 Valor	2oz/a	0b	228	21	30b	45e	46c	872-	54c
10 Outlook	18oz/a	0b	229	20	23b	74abc	21d	967-	55bc
LSD P=.05		2.3	43.3	1.8	7.8	8.7	11.3	204.6	2.9
Treatment F		9.000	0.940	0.846	179.594	63.687	48.965	1.188	5.741
Treatment Prob(F)		0.0001	0.5082	0.5821	0.0001	0.0001	0.0001	0.3417	0.0002

Means followed by same letter or symbol do not significantly differ (P=.05, LSD)

Flax Tolerance to Preemergence and Postemergence Herbicides

Flax 'York' was planted on May 15, 2018 at 38 lb/A at a depth of 1.5 inches using a John Deere 1590 no-till drill. Prior to planting, on May 4, the entire field was treated with glyphosate (Cornerstone 5 Plus @ 32 oz/A) to control winter annual weeds. Urea fertilizer (46-0-0) was applied on May 2 at a rate of 45 lb/A. Preemergence herbicide treatments were applied on May 16 using a tractor mounted research spray using a spray volume of 10 gallons per acre. Flax emerged on May 24. Postemergence treatments were applied on June 5. Flax was evaluated visually for injury at 7, 15, and 38 days after postemergence treatments were applied. Injury from POST application of Talinor was severe (61 to 81%), whereas PRE application of Talinor caused little or no injury. However, Talinor acts primarily as a POST herbicide and resulted in little control of either common mallow or kochia. POST applications of Talinor provided fair control of both common mallow and kochia. Armezon caused injury (bleaching) to flax with the injury being greater when applied at 0.75 oz/A compared with 0.5 oz/A at 15 DAT. Armezon in this trial provided only fair control of common mallow or kochia. Bison (bromoxynil plus MCPA) also caused minor injury to flax and provided fair to poor control of common mallow and kochia. Basagran caused very little injury to flax and fair control of common mallow but poor control of kochia. Raptor caused moderate injury to flax (29% 15 DAT) but provided excellent control of common mallow and fair control of kochia. The tank-mix of Basagran plus Raptor showed less injury to flax 15 DAT and also provided excellent common mallow control and fair control of kochia. Flax was harvested on September 28. Flax yield was reduced by POST Talinor treatments and in the untreated control. Even though moderate injury occurred following Raptor application, flax yield was not reduced and was second highest numerically or all treatments. Note: trial was impacted by a severe hailstorm on the night of June 26 that completely defoliated flax and weeds in this trial. This may have impacted both weed control and yield potential in this trial.

Table. Flax response and weed control following preemergence and postemergence herbicide application.

			Flax			Common mallow		Kochia	Flax	
			7 DAT	15 DAT	38 DAT	15 DAT	38 DAT	15 DAT	Yield	Test
Treatment	Rate	Timing	—— % Injury ——			———% control———			LB/A	LB/BU
1 Untreated			0	0	0	0	0	0	937bc	49.33bc
2 Coact+	2.75oz/a	PRE	0e	0f	0c	5d	28e	0d	1067ab	51.53ab
Talinor	13.7oz/a									
COC	1% v/v									
3 Coact+	3.6oz/a	PRE	9d	0f	4c	0d	45d	23c	989ab	51.75a
Talinor	18.2oz/a									
COC	1% v/v									
4 Coact+	2.75oz/a	POST	73b	61b	70a	65b	56bcd	55ab	731cd	47.40c
Talinor	13.7oz/a									
COC	1% v/v									
5 Coact+	3.6oz/a	POST	81a	78a	74a	74a	70b	65ab	651d	49.85ab
Talinor	18.2oz/a									
COC	1% v/v									
6 Armezon	0.5oz/a	POST	14cd	0f	0c	64bc	60bc	63ab	1174a	51.55ab
COC	1% v/v									
7 Armezon	0.75oz/a	POST	12d	13de	4c	65b	69b	49b	1038ab	50.43ab
COC	1% v/v									
8 Bison	1pt/a	POST	10d	14d	5c	55c	53cd	50ab	947abc	51.10ab
9 Basagran	1pt/a	POST	3e	6ef	3c	63bc	64bc	48b	1061ab	50.58ab
COC	1% v/v									
10 Raptor	4oz/a	POST	18c	29c	15b	80a	100a	70a	1118ab	51.15ab
NIS	0.25% v/v									
28% N	2.5% v/v									
11 Basagran	1pt/a	POST	11d	18d	14b	80a	92a	66ab	1094ab	51.90a
Raptor	4oz/a									
MSO	1% v/v									
LSD P=.05			4.94	6.89	8.05	8.45	14.92	17.75	229.1	4.94
Treatment F			267.731	121.505	98.073	112.363	28.870	13.547	4.072	267.731
Treatment Prob(F)			0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0017	0.0001

Means followed by same letter or symbol do not significantly differ (P=.05, LSD)
PRE, preemergence treatments were applied on May 16; POST, postemergence treatments were applied on June 5.

Sunflower response and weed control from herbicides applied pre-plant and post-plant preemergence near Hettinger, ND

A trial was established on May 22, 2018 to determine sunflower response and weed control following early pre-plant (EPP) and preemergence (PRE) herbicide treatments. On May 31, sunflower were planted in 30-inch rows using a John Deere planter at a rate of 20,000 seeds/A at a depth of 1.5 inches. Nine days prior to planting, and EPP treatments were applied using a hand-held back-pack sprayer with a 76-inch spray boom. PRE treatments were applied on June 4 using the same procedures. All EPP and PRE treatments were tank-mixed with glyphosate (Cornerstone 5 Plus @ 32 oz/A plus AMS at 8.5 lbs/100 Gal). The delay between planting and PRE application was due to persistent winds that prevented application. Sunflower emerged on June 7. Weeds emerging in trial included green foxtail and wild buckwheat. Green foxtail was controlled equally well when treatments were applied preplant or PRE. Wild buckwheat control was almost always greater following preplant application compared with PRE application. This may be due to greater amounts of rainfall after preplant vs PRE application which allowed for greater emergence of wild buckwheat following the PRE application timing. Sunflower yield was not affected by herbicide treatment or timing of herbicide treatment. Although yield in untreated plots was numerically the lowest, the difference was not significant. Weed populations in this trial were low, which was likely the reason for lack of yield response to herbicide treatments.

Table. Sunflower response and weed control following early pre-plant and preemergence herbicide treatments.

				Green foxtail		Wild buckwheat		
	Rate		Sunflower	28 DAT	42 DAT	28 DAT	42 DAT	Sunflower yield
Treatment	oz/A	Timing	% injury	——————% control——————				lb/A
1Untreatead			0	0	0	0	0	3280
2Authority Supreme	8.5	EPP	0	87ab	88b	90a	91ab	3580
3Spartan Charge	5.75	EPP	0	71d	66d	90a	94a	3637
4Spartan Elite	26	EPP	0	98a	96a	90ab	91ab	3893
5Zidua SC	4	EPP	0	89ab	91ab	75bc	820bc	3625
6Authority Supreme	5.8	PRE	0	88ab	93ab	68c	75c	3985
7Authority Supreme	8.5	PRE	0	94ab	94ab	68c	74c	4110
8Spartan Charge	3.75	PRE	0	74cd	79c	71c	79bc	3856
9Spartan Elite	19	PRE	0	85bc	92ab	73c	78c	3823
10Zidua SC	3	PRE	0	88ab	95a	78abc	86abc	3679
LSD P=.05			.	10.76	7.01	13.89	11.74	602.05
Treatment F			0.000	4.439	15.797	3.672	3.086	0.926
Treatment Prob(F)			1.0000	0.0029	0.0001	0.0079	0.0183	0.5213

Means followed by same letter or symbol do not significantly differ (P=.05, LSD)
EPP, early pre plant treatments, applied on May 22 (9 days before planting; PRE, preemergence treatments, applied on June 4 (4 days after planting)

Evaluation of the interaction of injectable trace mineral and vaccination protocol on feed intake, performance and immune response of weaned calves

Janna Kincheloe[1], James Gaspers[2], Gerald Stokka[2] and Christopher Schauer[1]

This experiment evaluated the effects of respiratory vaccine and injectable trace mineral (ITM) on calf performance, feed intake and immune response. Calves in this study had similar average daily gain, feed intake and feed efficiency regardless of treatment. The use of an injectable trace mineral did not influence immune response. Additionally, we found minimal differences in antibody response from vaccinated vs. unvaccinated calves.

Summary

Stress at weaning can compromise immune function and performance of calves. Proper vaccination and adequate mineral status are two factors that may influence the susceptibility of weaned calves to respiratory diseases. Sixty-four Angus calves from the NDSU Hettinger Research Extension Center were utilized for this study. Three weeks prior to weaning, calves were allocated randomly to treatment in a randomized complete block design with a 2 × 2 factorial treatment structure including administration or no administration of 1) a MULTIMIN90 injectable trace mineral or 2) a vaccine targeting viral respiratory diseases. Following preweaning treatments, calves were returned to dams and managed as a common group until weaning. Calves were assigned to pens, with four animals per pen and four pens per treatment. Calves were fed a forage-based backgrounding diet for 37 days and marketed at a local livestock auction. Weights and blood samples were collected at preweaning, weaning and the end of the feeding period. Serum was separated from blood samples and analyzed for bovine respiratory syncytial virus (BRSV) and bovine viral diarrhea virus type 2 (BVDV 2) antibody responses. No differences were observed for calf feed intake, average daily gain (ADG) or feed efficiency due to treatments ($P > 0.10$). Vaccinated calves had increased BVDV 2 titers, compared with nonvaccinated calves, with titers decreasing in nonvaccinated calves from the beginning to the end of the study ($P < 0.001$). BRSV titers were not significant based on vaccination or injectable trace mineral (ITM) treatment ($P > 0.30$). Injectable trace mineral treatment did not affect titer levels for BRSV or BVDV 2 ($P = 0.58$). Vaccination for respiratory diseases and injection of trace mineral had minimal influence on animal performance and immune response in this study.

Introduction

Respiratory diseases are some of the most common and costly issues in the beef industry in terms of morbidity, mortality and widespread impacts on production. Deficiencies of trace minerals such as selenium, copper, zinc, cobalt and iron have been shown to be a factor in reduced disease resistance (Spears, 1995).

With increasing pressure to reduce the use of antibiotics in animal agriculture, we see a need to develop alternative management strategies that can be used during times of stress, such as weaning when the immune system may be compromised. Injectable trace mineral sources have been suggested to be beneficial during a period of increased stress or metabolic need to allow for rapid increases in trace mineral status and liver storage of minerals.

Data evaluating the use of injectable trace minerals with or without standard vaccines in weaning protocols is lacking. The current experiment was designed to evaluate the influence of a MULTIMIN90 injectable trace mineral or a negative control with or without standard preweaning and weaning vaccinations for respiratory diseases on feed intake, performance and immune response of beef calves consuming a forage-based diet in an approximately 35-day postweaning period.

Experimental Procedures

Three weeks prior to weaning on day zero of the experiment, 64 Angus calves raised at the NDSU Hettinger Research Extension Center were assigned randomly to one of four treatment groups: 1) MULTIMIN90 injection and vaccination for respiratory diseases (Vac-90); 2) No MULTIMIN90 injection, only vaccination for respiratory diseases (Vac); 3) MULTIMIN90 injection without vaccination for respiratory diseases (NoVac-90); and 4) No MULTIMIN90 injection or vaccina-

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tion for respiratory diseases (Con). MULTIMIN90 is an an injectable chelated aqeuous source of supplemental zinc, manganese, selenium and copper.

All calves received an injection of Ultrabac 7/Somubac for the prevention of clostridial diseases and *H. somni*. Only calves assigned to Vac and Vac-90 treatments received an additional injection of Bovi-Shield Gold One Shot for prevention of BVDV types 1 and 2, BRSV, infectious bovine rhinotracheitis (IBR), parainfluenza virus type 3 (PI3) and *Mannheimia haemolytica*.

Calves assigned to Vac-90 and NoVac-90 treatments received one injection of MULTIMIN90 based on recommended product dosage guidelines of 1 milliliter (mL) per 100 pounds of body weight. All vaccines and MULTIMIN90 were injected in the neck.

Calves were weighed and blood samples were collected via jugular venipuncture to determine pretreatment mineral status. Calves were returned to their dams and no further treatments were applied prior to weaning.

At weaning (day 21 of the experiment), calf weights and blood samples again were collected via jugular venipuncture, and calves were assigned to pens for the postweaning feeding trial. Each previously described treatment had four pen replicates, with four calves per pen.

The initial diet was fed from days one to 22 and consisted of mixed grass hay, haylage, soybean hull pellets, barley and protein supplement. Due to calves excessively sorting the diet, a portion of the soybean hull pellets was replaced with oats on day 23 and fed through the remainder of the trial.

Both diets were formulated to achieve approximate gains of 1.5 to 2 pounds/head/day (Table 1). Feed intake by pen was monitored by NDSU personnel. Feed intake and calf weight changes were utilized to calculate feed efficiency and average daily gain (ADG) by pen.

Three calves received one-time individual treatments of oxytetracycline due to signs of respiratory illness on day 19 (n = 2; one head each from Vac-90 and Vac treatments) and day 21 (n = 1; one head from NoVac-90 treatment) of the study. Treated calves remained in pens. Oral chlortetracycline (CTC) was administered to all calves on the study for a five-day period starting on day 27 due to reduced feed intake, abnormal nasal discharge, coughing and general lethargy.

The postweaning feeding period was concluded on Nov. 9. Final calf weights and post-treatment blood samples were collected on this date. Calves were sold at a local livestock auction market the following week. Serum samples collected on day zero (preweaning) and day 58 (end of postweaning feeding period) were packaged on ice and shipped overnight to the Texas A&M Veterinary Medical Diagnostic Laboratory in Amarillo, Texas, for BRSV and BVDV 2 antibody titer analyses.

All data were analyzed using the mixed procedure of SAS (SAS Ins. Inc., Cary, N.C.). Variables analyzed included ADG, feed intake, feed efficiency, BRSV antibody titers and BVDV 2 antibody titers. Antibody titers were converted using the natural log to normalize data. Significance was determined with an alpha of $P \leq 0.05$.

Results and Discussion

Preweaning weights across treatments averaged 502 pounds ± 1.5, and weights at weaning averaged 554 pounds ± 3.7. We found no effect ($P > 0.20$) due to either treatment or their interaction on ADG from preweaning to the end of the feeding period (avg. 2.34 pounds/head/day ± 0.122). Additionally, we found no differences ($P > 0.10$) in feed intake (DM feed/head/day) or feed efficiency (DM feed/pound of gain) during the postweaning feeding period (avg. 12.97 pounds ±

Table 1. Ingredient and nutrient composition (dry-matter [DM] basis) of postweaning rations for calves receiving or not receiving injections of MULTIMIN®90 or standard respiratory vaccines.

Item	Diet 1 (days 1 to 22)	Diet 2 (days 23 to 35)
Diet composition (DM basis)		
Mixed grass hay, %	36.7	41.9
Soybean hull pellets, %	38.3	18.1
Haylage, %	5.4	6.3
Barley, %	15.5	18.2
Oats, %	—	15.8
Protein supplement, %	4.0	5.2
Nutrient composition (DM basis)		
Diet dry matter, %	84.4	83.9
Crude protein, %	11.7	11.9
ADF, %	35.0	27.4
NDF, %	52.2	43.9
TDN, %	59.3	65.2
NE_m, Mcal/lb	0.58	0.67
NE_g, Mcal/lb	0.31	0.40

0.599 and 5.86 ± 0.250, respectively).

Injectable trace mineral (ITM) treatment did not influence BVDV 2 or BRSV titer response ($P \geq 0.23$). The three-way interaction of vaccination treatment, ITM and day of sampling were not significant for BVDV 2 or BRSV titer response ($P \geq 0.16$). Vaccination treatment and day were significant for BVDV type 2 titers ($P < 0.001$; Figure 1). Bovine respiratory syncytial virus titer response was not different based on vaccination or ITM treatment ($P > 0.30$). The interaction of BRSV titers by day was significant ($P = 0.002$; Figure 2).

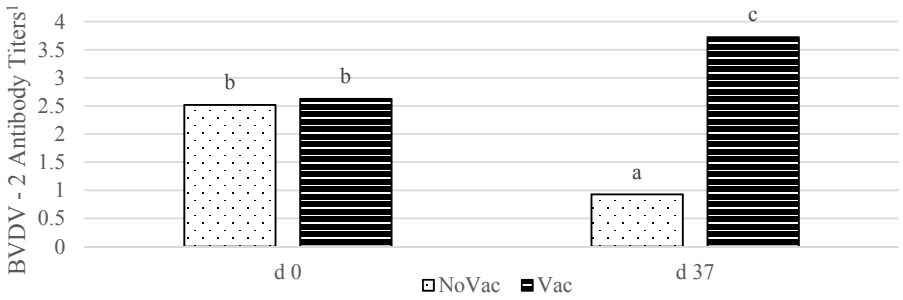
In the current study, none of the calves in the NoVac group responded with BRSV or BVDV 2 titer increases following injection. However, antibody responses observed for BVDV 2 and BRSV for calves assigned to the Vac groups were unexpected. Only 53 and 28 percent, respectively, of calves in the Vac group had any positive titer change to BVDV 2 and BRSV following vaccination.

All calves in this study received a multivalent modified live vaccine containing IBR, PI3, BRSV and BVDV types 1 and 2 at branding on June 6, 2017. A second preweaning dose was administered on Sept. 12, 2017. Three- to four-fold increases in antibody titer are considered to be indicative of a positive response to vaccination.

We anticipated that the majority of calves would have equal to or greater than a three-fold titer response to the vaccine based on vaccination history. We have several possible explanations for the lack of response.

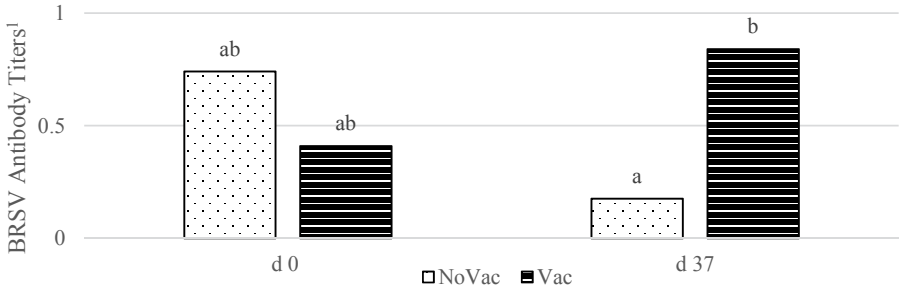
Modified live vaccines may be inactivated if mishandled and/or exposed to direct sunlight or temperature extremes during shipping, storage or vaccine administration. Additionally, temperature extremes could have affected serum samples submitted for antibody responses. Another possibility is that calves were highly stressed and experienced immunosuppression that prevented response to the administration of vaccine.

Trace minerals have an important role in optimizing the immune function of livestock, particularly during times of stress in feeder calves (Duff and Galyean, 2007). However, studies evaluating the response of injectable trace minerals (ITM) in feeder calves have produced variable responses. Additional research is warranted to help elucidate the timing of the trace mineral injection in relation to weaning in addition to helping define the relationship between trace mineral status and vaccine administration when evaluating health and performance responses.



[1]SN titer value were normalized using the Natural Log. *P* - value for treatment and treatment by day effects were less than 0.001. [a,b,c] Bars with different letters differ by $P < 0.05$.

Figure 1. Bovine viral diarrhea virus (BVDV) type 2 antibody titers by vaccination treatment across time.



[1]SN titer value were normalized using the Natural Log. *P* - value for treatment by day effects were less than 0.0015. [a,b,c] Bars with different letters differ by $P < 0.05$.

Figure 2. Bovine respiratory syncytial virus titers by vaccination treatment across time.

Acknowledgments

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Literature Cited

Arthington, J.D., and L.J. Havenga. 2012. Effect of injectable trace minerals on the humoral immune response to multivalent vaccine administration in beef calves. J. Anim. Sci. 90:1966-1971

Duff, G.C., and M.L. Galyean. 2007. Board-invited review: Recent advances in management of highly stressed, newly received feedlot cattle. J. Anim. Sci. 85:823–840.

Spears, J.W. 1995. Improving cattle health through trace mineral supplementation. Proc., The Range Beef Cow Symposium XIV. Available at: https://digitalcommons.unl.edu/cgi/viewcontent.cgi?article=1190&context=rangebeefcowsymp

Impacts of flax on female reproductive traits when supplemented prior to breeding in sheep

Amanda Long[1], Ethan Schlegel[2] and Christopher Schauer[1]

The objective of this study was to determine the effect of flax supplementation on reproductive parameters in multiparous ewes. The results indicate offering Flaxlic Sheep tubs will not alter the parameters of reproductive efficiency, including pregnancy rate, lambing rate, and prolificacy rate.

Summary

The objective of this study was to evaluate the effectiveness of flax supplementation on plasma fatty acid profile, serum progesterone concentration, and first-cycle pregnancy parameters. Two hundred forty multiparous Rambouillet ewes were assigned randomly to 24 pens (10 ewes/pen; n = 12). Ewes were fed a diet consisting of chopped hay that was balanced for flushing for 35 days. Pens were assigned randomly to one of two treatments for the 35-day feeding period: Flaxlic Sheep Tub (FLX) (intake= 5.32 ounces/ewe/day) or control (CON). Ewes were weighed on consecutive days at the beginning (days zero and 1) and end (days 34 and 35) of the study, as well as once every seven days to monitor weight gain. Blood samples were taken weekly on a subset of five ewes for the evaluation of circulating serum progesterone and omega-3 fatty acid concentrations. On day 18, intact male rams were placed in adjacent pens to stimulate estrus. After the dietary treatment protocol, ewes were comingled and placed in a pasture for breeding. At lambing, birthweight, birth type, and sex were recorded.

No differences were observed for initial weights and body condition score (BCS) ($P \geq 0.45$; 156.3 pounds and 3.1, respectively) or final weights and BCS ($P \geq 0.23$; 153.9 pounds and 3, respectively). No differences were observed ($P \geq 0.41$) for pregnancy rate (63.3 percent ± 4.7), prolificacy rate (152.6 percent ± 6.6), or lambing rates (95.8 percent ± 7.06) between CON and FLX treatments. No treatment by day interactions or treatment effects were observed ($P \geq 0.28$) for serum progesterone concentration. Our results are similar to results of studies in cattle, which demonstrated that flax did not have an effect on female reproductive traits. However, our results are in contrast with flax research conducted in other multiple-bearing species such as rabbits and rats.

Introduction

Fertility can be improved prior to breeding in sheep by improving nutritional management. This can be done by improving the ration in a flushing protocol. Flushing is a sudden increase in nutrition to facilitate follicular growth. This leads to the production of more eggs to ovulate and the potential for more lambs at birth. The addition of flaxseed to a flushing protocol has the potential to further enhance the effects of flushing.

Flaxseed supplements two important fatty acids: Alpha-linolenic acid (ALA; C18:3 n-3), an omega-3 fatty acid, and linoleic acid (LA: C18:2 n-6), an omega-6 fatty acid. Of the total fats in flax oil, 57 percent is ALA and 16 percent is LA (Morris, 2007).

Flaxseed has been shown to increase ALA and LA content in the milk of sheep, inferring flaxseed's fatty acids can be absorbed during digestion, enter the blood, and be transferred to the milk of sheep (Luna et al., 2008) and cows (Neveu et al., 2014). Additionally, flaxseed has been shown to increase ovulations in flax-fed litter-bearing species (Scholljegerdes et al., 2011; Abayasekara and Wathes, 1999; Trujillo and Broughton, 1995).

ALA and LA are precursors for prostaglandin synthesis. Increasing these fatty acids in the diet with the addition of flaxseed may affect reproduction because they have been shown to be essential for these prostaglandin precursors, as well as for structural fats (Singh et al., 2011). Supplementation of flaxseed has been shown to increase the size of the corpus luteum and increase subsequent progesterone concentrations (Lessard et al., 2003; Petit and Twagiramungu, 2006).

The objective of the present study was to determine if supplementation of flaxseed prior to breeding in Rambouillet ewes would improve reproductive parameters. The Flaxlic Sheep Tub was utilized as the supplementation method. The inclusion of flax in the flushing protocol should increase omega-3 and omega-6 fatty acids in the diet and alter key reproductive hormone concentrations.

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[2]New Generation Supplements, Belle Fourche, S.D.

Experimental Procedures

Two hundred forty multiparous Rambouillet ewes were kept in 24 pens in groups of 10 (n = 12). Ewes in every other pen were given a Flaxlic Sheep Tub (FLX). The Flaxlic Sheep Tub included 21 percent ground flaxseed and 6.4 percent flaxseed oil, as well as soybean meal and beet molasses.

The flax tub contained at least 12 percent crude protein, 15 percent crude fat, a maximum of 2 percent crude fiber and 2.5 percent acid detergent fiber. In terms of mineral, calcium, phosphorus, cobalt, iodine, manganese, selenium and zinc were supplied. The flax tub also supplemented vitamins A, D and E. The control (CON) pens did not get a flax tub but were supplemented with minerals by top dressing the ration (Hettinger Sheep Mineral 16-8).

Ewes were fed a diet of chopped hay for 35 days. The diet was balanced for a 154-pound ewe at a flushing rate. The diet was altered throughout the study to account for weight changes, with the CON treatment receiving more of the basal diet than the FLX treatment (3.77 and 3.46 pounds per head per day, respectively).

Ewes were weighed weekly. Body condition score was taken at the beginning and end of the trial. Blood was collected by jugular venipuncture from five ewes of average weight from each group on each weigh day, for a total of 120 ewes per week, for progesterone and fatty acid analysis.

On day 17, 10 mature rams were placed alongside the ewes for fence line male contact to induce cycling. On day 35, flax tubs were removed, and the 24 groups were comingled on pasture and rams were introduced for breeding.

Prior to lambing, ewes were allocated randomly to indoor pens of 15 ewes per pen. Lambing occurred from Jan. 14 through Feb. 26, 2018. At lambing, lamb birthweight, birth type, and sex were recorded. Lambs were docked at 1 to 2 weeks of age. Male lambs were not castrated at this time.

At approximately 14 days of age, lambs were moved to an outside dry lot with their dams. They remained comingled in the outdoor pens until weaning. Weights were taken of lambs at approximately 60 days of age.

Results and Discussion

Initial weights and body condition score did not differ between treatment groups. As designed, the final weights and body conditions scores did not differ (Table 1). The ewes were managed across the 35-day feeding period to achieve this result, utilizing increased hay intake for the CON treatment to ensure any effects observed were due to the addition of flax, not merely due to the addition of the entire tub.

We found no treatment by day effects ($P > 0.05$). Additionally, no differences occurred between treatments ($P = 0.28$) for progesterone concentration, but a day effect was found ($P < 0.001$). Progesterone increased in both treatments on days 28 and 35 (0.83 and 1.45 nanograms per milliliter [ng/mL], respectively; $P < 0.001$). Ewes were considered to be cycling when circulating progesterone rose above 1 ng/mL.

We found no differences ($P \geq 0.41$) in lambing data between FLX and CON (Table 3). The goal of adding flaxseed was to increase synthesis of progesterone. No difference was found in lamb birthweight (FLX = 11.96 pounds CON = 11.71 pounds; P = 0.28). Because no difference was found between treatment groups in progesterone concentration, the lambing data supports the progesterone data suggesting minimal effects of feeding FLX.

These results are in contrast with multiple studies involving

Table 1. Initial and final weight data for FLX and CON treatments[1].

	Treatment			
Item	CON	FLX	SEM	*P*-Value[3]
Initial weight, lbs.	156.5	156.1	0.42	0.47
Initial BCS[2]	3.09	3.11	0.024	0.45
Final weight, lbs.	153.2	154.6	0.81	0.23
Final BCS	2.97	2.98	0.05	0.88

[1]FLX = Flaxlic tub supplemented ewes; CON = control ewes.
[2]Body condition score, on a scale of 1-5 (1 = extremely thin, 5 = obese).
[3]*P*-value for F-test across treatments (n = 12 for FLX and CON treatments).

Table 2. Influence of feeding flax on progesterone concentration in ewes.

	Day					
Item[1], ng/mL	0	7	14	21	28	35
FLX	0.2	0.15	0.22	0.18	0.99	1.50
CON	0.17	0.17	0.16	0.26	0.67	1.41
P-value	0.88	0.93	0.71	0.61	0.04*	0.55

[1]FLX- Flaxlic Tub; CON-Control group.
*Significant values ($P < 0.05$).

omega-3 fatty acid additions in a livestock ration (Ambrose et al., 2006; Petit et al., 2008; Scholljegerdes et al., 2014). However, the results were in agreement with studies such as Petit et al. (2008), who indicated no increase in oocyte production in flax-fed dairy cattle.

Table 3. Influence of feeding flax on lambing data in ewes[1].

	Treatment			
Item[2]	CON	FLX	SEM	*P*-Value[3]
Pregnancy rate, %	61.7	65.0	4.71	0.62
Prolificacy rate, %	150.2	155.0	6.6	0.61
Lambing rate, %	91.7	100.0	7.06	0.41

[1]FLX = Flaxlic tub supplemented ewes; CON = control ewes.
[2]Pregnancy = percentage pregnant first cycle per ewe treated; Prolificacy = lambs first cycle per ewe lambed; Lambing rate = lambs first cycle per ewe treated.
[3]*P*-value for F-test across treatments (n = 12 for FLX and CON treatments).

Acknowledgments

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Literature Cited

Abayasekara, D.R.E., and D.C. Wathes. 1999. Effects of altering dietary fatty acid composition on prostaglandin synthesis and fertility. Prostaglandins, Leukotrienes and Essential Fatty Acids. 61:275-287.

Ambrose, D.J., J.P. Kastelic, R. Corbett, P.A. Pitney, H.V. Petit, J.A. Small, and P. Zalkovic. 2006. Lower pregnancy losses in lactating dairy cows fed a diet enriched in α-linolenic acid. J. Dairy Sci. 89:3066-3074.

Lessard, M., N. Gagnon and H.V. Petit. 2003. Immune response of postpartum dairy cows fed flaxseed. J Dairy Sci. 86:2647-2657.

Luna, P., A. Bach, M. Juarez and M.A. de la Fuente. 2008. Influence of diets rich in flax seed and sunflower oil on the fatty acid composition of ewes' milk fat, especially on the level of conjugated linoleic acid, n-3 and n-6 fatty acids. Int. Dairy J., 18: 99-107

Morris, D.H. 2007. Flax: a health and nutrition primer. 4th ed. Flax Council of Canada, Winnipeg, Manitoba, Canada.

Neveu, C., B. Baurhoo and A. Mustafa. 2014. Effect of feeding extruded flaxseed with different grains on the performance of dairy cows and milk fatty acid profile. J. Dairy Sci. 97:1543-1551.

Petit, H.V. and H. Twagiramungu. 2006. Conception rate and reproductive function of dairy cows fed different fat sources. Theriogenology 66:1316-1324.

Petit, H.V., F.B. Cavalieri, G.T.D. Santos, J. Morgan, and P. Sharpe. 2008. Quality of embryos produced from dairy cows fed whole flaxseed and success of embryo transfer. J. Dairy Sci. 91:1786-1790.

Scholljegerdes, E.J., L.A. Lekatz, and K.A. Vonnahme. 2011. Effects of short-term oilseed supplementation on reproductive performance in beef heifers. Can. J. Anim. Sci. 91:221-229.

Scholljegerdes, E.J., L.A. Lekatz, and K.A. Vonnahme. 2014. Effects of short-term oilseed supplementation on plasma fatty acid composition, progesterone, and prostaglandin F metabolite in lactating beef cows. Animal. 8:777-785.

Singh, K.K., D. Mridula, J. Rehal, and P. Barnwal. 2011. Flaxseed: a potential source of food, feed and fiber. Crit. Rev. Food. Sci. Nutr. 51:210-222.

Trujillo E.P. and K. S. Broughton. 1995. Ingestion of n-3 polyunsaturated fatty acids and ovulation in rats. J. Reprod. Fertil. 105:197–203.

Presentations, Outreach and Publications

Christopher Schauer, Hettinger REC Director and Animal Scientist

Presentations and Outreach

Dickinson State University Sheep Lab

Hettinger Research Extension Center, Hettinger, ND
February 8, 2018

NDSU Hettinger REC Sheep Research and Outreach Update
NDSU REC Spring Conference, Fargo, ND
February 28, 2018

Rambouillet Ram Test Results.
Ram Test Field Day, Hettinger, ND
March 10, 2018

OFDA Testing and Demonstration
Columbia Sheep Breeders Association National Show and Sale, Gillette, WY
June 14-15, 2018

Berry College Tours and Research Update
HREC, Hettinger, ND
June 23, 2018

ND State Fair Sheep Carcass Ultrasound Competition
ND State Fair, Minot, ND
July 24, 2018

OFDA demonstration
Newell Ram Sale, Newell, SD
September 20-21, 2018

Sheep Nutrition for Beginners
Starter Flock Sheep School, Hettinger, ND
September 22, 2018

NDSU Hettinger REC Sheep Research and Outreach Update
NDLWPA 2018 Annual Convention, Medora, ND
October 13, 2018

Impacts of flax on reproductive traits when supplemented prior to breeding in sheep
ND Flax Council, Bismarck, ND
October 15, 2018

Bridging the Gap Between Research and Extension in Your County
NDSU Fall Extension/REC Conference, Bismarck, ND

October 24, 2018

Carcass and Reproductive Ultrasound
BSC Animal Science Lab, Bismarck, ND
November 2, 2018

History of the Hettinger REC
NDSU Rural Leadership, Hettinger, ND
November 15, 2018

NDSU Shearing School
Hettinger, ND
November 17-19, 2018

NDSU and ASI Wool Classing School
Hettinger, ND
November 17-19, 2018

Publications

Crane, A.R., R.R. Redden, M.S. Crouse, J.D. Kirsch, J.E. Held, K.C. Swanson, and **C.S. Schauer*.** 2018. Influence of dried distiller's grains with solubles on ram lamb growth and reproductive traits. J. Anim. Sci. 96:1484-1494. doi: 10.1093/jas/sky031

Long, E., E. Schlegel, and **C. Schauer**. 2018. Impacts of flax on female reproductive traits when supplemented prior to breeding in sheep. 2018 NDSU Beef and Sheep Report. AS1778:22-24.

Kincheloe, J., J. Gaspers, G. Stokka, and **C. Schauer**. 2018. Evaluation of the interaction of injectable trace mineral and vaccination protocol on feed intake, performance, and immune response of weaned calves. 2018 NDSU Beef and Sheep report. AS1778:12-14.

Grants

Impacts of banamine injection on pain responses of either rubber ring castrated and tail docked or surgically castrated and burdizzo docked lambs. ND-SBARE: $9,555. Funded February, 2018. (PI)

Wildlife and Range Science

Benjamin Geaumont, Research Assistant Professor
Daniel Graham, Research Specialist

Geaumont, B.A. 2018. Ring-necked Pheasant Ecology in a Changing North Dakota Landscape. Pheasants Forever National Pheasant Fest, February 15-18, Sioux Falls, SD.

Geaumont, B.A. 2018. Conservation Crisis in North Dakota: A birds-eye view. North Dakota State University Extension and Research Extension Center Fall Conference, October 22-25, Bismarck, ND.

Geaumont, B.A. 2018. Carving a Niche in Southwest North Dakota: Wildlife and Range Research at the Hettinger Research Extension Center. Rural Leadership North Dakota, November 15, Hettinger, ND.

Antonsen, A, C. Pei, J. Harmon, T. Hovick, R. Limb, and **B. Geaumont**. 2018. Statewide status update of threatened butterfly pollinators in North Dakota. North Central Branch of the Entomology society of America, March 18-21, Madison, WI.

Cutter, J., T. Hovick, **B. Geaumont**, D. McGranahan, R. Limb. 2018. Variation in Pollinator Resources across Former Conservation Reserve Program Fields Managed with Patch-burn Grazing Using Cattle or Sheep. Society for Range Management National Conference, February 1-7. Sparks, NV.

Spiess, J., M. Lakey, D. McGranahan, **B. Geaumont**, T. Hovick, R. Limb, and K. Sedivec. Heterogeneity in forage quality, quantity and vegetation structure determines rangeland livestock use under patch-burn grazing. Society for Range Management National Conference, February 1-7. Sparks, NV.

McGranahan, D., J. Spiess, and **B. Geaumont**. 2018. Our low-cost open-source GPS collars work well provide insight into spatial data collection. Society for Range Management National Conference, February 1-7. Sparks, NV.

Geaumont, B. 2018. North Dakota Wildlife. Bowman Conservation Days, September 28, Bowman, ND.

Geaumont, B. 2018, Careers in Wildlife. Bowman County Career Day, November 14, Bowman, ND.

Crops Day – Specialty Tour, Patch-Burn Grazing in Post CRP land. July 10, Hettinger, ND.

Publications

Geaumont, **B.A**., T.J., Hovick, R.F. Limb, W.M., Mack, A.R. Lipinski, and K.K. Sedivec. 2018. Plant and bird community dynamics in mixed-grass prairie grazed by native and domestic Herbivores. Rangeland Ecology and Management: *in press*, available online, 12 November.

Norland, J.E., Dixon, C.S., D.L. Larson, K.L. Askerooth, and **B.A. Geaumont**. 2018. Prairie reconstruction unpredictability and complexity: what is the rate of reconstruction failures? Ecological Restoration 36:263-266.

McGranahan, D.A., **B.A. Geaumont**, and J.W. Spiess. 2018. Assessment of a livestock GPS collar based on an open-source datalogger informs best practices for logging intensity. Ecology and Evolution 8:5649-5660.

Funding

Hovick, T., B. Geaumont, R. Limb, and D. McGranahan. 2018. Restoring disturbance to old CRP fields to promote ecosystem services – role of reseeding forbs. North Dakota Game and Fish Department-Section 6 Conservation Money. Additional funding brings total award to $145,000.

Hovick, T., B. Geaumont, J. Harmon, M. Oslie, J. Rickertsen, and R. Limb. 2018. Enhancing dry bean production with adjacent pollinator habitats: Quantifying the range and extent of benefits. North Dakota Department of Agriculture – specialty crops grant. Total Funding $127,085.

John Rickertsen, Hettinger REC Research Agronomist

Presentations and Outreach

New Varieties Update
West River Breeders, Reeder, ND
February 13, 2018

New Varieties and Research Update
Hettinger County Crop Imp. Asso., Regent, ND
February 14, 2018

New Varieties and Research Update
Taylor Farm Institute, Taylor, ND
February 14, 2018

New Varieties Update
Crop and Pest School, Williston, ND
March 7, 2018

Barley Varieties, Soybean Research
Hettinger REC Crop Tour, Hettinger, ND
July 10, 2018

Wheat Varieties
Dewey County SD Crop Tour
July 12, 2018

Small Grain Varieties
USDA-ARS Northern Plains Friends & Neighbors Day, Mandan, ND
July 19, 2018

Small Grain Varieties
Bowman County Crop Tour, Scranton, ND
July 25, 2018

Small Grain Varieties
Hettinger County Crop Tour, Regent, ND
July 26, 2018

Hettinger Agronomy Research Update
Tear Down the Walls, Northern Plains Agronomist Meeting, Deadwood, SD
July 29-30, 2018

Cover Crop Tour
Hettinger REC
October 19, 2018

New Varieties and Research Updates
35th Western Dakota Crops Day, Hettinger, ND
December 20, 2018

Publications

Shana M. Forster, John R. Rickertsen, Grant H. Mehring & Joel K. Ransom (2018) Type and placement of zinc fertilizer impacts cadmium content of harvested durum wheat grain, Journal of Plant Nutrition, 41:11, 1471-1481, DOI: 10.1080/01904167.2018.1457687

2017 Research Results, Area 4 SCD Cooperative Research Farm & USDA-NGPRL. Spring Wheat, Durum Wheat and Barley Variety Performance Results. In Proc. March 2018.

North Dakota Hard Winter Wheat Variety Trial Results for 2018. September 2018. NDSU Extension Service circular A1196-18.

North Dakota Hard Red Spring Wheat Variety Trial Results for 2018. October 2018. NDSU Extension Service circular A574-18.

North Dakota Dry Pea Variety Trial Results for 2018. October 2018. NDSU Extension Service circular A1469-18.

North Dakota Durum Wheat Variety Trial Results for 2018. October 2018. NDSU Extension Service circular A1067-18.

North Dakota Dry Bean Variety Trial Results for 2018. December 2018. NDSU Extension Service circular A654-18.

North Dakota Canola Variety Trial Results for 2018 and Selection Guide - A1124-18. November 2018. NDSU Extension Service circular A1124-18.

North Dakota Flax Variety Trial Results for 2018. November 2018. NDSU Extension Service circular A1105-18.

North Dakota Barley, Oat and Rye Variety Trial Results for 2018. December 2018. NDSU Extension Service circular A1049-18.

North Dakota and South Dakota Sunflower Hybrid Trial Results for 2018. December 2018. NDSU Extension Service circular A652-18.

North Dakota Soybean Variety Trial Results for 2018. December 2018. NDSU Extension Service circular A843-18.

North Dakota Corn Hybrid Trial Results for 2018. November 2018. NDSU Extension Service circular A793-18.

35th Annual Western Dakota Crops Day Research Report. December 2018. NDSU Hettinger Research Extension Center Ag. Report No. 35.

Grants

Sustainable systems for oilseed production in the northern Great Plains. (carinata research). Sun Grant Initiative. $4,299.

Western Regional Cool Season Food Legume Evaluation Trials. US Dry Pea and Lentil Council. $4,000.

Evaluation of fungicide seed treatments under different tillage, crop rotations and soil conditions. North Dakota Wheat Commission. $3,110.

Nitrogen Relationships of Soybean in Southwest ND. North Dakota Soybean Council. $6,011.

Assessment of Potassium and Phosphorus Mining in Soybean Fields in ND. North Dakota Soybean Council. $820

Management of Root Rots of Field Peas with Crop Rotation. Northern Pulse Growers Asso. $5,954

Developing an environment specific decision support system to help growers determine an optimum seeding rate for new wheat varieties. ND-SBARE. $10,393.

Effect of planting date and maturity on foliar and head diseases of durum. ND-SBARE. $2,016.

Dow Canola Megaplot Trial. Dow AgroSciences. $5,670.

Evaluation of Hybrid Spring Wheat at Hettinger and Rugby. Syngenta Crop Protection. $8,164.

Optimum Seeding Rate of Spring Wheat Hybrids. Syngenta Crop Protection. $21525.

Development of Hard White Specialty Spring Wheat Breeding Program. Ardent Mills. $40,500.

Contract entries for public variety trials. $25,500.

Caleb Dalley, Hettinger REC Research Weed Scientist

Presentations and Outreach

Weed Control in Southwest North Dakota
Wild World of Weeds Workshop, Fargo, ND
January 16, 2018

Weeds are Changing, So Should Your Approach to Control Them
The Best of the Best in Wheat Research and Marketing, Dickinson, ND
February 6, 2018

Weeds are Changing, So Should Your Approach to Control Them
The Best of the Best in Wheat Research and Marketing, Dickinson, ND
February 6, 2018

Weeds are Changing, So Should Your Approach to Control Them
The Best of the Best in Wheat Research and Marketing, Minot, ND
February 8, 2018

Soil Applied Herbicides in Legumes; Options and Challenges for Weed Control
CHS Agronomy Meeting, Dickinson, ND
February 13, 2018

Evaluation of Herbicide Options for Kochia Control in Western North Dakota
Western Society of Weed Science, Orange Grove, CA
March 12-15, 2018

Weed Control Research Updates
Hettinger REC Crop Tour, Hettinger, ND
July 10, 2018

Updates in Weed Control
35th Western Dakota Crops Day, Hettinger, ND
December 20, 2018

Publications

Abe, DG, **CD Dalley**, and BM Jenks (2019) Evaluation of herbicide options for kochia control in western North Dakota. *In* Proceedings of the Western Society of Weed Science, 71:27, Garden Grove, CA, 12-15 March, 2018.

Zollinger, R et al. (2018) North Dakota Weed Control Guide. North Dakota State University Extension Service Publication W-235.

Grants

Date Received	Title of Research Project	Source	Amount
3/1/2018	Evaluation of POST Crop Safety with Warrant Tank-Mixes in RR Canola	Monsanto	$6,800.00
3/18/2018	Evaluation of sunflower tolerance to fall-applied herbicides	SBARE	$4,000.00
4/15/2018	Oat Tolerance to Preemergence Herbicides	ND Crop Protection and Harmonization Board	$5,000.00
5/1/2018	Crop Tolerance to Fall Applied Herbicides	Northern Pulse Growers	$2,500.00
7/1/2018	Preharvest Options for Desiccation of Crop and Weed Biomass is Wheat	North Dakota Wheat Commission	$2,500.00
	Other unrestricted grant in aid	Various	**$58,600**
	Total		**$79,400**

Janna Block, Hettinger REC Extension Livestock Specialist

Presentations and Outreach

Beef Days
Hettinger and Amidon, ND
January 16-17, 2018

NDSU Extension Feedlot School
Carrington, ND
January 23-24, 2018

Agri-International Trade Show
Bismarck, ND
February 6-7, 2018

Crop and Livestock Meetings
Taylor and Regent, ND
February 14, 2018

NDSU/SDSU Extension Multistate Nutrition Workshop
Buffalo, SD
February 27, 2018

Golden Valley Crop/Livestock Workshop
Beach, ND
March 9, 2018

Sheep Carcass Ultrasound Certification School
Fargo, ND
April 16-18, 2018

Badlands Genetics AI School
Dickinson, ND
April 26, 2018

NDSU Off-Campus Specialists Meeting
Hettinger, ND
May 16-17, 2018

Beef Cattle Mineral Nutrition Workshop – Part I
Manning, ND and Lowry, SD
May 24-25, 2018

Cattlemen's Conversations – Fly Control for Grazing Cattle
Available at: https://www.youtube.com/watch?v=Qi4jotypOgY&feature=youtu.be
June 1, 2018

4-H Market Animal Nutrition/Showmanship Workshops
Wishek, Dahlen, and New Salem, ND
June 5, 6, and 8, 2018

Hettinger REC Field Day
Hettinger, ND
July 10, 2018

Ranch visits for Beef Cattle Mineral Nutrition program
Multiple locations across North and South Dakota
July 16-18 and August 13-15, 2018

North Dakota Stockmen's Association Annual Convention and Trade Show
Bismarck, ND
September 13-15, 2018

Livestock In-Service Training for Extension Agents
Rugby, ND
September 18-19, 2018

Beef Cattle Mineral Nutrition Workshop – Part II
Gettysburg, SD and Dickinson, ND
September 26 and October 4, 2018

Animal Science Careers Presentation to Hettinger High School FFA Students
Hettinger, ND
October 10, 2018

NDSU Extension Calf Backgrounding Series
McVille, Spiritwood, Napoleon, Granville, New Salem, and Killdeer, ND
October 16-18, 2018

NDSU Extension Fall Conference
Bismarck, ND
October 22-24, 2018

Publications

Kincheloe, J., J. Gaspers, G. Stokka, and C. Schauer. 2018. Evaluation of the interaction of injectable trace mineral and vaccination protocol on feed intake, performance, and immune response of weaned calves. North Dakota Beef and Sheep Report, p. 12-14. Available at: https://www.ag.ndsu.edu/publications/livestock/2018-north-dakota-beef-and-sheep-report-1/as1899.pdf

Grants

Blair, A.D., **J.J. Kincheloe**, K.C. Olson, K.R. Underwood, J.K. Grubbs, A.A. Harty, R.R. Salverson, T. Grussing, W. Rusche, C.S. Schauer, D. Stecher, and D. Drolc. Comparison of winter cow feeding strategies on fetal development, offspring performance and meat quality. South Dakota Beef Industry Council. $69,344. Funded August 2018.

2018 Advisory Board Minutes and Handouts

Hettinger Research Extension Center
Advisory Board Meeting- February 7, 2018

Board members present: Kat Weinert, Curt Stanly, Duaine Marxen, Cody Jorgenson, Wade Henderson, Jeremy Huether, Matt Neiderman, and Tom DeSutter (who joined via IVN Videoconferencing). Guest present: Chris Boreboom, Tim Faller, Lyle Warner and Ken Grafton (who joined via IVN Videoconferencing). Staff present: Christopher Schauer, John Rickertsen, Caleb Dalley, Benjamin Geaumont, Janna Kincheloe and Cassie Dick.

Kat W called the meeting to order at 1:00 pm.

Kat W asked for a motion to approve the previous meeting minutes. Jeremy H moved to accept the minutes and Cody J seconded. Motion passes, no opposing.

Kat W then asked for a motion to accept the agenda, Chris S asked to move Janna K to the beginning as she has a grant deadline. Wade H moved to accept the adjusted agenda, Matt N seconded. Motion passes, no opposing.

Legislative Update & Director Report
Ken Grafton- Budget cuts. Hiring freeze lifted. Ag Experiment departments lost thirty-one FTE positions. Morale is good even in difficult situations. SBARE will meet to discuss final prioritization.

Chris Boreboom- Budget cuts and permanent position closures. Most of extension budget funds people/salary. Cuts were across the board: County Agents, Area Specialists, Administration and Support Staff. Working on filling critical positions. SBARE formed a committee to review the Extension Program. Extension will need a lot of support, probably a tough year coming up again.

Chris Schauer- Director's Report. Handout. Infrastructure and strategic plan.

Scientist Reports
Janna Kincheloe- handout. Impact report: Nitrate QuikTest Certification Program, traveled to train county agents for the nitrate quiktest (nitrates present or not) and steps to take if present. Working on grants for calf to finish project and a beginning beef producers program.

Ben Geaumont- handout. Effects of drought. Pollinators- bee and butterfly surveys. Prescribed burn projects.

John Rickertsen- handout. Effects of drought- toughest on cool season crops. Many projects continuing into next year. Work on hiring a technician.

Caleb Dalley- handout. Effects of drought- too dry to get good stand for trials and pre-emergent.

Chris Schauer- handout. Did lots of outreach this year. Good years for national exposer for the Hettinger REC (sheep shearing & wool classing school). Sheep related programs are growing.

Open Discussion

Tim Faller- station budget cuts sometimes mean not always doing projects you want to do, but the projects that are available and needed. Will need support for agriculture work, need more producers coming forward, like the folks on our board to testify, not just administration.

Chris Boreboom- What do producers need in drought years. Need to be more proactive, not reactive in Extension.

Kat W- how to get CRP grass made available sooner. More apparent and available programs.

Wade H- need more information on cover crops. Becoming more important in our area with grazing and drought conditions. Can a farmer/rancher "lower our footprint", lower costs, and help improve farming techniques through cover crops and grazing?

Election of Board members and Officers

Kat W and Tom D have served a full term limit and have completed their time on the HREC Advisory Board. Ashley S, Cody J, Dave O and Wade H have completed their first term as of this meeting; they are eligible for re-election to one more term on the board. Matt N motioned to nominate Ashley S, Cody J, Dave O and Wade H to serve another term. Curt S seconded. Members present agreed to serve another term on the HREC Advisory Board. Motion passes, no opposing.

Kat W and Chris S asked for ideas for nominations to replace Kat W and Tom D. Names brought by the board: Torre Hovick, NDSU on campus Assistant Professor, Range Science - School of Natural Resource Sciences and Jacki Christman a local farmer/rancher. After discussion, Wade H motioned to ask Torre Hovick and Jacki Christman if they would like to join the HREC Advisory Board. Jeremy H seconded. No opposing, motion passes. Chris S will contact Torre H and Jacki C.

Kat W asked for a nomination to replace herself as Chair. After discussion, Matt N motioned to nominate Wade H as Chair and Cody J as Vice-Chair (to replace Wade H as vice chair). Wade H and Cody J both agreed to serve as Chair and Vice-Chair, respectively. Curt S second. Motion passes, no opposing.

Summer meeting: held in conjunction with the Hettinger Crops Tour in July.

Staff dismissed for executive session.

February 7, 2018 Advisory Board Meeting
NDSU-Hettinger Research Extension Center

Director's Report

Legislative Report:

- Extension Service Budget and SBARE review: Chris Boreboom
- Current Biennium
    - 13.65% Budget Reduction (approximately $342,000/biennium)
        - Won't hire Animal Science Research Specialist ($140,000/biennium)
        - Won't hire Agronomy Technician on hard funds ($120,000/biennium)
            - Moving forward on filling the position with soft funds and splitting it between Agronomy and Weed Science
        - I have moved all of my graduate students off of general funds to grant funds ($40,000/biennium)
        - $10,000 in salary for Cassie now paid for by Extension Service due to acquiring an Extension Specialist
        - $25,000 reduction in equipment funds (line item as part of the $342,000)
        - Remaining $7,000 will be balanced with less spending/increased reliance on grants (State Fleet, operating, etc.)
        - We may re-fill the Agronomy Technician on soft funds
    - Extension Specialist received a 10% reduction in her operating account to help balance the Extension Service budget
    - 10% hay crop – purchased about $100,000 of hay
    - Suffered about at a $30,000 loss due to listeria outbreak this past winter
- Next Biennium: SBARE testimony has concluded. We did not ask for anything, but highlighted the reduced technical support
- Staffing
    - Fully staffed, with the exception of the Agronomy Technician

Infrastructure:

- 1000 ewes
- 80 head of cows
- 110 head of cows at ARS in Mandan (fiscal agent for their cow herd)
- CASE IH rental agreement – 5 tractors, baler, bobcat, self-propelled windrower
- Housing: Utilizing a trailer at the trailer park and the old office by the Agronomy Lab.

Strategic Plan: 2015 – 2019

1. Evaluate alternative livestock production systems that increase profitability while maintaining environmental stability (Chris and Janna).
2. Conduct applied research that investigates the compatibility of agriculture and wildlife (Ben).
3. Evaluate weed control methods to increase crop and forage productivity in southwest North Dakota (Caleb).
4. Enhance dryland crop production while maintaining natural resources (John).
5. Integration of Livestock, Wildlife, Agronomy, and Weeds research programs into a farm-scale interdisciplinary research project (All).

February 7,2018 - Advisory Board Meeting
NDSU-Hettinger Research Extension Center

Animal Science Report

Graduate Students:

- Graduate students and undergrad technicians:
  - Alison Crane –PhD – Animal Science (graduate and is now the Kansas State University Sheep & Goat Extension Specialist)
  - Amanda Long – M.S. – Animal Science (Chris Schauer and Travis Hoffman)
  - 2-3 Animal Science internships for the summer

Strategic Plan - Progress towards goals: *Evaluate alternative livestock production systems that increase profitability while maintaining environmental stability*

- Outreach efforts:
  - Fall Ram Test - Field Day March 10, 2018
    - 82 rams from 25 producers: Rambouillet, Columbia, Dorset, Targhee, GeneLink
  - Shearing and Wool Classing School: November 18-20, 2017
    - Shearing School – 24 students from ND, SD, OR, MN, NE, CA, and WY
    - Wool School – 19 students from ND, SD, MT, MN, and Canada
  - Sheep Schools with Extension Service
    - Beginning sheep school with NDLWPA and starter flock recipients (September) 60+ students
  - OFDA: Newel Ram Sale, Rapid City Stockshow, Fiber Festival in Watertown, SD, processed over 1420 samples from 45 producers
  - Received $27,036 to conduct nation-wide carcass ultrasound training in sheep for certification for the National Sheep Improvement Program
    - I will be hosting schools in TX, ID, ND, WI, and the west coast
  - The HREC was featured in back-to-back issues of the Sheep Industry News, the monthly publication of the American Sheep Industry Association
- Sheep Research:
  - Alison's PhD program: all refereed publications are completed
    - Effects of DDGS on male fertility (performance, semen quality)
    - Effects of lasalocid and DDGS in lamb finishing rations (feedlot performance, N and S balance, S gas cap)
  - New project: ***Impacts of flax on female and male reproductive traits when supplemented prior to breeding in sheep*** (Amanda Long M.S. program)
    - Received $38,000 to fund salary as well as product donation
    - Acquired $20,000 in funds for the ewe and ram trials
      - Ewe trial is lambing right now, with ram trial starting this spring
  - Coordinate a national level program evaluating fecal egg count in Polypay sheep, collecting FEC data on 3,000 lambs and blood cards on all sires (about 50)
  - Pursuing funds through SBARE to evaluate the impacts of Banamine on pain responses of either rubber ring castrated and tail docked or surgically castrated and burdizzo docked lambs.
  - Pursing a research project to determine if there is a genetic marker for "blown legs" in Rambouillet rams

- Cattle Research:
    - Grazing studies with Range and Wildlife program (Integrated project – Strategic Plan #5)
    - Mineral calf backgrounding trial with Livestock Extension program
- Publications:
    - Refereed journal articles: 4 in 2017, 1 so far in 2018
    - Extension Publications: Publish with Extension Sheep Specialist
- Extension Specialist: Dr. Janna Kincheloe

2018 Winter Advisory Board Meeting
Wildlife and Range Research Update
Ben Geaumont and Dan Graham

Strategic Plan Aim - **Conduct applied research that investigates the compatibility of agriculture and wildlife**

Graduate Students – Advised

Jonathan Spiess, PhD – Range Sciences, Evaluate livestock selection and fire behavior within patch-burn grazing research.

Jasmine Cutter, M.S. – Range Sciences, Evaluate pollinators in our patch-burn grazing research.

Alex Rischette, M.S. – Range Sciences, Evaluate wildlife response to patch-burn grazing on Post-CRP.

* Derek Klostermeir, M.S. - Natural Resource Management, evaluation of ecological site descriptions at sharp-tailed grouse nest sites on the Grand River National Grasslands.

Additional Graduate Student Committees

Joe Orr, M.S. – Range Sciences, Impact of cattail encroachment on secretive marsh birds in North Dakota. Graduated December 2017.

Adrienne Antonsen, M.S. – Entomology, Statewide pollinator survey.

Chyna Pei, PhD – Range Sciences, Statewide pollinator survey.

Cameron Duquette, PhD – Range Sciences, Grassland bird response to patch-burn grazing in mixed-grass prairie.

Current Research Projects

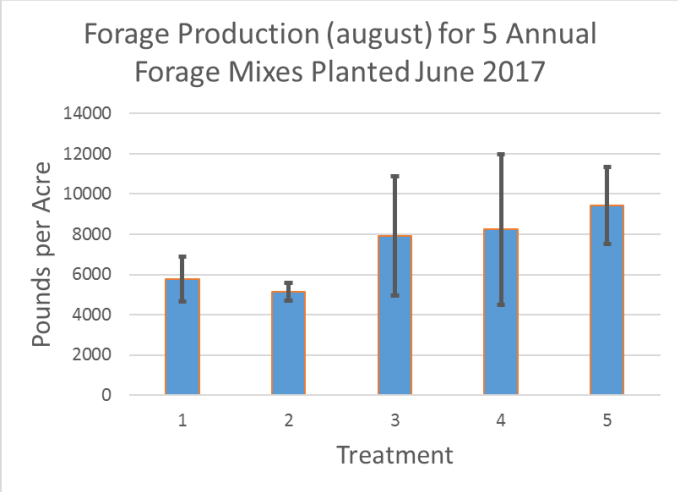
1. **Restoring disturbance to old Conservation Reserve Program Fields to Promote Ecosystem Services**. (C. Schauer, T. Hovick, R. Limb, and D. McGranahan)
    a. Evaluate the effects of patch-burn grazing in Conservation Reserve Program grasslands on livestock, vegetation, pollinators and wildlife in western North Dakota.
        i. Livestock, birds, vegetation, bees and butterflies
    b. Six, 160 acre pastures
        i. 3 with sheep
        ii. 3 with cow/calf pairs
    c. Six burns completed in October 2018

1a. Evaluate the ability of over seeding native forbs following prescribed fire to enhance habitat for pollinators.

a. Seeded (5), 1 acre plots within each prescribed fire area in mid-March 2017 and will do the same March 2018

2. **Annual forage mixes for southwest North Dakota: influence of planting date on forage production and pollinator communities.**

a. Interested in how incorporating annual forages into food plots for wildlife and forage for livestock may benefit pollinators and other insects. Also interested in how the surrounding landscape may influence wildlife and insect use of these plots.
    i. Planting Time Trial – designed to evaluate competition and production among different species within 5 seed mixtures (treatments) planted on three different dates (15 April, 15 May, 15 June). Also designed to provide surrogate pollinator cover.
        1. Data collection on forage production, bees, butterfly's and other insects is ongoing.



3. **Woody encroachment in the Northern Great Plains; effect on grassland birds, predator communities and livestock**.
    a. Collaboration with NDSU and ARS. (Analyses underway).
4. **Monitoring native pollinator communities throughout North Dakota: Status and Management considerations for bees and butterflies.** (CO-PIS: R. Limb, T. Hovick, and J. Harmon)
    a. Conducting statewide pollinator surveys. Access land use, floristic resources and pollinator associations. Funded by ND Department of Agriculture.

Strategic Plan Aim 5 - **Integration of Livestock, Wildlife, Agronomy, and Weeds research programs into a farm-scale interdisciplinary research project.**

Evaluate a livestock-crop integrated system using annual forages, winter wheat and sheep. Determine livestock gains, crop production, wildlife and insect use, and changes to soils.

a. Grazed standing wheat in spring 2017
b. Planted annual forages, warm season plants responded to late-July rain, provided grazing.
c. Collected insects – very poor year.

Publications

Geaumont, B.A., K.K., Sedivec, and C.S. Schauer. 2017. Ring-necked pheasant use of Post-Conservation Reserve Program Lands. Rangeland Ecology and Management 70 569-575.

McGranahan, D.A., **B.A. Geaumont**, and J.W. Spiess. 20XX. Livestock GPS collars based on an open-source datalogger, survives field conditions and informs best practices for logging intensity. (In Review).

Orr, J.T., T.J. Hovick, **B.A. Geaumont**, and T.M. Harms. 20XX. Density of secretive marshbirds in North Dakota. (In Review).

Geaumont, B.A., K.K. Sedivec, J.W. Stackhouse, and D. Graham. 20XX. From Indicator to Potential Focal Species: The Role of Grouse in Grassland Management. (Additional Statistics).

Mack, W.M., **B.A. Geaumont**, A.R. Lipinski, T.J. Hovick, R. Limb, and K.K. Sedivec. 20XX. Plant and bird community dynamics in mixed-grass prairie grazed by native and domestic herbivores. (Co-author review).

Mack, W.M., **B.A. Geaumont**, A.R. Lipinski, T.J. Hovick, and K.K. Sedivec. 20XX. Grassland bird nest site selection and survival on working landscapes grazed by cattle and occupied by black-tailed prairie dogs (co-Author review).

Geaumont, B.A. and J. Norland. 20XX. Influence of seed mixtures on native plant establishment in the badlands region of North Dakota (Final Co-author review).

February 7, 2018 Advisory Board Meeting
NDSU-Hettinger Research Extension Center
Agronomy Update – John Rickertsen
2017 Research Projects

Variety/Hybrid Performance Trials:

Twenty two yield trials were conducted on the following crops. (average yield)

Winter Wheat (82 bu)	*Field Pea (13 bu)*	*Canola (300 lb)*	*Sunflower (1900 lb)*
Spring Wheat (36 bu)	*Chickpea (488 lb)*	*Carinata (575 lb)*	*Corn (53 bu)*
Durum Wheat (36 bu)	*Lentil (355 lb)*	*Flax (3 bu)*	
Barley (45 bu)	*Dry Beans (1427 lb)*	*Safflower (wireworms)*	
Oats (62 bu)	*Soybean (24 bu)*		

2017 NDSU releases: "ND Benson" & "ND Stutsman" conventional soybeans, "ND17009GT" glyphosate tolerant (RR1) soybean, "ND VitPro" spring wheat, "ND Grano" & "ND Riveland" low Cd durum wheat. I am serving on the NDSU Variety Release Committee as the western REC representative.

Off Station Yield Trials:

Trials were located at Scranton, Regent and Mandan, New Leipzig was dropped due to time constraints and issues with good results there. These trials are located with farmer cooperators and with the USDA-ARS Northern Great Plains Lab at Mandan. Crops tested were spring wheat, durum wheat and barley.

Plant Breeding Nurseries:

Nurseries were planted for the following breeding programs.

Program	# of nurseries
NDSU Spring Wheat	4
NDSU Field Pea	3
NDSU Lentil	2
NDSU Canola	1
NDSU RR1 Soybean	1
Agrisoma Carinata	4
Syngenta Winter Wheat	1
Regional Spring Wheat	1
Regional Barley	1

Soybean Planting Date:

A study was initiated in cooperation with the Carrington REC to look at the performance of differing soybean maturities at Hettinger, Minot and Carrington. Four varieties were planted at three dates (May 4, May19, June2) and four seeding rates (150K, 175K, 200K). The May 4 & May 19 date had the highest yields, May 19 was the highest yielding over the past three years. There was no difference in yields among seeding rates.

Soybean Planting Date Three Year Averages 2015 - 2017						**Hettinger, ND**	
	Mature	Harvest	Plant	Test	Seed	Seed	Grain
Treatment	Date	Date	Height	Weight	Oil	Protein	Yield
			inches	lbs/bu	%	%	bu/ac
Planting Date							
May 4	9/5	9/16	24.7	52.5	17.4	33.0	27.0
May 19*	9/14	9/22	24.3	53.2	17.2	33.3	31.0
June 2	9/19	9/27	24.3	52.8	17.0	33.6	26.3
* Used vareity 30-20 yield (26.3 bu/ac) from nearby soybean yield trial in 2017.							

Nitrogen Relationships of Soybean in Southwest North Dakota:
In cooperation with Dickinson REC, a study comparing inoculation and nitrogen application on soybeans. Two cultivars were be planted at two populations of 80,000 and 160,000 plants per acre. Four N management strategies used were a control of no inoculant and no N added, no inoculant and 30 lbs of N added through urea, inoculant with no N added, and inoculant with 30 lbs of N added through urea. There were no yield differences among all the treatments, but there was significant differences in nodulation between the inoculant and no inoculant treatments. Funded by ND Soybean Council, applying for funding in 2018.

Management of Fusarium Root Rot of Field Peas and Wheat with Crop Rotation:
This project seeks to evaluate crop rotation strategies as a tool for managing existing problems with Fusarium root rot of peas and for preventing the buildup of Fusarium root rot of peas where the disease is not yet a problem. This was the fourth year of the trail and just one rotation was planted to peas, so there are limited results to report. In 2018 four rotation sequences will be planted to peas so we will be evaluating pea roots for disease. This trial is funded by the Northern Pulse Growers and will continue in 2018.

Rotation sequences. Crops for 2018
(1) field pea / spring wheat
(2) field pea / spring wheat / spring wheat
(3) field pea / spring wheat / spring wheat / spring wheat
(4) field pea / spring wheat / flax / spring wheat
(5) field pea / spring wheat / canola / spring wheat
(6) field pea / spring wheat / barley / canola / spring wheat / corn

Effect of Planting Date & Maturity on Disease (FHB) of Durum:
Study with plant pathologist at Williston REC looking at four durum varieties at three planting dates for visual fusarium head blight ratings and DON levels in grain. Funded by SBARE, will continue in 2018.

HRSW Nitrogen Rate X Timing:

Treatment	Planting Application	4-5 Leaf Application	Boot Stage Application	Anthesis Application	Protein	Yield
	--------- lb acre $^{-1}$ ----------				%	bu/ac
1	77 - urea	-	-	-	13.6	27.4
2	110 - urea	-	-	-	13.7	25.0
3	77 - urea	30 - urea	-	-	13.5	27.5
7	77- urea	-	30 - urea	-	13.7	28.7
11	77 - urea	-	-	30 - UAN	13.6	28.4
13	77 - urea	30 – UAN	-	-	13.5	28.7
15	77 - urea	-	30 - UAN	-	13.3	26.8
17	200 - urea	-	-	-	14.1	24.1
18	0	-	-	-	13.7	27.6

Seed Treatment Studies:
Company funded biological seed treatment trials conducted on winter wheat, spring wheat, corn and soybeans.

Other Agronomy Studies:
HRSW seeding rate, barley cover crop/intercrop, soybean population, carinata seeding rate, carinata planting date.

New Studies for 2018:
Hybrid spring wheat seeding rate, funded by Syngenta.

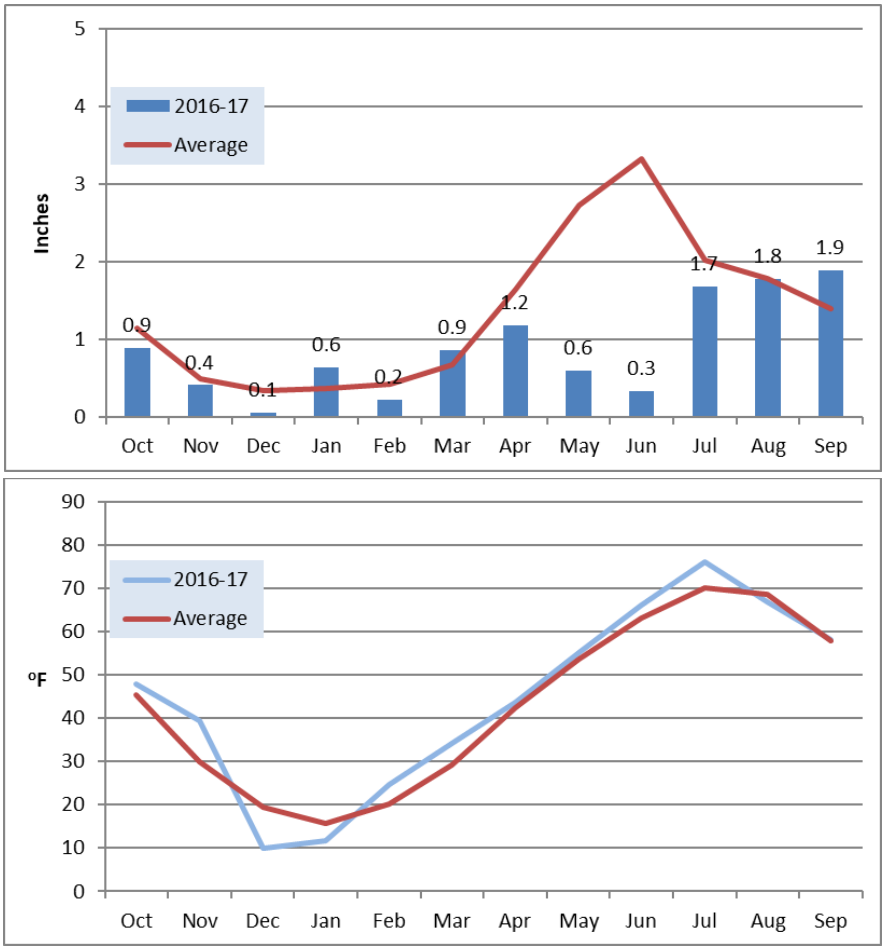
Presentations and Outreach:

- County Crop Improvement meetings at Reeder, Regent and Taylor. February 2017.
- Western Crop & Pest School, Dickinson. March 2017.
- KNDC-TTO, discuss agronomy research, current issues. June-July 2017.
- Hettinger REC Crop Tour. July 2017.
- Off station variety plot tours at Scranton & Regent. July 2017.
- Friends & Neighbors Day, UDSA-ARS Mandan. July 2017.
- Western Dakota Crops Day. December 2017.

Project Upgrades:
New weigh system on research plot combine, repairs and upgrades to combine ($76,680).

Hettinger REC summer crop tour will be on July 10, 2018

Precipitation & Temperature 2016-17



Hettinger Research Extension Center
Advisory Board Meeting- July 10, 2018

Members present: Ashley Sabin, Cody Jorgenson, Wade Henderson, Torre Hovick, Jacki Christman, Curt Stanly, Jeremy Huether, Dustin Freitag and Sean Seamands. Guests present: Dean Wehri, SBARE Representative, Charlie Stoltenow, Tim Faller, Ken Grafton, Jim Gray and Greg Lardy. Staff present: Christopher Schauer, Ben Geaumont, Janna Kincheloe, Caleb Dalley, John Rickertsen and Cassie Dick.

Wade Henderson called the meeting to order at 12:40 pm.

Wade Henderson asked for a motion to approve the minutes from the previous meeting. Cody Jorgenson motioned to accept the minutes and Ashley Sabin seconded. The motion passes, no opposing.

Wade asked for a motion to approve the agenda. Request to move Ben Geaumont range and wildlife report to beginning of scientists reports, as he has a patch burning tour starting at 3:00 pm. Jeremy Heuther motioned to accept change and agenda, Sean Seamands seconded. Motion passes, no opposing.

Chris Schauer introduced new board members: Jacki Christman- local farmer and rancher. Torre Hovick, NDSU Range Science.

Legislative/Research & Extension Update

Ken Grafton thanked the members of the advisory board, and spoke on the Governors recommendations for the state budget. Dean W reported that SBARE has completed their ranking for the state budget. He recommends getting more people into testify; need to be a louder voice for agriculture research and extension. Greg Lardy (new Extension Director) is learning the position and dealing with budget cuts. Jim Gray is working with counties to replace county agents; Adams, Grant and Bowman have vacancies. Charlie S spoke on website and improving the structure for better impact. In addition, we now have Extension representative in all RECs.

Director Report- Chris Schauer, handout provided.

Range & Wildlife Report- Ben Geaumont, handout provided.

Agronomy Report- John Rickertsen, handout provided.

Weed Science Report- Calen Dalley, handout provided.

Animal Science Report- Chris Schauer, handout provided.

Livestock Extension Specialist Report- Janna Kincheloe, handout provided.

Strategic Plan- 2015-2019 almost complete. We will work on putting something together for the next meeting for the next.

Open Discussion-
Jacki Christman asked about growth regulators? John R, will be more in the future, spread across different REC stations, all have different growing environments. John R also stated that precision ag using unarmed aircrafts (drones) will be more of a factor in the future and the Hettinger REC should not have troubles using that new technology, working with the local airport.

Winter meeting- TBA

Staff dismissed for executive session.

July 10, 2018 Advisory Board Meeting
NDSU-Hettinger Research Extension Center

Director's Report

Legislative Report:

- Ag Administration: Ken Grafton and Greg Lardy
- Current Biennium
    - 13.65% Budget Reduction (approximately $342,000/biennium)
        - Didn't hire Animal Science Research Specialist ($140,000/biennium)
        - Didn't hire Agronomy Technician on hard funds ($120,000/biennium)
            - Hired Michael Adsero on soft funds this spring
        - I have moved all of my graduate students off of general funds to grant funds ($40,000/biennium)
        - $10,000 in salary for Cassie now paid for by Extension Service due to acquiring an Extension Specialist
        - $25,000 reduction in equipment funds (line item as part of the $342,000)
        - Remaining $7,000 will be balanced with less spending/increased reliance on grants (State Fleet, operating, etc.)
    - Extension Specialist received a 10% reduction in her operating account to help balance the Extension Service budget
    - 10% hay crop – purchased about $100,000 of hay
    - Suffered about at a $30,000 loss due to listeria outbreak this past winter
- Staffing
    - Fully staffed!
- Next Biennium: SBARE testimony has concluded. We did not ask for anything, but highlighted the reduced technical support.
    - Governor's guidelines: Another 10% reduction ($216,750)
        - This would be tough. All research techs would become soft funded.

Infrastructure:

- 1000 ewes
- 80 head of cows
- 110 head of cows at ARS in Mandan (fiscal agent for their cow herd)
- CASE IH rental agreement – 5 tractors, baler, bobcat, self-propelled windrower
- Housing: Utilizing a trailer at the trailer park and the old office by the Agronomy Lab.
- Hail from June: waiting on appraisal. Multiple buildings and some of our annual forage. Hay is running 0.75 to 1 ton/acre.

Strategic Plan: 2015 – 2019

1. Evaluate alternative livestock production systems that increase profitability while maintaining environmental stability (Chris and Janna).
2. Conduct applied research that investigates the compatibility of agriculture and wildlife (Ben).
3. Evaluate weed control methods to increase crop and forage productivity in southwest North Dakota (Caleb).
4. Enhance dryland crop production while maintaining natural resources (John).
5. Integration of Livestock, Wildlife, Agronomy, and Weeds research programs into a farm-scale interdisciplinary research project (All).

July 10,2018 - Advisory Board Meeting
NDSU-Hettinger Research Extension Center

Animal Science Report

Graduate Students:

- Graduate students and undergrad technicians:
  - Amanda Long – M.S. – Animal Science (Chris Schauer and Travis Hoffman)
  - Paige Anderson – M.S. – Animal Science starting next week
  - 2 Animal Science internships for the summer

Strategic Plan - Progress towards goals: *Evaluate alternative livestock production systems that increase profitability while maintaining environmental stability*

- Outreach efforts:
  - Fall Ram Test - Field Day March 10, 2018
    - 82 rams from 25 producers: Rambouillet, Columbia, Dorset, Targhee, GeneLink
  - Shearing and Wool Classing School: November 18-20, 2017
    - Shearing School – 24 students from ND, SD, OR, MN, NE, CA, and WY
    - Wool School – 19 students from ND, SD, MT, MN, and Canada
  - Sheep Schools with Extension Service
    - Beginning sheep school with NDLWPA and starter flock recipients (September) 60+ students
  - OFDA: Newel Ram Sale, Rapid City Stock show, Fiber Festival in Watertown, SD, processed over 1420 samples from 45 producers
  - Received $27,036 to conduct nation-wide carcass ultrasound training in sheep for certification for the National Sheep Improvement Program
    - Taught schools in TX and ND, and coordinated schools in WI and ID
    - Looking at teaching schools at Penn State and Kansas State next year
  - The HREC was honored by the Columbia Sheep Breeders Association with a lifetime achievement award (also honored Dr. LeRoy Johnson, the director of the HREC in the 1950'-60's.
- Sheep Research:
  - ***Impacts of flax on female and male reproductive traits when supplemented prior to breeding in sheep*** (Amanda Long M.S. program)
    - Received $38,000 to fund salary as well as product donation
    - Acquired $20,000 in funds for the ewe and ram trials
      - Ewe trial is completed and ram trial is ongoing.
  - Coordinate a national level program evaluating fecal egg count in Polypay sheep, collecting FEC data on 3,000 lambs and blood cards on all sires (about 50)
  - New Project: ***Impacts of banamine injection on pain responses of either rubber ring castrated and tail docked or durgically castrated and burdizzo docked lambs*** (Paige Anderson M.S. program funded by SBARE) – project starts this fall
  - Pursing a research project to determine if there is a genetic marker for "blown legs" in Rambouillet rams
- Cattle Research:
  - Grazing studies with Range and Wildlife program (Integrated project – Strategic Plan #5)

- Publications:
    - Refereed journal articles: 4 in 2017, 1 so far in 2018
    - Amanda presented her ewe trial at the National Flax meetings
- Extension Specialist: Dr. Janna Kincheloe

2018 Summer Advisory Board Meeting
Wildlife and Range Research Update
Ben Geaumont and Dan Graham

Strategic Plan Aim - **Conduct applied research that investigates the compatibility of agriculture and wildlife**

Graduate Students – Co-Advised

Jonathan Spiess, PhD – Range Sciences, Evaluate livestock selection and fire behavior within patch-burn grazing research (Devan McGranahan).

Jasmine Cutter, M.S. – Range Sciences, Evaluate pollinators in our patch-burn grazing research (Torre Hovick).

Alex Rischette, M.S. – Range Sciences, Evaluate wildlife response to patch-burn grazing on Post-CRP (Torre Hovick).

Additional Graduate Student Committees

Adrienne Antonsen, M.S. – Entomology, Statewide pollinator survey.

Chyna Pei, PhD – Range Sciences, Statewide pollinator survey.

Cameron Duquette, PhD – Range Sciences, Grassland bird response to patch-burn grazing in mixed-grass prairie.

Current Research Projects

1. **The utility of unmanned aerial systems for monitoring sharp-tailed grouse leks** (Hovick, Graham, and Nowatzki).
    a. evaluate the feasibility of using UAS to locate and monitor leks of sharp-tailed grouse.
2. **Restoring disturbance to old Conservation Reserve Program Fields to Promote Ecosystem Services**. (C. Schauer, T. Hovick, R. Limb, and D. McGranahan)
    a. Evaluate the effects of patch-burn grazing in Conservation Reserve Program grasslands on livestock, vegetation, pollinators and wildlife in western North Dakota.
        i. Livestock, birds, vegetation, bees and butterflies
    b. Six, 160 acre pastures
        i. 3 with sheep
        ii. 3 with cow/calf pairs
    c. Six burns completed in October 2018

2a. Evaluate the ability of over seeding native forbs following prescribed fire to enhance habitat for pollinators.

a. Seeded (5), 1 acre plots within each prescribed fire area in mid-March 2018

3. **Annual forage mixes for southwest North Dakota: influence of planting date on forage production and pollinator communities.**
    a. Interested in how incorporating annual forages into food plots for wildlife and forage for livestock may benefit pollinators and other insects.

b. Hammered by hail.

4. **Monitoring native pollinator communities throughout North Dakota: Status and Management considerations for bees and butterflies.** (CO-PIS: R. Limb, T. Hovick, and J. Harmon)
    a. Conducting statewide pollinator surveys. Access land use, floristic resources and pollinator associations. Funded by ND Department of Agriculture.

Strategic Plan Aim 5 - **Integration of Livestock, Wildlife, Agronomy, and Weeds research programs into a farm-scale interdisciplinary research project.**

Evaluate a livestock-crop integrated system using annual forages, winter wheat and sheep. Determine livestock gains, crop production, insect use, and changes to soils.

a. Winter wheat was a complete failure
b. Annual forages were set back by hail

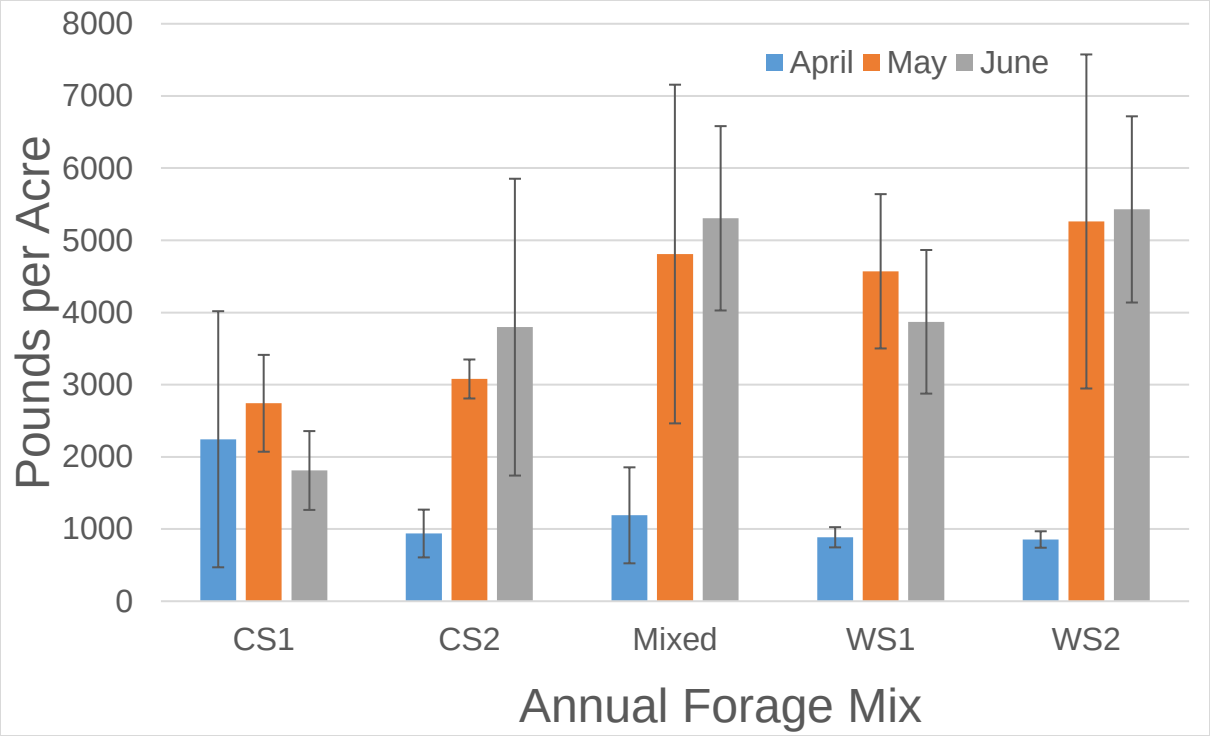
Peer Reviewed Publications

McGranahan, D.A., **B.A. Geaumont**, and J.W. Spiess. 2018. Livestock GPS collars based on an open-source datalogger, survives field conditions and informs best practices for logging intensity. Ecology and Evolution 8:5649-5660.

Norland, J.E., C.S. Dixon, D.L. Larson, K.L. Askerooth, and **B.A. Geaumont**. 2018. Prairie reconstruction unpredictability and complexity: What is the rate of reconstruction failures? Ecological Restoration: Accepted July 2018.

Geaumont, **B.A**. W. Mack, A.R. Lipinski, T.J. Hovick, R. Limb, and K.K. Sedivec. 20XX. Plant and bird community dynamics in mixed-grass prairie grazed by native and domestic herbivores. Rangeland Ecology and Management, (revision 1).

Geaumont, B.A. and J. Norland. 20XX. Influence of seed mixtures on native plant establishment in the badlands region of North Dakota. (submitted 4/16/2018)



Average planted annual forage production from 2016-2018 across five treatments replicated three times each at three different planting dates. Forage production was measured mid-August. Averages do not include biomass attributed to weed species. We designed annual forage mixes to provide biomass for livestock and nectaring resources for pollinators.

CS1 = Cool Season 1 = buckwheat, lentil, flax, oat, barley, radish, safflower, sunflower, turnip

CS2 = Cool Season 2 = buckwheat, pea, flax, millet, barley, radish, safflower, sunflower, turnip

Mixed = buckwheat, lentil, turnip, radish, barley, sorghum-sudan grass

WS1 = Warm Season 1 = flax, radish, sunflower, turnip, proso millet, sorghum-sudan grass, barley

WS2 = Warm Season 2 = buckwheat, lentil sunflower, radish, proso millet, sorghum-sudan grass, flax, safflower

July 10, 2018 Advisory Board Meeting
NDSU-Hettinger Research Extension Center
Agronomy Update – John Rickertsen

2018 Research Projects

Variety/Hybrid Performance Trials:

Winter Wheat	*Winter Rye*	*Soybean*	*Safflower*
Spring Wheat	*Field Pea*	*Canola*	*Sunflower*
Durum Wheat	*Chickpea*	*Flax*	*Corn*
Barley	*Lentil*		
Oats	*Dry Beans*		

Off Station Yield Trials:
Trials located at Scranton, Regent, and Mandan. These trials are located with farmer cooperators and with the USDA-ARS Northern Great Plains Lab at Mandan. Crops tested are spring wheat, durum wheat and barley.

Plant Breeding Nurseries & Advanced Trials:
Nurseries & advanced yield trials were planted for the following breeding programs.

NDSU Spring Wheat	NDSU Field Pea
NDSU Early Generation	NDSU Lentil
Syngenta Spring Wheat	NDSU Canola
Regional Spring Wheat	Regional Barley
NDSU Soybean (RR1)	

Agronomy Studies:

- Carinata Seeding Rate.
- Carinata Planting Date.
- HRSW Seed Treatment.
- HRSW Seeding Rate.
- Barley Cover Crop Timing.
- Soybean Population in 30” & 7” rows.
- Soybean Nitrogen & Inoculant Trial.
- Management of Fusarium Root Rot of Field Peas and Wheat with Crop Rotation.
- Durum Wheat Planting Date, Fusarium Head Blight.

2018 Personnel

Hettinger Research Extension Center

Christopher Schauer	Director and Animal Scientist
Janna Kincheloe	Area Extension Specialist, Livestock Systems
Benjamin Geaumont	Research Assistant Professor/Wildlife and Range Science
John Rickertsen	Associate R/E Center Specialist/Agronomy
Caleb Dalley	Research Weed Scientist
Daniel Graham	Wildlife and Range Technician
Daniel Guimaraes Abe	Weed Science Technician
Michael Adsero	Agronomy Technician
Terri Lindquist	Finance Paraprofessional
Cassie Dick	Administrative Secretary
Don Stecher	Manager of Ag Operations
David Pearson	Research Technician/Shepherd
Donald Drolc	Research Technician/Livestock
Stephanie Schmidt	Research Technician/Livestock

Range and Wildlife Graduate Students
Jasmine Cutter and Alex Rischette
Animal Science Graduate Students
Amanda Long and Paige Anderson

The Hettinger Research Extension Center hires individuals on a part-time basis to help in the research effort. Many of these are students as well as local residence. We would like to acknowledge the following people who helped at some time during the past year: Zach Rickertsen, Rebecca Knutson, Katie Graham, Kaitlin Jahner, Justice Anderson, Rachel Ouren and Kaden Schauer .

Advisory Board Members

Kat Weinert, Chair	Hettinger, ND	Tom DeSutter	Fargo, ND
Ethan Andress	Hettinger, ND	Dave Ollila	Rapid City, SD
Dustin Laufer	Hettinger, ND	Jeremy Huether	Mott, ND
Curt Stanley	Bismarck, ND	Matt Neiderman	Morristown, SD
Duaine Marxen	Mott, ND	Dustin Freitag	Bowman, ND
Ashley Sabin	Elgin, ND	Sean Seamands	Lemmon, SD
Cody Jorgenson	Hettinger, ND	Jamie Enerson	Hettinger, ND
Wade Henderson, Vice Chair	Lodgepole, SD	Dean Wheri, SBARE Rep.	Mott, ND

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