


North Dakota State University

Hettinger Research Extension Center

2014 Annual Report

NDSU | HETTINGER RESEARCH EXTENSION CENTER

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NORTH DAKOTA **AGRICULTURE EXPERIMENT STATION**

Hettinger Research Extension Center

Hettinger REC Research in Brief

- Integrated crops, livestock, and range research
- Variety, herbicide, and crop production research
- Lamb and beef feedlot nutrition and management
- Reproductive management of fall, winter, and spring lambing ewes
- Alternative, co-product, and "Natural" feeds for ruminants
- Multiple-land use management including cropping systems, livestock, and wildlife as potential outputs
- Range monitoring techniques

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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

- Distributed foundation seed produced at NDSU research centers, making new varieties available to southwest North Dakota producers.

- Conducted crop variety, forage, plant disease, and herbicide trials as well as off-station variety testing at Regent, Scranton, New Leipzig, Selfridge, and Mandan.
- Conducted biofuel trial in conjunction with other REC's.
- Evaluate new varieties and technologies for drought tolerant corn and wheat and preventing damage from wheat stem sawfly.

RANGE AND LIVESTOCK

- Lead a multi-agency and multi-discipline research project evaluating the reclamation of grazing lands inhabited by prairie dogs on the Standing Rock Sioux Reservation.
- Evaluation of rangeland restoration and wildlife habitat opportunities on the Elkhorn Ranch near Medora, ND.
- Evaluated the use of cover crops for soil health benefits and for fall grazing of pregnant ewes.

HREC Crops, Weeds, Livestock, and Range

- Conducted multiple research projects evaluating environmental and economic consequences of multiple-use management of agricultural lands in the Northern Great Plains including nesting success of upland birds, and telemetry of upland chicks.

- Continued research in “Value Added Animal Production”; a research program focused on evaluating forage, grain, byproduct, and marketing alternatives in calf backgrounding and lamb finishing.

- Evaluated supplementation strategies during pregnancy and their effect on embryonic death loss, fetal development, and potential feedlot and reproductive performance of offspring.

- 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

- Conduct annually the HREC Beef Day, Sheep School, Shearing School, Wool Classing School, Carcass Ultrasound School, Crops Tours, Crops Day, and Soil Health Workshops.

- Published “Importance of Range Monitoring” video.

- Published NDSU Sheep Research Report and Hettinger Crops Day Report and contributed to NDSU Beef and Range Report.

HREC Research Faculty

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Weather Summary - Hettinger

Frost Free Days

	28°F	32°F	Normal 32°F
Date of Last Frost	May 15	May 15	May 18
Date of First Frost	September 12	September 12	September 20
Frost Free Days	**120**	**120**	**125**

Precipitation (inches)

Month	2009-10	2010-11	2011-12	2012-13	2013-14	59 Year Average
October	2.3	0.4	0.8	0.7	4.4	1.1
November	0.0	0.6	0.0	0.1	0.2	0.5
December	2.0	0.6	0.2	0.5	0.5	0.3
January	0.3	1.1	0.4	0.2	0.1	0.4
February	0.2	1.0	0.5	0.2	0.3	0.4
March	0.7	0.7	0.2	0.2	0.6	0.7
April	1.8	2.3	3.0	0.2	1.6	1.6
May	3.7	4.6	2.2	7.9	1.6	2.6
June	2.9	3.4	2.4	3.7	5.1	3.3
July	3.7	1.9	3.9	2.0	0.9	2.0
August	2.4	2.3	2.2	1.8	5.2	1.7
September	3.2	0.4	0.0	3.4	1.3	1.4
April-Sept.	**14.5**	**14.5**	**13.7**	**15.6**	**14.3**	**11.3**
Total	**23.2**	**19.2**	**15.7**	**20.7**	**21.7**	**16.2**

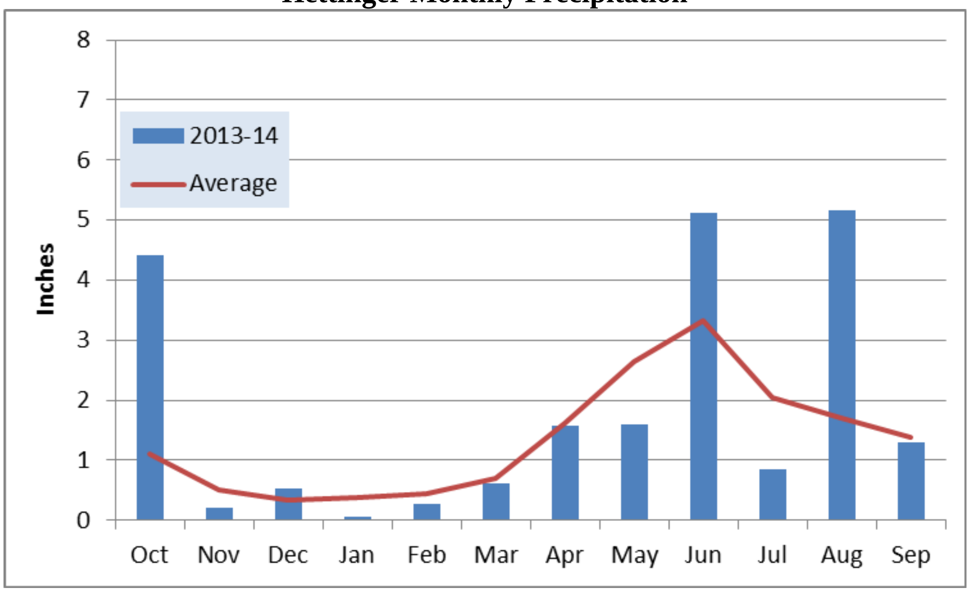
Air Temperature (°F)

Month	2009-10	2010-11	2011-12	2012-13	2013-14	59 Year Average
October	36.8	48.5	48.2	42.1	39.7	45.6
November	36.9	28.0	30.9	32.4	28.8	30.0
December	9.5	13.4	23.9	18.5	12.9	19.7
January	13.6	12.7	24.2	18.3	16.6	15.2
February	11.7	14.7	21.8	26.7	10.1	20.0
March	31.2	22.8	44.4	27.4	26.5	28.8
April	44.8	39.4	46.9	35.5	39.1	42.6
May	50.0	50.2	53.6	53.5	52.8	53.7
June	62.0	62.0	66.5	61.7	59.5	63.1
July	67.6	71.3	75.2	68.1	66.4	70.1
August	68.6	65.3	67.8	69.5	66.0	68.7
September	56.3	56.9	59.4	62.5	56.4	57.8
Average	**40.7**	**40.4**	**46.9**	**43.0**	**39.6**	**42.9**

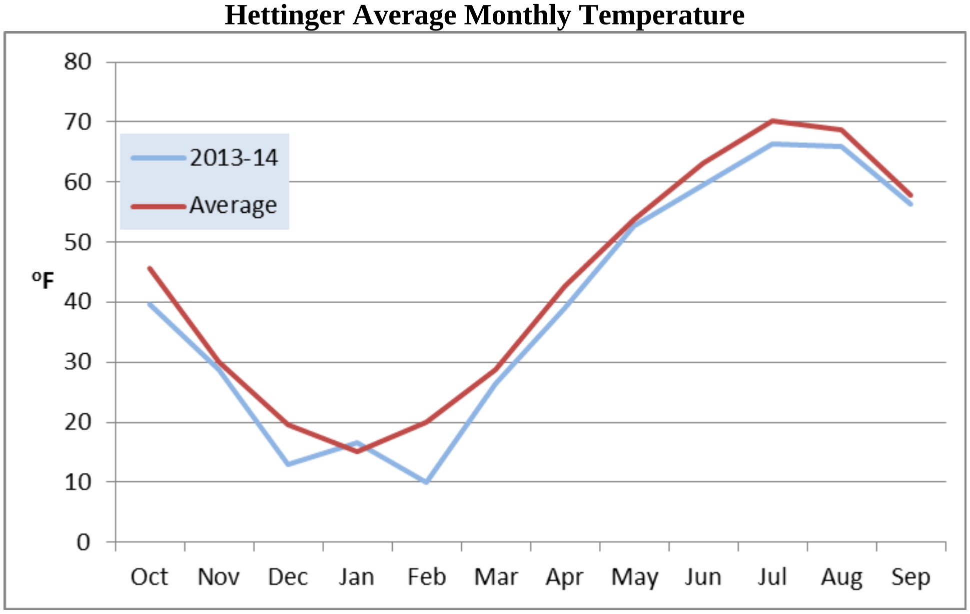
Corn Growing Degree Days (GDD)

Month	2010	2011	2012	2013	2014	42 Year Average
May	210	161	266	266	245	254
June	393	358	498	381	330	407
July	536	631	688	543	526	571
August	547	555	504	553	504	523
September	278	347	411	403	313	311
Total	**2032**	**2052**	**2367**	**2146**	**1918**	**2065**

Hettinger Monthly Precipitation



Hettinger Average Monthly Temperature



Barley - 2014	**Hettinger, ND**

Variety	Days to Head	Plant Height	Plant Lodge	Plump	Test Weight	Grain Protein	----- Grain Yield ----- 2012	2013	2014	Average Yield 2 yr	3 yr
	*	inches	0-9**	%	lbs/bu	%	------------ Bushels per acre ------------				
TWO ROW											
Rawson	69	37	1	95	50.4	11.7	87.3	116.1	102.1	109.1	101.8
Conrad	74	34	2	96	51.4	11.9	91.0	102.7	109.3	106.0	101.0
Conlon	64	36	4	98	52.9	12.6	80.2	102.1	118.2	110.2	100.2
Pinnacle	70	36	1	96	52.3	10.6	71.7	110.5	115.1	112.8	99.1
CDC Copeland	77	41	1	97	50.4	11.7	79.0	103.5	110.0	106.8	97.5
AC Metcalfe	78	39	6	96	50.4	13.9	54.7	87.4	86.9	87.2	76.3
SIX ROW											
Innovation	70	37	2	97	50.8	12.5	102.5	122.4	122.3	122.4	115.7
Tradition	69	38	2	97	50.7	12.9	93.5	124.1	120.2	122.2	112.6
Celebration	69	37	3	97	50.0	13.1	99.5	110.7	115.3	113.0	108.5
Stellar-ND	68	37	5	98	50.3	12.3	94.3	107.9	122.2	115.1	108.1
Lacey	70	36	4	98	51.3	12.6	91.0	116.5	114.2	115.4	107.2
Quest	70	38	3	94	49.8	12.6	90.6	114.0	110.4	112.2	105.0
Trial Mean	70	37	2	96	50.9	12.1	91.0	115.5	115.5	--	--
C.V. %	1.1	3.8	40.5	0.8	0.7	4.8	5.1	5.6	3.0	--	--
LSD 10%	1	2	1	1	0.4	0.7	5.5	7.6	4.1	--	--

* Days to Head = the number of days from planting to head emergence from the boot.

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

Planting Date: April 22

Harvest Date: August 11

Previous Crop: Spring Wheat Green Fallow

Barley - 2014 **Scranton, ND**

Variety	Plant Height	Plant Lodge	Test Weight	Grain Protein	----- Grain Yield ----- 2012	2013	2014	Average Yield 2 yr	3 yr
	inches	0-9*	lbs/bu	%	------------ Bushels per acre ------------				
TWO ROW									
Conlon	34	4	46.7	12.4	86.7	81.0	74.0	77.5	80.6
Rawson	36	0	44.8	11.2	81.1	92.5	90.0	91.3	87.9
Pinnacle	36	2	45.6	10.6	80.4	93.5	81.3	87.4	85.1
SIX ROW									
Celebration	36	3	44.3	13.3	85.1	82.6	75.3	79.0	81.0
Quest	35	3	44.9	12.7	72.5	94.6	80.6	87.6	82.6
Innovation	34	2	44.0	12.5	88.4	80.3	83.0	81.7	83.9
Trial Mean	35	2	45.0	12.1	82.4	87.4	80.7	--	--
C.V. %	4.0	22.7	0.7	4.8	5.0	9.6	7.3	--	--
LSD 10%	2	1	0.4	0.7	5.1	10.4	7.3	--	--

* 0 = no lodging, 9 = 100% lodged.
Planting Date: April 24
Harvest Date: September 4
Previous Crop: Spring Wheat

Barley - 2014 **Regent, ND**

Variety	Plant Height	Plant Lodge	Test Weight	Grain Protein	----- Grain Yield ----- 2012	2013	2014	Average Yield 2 yr	3 yr
	inches	0-9*	lbs/bu	%	------------ Bushels per acre ------------				
TWO ROW									
Conlon	33	3	46.7	13.2	69.1	88.4	71.0	79.7	76.2
Rawson	34	0	45.5	11.5	48.8	107.6	84.8	96.2	80.4
Pinnacle	38	1	44.9	11.3	65.3	106.3	73.2	89.8	81.6
SIX ROW									
Celebration	37	2	44.2	13.9	52.4	98.9	87.9	93.4	79.7
Quest	36	2	44.5	13.3	50.9	95.9	84.1	90.0	77.0
Innovation	36	1	43.3	13.1	67.2	104.8	77.1	91.0	83.0
Trial Mean	36	1	44.8	12.7	58.9	100.3	79.0	--	--
C.V. %	3.8	34.4	1.3	4.7	6.2	4.5	12.5	--	--
LSD 10%	2	2	0.7	1.8	4.5	5.5	12.3	--	--

* 0 = no lodging, 9 = 100% lodged.
Planting Date: April 24
Harvest Date: September 4
Previous Crop: Spring Wheat

Barley - 2014 **New Leipzig, ND**

Variety	Plant Height	Plant Lodge	Test Weight	Grain Protein	----- Grain Yield ----- 2012**	2013	2014	Average Yield 2 yr	3 yr
	inches	0-9*	lbs/bu	%	------------ Bushels per acre ------------				
TWO ROW									
Conlon	34	4	45.9	12.0	--	76.0	69.3	72.7	--
Rawson	35	2	45.1	10.9	--	90.5	83.9	87.2	--
Pinnacle	36	3	44.9	10.3	--	81.9	81.8	81.9	--
SIX ROW									
Celebration	35	4	43.3	13.2	--	90.1	81.6	85.9	--
Quest	36	4	44.1	12.3	--	92.4	83.8	88.1	--
Innovation	34	3	42.8	12.2	--	93.0	78.5	85.8	--
Trial Mean	35	3	44.3	11.8	--	87.3	79.8	--	--
C.V. %	3.2	37.5	1.1	3.5	--	7.9	7.6	--	--
LSD 10%	1	2	0.6	0.5	--	8.5	7.5	--	--

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

** New Liepzig was not planted in 2012.

Planting Date: April 25

Harvest Date: August 29

Previous Crop: Spring Wheat

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Canola - Clearfield - 2014 **Hettinger, ND**

Brand	Variety	Oil Type	Days to Bloom	Bloom Duration	Days to Mature	Plant Height	Lodging	Test Weight	Oil Content	Seed Yield 2013	Seed Yield 2-Yr. Avg.
		*	**	days	**	inches	0 - 9***	lbs/bu	%	-------lbs/a-------	
Mycogen	Nexera 2012 CL	TR	49	21	88	43	2	50.3	40.3	1412	950
Mycogen	Nexera 2020 CL	HO	51	21	90	44	2	50.8	41.0	1507	--
Mycogen	CL2537382H	HO	51	20	89	45	1	50.8	41.9	1642	--
Mycogen	CL2537385H	HO	49	23	90	45	2	49.3	39.6	1596	--
Trial Mean			50	21	89	44	2	50.3	40.7	1539	--
C.V. %			0.5	2.0	0.5	3.7	31.4	1.1	3.8	11.3	--
LSD 10%			1	1	1	2	1	0.7	2.0	225	--

* Type: TR-Traditional Oil Type, HO-High Oleic Oil Type.

** Days after planting.

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

Planting Date: May 6

Harvest Date: August 20

Previous Crop: Durum Wheat

NDSU Hettinger Reserch Extension Center

Canola - Roundup Ready - 2014 **Hettinger, ND**

Brand	Variety	Oil Type	Days to Bloom	Bloom Duration	Days to Mature	Plant Height	Lodging	Test Weight	Oil Content	Seed Yield 2014	Seed Yield 3-Yr. Avg.
		*	**	days	**	inches	0 - 9***	lbs/bu	%	-------lbs/a-------	
Mycogen	Nexera 1012 RR	HO	50	25	93	46	1	50.3	40.2	1748	1385
Mycogen	Nexera 1016 RR	HO	49	21	88	42	2	49.9	42.1	1347	1161
Mycogen	G2537736H	HO	49	22	88	40	2	50.2	39.4	1684	--
Star Specialty Seed	Star 402	TR	45	22	85	39	2	51.1	45.9	1886	1491
Cargill	V12-1	HO	49	21	89	39	1	50.1	42.3	1997	1611
Cargill	09H7757	TR	51	22	90	44	1	50.2	41.6	2103	--
Cargill	08H0004	HO	54	20	92	45	2	48.8	41.5	2148	--
Cargill	09H7763	TR	49	21	87	37	2	51.0	42.5	1893	--
Croplan	HyClass 930	TR	46	19	83	35	2	51.2	46.3	1641	1405
Croplan	HyClass 955	TR	47	20	85	39	2	51.4	44.6	1793	1622
Croplan	HyClass 969	TR	48	21	87	38	2	51.2	43.5	1775	--
BrettYoung	6044 RR	TR	48	22	88	39	1	52.0	42.5	1787	--
BrettYoung	6070 RR	TR	46	23	87	39	2	50.5	42.2	1851	1500
Integra	7150	TR	46	20	84	34	2	50.9	45.3	1637	--
Proseed	300 Mag	TR	47	22	87	39	1	50.8	44.2	1664	--
Proseed	44 Mag	TR	49	22	89	37	2	49.9	42.8	1705	--
Trial Mean			48	21	88	40	2	50.6	42.9	1791	--
C.V. %			2.8	4.8	0.8	5.2	34	0.9	2.7	12.5	--
LSD 10%			1	1	1	3	1	0.5	1.4	265	--

* Type: TR-Traditional Oil Type, HO-High Oleic Oil Type.

** Days after planting.

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

Planting Date: May 6

Harvest Date: August 20

Previous Crop: Durum Wheat

Chickpea - 2014 **Hettinger, ND**

Variety	Days to Flower	Height	Lodging	1,000 Seed Wt.	Seeds Lb	Seed Size (mm) <8	8-9	9-10	>10	Test Weight	Grain Yield 2012	2013	2014	Average Yield 2 yr	3 yr
	DAP*	inches	0 - 9**	gm	seeds	%				lb/bu	lb/a				
Kabuli Type															
CDC Alma	54	15	0	422	1075	5	45	47	4	54.4	--	2131	3386	2759	--
CDC Frontier	53	23	0	378	1200	7	71	20	2	55.0	2855	2380	4719	3550	3318
CDC Luna	54	16	0	399	1139	8	49	40	3	51.1	3134	1976	3844	2910	2985
CDC Orion	53	20	0	479	948	2	20	48	30	53.0	--	2202	3998	3100	--
Dylan	53	21	0	497	914	23	14	14	50	51.7	1445	1214	2406	1810	1688
Sawyer	53	19	0	450	1009	3	29	48	21	55.9	2242	1781	3223	2502	2415
Sierra	54	23	0	549	827	3	7	22	68	53.7	1457	610	1936	1273	1334
BGC090017	53	22	0	455	997	5	33	47	16	56.7	--	2322	4164	3243	--
BGC090018	54	21	0	487	932	4	23	44	29	56.5	--	2180	4204	3192	--
BGC090024	53	22	0	483	940	2	20	44	34	56.5	--	2093	3446	2770	--
Small Kabuli Type															
B-90	54	22	0	305	1493	62	37	1	0	50.3	2813	1914	4204	3059	2977
Desi Type															
CDC Anna	52	23	0	207	2195	80	19	0	0	49.1	2651	2281	4718	3500	3217
Mean	53	21	0	455	1170	13	24	30	32	53.3	2227	1924	3369	--	--
C.V. %	1.0	8.0	0.0	3.4	4.9	24.8	18.0	12.1	14.7	2.3	6.6	11.4	11.1	--	--
LSD 10%	1	2	0	19	61	4	5	4	6	1.5	180	262	443	--	--

* Days after planting.

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

Planting Date: May 8

Harvest Date: September 16

Previous Crop: Oat

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Corn - 2014 **Hettinger, ND**

Company	Hybrid	Traits*	Relavtive Maturity*	Plant Height	Ear Height	Stalk Lodge	Moisture Content	Test Weight	Yield 2014
			days	inches	inches	%	%	lbs/bu	bu/ac
Integra	9333	RR, VT2P	83	94	38	0	13.4	53.7	103.6
Integra	9352	RR, VT3P	85	88	33	1	11.9	50.7	116.5
Integra	3537	RR, VT3P	85	91	35	0	11.6	51.1	118.0
Proseed	1283 VT2P	RR, VT2P	83	84	34	0	13.5	53.0	104.0
Proseed	1083 GT3000	GT, LL, 3000GT	83	93	34	0	12.5	49.2	120.5
Proseed	1384 VT2P	RR, VT2P	84	91	33	0	13.0	54.5	110.2
Proseed	PX85VT2PR	RR, VT2P	85	93	37	0	11.6	50.8	104.6
Proseed	1185 RR	RR	85	93	37	0	11.6	50.3	116.6
Proseed	1286 VT2P	RR, VT2P	86	91	37	1	12.5	51.7	124.3
Legacy Seeds	L2213 VT2P	RR, VT2P	82	85	32	0	13.0	53.4	114.6
Legacy Seeds	L2314 VT2P	RR, VT2P	83	90	35	2	11.5	51.9	120.1
Legacy Seeds	L2413 VT2PRO RIB	RR, VT2P	84	92	35	0	13.2	55.4	111.3
Legacy Seeds	L2643 VT2PRO RIB	RR, VT2P	86	95	37	0	12.0	51.9	122.5
Legacy Seeds	L2813 VT2PRO RIB	RR, VT2P	87	96	37	0	12.5	51.7	123.5
Legacy Seeds	L2914 VT2PRO	RR, VT2P	88	99	37	0	13.2	52.0	115.3
Legacy Seeds	L3011 VT3PRO RIB	RR, VT3P	91	98	38	1	14.5	49.9	127.0
Peterson FS	71N78	RR	78	91	37	0	12.3	53.2	110.6
Peterson FS	71D83	RR, VT2P	83	86	34	1	13.5	53.4	110.7
Peterson FS	75K85	RR, VT2P	85	94	35	0	11.6	51.9	118.1
Nuseed	8202 VP3220	RR, VIP	82	97	36	0	12.4	47.3	93.3
Nuseed	2852 GTCBLL	GT, CB, LL	85	97	35	1	16.1	47.1	103.7
Nuseed	8504 VT2P	RR, VT2P	85	90	33	0	12.0	51.5	111.6
AgVenture	RL2289AM	RR, CB	82	92	36	0	11.1	50.9	118.7
AgVenture	GL2949ABW	GT, CBRW, LL	84	96	36	0	11.5	48.5	105.3
AgVenture	GL2932AB	GT, LL, 3000GT	85	95	38	0	11.7	46.3	103.7
AgVenture	Exp N980x939	RR	90	94	36	0	15.7	44.4	95.8
REA Hybrids	1B820-RIB	RR, VT2P	82	88	34	0	12.9	52.8	117.1
REA Hybrids	2B550-RIB	RR, VT2P	85	89	33	1	11.5	51.9	117.4
REA Hybrids	2B850-RIB	RR, VT2P	85	84	30	0	12.4	51.0	110.2
REA Hybrids	2B870-RIB	RR, VT2P	87	102	37	0	11.4	49.7	115.6
REA Hybrids	2A871-RIB	RR, SS	87	88	34	0	15.1	50.9	106.0
REA Hybrids	3A377-RIB	RR, SS	89	96	35	0	12.2	48.2	119.6
Trial Mean				92	35	0	12.7	50.9	112.8
C.V. %				3.1	5.3	219.0	4.9	2.0	7.7
LSD 10%				3	2	1	0.7	1.2	10.1

* Traits and relavtive maturity provided by the company.

Planting Date: May 22

Harvest Date: October 23

Previous Crop: Wheat

Trial was hit with a hard freeze on September 10.

Dry Bean - 2014	**Hettinger, ND**

Variety	Type	Days to Flowering	Plant Height	Plant Lodge	Test Weight	Grain Yield 2011	Grain Yield 2013	Grain Yield 2014	Average Yield 2 yr	Average Yield 3 yr
		DAP*	inches	0-9**	lbs/bu	lbs per acre				
LaPaz	Pinto	52	21	5	60.0	1916	2779	2140	2460	2278
Lariat	Pinto	54	19	7	56.9	2068	2571	2081	2326	2240
Maverick	Pinto	50	17	7	59.2	1791	2152	1824	1988	1922
Sinaloa	Pinto	51	21	4	59.3	--	--	2125	--	--
Stampede	Pinto	51	19	5	59.1	1914	2552	1922	2237	2129
Windbreaker	Pinto	48	16	5	57.8	1645	2216	1833	2025	1898
ND-307	Pinto	49	17	5	58.0	2184	2813	1892	2353	2296
ND020351-R	Pinto	48	20	5	59.0	--	2786	2057	2422	--
SF103-8	Pinto	47	18	4	58.1	--	--	1727	--	--
23ST27	Pinto	49	17	7	60.9	--	--	2003	--	--
ND060197	Pinto	50	18	6	59.8	--	--	1930	--	--
Avalanche	Navy	51	18	3	62.4	1549	2571	1583	2077	1901
Ensign	Navy	52	19	6	60.7	1401	2780	1682	2231	1954
HMS Medalist	Navy	52	18	3	62.8	1253	2562	1658	2110	1824
Norstar	Navy	51	15	5	64.0	--	1653	1701	1677	--
Vista	Navy	51	19	3	61.8	1370	1994	1809	1902	1724
T9905	Navy	51	18	4	61.7	--	3082	1913	2498	--
Merlot	Sm Red	51	19	5	60.2	1496	1961	1752	1857	1736
Rio Rojo	Sm Red	49	18	6	61.8	--	2548	2075	2312	--
Sedona	Pink	50	19	6	58.2	612	1533	1437	1485	1194
Rosetta	Pink	51	20	4	61.0	--	--	1839	--	--
Eclipse	Black	50	18	4	60.7	1707	2246	2098	2172	2017
Loreto	Black	51	18	5	60.2	1502	2190	1855	2023	1849
Trial Mean		50	18	5	60.2	1656	2402	1867	--	--
C.V. %		--	6.9	15.8	1.2	7.5	7.7	8.2	--	--
LSD 10%		--	2	1	0.8	177	217	180	--	--

* Days after planting.

** 0 = no lodging, 9 = lying flat on ground.

Planting Date: June 4

Harvest Date: September 26

Seeding Rate: 100,000 live seeds / acre.

Previous Crop: Winter Wheat

NDSU Hettinger Research Extension Center

Durum Wheat - 2014 **Hettinger, ND**

Variety	Days to Head	Plant Height	Plant Lodge	Test Weight	Grain Protein	----- Grain Yield ----- 2012	2013	2014	Average Yield 2 yr	3 yr
	*	inches	0-9**	lbs/bu	%	------------- Bushels per acre -------------				
Tioga	74	42	4	59.3	10.9	64.2	59.9	79.8	69.9	68.0
Joppa	76	41	3	60.7	10.9	66.8	51.1	85.7	68.4	67.9
Alkabo	74	41	2	59.9	10.7	64.9	50.5	82.6	66.6	66.0
CDC Verona	75	39	3	59.4	11.9	60.5	55.6	79.1	67.4	65.1
Strongfield	76	38	3	58.9	12.8	66.4	52.4	75.7	64.1	64.8
Divide	75	40	4	60.3	10.6	56.7	55.1	81.6	68.4	64.5
Mountrail	74	41	3	60.1	11.0	53.6	55.3	83.3	69.3	64.1
Carpio	77	41	3	59.9	11.5	59.6	50.3	80.5	65.4	63.5
Ben	75	42	3	60.1	12.0	62.5	53.2	73.0	63.1	62.9
Rugby	74	45	4	60.3	11.3	60.3	51.3	74.9	63.1	62.2
AC Commander	76	30	2	56.7	12.5	72.9	43.7	69.7	56.7	62.1
Lebsock	74	39	2	60.3	11.7	63.4	49.5	71.8	60.7	61.6
AC Navigator	74	31	2	57.9	12.3	73.2	42.3	65.1	53.7	60.2
Grenora	77	37	3	57.3	12.6	58.3	52.6	68.1	60.4	59.7
Pierce	77	40	2	58.9	12.3	62.9	47.2	64.3	55.8	58.1
Maier	77	37	2	58.5	13.0	64.8	42.3	66.3	54.3	57.8
Alzada	73	31	4	56.4	12.5	69.6	35.0	56.8	45.9	53.8
VT Peak	73	37	4	61.4	11.6	--	63.3	80.4	71.9	--
Trial Mean	75	40	3	59.6	11.6	64.5	56.0	78.2	--	--
C.V. %	0.9	3.5	29.9	0.7	3.4	4.9	7.0	4.5	--	--
LSD 10%	1	2	1	0.5	0.5	3.7	4.6	4.1	--	--

* Days to Head = the number of days from planting to head emergence from the boot.

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

Planting Date: April 22

Harvest Date: August 27

Previous Crop: Spring Wheat Green Fallow

Durum Wheat - 2014 Scranton, ND

Variety	Plant Height	Plant Lodge	Test Weight	Grain Protein	----- Grain Yield ----- 2012	2013	2014	Average Yield 2 yr	3 yr
	inches	0-9*	lbs/bu	%	------------ Bushels per acre ------------				
Alkabo	39	4	58.2	11.9	49.5	57.5	64.9	61.2	57.3
Carpio	40	7	58.1	11.9	39.6	55.3	57.8	56.6	50.9
Divide	39	6	58.9	11.6	50.2	54.6	61.5	58.1	55.4
Joppa	37	6	57.3	12.0	50.4	60.7	63.5	62.1	58.2
Mountrail	39	5	57.7	11.4	50.4	52.9	67.6	60.3	57.0
Tioga	41	5	56.2	11.8	51.5	61.2	61.1	61.2	57.9
Trial Mean	39	5	57.7	11.8	48.2	56.5	62.7	--	--
C.V. %	2.9	9.0	0.7	3.8	4.7	5.8	6.3	--	--
LSD 10%	2	2	0.5	0.5	2.7	4.0	4.8	--	--

* 0 = no lodging, 9 = 100% lodged.
Planting Date: April 24
Harvest Date: September 9
Previous Crop: Spring Wheat

Durum Wheat - 2014 Regent, ND

Variety	Plant Height	Plant Lodge	Test Weight	Grain Protein	----- Grain Yield ----- 2012	2013	2014	Average Yield 2 yr	3 yr
	inches	0-9*	lbs/bu	%	------------ Bushels per acre ------------				
Alkabo	42	4	53.9	13.6	33.5	65.5	46.9	56.2	48.6
Carpio	43	5	52.5	14.5	28.8	64.9	46.9	55.9	46.9
Divide	44	4	54.7	14.3	30.1	64.5	46.9	55.7	47.2
Joppa	41	4	52.7	13.8	40.6	67.1	49.9	58.5	52.5
Mountrail	42	4	50.8	14.1	37.1	61.9	47.2	54.6	48.7
Tioga	44	4	52.6	14.3	40.7	69.7	46.3	58.0	52.2
Trial Mean	42	4	52.8	14.1	36.0	65.8	47.4	--	--
C.V. %	3.4	19.7	2.9	4.8	5.4	5.9	9.3	--	--
LSD 10%	2	1	1.9	0.8	2.4	4.8	5.5	--	--

* 0 = no lodging, 9 = 100% lodged.
Planting Date: April 24
Harvest Date: September 9
Previous Crop: Spring Wheat

Durum Wheat - 2014 — Mandan, ND

Variety	Plant Height	Plant Lodge	Test Weight	Grain Protein	----- Grain Yield ----- 2012	2013	2014	Average Yield 2 yr	3 yr
	inches	0-9*	lbs/bu	%	------------ Bushels per acre ------------				
Alkabo	39	4	54.2	10.8	76.9	77.1	74.2	75.7	76.1
Carpio	41	6	54.2	11.0	57.1	84.6	67.6	76.1	69.8
Divide	41	7	54.8	11.0	80.2	79.8	69.3	74.6	76.4
Joppa	41	5	52.3	10.8	82.4	85.3	74.9	80.1	80.9
Mountrail	40	4	52.4	10.6	78.2	80.4	76.0	78.2	78.2
Tioga	42	6	53.6	11.0	82.0	86.4	68.7	77.6	79.0
Trial Mean	41	5	53.6	10.9	75.4	82.1	71.8	--	--
C.V. %	3.2	19.7	1.5	4.4	3.3	4.1	7.4	--	--
LSD 10%	2	1	1.0	0.6	3.0	4.1	6.6	--	--

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

Planting Date: April 25

Harvest Date: August 29

Previous Crop: Barley

Flax - 2014	**Hettinger, ND**

Variety	Days to Bloom	Plant Height	Test Weight	Oil Content	Seed Yield 2014	Seed Yield 3-Yr. Avg.
	**	inches	lbs/bu	%	-------bu/a-------	
Bison	53	26	54.3	41.2	30.7	--
Carter*	53	25	55.2	41.1	29.5	22.7
CDC Arras	53	27	54.7	40.0	30.3	24.4
CDC Bethume	53	28	55.1	40.7	30.4	24.7
CDC Glas	54	25	53.2	41.7	35.2	--
CDC Santuary	54	26	54.0	42.0	35.6	--
CDC Sorrel	54	28	54.5	41.7	32.8	--
GoldND*	55	27	54.5	41.8	32.8	--
Hanley	53	27	54.4	40.8	32.0	23.7
Lightning	54	26	55.1	40.7	31.8	22.6
Linott	54	28	55.7	39.7	32.0	--
McGregor	54	27	55.0	40.7	34.6	--
Neche	54	26	55.0	41.1	30.3	--
Nekoma	53	26	55.0	41.1	32.8	24.9
Omega*	55	26	55.1	40.6	31.2	--
Pembina	53	26	54.4	40.5	31.5	24.4
Praire Blue	54	25	54.5	41.9	34.4	26.2
Prairie Grande	53	24	52.7	41.5	32.8	25.7
Prairie Sapphire	54	26	54.1	43.3	33.7	26.8
Prairie Thunder	54	26	54.7	40.4	33.1	--
Rahab 94	53	24	53.6	41.5	34.4	--
Shape	54	26	54.0	43.0	33.2	--
Webster	54	27	55.3	41.3	31.7	24.7
York	54	25	53.7	40.7	31.7	27.5
Neela	53	26	54.8	41.2	37.6	--
Trial Mean	54	26	54.3	41.6	32.2	--
C.V. %	4.9	1.0	1.0	1.2	10.0	--
LSD 10%	0.6	1	0.6	0.6	3.8	--

* Yellow seed type.

** Days after planting.

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

Planting Date: May 6

Harvest Date: August 29

Previous Crop: Durum Wheat

Hard Red Spring Wheat - 2014 Hettinger, ND

Variety	Days to Head	Plant Height	Plant Lodge	Test Weight	Grain Protein	----- Grain Yield ----- 2012	2013	2014	Average Yield 2 yr	3 yr
	*	inches	0-9**	lbs/bu	%	------------ Bushels per acre ------------				
WB-Digger	73	38	1	59.9	12.7	83.5	75.8	92.5	84.2	83.9
Advance	72	36	2	61.5	12.7	84.9	67.8	89.0	78.4	80.6
SY Soren	72	33	0	61.3	13.4	82.2	72.2	86.2	79.2	80.2
Samson	72	33	0	59.2	11.8	79.2	70.4	90.1	80.3	79.9
SY Rowyn	71	35	2	60.3	12.0	83.7	69.5	85.0	77.3	79.4
Prevail	71	39	1	61.0	12.2	84.1	66.4	87.2	76.8	79.2
SY 605CL	71	38	0	62.0	14.1	80.3	71.8	83.1	77.5	78.4
SY Tyra	74	31	0	60.4	11.8	82.5	66.0	85.7	75.9	78.1
Velva	73	36	0	59.2	13.0	79.1	68.0	85.7	76.9	77.6
Elgin-ND	72	40	0	60.8	13.4	77.0	66.7	88.5	77.6	77.4
Brennan	72	34	0	60.0	12.5	79.9	69.8	80.4	75.1	76.7
Breaker	74	36	0	61.5	13.2	76.2	69.0	84.5	76.8	76.6
Sabin	73	38	3	60.3	13.8	82.7	65.4	81.2	73.3	76.4
Rollag	72	34	1	61.6	13.7	80.4	63.9	84.2	74.1	76.2
RB07	71	35	1	60.1	13.3	79.5	62.7	84.1	73.4	75.4
Jenna	74	35	1	60.0	13.0	72.0	67.7	86.5	77.1	75.4
Prosper	76	39	0	60.7	11.7	76.6	63.0	86.3	74.7	75.3
Forefront	69	41	2	61.2	13.2	75.7	64.9	85.2	75.1	75.3
Norden	72	34	0	62.3	12.5	76.5	65.8	83.5	74.7	75.3
Howard	73	38	1	61.5	12.9	73.0	69.9	80.3	75.1	74.4
Linkert	74	34	0	60.8	14.2	80.4	61.0	80.5	70.8	74.0
Select	68	39	1	62.7	12.7	73.1	66.0	82.6	74.3	73.9
Steele-ND	73	39	2	61.3	13.6	72.2	67.3	80.9	74.1	73.5
Barlow	71	39	0	60.9	13.8	71.5	68.2	80.1	74.2	73.3
WB-Mayville	71	33	0	59.6	13.2	76.6	62.6	79.7	71.2	73.0
Faller	74	38	1	61.1	11.9	68.8	54.4	94.1	74.3	72.4
Mott	75	39	0	60.8	12.9	73.2	65.0	78.9	72.0	72.4
Glenn	72	39	0	62.4	14.5	71.4	60.2	77.1	68.7	69.6
Vantage	77	35	0	61.1	14.9	67.6	60.0	75.4	67.7	67.7
ND 901 CL Plus	73	40	0	60.0	14.9	69.0	55.7	73.5	64.6	66.1
WB-Gunnison	71	35	3	60.0	12.6	70.3	51.8	73.4	62.6	65.2
LCS Albany	73	37	1	59.1	12.2	--	75.7	95.4	85.6	--
MS Stingray	75	38	0	58.7	10.5	--	70.9	95.9	83.4	--
LCS Iguacu	73	34	0	59.8	11.1	--	69.1	88.2	78.7	--
LCS Breakaway	71	34	0	62.2	13.5	--	69.6	86.4	78.0	--
LCS Powerplay	73	35	2	60.8	12.4	--	69.8	82.9	76.4	--

Table continues on next page.

Hard Red Spring Wheat - 2014 **Hettinger, ND**

Variety	Days to Head	Plant Height	Plant Lodge	Test Weight	Grain Protein	----- Grain Yield ----- 2012	2013	2014	Average Yield 2 yr	3 yr
	*	inches	0-9**	lbs/bu	%	------------ Bushels per acre ------------				
Croplan HRS 3419	75	35	0	60.2	11.8	--	--	97.9	--	--
WB-9507	71	37	2	58.7	12.2	--	--	92.8	--	--
MS Chevelle	71	34	2	60.2	10.7	--	--	91.3	--	--
Croplan HRS 3378	72	35	0	60.9	12.1	--	--	89.6	--	--
Croplan HRS 3361	73	36	0	60.1	11.7	--	--	88.2	--	--
WB-9879CLP+	72	34	1	59.5	12.3	--	--	83.4	--	--
SY Ingmar	72	33	0	61.3	13.2	--	--	82.1	--	--
Trial Mean	72	37	1	60.7	12.8	42.1	75.9	84.8	--	--
C.V. %	1.4	3.4	105.4	0.7	3.7	6.6	4.6	5.2	--	--
LSD 10%	1	1	1	0.5	0.5	3.5	4.1	5.2	--	--

* Days to Head = the number of days from planting to head emergence from the boot.

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

Planting Date: April 22

Harvest Date: August 21

Previous Crop: Spring Wheat Green Fallow

Hard Red Spring Wheat - 2014									Scranton, ND

	Plant	Plant	Test	Grain	----- Grain Yield -----			Average Yield	
Variety	Height	Lodge	Weight	Protein	2012	2013	2014	2 yr	3 yr
	inches	0-9*	lbs/bu	%	------------ Bushels per acre ------------				
Advance	33	6	59.3	12.2	--	54.3	58.1	56.2	--
Barlow	36	4	59.6	13.0	48.9	61.9	61.9	61.9	57.6
Brennan	30	3	59.0	12.8	--	--	62.3	--	--
Elgin-ND	37	3	59.0	12.6	58.2	61.6	60.2	60.9	60.0
Faller	36	2	58.8	11.7	41.1	55.1	67.7	61.4	54.6
Forefront	38	3	60.2	13.1	--	53.3	57.9	55.6	--
Glenn	37	2	61.4	13.3	50.7	55.2	54.6	54.9	53.5
LCS Albany	33	3	57.0	11.5	--	--	63.2	--	--
LCS Powerplay	32	4	58.8	11.6	--	--	57.7	--	--
Mott	37	2	59.3	13.0	43.3	63.7	62.2	63.0	56.4
Prevail	37	2	59.4	12.2	--	--	66.4	--	--
Prosper	35	2	58.3	12.3	44.0	57.3	56.6	57.0	52.6
RB07	32	4	58.6	13.0	51.3	57.1	55.8	56.5	54.7
Sabin	37	5	58.7	13.0	49.4	53.5	55.0	54.3	52.6
Select	37	5	60.3	12.1	51.2	56.4	56.7	56.6	54.8
SY Soren	30	6	59.1	12.8	53.1	55.7	62.6	59.2	57.1
SY Rowyn	32	5	58.2	12.4	--	--	56.8	--	--
Velva	35	2	57.9	12.6	50.1	66.4	59.7	63.1	58.7
WB-Digger	34	4	58.6	11.9	--	--	68.3	--	--
SY 605CL	35	3	59.8	12.8	--	--	65.7	--	--
Trial Mean	35	3	59.1	12.5	49.3	57.8	60.5	--	--
C.V. %	3.4	33.1	0.8	2.4	5.8	8.0	7.6	--	--
LSD 10%	2	2	0.6	0.4	3.4	5.5	6.3	--	--

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

Planting Date: April 24

Harvest Date: September 4

Previous Crop: Spring Wheat

Hard Red Spring Wheat - 2014 Regent, ND

Variety	Plant Height	Plant Lodge	Test Weight	Grain Protein	----- Grain Yield ----- 2012	2013	2014	Average Yield 2 yr	3 yr
	inches	0-9*	lbs/bu	%	------------ Bushels per acre ------------				
Advance	35	6	57.4	13.5	--	65.1	61.8	63.5	--
Barlow	38	4	56.3	14.2	51.1	67.4	60.2	63.8	59.6
Brennan	34	4	57.3	14.1	--	--	58.1	--	--
Elgin-ND	39	3	56.4	14.1	60.9	73.8	64.4	69.1	66.4
Faller	37	2	56.7	13.2	43.0	68.3	64.3	66.3	58.5
Forefront	39	3	58.1	13.9	--	71.8	64.1	68.0	--
Glenn	39	3	60.2	14.5	53.0	62.5	56.0	59.3	57.2
LCS Albany	34	4	55.3	13.0	--	--	63.3	--	--
LCS Powerplay	36	4	57.4	14.2	--	--	57.5	--	--
Mott	40	2	56.2	14.3	45.2	69.9	57.8	63.9	57.6
Prevail	37	3	57.2	13.3	--	--	62.6	--	--
Prosper	38	2	56.4	13.7	46.0	71.4	58.9	65.2	58.8
RB07	33	4	56.5	14.0	53.6	69.0	55.2	62.1	59.3
Sabin	37	6	57.1	14.3	51.6	70.2	60.1	65.2	60.6
Select	37	5	57.9	13.4	53.5	72.1	60.6	66.4	62.1
SY Soren	33	6	57.1	14.1	55.5	72.6	60.8	66.7	63.0
SY Rowyn	34	6	56.3	13.9	--	--	54.5	--	--
Velva	37	3	55.5	13.7	52.4	73.3	61.1	67.2	62.3
WB-Digger	37	4	55.9	13.5	--	--	66.8	--	--
SY 605CL	36	3	58.3	14.5	--	--	65.9	--	--
Trial Mean	36	4	57.0	13.9	51.5	69.8	60.7	--	--
C.V. %	3.7	29.8	1.2	2.2	5.8	5.7	8.0	--	--
LSD 10%	2	1	0.8	0.4	3.5	4.8	5.7	--	--

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

Planting Date: April 24

Harvest Date: September 4

Previous Crop: Spring Wheat

Hard Red Spring Wheat - 2014 **New Leipzig, ND**

Variety	Plant Height	Plant Lodge	Test Weight	Grain Protein	----- Grain Yield ----- 2012**	2013	2014	Average Yield 2 yr	3 yr
	inches	0-9*	lbs/bu	%	------------ Bushels per acre ------------				
Advance	34	4	56.7	11.8	--	55.5	62.0	58.8	--
Barlow	38	2	57.0	13.1	--	57.7	64.0	60.9	--
Brennan	30	4	57.1	12.9	--	--	65.3	--	--
Elgin-ND	38	3	55.9	12.8	--	59.2	65.6	62.4	--
Faller	36	2	56.1	12.1	--	53.5	67.5	60.5	--
Forefront	39	3	58.2	12.8	--	60.3	59.8	60.1	--
Glenn	36	2	57.0	13.8	--	57.6	53.3	55.5	--
LCS Albany	33	2	55.3	11.8	--	--	64.4	--	--
LCS Powerplay	34	4	56.0	12.2	--	--	62.6	--	--
Mott	37	1	56.5	13.2	--	64.4	55.7	60.1	--
Prevail	34	3	57.3	12.3	--	--	66.4	--	--
Prosper	34	2	56.3	12.5	--	56.7	60.3	58.5	--
RB07	33	3	56.5	13.3	--	56.2	60.4	58.3	--
Sabin	36	4	56.3	12.9	--	54.3	58.3	56.3	--
Select	35	4	58.1	12.3	--	63.2	62.0	62.6	--
SY Soren	30	1	57.4	13.1	--	59.4	65.2	62.3	--
SY Rowyn	31	2	55.7	12.4	--	--	58.3	--	--
Velva	35	1	55.2	13.0	--	65.9	67.9	66.9	--
WB-Digger	35	3	56.5	12.6	--	--	68.8	--	--
SY 605CL	35	2	57.8	13.8	--	--	65.6	--	--
Trial Mean	34	2	56.6	12.7	--	58.8	62.7	--	--
C.V. %	3.6	32.3	1.1	3.2	--	7.9	7.4	--	--
LSD 10%	1	1	0.7	0.5	--	5.5	5.5	--	--

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

** New Leipzig was not planted in 2012.

Planting Date: April 25

Harvest Date: August 29

Previous Crop: Spring Wheat

Hard Red Spring Wheat - 2014 **Mandan, ND**

Variety	Plant Height	Plant Lodge	Test Weight	Grain Protein	----- Grain Yield ----- 2012	2013	2014	Average Yield 2 yr	3 yr
	inches	0-9*	lbs/bu	%	------------ Bushels per acre ------------				
Advance	34	4	54.4	12.2	--	70.3	76.8	73.6	--
Barlow	36	2	53.3	12.5	71.2	72.4	73.4	72.9	72.3
Brennan	32	2	52.7	12.8	--	--	72.3	--	--
Elgin-ND	36	1	52.4	12.1	69.1	78.1	76.9	77.5	74.7
Faller	36	2	54.4	11.1	64.5	76.9	85.4	81.2	75.6
Forefront	37	2	55.7	11.1	--	78.2	72.9	75.6	--
Glenn	37	1	55.4	12.3	65.4	70.8	69.7	70.3	68.6
LCS Albany	33	2	53.1	10.6	--	--	80.9	--	--
LCS Powerplay	32	2	53.3	11.1	--	--	71.1	--	--
Mott	37	1	54.1	12.2	69.1	75.0	76.0	75.5	73.4
Prevail	35	2	54.3	11.7	--	--	73.9	--	--
Prosper	35	1	54.1	10.8	68.1	71.9	76.1	74.0	72.0
RB07	31	1	53.2	12.6	69.0	72.3	72.2	72.3	71.2
Sabin	36	4	55.1	12.0	77.4	79.7	74.4	77.1	77.2
Select	37	2	55.5	11.5	75.7	70.9	74.7	72.8	73.8
SY Soren	31	1	54.2	12.6	77.1	76.9	72.5	74.7	75.5
SY Rowyn	30	2	53.7	11.2	--	--	74.7	--	--
Velva	34	1	52.0	11.7	70.2	71.9	72.9	72.4	71.7
WB-Digger	35	3	52.2	12.0	--	--	76.7	--	--
SY 605CL	35	2	53.9	12.2	--	--	72.8	--	--
Trial Mean	34	2	53.9	11.8	70.0	74.3	74.8	--	--
C.V. %	4.0	39.7	1.3	5.8	3.1	7.3	6.2	--	--
LSD 10%	2	1	0.8	0.8	2.6	6.5	5.5	--	--

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

Planting Date: April 25

Harvest Date: August 29

Previous Crop: Barley

Lentil - 2014 **Hettinger, ND**

Variety	Days to Flower	Height	Lodging	Seed Protein	1,000 Seed Wt.	Seeds Lb	Test Weight	----- Grain Yield ----- 2011	2012	2013	Average Yield 2 yr	3 yr
	DAP*	inches	0 - 9**	%	gm	seeds	lb/bu	-----------------------lb/a-------------------------				
Large Green Type												
CDC Greenland	57	15	6	23.7	71	6404	56.3	1928	1789	2182	1986	1966
Pennell	57	16	6	23.9	63	7168	58.6	1698	1457	2269	1863	1808
Riveland	56	15	6	23.4	76	6009	56.2	1388	1580	2075	1828	1681
Medium Green Type												
Avondale	57	17	6	21.9	58	7852	59.4	--	2171	2700	2436	--
CDC Richlea	57	15	6	23.5	59	7722	57.0	1986	1890	2084	1987	1987
Merrit	55	14	6	24.5	67	6811	58.0	--	--	2244	--	--
Small Green Type												
CDC Viceroy	58	16	6	25.8	34	13268	61.8	1962	3046	2388	2717	2465
Essex	57	17	7	23.1	49	9276	58.3	1875	2171	2031	2101	2026
Eston	57	15	6	25.1	37	12353	60.9	--	2273	2601	2437	--
French Green Type												
CDC Lemay	58	16	8	23.7	36	12612	61.2	1689	2393	2603	2498	2228
Small Red Type											--	--
CDC Red Rider	58	16	5	24.7	50	9117	58.0	--	3133	2475	2804	--
CDC Redberry	57	17	2	24.8	42	10720	61.2	1876	2919	2731	2825	2509
CDC Redcoat	58	18	5	23.0	42	10908	60.8	--	--	2846	--	--
CDC Rosetown	58	18	5	24.8	37	12401	61.8	2130	2942	2319	2631	2464
CDC Rouleau	57	17	5	23.1	42	10765	59.8	1776	1926	2842	2384	2181
Crimson	56	14	9	23.6	35	12972	62.4	--	--	2465	--	--
Spanish Brown Type												
Morena	57	16	6	24.0	39	11597	61.2	2094	2478	1929	2204	2167
Pardina	56	15	8	23.7	41	11118	60.8	--	--	2602	--	--
Mean	57	16	6	24	50	9621	59.6	1932	2283	2394	--	--
C.V. %	0.7	6.0	12.7	2.6	5.4	4.7	1.1	5.8	12.3	10.2	--	--
LSD 10%	1	1	1	0.7	3	529	0.8	133	332	289	--	--

* Days after planting.

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

Planting Date: May 6

Harvest Date: August 18

Previous Crop: No-till Green Fallow Spring Wheat

Clearfield Lentil - 2014 **Hettinger, ND**

Variety	Days to Flower	Height	Lodging	1,000 Seed Wt.	Seeds Lb	Test Weight	----- Grain Yield ----- 2012	2013	2014	Average Yield 2 yr	3 yr
	DAP*	inches	0 - 9**	gm	seeds	lb/bu					
Medium Green Type											
CDC Imigreen CL	57	16	5	59	7694	51.3	1212	2640	2311	2476	2054
CDC Impress CL	56	14	7	57	7996	48.5	1795	3260	2635	2948	2563
Small Red Type											
CDC Maxim CL	56	17	3	44	10294	53.1	2039	3132	3566	3349	2912
CDC Impala CL	59	16	7	41	11048	54.3	1807	3086	2754	2920	2549
Mean	57	16	5	50	9258	51.8	1663	3029	2817	--	--
C.V. %	1.0	5.9	5.4	5.3	5.8	1.2	5.5	8.2	6.6	--	--
LSD 10%	1	1	1	3	697	0.8	112	322	240	--	--

* Days after planting.

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

Planting Date: May 6

Harvest Date: August 25

Previous Crop: No-till Green Fallow Spring Wheat

Oat - 2014 **Hettinger, ND**

Variety	Days to Head	Plant Height	Plant Lodge	Test Weight	----- Grain Yield ----- 2012	2013	2014	Average Yield 2 yr	3 yr
	*	inches	0-9**	lbs/bu	------------ Bushels per acre ------------				
CDC Minstrel	77	54	0	33.1	140.4	167.9	191.5	179.7	166.6
Jury	74	47	5	37.5	135.3	163.1	196.0	179.6	164.8
Newburg	73	50	5	36.0	126.2	172.5	192.7	182.6	163.8
Otana	75	49	5	37.2	141.6	167.6	181.3	174.5	163.5
Furlong	77	48	0	33.5	131.1	162.2	192.8	177.5	162.0
Horsepower	72	50	1	37.2	132.9	159.5	192.0	175.8	161.5
Rockford	75	47	0	37.8	126.9	156.1	199.8	178.0	160.9
Killdeer	75	50	0	35.3	131.0	164.0	185.5	174.8	160.2
Leggett	77	46	0	35.5	124.6	162.4	193.2	177.8	160.1
AC Pinnacle	80	44	0	32.6	133.0	148.8	173.5	161.2	151.8
Stallion	75	46	4	37.7	139.0	150.8	157.1	154.0	149.0
Beach	78	49	1	35.9	120.3	152.2	171.0	161.6	147.8
CDC Dancer	79	48	0	32.9	118.9	151.5	165.2	158.4	145.2
Souris	77	51	0	32.6	118.3	136.7	128.9	132.8	128.0
HiFi	77	53	0	32.8	111.5	135.6	130.1	132.9	125.7
Hytest	76	48	5	37.5	120.5	130.2	109.0	119.6	119.9
Goliath	74	53	4	36.5	--	161.0	195.8	178.4	--
Deon	78	53	0	36.0	--	--	200.9	--	--
Paul (hull-less)	78	50	0	39.4	--	--	131.7	--	--
Trial Mean	76	50	2	35.8	124.3	157.0	175.8	--	--
C.V. %	1.0	7.9	62.6	2.4	3.8	5.0	6.3	--	--
LSD 10%	1	5	2	1.0	5.6	9.3	13.0	--	--

* Days to Head = the number of days from planting to head emergence from the boot.
** 0 = no lodging, 9 = 100% lodged.
Planting Date: April 22
Harvest Date: August 19
Previous Crop: Chemical Fallow

NDSU Hettinger Research Extension Center

Field Pea - 2014 **Hettinger, ND**

Variety	Days to Flower	Flower Duration	Days to Mature	Vine Length	Canopy Height	Height Index	Lodging	Seed Protein	1,000 Seed Wt.	Seeds Lb	Test Weight	Seed Yield 2014	Seed Yield 2-Yr. Avg.	Seed Yield 3-Yr. Avg.
	DAP[1]	days	DAP[1]	inches	inches	%[2]	0 - 9[3]	%	gm	seeds	lb/bu	---------------bu/a---------------		
Yellow Cotyledon Type														
Abarth	52	23	88	30	21	70	4	25.6	234	1942	59.8	54.8	--	--
DS Admiral	53	22	89	26	19	73	4	24.6	226	2008	61.2	55.5	54.8	52.7
Agassiz	53	27	94	28	20	71	5	26.7	227	2003	60.6	52.8	52.7	50.1
Bridger	52	21	87	26	19	72	4	24.9	216	2103	60.7	59.8	56.4	55.0
Durwood	54	22	90	32	26	80	4	25.9	224	2031	61.1	53.2	--	--
Gunner	55	22	90	32	22	68	5	25.4	210	2163	60.8	56.6	52.2	50.8
Korando	50	24	88	27	21	77	4	28.0	237	1913	59.7	51.6	50.4	51.3
CDC Meadow	53	24	91	27	22	81	4	24.6	198	2296	60.7	54.4	52.5	--
SW Midas	54	23	91	28	17	61	6	24.9	196	2320	61.5	51.0	51.0	50.3
Mystique	54	23	91	29	23	78	4	25.6	234	1946	60.6	56.4	--	--
Nette	52	20	86	27	21	77	5	24.4	207	2195	61.7	56.9	52.7	--
Torch	57	16	87	25	22	89	3	26.5	247	1840	61.4	54.9	--	--
Quantim	54	19	87	33	19	60	6	25.1	273	1665	61.1	58.5	--	--
PUSA 11002	51	21	86	22	18	81	5	26.8	175	2596	60.8	45.2	46.5	47.9
Green Cotyledon Type														
Aragorn	52	22	87	25	17	69	6	24.9	191	2374	60.2	46.4	--	--
Arcadia	54	19	87	25	15	61	8	24.3	196	2317	60.3	56.9	55.6	54.4
Cruiser	53	23	91	25	17	66	6	24.7	188	2419	60.8	46.5	45.7	45.4
Majoret	54	20	88	28	16	56	5	27.5	221	2055	61.6	47.7	49.3	46.6
Shamrock	54	19	87	30	19	65	5	25.0	231	1963	60.7	58.3	--	--
CDC Striker	54	22	90	25	16	67	7	24.7	194	2340	61.1	53.4	53.0	51.9
Mean	53	22	89	27	19	71	5	25.5	215	2139	60.9	53.6	--	--
C.V. %	1.1	5.1	1.1	7.8	8.8	11.0	20.0	2.4	3.9	3.9	1.0	6.7	--	--
LSD 10%	1	1	1	3	2	9	1	0.7	10	98	0.7	4.3	--	--

[1] Days after planting.

[2] Harvest Index; Plant height at time of harvest relative to plant height at end of bloom.

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

Planting Date: May 6

Harvest Date: August 18

Previous Crop: Oats

Safflower - 2014 **Hettinger, ND**

Variety	Days to Flower	Plant Height	Test Weight	-------Grain Yield-------- 2012	2013	2014	Average Yield 2-Yr	3-Yr
	DAP*	inches	lbs/bu	------------------- lbs per acre -------------------				
Cardinal	90	37	36.0	2381	2394	1043	1719	1939
Finch	88	33	36.9	2073	2272	897	1585	1747
MonDak	90	35	35.5	2358	2303	1070	1687	1910
Montola 2003	92	32	34.7	2060	2186	991	1589	1746
Morlin	92	31	32.3	--	1776	735	1256	--
Nutrasaff	89	34	35.1	1366	2124	867	1496	1452
Hybrid 9049	90	36	32.5	2601	2978	1063	2021	2214
Hybrid 1601	89	31	37.0	2993	2182	1195	1689	2123
Trial Mean	90	34	35.0	2272	2277	983	1630	1876
C.V. %	0.8	3.7	3.2	10.6	8.8	21.7	--	--
LSD 10%	1	2	1.6	320	244	NS	--	--

* Days after planting.

Planting Date: May 6

Harvest Date: September 22

Previous Crop: Spring Wheat

NDSU Hettinger Reaserch Extension Center

Soybean - Conventional - 2014 **Hettinger, ND**

Company/ Brand	Variety	Maturity	Plant Height	Test Weight	Seed Oil	Seed Protein	Grain Yield 2012	Grain Yield 2013	Grain Yield 2014	Average Yield 2-Yr	Average Yield 3-Yr
			inches	lbs/bu	%	%	Bushels per acre				
NDSU	Traill	00.0	31	55.0	15.0	36.9	22.6	44.4	42.5	43.5	36.5
NDSU	Cavalier	00.9	32	53.5	15.7	34.8	30.5	42.6	41.9	42.3	38.3
NDSU	Ashtbula	0.4	31	54.6	16.6	33.5	33.6	46.1	48.0	47.1	42.6
NDSU	Sheyenne	0.7	31	55.6	15.8	33.7	38.5	47.1	50.8	49.0	45.5
Trial Mean		--	32	54.7	15.6	35.3	31.6	44.1	44.4	45.4	40.7
C.V. %		--	2.7	1.2	1.8	1.5	4.9	5.9	5.5	--	--
LSD 10%		--	1	0.8	0.3	0.7	1.9	1.7	3.0	--	--

Planting Date: May 21
Harvest Date: October 7
Previous Crop: Winter Wheat

NDSU Hettinger Research Extension Center

Soybean - Roundup Ready - 2014	**Hettinger, ND**

Company/Brand	Variety	Maturity	Plant Height	Test Weight	Seed Oil	Seed Protein	-----Grain Yield----- 2013	2014	Average 2-Yr
			inches	lbs/bu	%	%	-------- Bushels per acre -------		
Legacy Seeds	LS-0134	0.1	25	54.8	14.5	35.3	--	49.5	--
Legacy Seeds	LS-0214	0.2	30	53.0	15.6	35.1	--	50.6	--
Proseed	30-20	0.2	31	53.0	15.8	35.0	--	53.4	--
Legacy Seeds	LS-0334	0.3	29	53.8	14.7	35.7	--	49.5	--
Integra	20300	0.3	27	54.0	14.4	35.3	40.5	46.4	43.5
Integra	20456	0.4	28	54.5	15.1	34.5	--	49.9	--
Peterson FS	15R04	0.4	29	54.6	14.9	34.9	--	48.3	--
AgVenture	04E4RR	0.4	28	53.2	15.2	34.2	--	47.0	--
Proseed	11-50	0.5	32	53.7	14.8	33.9	--	51.2	--
AgVenture	05B5RR	0.5	28	53.5	16.4	32.4	--	50.0	--
Legacy Seeds	LS-0634N	0.6	28	53.9	14.6	35.3	--	46.3	--
NuTech Seed	7063	0.6	28	53.7	15.9	33.1	--	46.6	--
Integra	20600	0.6	31	53.7	14.9	33.8	43.1	50.4	46.8
Integra	20646N	0.6	30	53.8	14.3	36.1	--	48.5	--
Peterson FS	14R06N	0.6	28	53.9	14.1	36.2	--	47.3	--
Legacy Seeds	LS-0833N	0.8	31	54.3	14.6	34.6	--	46.6	--
NuTech Seed	6084R	0.8	26	54.4	14.6	35.5	--	42.3	--
AgVenture	08E5RR	0.8	27	55.2	15.5	33.5	--	41.6	--
AgVenture	09E1RR	0.9	30	54.5	15.1	34.8	--	38.2	--
Legacy Seeds	LS-1134N	1.1	31	54.5	14.6	34.5	--	39.6	--
AgVenture	12B2RR	1.2	30	54.9	14.6	33.5	--	41.4	--
		--	29	54.0	15.0	34.6	43.6	46.9	45.2
C.V. %		--	5.4	0.9	2.6	2.0	6.2	5.7	--
LSD 10%		--	2	0.6	0.5	0.8	3.3	3.2	--

Planting Date: May 21
Harvest Date: October 7
Previous Crop: Winter Wheat

NDSU Hettinger Research Extension Center

Oil Type Sunflower - 2014 | **Hettinger, ND**

Company/Brand	Hybrid	Oil Type & Traits	Days to Bloom	Plant Height	Lodging	Test Weight	Oil Content	Yield 2014	Yield 2-Year
		*	**	inches	%	lbs/bu	%	lbs/ac	lbs/ac
AgVenture	3N93 DM	HO, CL ,DM	72	50	0	26.6	***	983	1200
AgVenture	3N94DM	NS, CL, DM	74	54	11	28.3		1281	1937
AgVenture	AF3H681ES	HO, EX, DM	74	60	1	26.5		853	--
AgVenture	AF3N692ES	NS, EX, DM	76	56	1	26.1		594	--
AgVenture	EXF4N14		79	53	2	26.6		1401	--
AgVenture	EXF4N15DM		75	51	2	27.2		1544	--
Croplan	432 E	NS, EX, DM	71	50	5	26.6		989	1484
Croplan	545 CL	NS, EX, DM	76	56	3	26.3		1536	--
Geonosys	11G08	NS	76	63	3	28.7		935	1451
Geonosys	12G20	HO, CL	74	53	10	27.9		1710	1932
Geonosys	12G25	HO, CL	74	54	5	28.4		1501	--
Geonosys	12E06	HO, DM	73	60	4	28.7		1255	1678
Geonosys	12E12	HO, CL ,DM	74	62	4	27.2		741	1304
Geonosys	12E13	HO, CL ,DM	74	60	7	26.4		1111	1373
Geonosys	12E14	HO, CL ,DM	75	65	1	25.4		1226	1575
Mycogen Seeds	8H449CLDM	NS, CL, DM	75	50	3	30.2		1533	1731
Mycogen Seeds	8D310CL	NS, CL	74	59	3	26.8		1429	1533
Nuseed	Falcon	NS, EX	75	51	1	27.0		1223	1808
Nuseed	Camaro II	NS, CL, DM	75	57	8	27.7		1305	1676
Nuseed	Talon	NS, EX	71	52	2	26.3		1039	--
Nuseed	Cobalt II	HO, CL, DM	72	54	5	26.3		892	1253
Nuseed	Hornet	HO, CL, DM	78	59	8	26.3		1711	2055
Nuseed	Badger	TR, CL	73	58	8	26.1		1253	--
Nuseed	Badger DMR	TR, CL, DM	71	55	4	26.2		1101	--
Nuseed	Badger HO	HO, CL, DM	68	53	2	25.7		796	--
Proseed	E-21 CL	HO, CL	74	60	5	26.3		653	1150
Proseed	E-31 CL	HO, CL	74	60	3	25.1		1024	1466
Proseed	E-85 CL	HO, CL	75	66	4	25.7		1111	1379
Proseed	E-362436	HO	73	63	11	28.7		1115	1531
Syngenta	7111 HO/CL/DM	HO, CL, DM	71	48	6	27.6		963	1201
Syngenta	7717 HO/CL/DM	HO, CL ,DM	72	52	0	28.1		1857	--
Syngenta	3495 NS/CL/DM	NS, CL ,DM	75	57	6	30.6		1394	--
Syngenta	NX34420 HO/CL/DM	HO, CL ,DM	75	58	13	27.5		1781	--
USDA	Hybrid 894	TR	72	55	4	26.3		1093	--
Trial Mean			74	56	4	27.1		1204	1912
C.V. %			4.9	1.2	107.4	2.8		15	--
LSD 10%			1	3	7	0.9		219	--

* Type: TR-Traditonal, NS-NuSun, HO-High Oleic, CL=Clearfield, EX=ExpressSun, DM=Downy Mildew Resistant

** Days after planting.

*** Oil data was not available at time of printing, results will be updated on the HREC website.

http://www.ag.ndsu.edu/HettingerREC/agronomy

Planting Date: May 22

Harvest Date: November 6

Previous Crop: Wheat

Hard Red Winter Wheat - 2014	**Hettinger, ND**

Variety	Spring Stand	Heading Date	Plant Height	Plant Lodge*	Test Weight	Grain Protein	----- Grain Yield ----- 2010	2012	2014	Average Yield 2 yr	3 yr
	%		inches	0-9	lbs/bu	%	------------ Bushels per acre ------------				
Decade	78	6/19	35	0.0	62.0	12.3	75.3	68.4	102.9	85.6	82.2
Overland	70	6/19	36	2.3	62.3	11.6	80.2	73.8	91.6	82.7	81.9
AC Radiant	74	6/22	37	0.5	61.5	11.1	83.1	72.9	87.5	80.2	81.2
Ideal	71	6/21	35	3.0	62.1	11.1	76.6	66.3	95.8	81.0	79.6
Lyman	67	6/18	36	3.8	62.6	12.6	72.3	73.7	91.0	82.3	79.0
Jerry	83	6/22	40	3.3	61.5	11.5	78.5	66.3	85.2	75.7	76.7
Accipiter	76	6/24	35	3.0	60.7	10.9	84.3	58.3	81.2	69.8	74.6
Art	64	6/18	33	0.5	62.1	11.8	74.5	59.7	83.6	71.7	72.6
Peregrine	80	6/23	40	3.3	62.6	10.7	68.5	46.9	96.2	71.6	70.5
SY Wolf	70	6/20	32	0.0	60.6	11.9		62.2	95.7	78.9	--
WB Matlock	74	6/22	36	3.0	62.3	11.6		67.2	86.6	76.9	--
McGill	75	6/19	37	3.3	61.0	10.8		61.8	85.8	73.8	--
AC Emerson	68	6/22	36	0.0	62.4	12.3			94.9	--	--
Freeman	71	6/17	33	2.8	60.3	11.6			93.6	--	--
Flourish	79	6/21	33	1.0	59.9	11.0			88.8	--	--
WB Grainfield	59	6/16	33	1.5	61.4	11.5			88.1	--	--
Redfield	71	6/19	34	3.5	61.5	11.3			88.0	--	--
AC Gateway	68	6/22	33	0.0	61.6	12.0			87.9	--	--
Moats	68	6/22	38	1.8	62.4	11.3			85.6	--	--
CDC Falcon	79	6/21	34	2.8	60.4	10.9			85.2	--	--
AC Broadview	69	6/21	34	4.8	60.7	10.8			84.9	--	--
Alice (white)	65	6/18	30	4.8	60.3	11.3			72.7	--	--
Robidoux	59	6/20	34	4.0	59.7	11.3			71.5	--	--
Trial Mean	71	6/20	35	2.2	61.4	11.4	74.5	63.7	88.1	--	--
C.V. %	13.3	0.5	3.6	53.6	0.8	2.0	5.4	7.7	4.9	--	--
LSD 10%	11	1	1	1.4	0.6	0.3	5.7	5.8	5.9	--	--

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

Planting Date: September 25

Harvest Date: August 13

Seeding Rate: 1 million live seeds / acre

Previous Crop: Spring Wheat Green Fallow

Effects of corn particle size and forage level on performance and carcass traits of yearling steers during finishing

C.L. Engel[1], V. L. Anderson[1] and C.S. Schauer[2]

The objective of this project was to evaluate corn processed by fine grinding or rolling or fed whole in relation to dietary forage level for finishing yearling steers. Results indicate when forage levels are greater than 15.5 percent on a dry-matter basis, dry rolling or finely grinding corn to maintain a particle size greater than 1.35 ± 0.16 millimeters (mm) and less than 5.49 ± 0.14 mm (2.84 ± 0.12 mm on average) will result in optimum feed efficiency and dry-matter intake (DMI) for finishing yearling steers.

Summary

One hundred twenty black crossbred yearling steers were used to evaluate the effects of corn processing and particle size (whole, WC; dry rolled, RC; and ground corn, GC; 5.49 ± 0.14 mm, 2.84 ± 0.12 mm and 1.35 ± 0.16 mm mean particle size, respectively) on performance and carcass traits in finishing steers fed diets with decreasing forage levels. The experiment was conducted at the NDSU Carrington Research Extension Center research feedlot during the winter of 2013-14. The amount of forage in the diet on a dry-matter basis started at 31.5 percent and decreased at 41-day intervals to 25 and 15.5 percent and a final level of 13.5 percent for the last 22 days on feed across all three corn-processing level treatments. Forage levels are defined as the sum of the hay fed and 50 percent of the dietary corn silage component. Diets within respective forage levels were similar in ingredients and nutrient composition. Totally mixed rations were offered in concrete fence-line bunks once daily and fed to appetite for each pen. Average daily gain was not different ($P = 0.21$) throughout the entire feeding period. DMI throughout the entire feeding period was greater ($P = 0.01$) for WC, compared with DR and GC, which were not different ($P > 0.05$; 31.8, 29.9, 29.2 pounds/head/day; WC, DR, GC, respectively). Efficiency of gain (gain-to-feed) was not different ($P > 0.05$) for RC (0.169) and GC (0.166) but lower ($P = 0.002$) for WC (0.154). Carcass traits, with the exception of percent of kidney pelvic and heart fat (KPH), were not different ($P \geq 0$ .07) among corn-processing levels. The percent of KPH was greater ($P = 0.01$) for WC vs. RC and GC. When forage levels were greater than 15.5 percent of diet dry matter, processing corn vs. feeding whole corn resulted in reduced DMI and improved gain efficiency in finishing rations for yearling cattle.

Introduction

Corn often is processed by dry rolling, grinding or steam flaking for most feedlot rations. Corn processing has been reported to increase starch digestibility and improve performance of feedlot cattle. Processing corn through a roller or hammer mill breaks open the kernel, exposing the starch fraction and increasing the surface area for moistening and bacterial attachment, which increases the rate of digestion in the rumen. The topic of how much processing and when to process still is debated among producers and nutritionists. Forage level and moisture content of other dietary ingredients, as well as other unknown factors, may interact with the processing level and contribute to the variability in animal response. Our objective was to evaluate the response to differences in corn particle size when higher dietary forage levels are utilized for finishing yearling steers.

Experimental Procedures

All procedures were approved by the NDSU Animal Care and Use Committee. One hundred twenty black crossbred yearling steers (897 ± 2.52 pounds body weight) were used to evaluate three corn-processing levels in feedlot finishing diets across three decreasing forage levels in a randomized complete block design. Steers were blocked by receiving body weight (four weight blocks) and allotted to one of 12 pens (10 animals per pen) at the NDSU Carrington Research Extension Center. Within each block, pens were assigned randomly to one of three corn-processing treatments to achieve different corn particle sizes: 1) whole corn (WC), 2) dry-rolled corn (RC) and 3) finely ground corn (GC); (Table 1).

Diets were formulated to be similar in protein and energy to meet or exceed National Research Council (NRC) nutrient requirements, and included Rumensin, vitamins and minerals. The amount of forage in

[1]Carrington Research Extension Center, NDSU
[2]Hettinger Research Extension Center, NDSU

Table 1. Formulation and nutrient composition of diets for yearling steers fed whole, dry-rolled or finely ground corn with decreasing forage levels.

Ingredient	31.5% Forage, period 1[1]	25% Forage, period 2[1]	15.5% Forage, period 3[1]	13.5% Forage, period 4[2]	Overall[3]
	Dry matter basis				
Corn, %[4]	23.0	35.0	53.0	55.0	41.0
MDGS, %	24.0	25.0	24.0	24.0	24.0
Corn silage, %	39.0	28.0	13.0	11.0	23.0
Hay, %	12.0	11.0	9.0	8.0	10.0
Supplement, %	2.0	2.0	2.0	2.0	2.0
Item					
CP, %	13.4	13.8	14.1	14.1	13.8
NEg, Mcal/lb	0.49	0.53	0.57	0.58	0.54
DM, %	45.2	50.5	60.7	62.3	53.2
Diet concentrate, %	68.5	75.0	84.5	86.5	78.5
Diet forage, %	31.5	25.0	15.5	13.5	21.5

[1]41 days in each period.
[2]22 days in the period.
[3]Diet composition averaged throughout the entire 145-day finishing trial.
[4]All three treatment diets, within respective forage level periods, were similar in composition. The only difference was how the corn was processed (whole, dry rolled or finely ground).

the diet for all three corn-processing treatments in the initial feeding period was 31.5 percent (dry-matter basis) and decreased at 41-day intervals to 25 and 15.5 percent, followed by a final level of 13.5 percent for the last 22 days of the experiment.

Forage levels are defined as the sum of the hay and 50 percent of the diet corn silage components. Totally mixed diets were offered for *ad libitum* intake and delivered to fence-line bunks once per day. Dietary ingredient samples were collected every 28 days and analyzed for nutritional composition at a commercial lab. Each corn processing type was analyzed for particle size following the procedures of Behnke (1985) at a commercial laboratory using a Tyler Ro-Tap Shaker Model RX-29 and 14 Sieves [4, 6, 8, 12, 16, 20 (with brush), 30 (with brush), 40 (with brush), 50 (with brush), 70 (with brush), 100 (with brush and ball), 140 (with brush), 200 (with brush and ball) and 270 screens plus bottom pan and cover lid]. Mean particle size for the whole, rolled and ground corn was 5.49 ± 0.14 mm, 2.84 ± 0.12 mm and 1.35 ± 0.16 mm, respectively.

Steers were weighed and implanted with 120 milligrams (mg) of trenbolone acetate and 24 mg of estradiol (Revalor S; Merck Animal Health, Whitehouse Station, N.J.) at the start of the trial. Steers were weighed every 41 days for the 145-day feeding period, with the final feeding period of 22 days. One steer died due to causes not related to treatment. All cattle were harvested on the same date at Tyson Fresh Meats, Dakota City, Neb. Hot carcass weights were obtained at harvest. Carcass attributes were evaluated by a trained grader after a 24-hour chill: 12th rib-fat depth; rib-eye area; kidney, pelvic and heart fat (KPH); marbling; and USDA yield grade. Performance and carcass characteristics were analyzed using the GLM procedure of SAS (SAS Inst. Inc., Cary, N.C.) and pen was the experimental unit.

Results and Discussion

Body weight and average daily gain (ADG) were not different ($P \geq 0.19$) within each forage level period and throughout the entire feeding period (Table 2). Gorocica- Buenfil and Loerch (2005) observed a similar effect on animal performance among cattle fed whole corn, cracked corn or a shifting diet combination of whole or cracked corn with high-forage (18.2 percent corn silage) or low-forage (5.2 percent corn silage) diets. Swanson et al. (2013) found that decreasing corn particle size, through different degrees of dry rolling, did not impact ADG, DMI or G-to-F.

In this study, DMI was similar ($P= 0.24$) for DR and GC and greatest ($P \leq 0.01$) for WC (29.9 = 29.2 < 31.8 pounds, respectively; Table 2). Throughout the entire study, efficiency of gain was greatest ($P = 0.003$) with RC (0.169) and GC (0.166) and lowest with WC (0.154). A similar efficiency response was observed ($P \leq 0.01$) in the 31.5 and 25 percent forage feeding periods, but the effect diminished as forage levels decreased below 15.5 percent.

Vander Pol et al. (2008) found that feed intake decreased as the level of corn processing increased. They also found feed efficiency was improved for cracked corn vs. whole and fine-ground corn diets. In a review of the literature, Owens et al. (1997) reported that feed efficiency was not improved by dry rolling vs. feeding whole corn. The lack of difference partially was attributed to dietary roughage levels being lower in diets containing whole corn compared with dry-rolled corn (6 vs. 7.9 percent).

In the current study, forage levels were greater throughout the entire feeding period than the studies reviewed by Owens et al. (1997) and may explain why dry-matter intake decreased with processed corn treatments and RC and GC showed similar improvements in feed efficiency vs. WC. All carcass characteristics, with the exception of percent kidney pelvic and heart fat (KPH), were not different ($P \geq 0.07$) among corn processing levels (Table 3). The percent KPH was not different ($P > 0.05$) for RC and GC but greater for WC ($P = 0.01$).

These results may indicate that when forage levels are greater than 15.5 percent on a dry-matter basis, processing corn by dry rolling or fine grinding to maintain a particle size greater than 1.35 ± 0.16 mm and less than 5.49 ± 0.14 mm (2.84 ± 0.12 mm on average), as compared with whole corn, will result in decreased DMI and improved gain efficiency for finishing yearling steers.

Acknowledgments

The authors express their appreciation to the North Dakota Corn Utilization Council for partial funding for this study and to the technicians and administrative support personnel at the Carrington Research Extension Center for their contributions to this experiment. Appreciation is also expressed to the Hettinger Research Extension Center for providing the cattle for this work.

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Table 2. Animal performance for yearling steers fed diets containing whole, dry-rolled or finely ground corn with decreasing forage levels.

	Whole	Rolled	Ground	Std Err	*P*-Value
31.5% Forage, period 1[1]					
Body weight, lb.	1,141	1,153	1,148	6.56	0.52
ADG, lb.	5.73	6.17	5.93	0.15	0.19
DMI, lb.	27.5	26.5	26.2	0.34	0.07
G:F	0.208[b]	0.233[a]	0.227[a]	0.005	0.04
25% Forage, period 2[1]					
Body weight, lb.	1,318	1,340	1,337	8.35	0.24
ADG, lb.	4.12	4.35	4.39	0.12	0.30
DMI, lb.	31.7	30.6	30.8	0.51	0.31
G:F	0.130[b]	0.143[a]	0.143[a]	0.002	0.01
15.5% Forage, period 3[1]					
Body weight, lb.	1,510	1,530	1,512	15.99	0.71
ADG, lb.	4.83	4.64	4.27	0.25	0.35
DMI, lb.	35.0[a]	32.3[b]	30.9[b]	0.64	0.01
G:F	0.138	0.144	0.138	0.006	0.65
13.5% Forage, period 4[2]					
Body weight, lb.	1,610	1,625	1,604	10.17	0.36
ADG, lb.	5.00	5.04	4.84	0.39	0.93
DMI, lb.	34.2[a]	30.2[b]	28.6[b]	0.66	0.002
G:F	0.146	0.167	0.17	0.016	0.66
Overall[3]					
Initial body weight, lb.	901	894	899	2.52	0.17
Final body weight, lb.	1,610	1,625	1,604	10.17	0.36
ADG	4.89	5.05	4.86	0.07	0.21
DMI	31.8[a]	29.9[b]	29.2[b]	0.37	0.01
G:F	0.154[b]	0.169[a]	0.166[a]	0.002	0.002

[1] 41 days in the period.
[2] 22 days in the period.
[3] overall days on feed, 145 days.
[abc] Means within rows with common superscripts are similar, $P > 0.05$.

Table 3. Carcass performance for yearling steers fed diets containing whole, dry-rolled or ground corn with decreasing forage levels.

	Whole	Rolled	Ground	Std Err	*P*-Value
Marbling score[1]	552.9	538.0	579.3	12.01	0.12
Hot carcass weight, lb.	959.3	964.2	948.5	7.13	0.34
Backfat, in.	0.69	0.74	0.72	0.01	0.15
REA, sq. in.	14.16	14.06	14.38	0.13	0.26
Yield grade[2]	3.84	3.98	3.76	0.05	0.07
KPH, %	2.46[a]	2.29[b]	2.35[b]	0.03	0.01
Dressing percent, %	62.8	62.5	62.5	0.22	0.67

[1] USDA Quality grades based on scores of 300-399 = select, 400-499 = low choice, 500-599 = average choice, 600-699 = high choice, 700+ = prime.
[2] Yield grade is composite calculation of fat to lean yield in a carcass based on a relationship of hot carcass weight, rib-eye area, fat thickness and KPH; low values = lean carcasses.
[abc] Means within rows with common superscripts are similar, $P > 0.05$.

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Sheep

Research Report

Hettinger Research Extension Center

Department of Animal Science

North Dakota State University

Report No. 54

October 2014

NDSU | HETTINGER RESEARCH EXTENSION CENTER

Effects of maternal nutrition and arginine supplementation on characteristics of wool quality in offspring

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The objectives of this study were to evaluate effects of maternal nutritional plane and rumen-protected arginine supplementation on postnatal offspring wool quality and follicle development. We hypothesized that lambs from ewes receiving diets fed to nutrient requirements would have a greater density of wool follicles and more improved wool quality than lambs from nutrient restricted ewes; we also hypothesized that lambs from restricted ewes receiving a rumen-protected arginine supplement would present similar wool follicle numbers and quality to those lambs from adequately fed dams. We found that though maternal nutrient restriction did not appear to affect wool quality, maternal rumen-protected arginine supplementation may increase wool follicle density in offspring from nutrient-restricted dams and therefore potentially increase wool production.

INTRODUCTION

The United States' total wool supply has been declining over the last twenty years. In 1990, U.S. wool supply totaled 214.8 million clean pounds, with 131.9 million clean pounds in 2000 and dropping to 56.3 million clean pounds in 2010 (USDA, 2013). Similarly, total yield per head has been decreasing, albeit not as drastically (7.8 lb/head in 1990, 7.6 lb/head in 2000, and 7.3 lb/head in 2010; USDA 2013). These data support a need for improvement in U. S. wool production.

Development of wool follicles occurs during fetal life and plays an important role in postnatal wool output (Magolski et al., 2011). Skin has a defined number of dermal cells in the embryonic stage that will eventually permit postnatal follicle formation, meaning that postnatal wool follicle numbers are pre-determined by fetal development during gestation. Nutrition, especially amino acid availability, impacts wool growth and follicle development (Rogers, 2006). When maternal nutrition, particularly amino acid availability, during pregnancy is restricted, this can result in a decrease in wool follicle development (Schinckel and Short, 1960).

Knowing this, we hypothesize that lambs from ewes receiving diets fed to meet nutrient requirements during gestation will have a greater density of wool follicles and increased wool quality compared to lambs from ewes restricted in nutrients during gestation. We also hypothesize that lambs from ewes restricted in nutrients, but receiving a rumen-protected arginine supplement will present similar wool follicle numbers and quality to those lambs from dams receiving full nutrient requirements during gestation.

PROCEDURES

Ewes were confirmed pregnant and randomly assigned to one of three treatments at day 54 (standard deviation of start date was 3.89 days) of gestation: control (**CON**) receiving 100% NRC (1985, 2007) energy requirements, restricted (**RES**) receiving 60% of CON nutrients, and restricted plus arginine (**RES-ARG**) receiving the restricted diet in addition to a rumen-protected arginine supplement dosed at 81.7 mg/lb (180 mg/kg) body weight. All ewes were receiving a complete pelleted diet once daily containing 34% dehydrated alfalfa meal, 27% dehydrated beet pulp, 25% wheat middlings, 9% ground corn, 5% soybean meal, and a trace mineral premix exchanged for ground corn at the rate of 12 pounds per ton on an as fed basis. Rumen-protected arginine supplements were mixed into 0.11

pounds of corn and fed once a day at 8:00 am, just prior to offering pelleted diet. Ewes were weighed every 14 days, and diets were adjusted as necessary. Ewes were carried through gestational term on these treatments. Immediately post-lambing, lambs were separated from ewes and raised independent of their dam.

Lambs were maintained on a common diet of artificial colostrum for 20 hours after birth, dosed at 8.7 mL/lb body weight 0 and 2 hours post birth, and 11.6 mL/lb body weight 4, 8, 12, 16, and 20 hours post birth. These was followed by ad libitum milk replacer (Super Lamb Milk Replacer, Merrick's Inc., Middleton, WI) and water in addition to long stem mid-bloom alfalfa hay and creep feed for the remainder of the project. At 54 days of age (with a standard deviation of 3 days), lambs were weighed prior to stunning by captive bolt. Following wool collection, the corresponding 3 cm^2 sections of skin were obtained from the side (between 10^{th} and 12^{th} rib) and britch regions of the lamb for further histological analysis.

Skin sections were fixed and stained via a procedure using Mayer's Hematoxylin and Schiff Reagent. Sections were processed, embedded in paraffin blocks, and applied to glass slides for microscopic imaging. Photomicrograph images were analyzed in Image-Pro Plus software to measure two 1 mm^2 sections and count the total number of wool follicles visible in these areas. An average of the follicle counts for each of the two squares was taken for each lamb – one average value for the side and one average value for the britch.

Side and britch wool samples were sent to Montana Wool Laboratory (Bozeman, MT) for analyses of mean fiber diameter, fiber diameter SD, and comfort factor with the Optical Fiber Diameter Analyzer 100.

RESULTS

Birth weight and growth performance of the lambs have been reported previously (Peine et al., 2013). At d 54 of age, there was no difference ($P \geq 0.16$) in lamb body weight due to maternal nutrition treatment, twin status, or fetal sex.

No differences ($P = 0.41$) were observed in follicle numbers between maternal nutrition treatments for skin samples taken from the side of the lamb, however singleton lambs had greater wool ($P = 0.04$) follicle density than twin lambs (87 ± 4.2 vs. 66 ± 9.1 follicles per 1 mm^2, respectively) (Table 1). In samples taken from the britch, lambs from RES-ARG ewes had greater ($P = 0.02$) wool follicle density than lambs from CON ewes, and tended to have greater ($P = 0.13$) wool follicle density than lambs from RES ewes. Singleton lambs also tended to have greater ($P = 0.13$) wool follicle density than twin lambs in samples taken from the britch.

The wool quality data reflected that mean fiber diameter, fiber diameter, and comfort factor all showed no differences between treatment, twin status, or fetal sex ($P \geq 0.15$).

DISCUSSION

Lambs from RES-ARG ewes had greater wool follicle density than lambs from CON ewes, and tended to have more wool follicle density than lambs from RES ewes in skin samples taken from the britch. Arginine is a precursor to synthesis of polyamines, which regulate DNA and protein synthesis, cell proliferation and differentiation, and regulation of gene expression (Kwon et al., 2003). Arginine-induced polyamine synthesis may have permitted differentiation and proliferation of wool follicle cells during fetal development. In addition, arginine is also a precursor to nitric oxide (**NO**) which regulates blood flow (Martin et al., 2001). Increased blood flow due to arginine supplementation and NO regulation may provide more nutrient availability for wool growth.

Twin status may have induced differences in wool follicle numbers in both the side and britch skin. Singleton lambs had greater wool follicle density in skin samples from the side than twin lambs. Similarly, singleton lambs tended to have greater wool follicle density in skin samples from the britch than twin lambs. This is probably due to singleton lambs having less competition for nutrients during fetal development than twin lambs (Freer et al., 1997).

There were no differences in mean fiber diameter, fiber diameter SD, or comfort factor based on maternal treatment, fetal number, or sex of the offspring. These results demonstrate a lack of improvement in wool quality in terms of fiber diameter based on either maternal nutrition or rumen-protected arginine supplementation.

IMPLICATIONS

These data imply that arginine supplementation has the potential to increase wool follicle density in offspring from ewes restricted in nutrients during gestation. However, arginine supplementation did not increase wool quality in those offspring.

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Table 1. Effect of maternal nutrition and arginine supplementation on wool follicle numbers and various wool quality measurements[1]

	Maternal Treatment[2]				*P* - values		
Item	CON	RES	RES-ARG	SEM	Treatment	Fetal no.	Sex
54 day body weight (lb)	52.6	48.3	52.2	2.27	0.25	0.81	0.16
Follicle No.							
Side	85	74	71	9.5	0.29	0.04	0.29
Britch	86[a]	93[ab]	106[b]	6.3	0.05	0.13	0.97
Mean fiber diameter (µm)							
Side	18.8	18.4	18.3	0.31	0.32	0.33	0.15
Britch	20.9	21.5	20.8	0.43	0.40	0.30	0.45
Fiber diameter SD (µm)							
Side	4.8	4.9	4.9	0.16	0.75	0.37	0.56
Britch	5.6	6.0	5.6	0.29	0.46	0.27	0.65
Comfort factor							
Side	98.5	98.5	98.6	0.37	0.98	0.57	0.13
Britch	94.6	93.1	95.0	1.35	0.47	0.16	0.16

[1]Wool follicle numbers and quality were assessed in offspring from ewes fed complete pelleted diets at varying levels of nutrient requirements with or without rumen-protected arginine (RP-ARG) supplementation.
[2]Treatments were administered to ewes as a complete pelleted diet daily. Rumen-protected arginine supplement was mixed in a 50 g fine ground corn carrier. Treatments were control (CON, 100% NRC requirements, n = 11), restricted (RES, 60% CON nutrients, n = 11), and restricted + arginine (RES-ARG, RES + rumen-protected arginine supplement, n = 10). Rumen-protected arginine was dosed at 81.7 mg/lb (180 mg/kg) BW.
[a,b,c] Means within a row without a common letter superscript differ ($P \leq 0.05$).

Ovine progressive pneumonia virus infection rate and incidence of genetic susceptibility diplotype in North Dakota sheep flocks[1]

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The objectives for the project were to determine the incidence of sheep serologically positive for ovine progressive pneumonia virus (OPPV) and frequency of diplotypes known to affect OPPV susceptibility in sheep. Of the 12 flocks tested, 1/3 had a high incidence of OPPV positive sheep and 2/3 had a low incidence or no sheep test positive for OPPV. Sheep with both copies of the more favorable diplotype "1" had a lower incidence of OPPV positive sheep than sheep with at least one unfavorable haplotype "2 or 3". Younger ewes had a lower OPPV infection rate.

[1]This project was supported by North Central Sustainable Agriculture Research and Education - Farmer Rancher Grant Program.

INTRODUCTION

Ovine progressive pneumonia (OPP) is a slowly progressive viral disease of adult sheep. Often, the first sign noticed is a general loss of body condition referred to as "thin ewe syndrome." Another common sign of OPP is an increased breathing effort at rest. Infected ewes can develop "hard bag," an enlarged, firm udder with reduced or no milk flow.

Once infected, animals remain infected for life, although many never show clinical signs of the disease. Flocks infected with OPPV can have lowered production efficiency because higher adult death loss, early culling, decreased milk production and lower weaning weights. Recent research at the U.S. Meat Animal Research Center (US-MARC) in Clay Center, Neb., has discovered a genetic marker that can identify animals that are less susceptible to OPPV infection. This new genetic test, TMEM 154, determines the risk level for infection with OPPV. There are three haplotypes that are most common and they are depicted as 1, 2, and 3. Every animal has two copies of a haplotype, which is referred to as a diplotype.

This disease is transmitted from ewe to lamb at an early age (vertical transmission) or transmitted from sheep to sheep as adults (horizontal transmission) throughout their lifetime. Although, some literature indicates that most transmission is from ewe to lamb, research at US-MARC has shown that horizontal transmission is quite common and typically occurs during the lambing season and/or when sheep are housed in close quarters.

PROCEDURES

We identified 12 different sheep flocks in North Dakota who volunteered to be a part of the project. Each flock was able to test up to 50 adult animals per breed. In total, we sampled 735 adult sheep. Sheep breed and age data were recorded on each animal. Blood samples were taken via jugular venipuncture. Samples were sent to a centralized laboratory (GeneSeek, Lincoln NE) where they were analyzed for OPPV serum antibody and tested with the OPPV genetic susceptibility test (TMEM 154). Serological samples were classified into positive, negative, and questionable categories based on the assay guidelines. Questionable samples were rerun and all sheep were placed into positive or negative categories based on the second assay. If any flock had at least one positive animal they were categorized as an infected flock. Breed, age and diplotype were used as class variables. Animal infection status was analyzed using the GLIMMIX procedures of SAS for all sheep and sheep from only infected flocks. Means were considered different at $P \leq 0.10$.

RESULTS AND DISCUSSION

Figure 1 categorizes each flock by the percent flock OPPV infection rate. Eight of the 12 flocks (66 %) had at least one sheep test positive for OPPV, which is considerably higher than what the Animal and Plant Health Inspection Service (APHIS) estimates the US sheep industry's prevalence rate of OPP (36%). This could be due to our relatively small sample size or the difference in flock management in North Dakota compared to the rest of the nation. Within infected flocks, 2 to 76 % of the sheep within each flock tested positive for OPPV. There were only 2 flocks that had a greater than 25% infection rate. The majority of flocks did not have any sheep test positive or had a low OPPV prevalence rate (≤ 25%). The overall OPPV prevalence rate of all sheep tested was 28 %, which is similar to the 24% prevalence rate estimated for the U.S. sheep industry by APHIS.

Diplotype status had an effect ($P < 0.01$) on OPPV infection rate of sheep in all flocks and within infected flocks (Table 1). Across all flocks, sheep with diplotype "1 1" had a lower ($P < 0.10$) infection rate than sheep with less favorable diplotypes ("1 2" "1 3" "1 4" "2 2" and "2 4"). Within infected flock, sheep with the diplotypes "1 1" "1 4" and "4 4" had a lower ($P < 0.10$) OPPV infection rate than sheep with the diplotypes "1 2" or "1 3". Sheep with diplotypes "2 2" "2 3" and "2 4" were not detected to be different ($P > 0.10$) from all there diplotypes, which is likely due to a low number of these diplotypes in the population. This data are consistent with findings from US-MARC that indicate an increase in risk of infection for sheep with at least one of the more undesirable haplotypes (2 or 3). Less is known about haplotype 4 and ongoing investigation of this haplotype is currently being done in collaboration with our lab and US-MARC. This data indicates that haplotype 4 provides some protection from infection; whereas, research from US-MARC indicated that the diplotype "4 4" was fully resistant to OPPV.

We were unable to detect an effect ($P = 0.15$) of age of sheep on OPPV infection rate of sheep within all flocks; however, within infected flocks age of sheep had an effect ($P = 0.02$) on OPPV infection rate (Table 1). Within infected flocks, 1 and 2 year old sheep had a lower ($P \leq 0.10$) OPPV infection rate than 3, 4, 5, 6, and 7 year old sheep. No differences ($P \geq 0.10$) were detected between sheep older than 8 years of age and sheep younger than 8 years of age, which was likely due to a low number of ewes tested beyond 7 year of age. Similarly, research at US-MARC indicates that the sheep with an undesirable diplotype are 3.5 and 7 times more likely to test positive for OPPV at 1 and 2 years of age, respectively. We likely reported a lower level of infection rate per year because many of the flocks had a low level of OPPV infection. Similarly, the disease is also known to increase ewe culling rate, which could skew the data because infected animals that show symptoms would likely have been removed from the flock. However, it does appear that our data is somewhat consistent with US-MARC and adult animals within an infected flock become OPPV positive over many years. Management decisions that reduce the contact between uninfected or younger ewes from contracting the disease from older or infected ewes warrants further investigation.

Breed of sheep had an effect ($P < 0.01$) on OPPV infection rate across all sheep and within infected flocks (Table 1). Within infected flocks, Rambouillet and Montadale sheep had lower OPPV infection rates than all of breeds. Similarly, Polypay and Suffolk sheep had lower ($P < 0.06$) OPPV infection rates than Columbia, Dorset, Hampshire, and Katahdin sheep. Katahdin sheep from infected flocks had the highest ($P < 0.01$) infection rate of all breeds. Frequency of haplotypes varied among breeds (Table 2). Within infected flocks, breeds that had a 90% or higher frequency of the more favorable haplotype "1" were less likely to be infected with OPPV, except for the Columbia breed. Similarly, the breeds that had 60% or lower frequency of the more favorable haplotype "1" were more likely to be infected with OPPV.

IMPLICATIONS

Ovine progressive pneumonia is prevalent in the North Dakota sheep industry. One third of the flocks tested had a high incidence of OPPV positive sheep. The prevalence and impact of the disease in these flocks is likely due to a combination of genetic susceptibility, presence of the virus, and management system. The OPPV genetic susceptibility test (TMEM 154) does not guarantee that sheep will be resistant to

OPPV but those that had more unfavorable at least one of the unfavorable haplotypes were more likely to test serologically positive. Breed of sheep has an impact on OPPV infection rate; however, this is likely a result of frequency of diplotype within breed. Additionally, younger ewes were less likely to be infected with the virus, which indicates that management decisions to isolate young uninfected ewes from older infected ewes could help reduce the impact of this disease on sheep flocks.

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Leymaster, K.A., C.G. Chitko-McKown, M.L. Lawson, G.P. Harhay, and M.P. Heaton. 2013. Effects of TMEM 154 haplotypes 1 and 3 on susceptibility to ovine progressive pneumonia virus following natural exposure in sheep. J. Anim. Sci. 91: 5114-5121.

Table 1. Number and percent of OPPV infected[1] sheep by diplotype, age, and breed

	All Flocks[2]		Infected Flocks[3]	
Item	OPPV Infection Rate (%)	SE	OPPV Infection Rate (%)	SE
Diplotype[4]				
1,1	21.0[a]	5.8	41.8[a]	7.2
1,2	38.7[b]	7.0	67.3[b]	9.1
1,3	34.6[b]	7.7	74.1[b]	9.8
1,4	43.0[b]	8.2	42.1[a]	10.3
2,2	63.5[b]	24.6	59.5[ab]	31.0
2,3	21.0[ab]	21.6	34.7[ab]	30.6
2,4	52.4[b]	12.3	57.1[ab]	14.4
4,4	34.7[ab]	21.8	27.5[a]	22.7
Age, years				
1	23.0	8.6	23.2[a]	10.0
2	15.0	8.4	22.9[a]	9.9
3	27.0	8.3	37.3[b]	9.8
4	23.4	8.7	35.9[b]	10.0
5	31.7	9.0	42.9[b]	10.9
6	14.0	9.1	44.8[b]	11.7
7	25.2	10.3	46.9[b]	12.5
8	23.1	10.6	42.4[ab]	13.9
9	22.6	15.3	35.7[ab]	18.5
10	37.8	30.2	81.8[ab]	42.8
Breed				
Columbia	54.8[c]	9.6	55.4[c]	11.3
Dorset	46.5[bc]	8.0	60.1[c]	10.0
Hampshire	46.4[bc]	9.3	70.0[cd]	11.0
Katahdin	39.6[b]	7.5	100.3[e]	10.0
Montadale	5.2[a]	13.0	8.2[a]	14.4
Polypay	42.6[bc]	8.5	40.4[b]	10.3
Rambouillet	12.2[a]	7.8	22.6[a]	10.0
Suffolk	11.0[a]	8.2	36.2[b]	11.2

[1]Infection status was determined by serological analysis for OPPV serum antibody
[2]Sheep were tested on 12 different farms (n = 720)
[3]Sheep from farms that had at least one OPPV positive animal (n = 493)
[4]Diplotypes of sheep tested for OPPV genetic susceptibility (TMEM 154)

Table 2: Haplotype frequency for each breed of sheep

	Haplotype[1]			
Item	1	2	3	4
Breed				
Columbia	0.99			0.01
Dorset	0.88	0.10	0.02	
Hampshire	0.53	0.16		0.31
Katahdin	0.59	0.13	0.17	0.09
Montadale	0.97			0.03
Polypay	0.86	0.04	0.08	0.02
Rambouillet	0.92	0.01	0.06	0.002
Suffolk	0.76	0.16	0.01	0.08

[1]Haplotype of sheep tested for OPPV genetic susceptibility (TMEM 154)

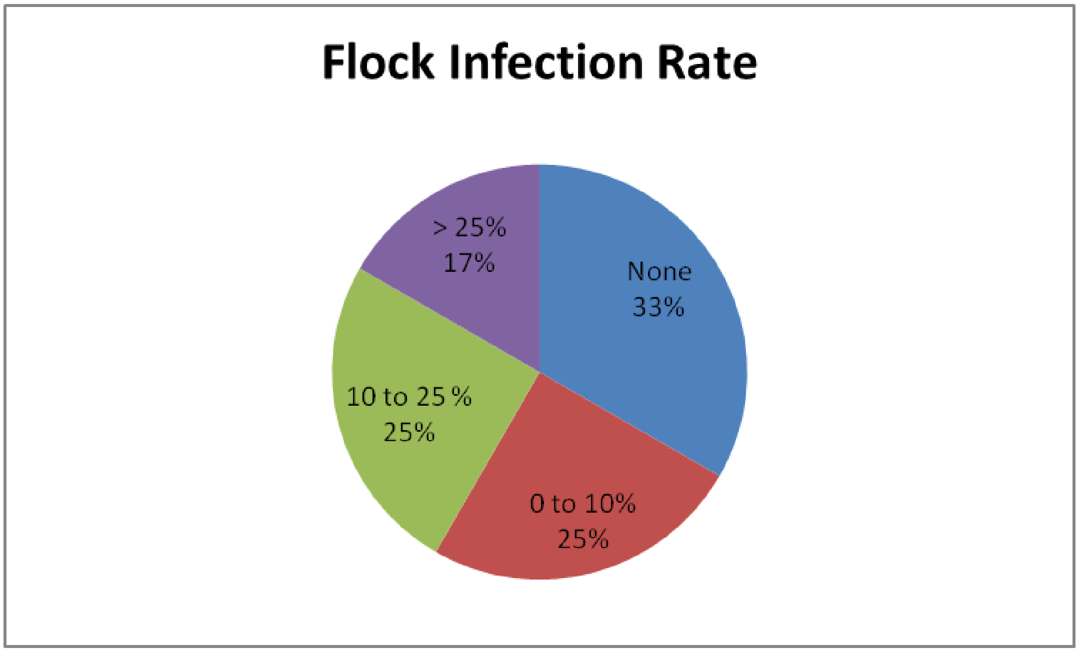

Figure 1. Flocks categorized by percent of sheep testing positive for OPPV as determined by serological testing

2014 North Dakota 4-H Lamb Ultrasound Carcass Evaluation

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Yield and quality of the lamb carcass are what ultimately determine the value of a lamb. The carcass evaluation system is used to evaluate the carcass merit of 4-H club lambs using data from ultrasound scans. Lambs are first weighed, given a leg score, and loin muscle eye area, fat thickness, and body wall thickness. The latter three measurements are determined by ultrasound scanning between the 12th and 13th ribs. All of this data will then be used to evaluate the carcass merit of individual lambs.

INTRODUCTION

The ultimate value of lamb is determined by carcass quality, with many factors playing a part in its evaluation. Ultrasound technology allows for the objective estimation of carcass traits in real-time of live animals (Grainer, 2001). This technology is important for the genetic improvement of carcass merit and is certainly an important tool for outreach to 4-H participants. Ultrasound measurement allows an opportunity to quantify conformation in an objective manner (Greiner, 2001) allowing lambs with superior carcass quality to be recognized through the ND premium lamb certification using the carcass evaluation live lamb index.

PROCEDURES

Determining Carcass Character. Carcass traits used to evaluate lamb carcasses are based on industry standards for dressing percentage and ultrasound measurements of fat and muscling.

<u>Hot carcass weight and dressing percentage:</u> The weight of the carcass after slaughter is referred to as hot carcass weight. The relationship between live weight and hot carcass weight is called dressing percentage, which is figured by dividing hot carcass weight by live weight. For lambs, the dressing percentage can vary between 45 and 57 percent. For this evaluation, we used a value of 54 percent, which is based on research data from club lambs. For example, a 150-pound lamb is estimated to have a hot carcass weight of 81 pounds (150 pounds x 54 percent).

<u>Backfat thickness:</u> This is the thickness of the fat from the ribeye muscle to the outer surface of the carcass measured at the midpoint of the ribeye muscle at the 12th rib location (Figure 1). Backfat thickness is the only factor used in the assignment of yield grades. Figure 1 illustrates the location of the backfat measurement over the center of the ribeye, between the 12th and 13th ribs. Fat thickness may be adjusted up or down to account for unusual fat distribution at the point of measurement. Backfat on carcasses usually ranges from 0.1 to 0.5 inch.

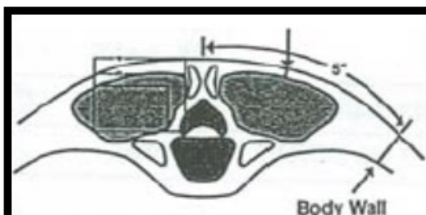

Figure 1. Locations of measurement of ribeye area, backfat thickness and body wall thickness are shown in this figure, which represents a cross section of the lamb carcass at the 12th rib. Ribeye area is the area of the longissimus muscle (ribeye).

Body wall thickness: This is a measurement across the lean, bone and fat of the lower rib 5 inches from the midline of the carcass (Figure 1). This area accumulates excess fat in some animals and is an indicator of expected trimmed cut yield from the carcass. Body wall thickness usually ranges from 0.5 to 1.2 inches.

Ribeye area (REA): This is an objective measure of muscling in lambs and is measured in square inches between the 12th and 13th ribs (Figure 1). REA measurements usually range from 1.5 to 4.0 square inches. REA is affected by the weight and muscularity of the live animal and provides a good estimate of the percentage of lean to bone in the carcass.

USDA yield grade: U.S. Department of Agriculture yield grades are calculated by using the following formula: YG = 0.4 + (10 × adj. fat thickness). USDA yield grades (1, 2, 3, 4, 5) categorize carcasses into groups according to the expected yield of trimmed, retail cuts. Yield grade 1 has the highest expected yield and 5 the lowest. For example, a lamb with 0.15 inch of backfat will have a USDA yield grade of 1.9 (0.4 + (10 x 0.15). Table 1 describes the assignment of yield grades based on backfat ranges and the average yield of semiboneless cuts for each yield grade.

Leg scores (Figure 2): These are used to evaluate muscling subjectively. Variations in leg score do not affect yield grade but are used to evaluate the attractiveness and lean yield of the lamb carcass. Leg scores usually range from 15 (very thick muscling) to 9 (thin muscling). A leg score of 12 is considered average for lamb leg muscling (slightly thick muscling).

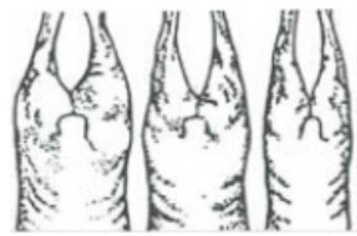

Figure 2. Examples of three leg scores are shown in Figure 2, with the thickest leg being a leg score 14, the middle example being a leg score 12 and the thinnest leg being a leg score 10.

Index System

If lambs make North Dakota premium lamb certification, the index system will rank lambs based on carcass merit. All premium lambs start with a base index value of 80. For each 0.1 inch increase in yield grade above 1.5, 0.25 point is deducted. For each 0.1 inch increase in loin muscle area above the base area for the lamb's weight class, lambs are given 1 point. For each 0.1 inch increase in body wall thickness above 0.8, lambs are deducted 2 points. Conversely, each 0.1 inch decrease in body wall thickness is rewarded with 2 points. Finally, lambs are given 2 additional points for each leg score above 12.

RESULTS

During the North Dakota State Fair, a total of 78 lambs were scanned for the 4-H live lamb carcass evaluation contest, belonging to 48 kids from 21 counties. Forty six percent of the lambs received the certification for ND premium lamb. The tables below list the carcass qualities and indices of the top ten lambs enrolled in the contest.

IMPLICATIONS

The ND live lamb carcass evaluation contest was developed to evaluate the carcass merit of 4H club lambs using data from the ultrasound scans. Through this program children involved have been impacted by being taught the value of ultrasounding sheep and other livestock and the impact it can have on the industry. Scientists explained the process of scanning, the qualities being scanned, and what the measurements can tell us about the individual animals. Through this program, we can positively impact the lamb industry by striving to have a superior product in club lambs.

LITERATURE CITED

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Greiner, S. P. 2001. Understanding sheep ultrasound measurements for carcass traits. Virginia Cooperative Extension Bulletin: Livestock Update, August

Table 1. Lamb Carcass Yield Grade Information (Maddock et al., 2013)

Yield Grade	Backfat Range	Average Estimated % Semi-boneless Yield
1	0.15 in and less	50.3
2	0.16- 0.25 in	49.0
3	0.26-0.35 in	47.7
4	0.36-0.45 in	46.4
5	0.46 in and greater	45.1

Table 2. North Dakota 4-H Lamb Live Carcass Index (Maddock et al., 2013)

Base Index	Yield Grade	Carcass Weight (lbs.)	Loin Muscle Area (in^2)	Body Wall Thickness (in.)	Leg Score
80	1.5	<50	2.7	Base = 0.8	Base= 12
		50-55	2.8		
		55-60	2.9		
		60-65	3.0		
		65-70	3.1		
		70-75	3.2		
		75-80	3.3		
		80-85	3.4		
		>85 lbs	3.5		
	(+ 0.1 in. = -0.25 units)		(+0.1 in^2 = +1 unit)	(+0.1 in. = -2 units) (-0.1 in. = +2 units)	

Table 3. Carcass data for the top ten lambs entered in the ND State Fair carcass contest

Exhibitor		Lamb Measurement								
First	Last	Lamb ID	Live Wt (#)	LMA (in.)	BF (in.)	BW (in.)	Leg Score	CWT	YG	LMA Class
Hadley	Detienne	280	132	4.24	0.28	0.55	13.5	71.3	3.2	2.7
Sheyenne	Freitag	598	129	3.80	0.20	1.02	13	69.7	2.4	2.6
Dylan	Rue	1431	106	3.52	0.20	0.71	12	57.2	2.4	2.4
Haley	Filipek	390	118	3.54	0.20	0.55	12.5	63.7	2.4	2.5
Lynsey	Schmitz	1417	119	3.69	0.28	0.55	14	64.3	3.2	2.5
Wyatt	Dunlop	404	119	3.57	0.24	0.63	13	64.3	2.8	2.5
Ty	Kulsrud	0037	111	3.31	0.20	0.35	12.5	59.9	2.4	2.4
Jaime	Lundquist	0940	103	3.53	0.28	0.75	12.5	55.6	3.2	2.4
Ashly	Miller	386	134	3.58	0.20	0.55	14	72.4	2.4	2.7
Wyatt	Dunlop	0221	117	3.42	0.28	0.51	12.5	63.2	3.2	2.5

Table 4. Index for the top ten lambs entered in the ND State Fair carcass contest

Exhibitor			Index					
First	Last	Lamb ID	Base	YG	LMA	BW	Leg Score	Final
Hadley	Detienne	280	80	-2.9	15.43	0.50	3	93.04
Sheyenne	Freitag	598	80	-0.9	12.03	-0.45	2	90.66
Dylan	Rue	1431	80	-0.9	11.22	0.18	0	90.49
Haley	Filipek	390	80	-0.9	10.38	0.50	1	89.96
Lynsey	Schmitz	1417	80	-2.9	11.93	0.50	4	89.54
Wyatt	Dunlop	404	80	-1.9	10.67	0.34	2	89.11
Ty	Kulsrud	0037	80	-0.9	9.07	0.89	1	89.04
Jaime	Lundquist	0940	80	-2.9	11.32	0.10	1	88.53
Ashly	Miller	386	80	-0.9	8.80	0.50	4	88.37
Wyatt	Dunlop	0221	80	-2.9	9.25	0.58	1	86.93

Table 5. Top ten lamb's data receiving the ND premium lamb certification

Exhibitor			ND Premium					
First	Last	Lamb ID	Wt	YG	LMA	BW	Leg Score	Final
Hadley	Detienne	280	1	1	1	1	1	5
Sheyenne	Freitag	598	1	1	1	1	1	5
Dylan	Rue	1431	1	1	1	1	1	5
Haley	Filipek	390	1	1	1	1	1	5
Lynsey	Schmitz	1417	1	1	1	1	1	5
Wyatt	Dunlop	404	1	1	1	1	1	5
Ty	Kulsrud	0037	1	1	1	1	1	5
Jaime	Lundquist	0940	1	1	1	1	1	5
Ashly	Miller	386	1	1	1	1	1	5
Wyatt	Dunlop	0221	1	1	1	1	1	5

2013 DAKOTA RAM TEST FINAL PERFORMANCE RESULTS[1]

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The Dakota Performance Ram Testing program was established primarily to identify differences in wool traits for rams managed under the same environmental conditions and plane of nutrition. Secondly, it was established to measure post-weaning growth rate as indicated by weight gain. An added feature is the evaluation of animal carcass merit using real-time ultrasound technology.

INTRODUCTION

The 2013 Dakota Performance Ram Test included 49 rams from 3 breeds. The ram test calendar listed below summarizes the dates on which specific activities were conducted during the test. Results are listed below, ranking indexed rams from high to low, and separates rams eligible for Certificate of Merit. Carcass data results are also included. Financially, it appears expenses exceeded our registration fee by approximately $23/head. Some of the values are estimates, as we do not account for any feed left in the bin. The % of blown legs was 8% (15% last year, 21% in 2011, 10% the 3 years before that). The last couple of years we have increased supplemental Vit D to 360 IU/lb diet, and this year we provided injectable Vitamin D every 28 d in an attempt to further alleviate these "rickets-like" symptoms. Obviously, Vitamin D is not the only problem. Overall, ADG was similar to the past couple of years (0.85 vs. 0.88 and 0.83), but we had no rams with ADG below 0.55 lbs/d, the minimum required for certification.

PROCEDURES

Fleece weight and staple length were calculated on a 365-day basis. Core samples were sent to Texas A&M University to determine fiber diameter, variability, and clean wool yield. Wool measurements for fiber were determined by the OFDA 2000. Average daily gain was calculated based on the total weight gain (including fleece) during the 140 d performance trial.

SCHEDULE 2013 DAKOTA FALL RAM TEST

September 7 - September 25, 2013	Rams to be delivered to the HREC
October 1, 2013	Rams weighed and started on test
October 2, 2013	Rams shorn
October 29, 2013	28 day weighing
November 26, 2013	56 day weighing
December 23, 2013	85 day weighing; trim hooves and re-vaccinate
January 21, 2014	112 day weighing
February 18, 2014	140 day weighing - End of growth test period Bleed B-ovis and DNA, staple length, wrinkle score, scrotal circumference
February 19, 2014	Rams shorn - core sampling, wool weights
March 14, 2014	Ultrasound
March 15, 2014	Field Day and Sale; rams pick up

[1]We would like to extend thanks to the consignors that took part in the Dakota Ram test, along with Dave Pearson, the Ram Test manager, and Dave Ollila for their continued dedication and assistance throughout this program.

Fiber Diameter: Core fiber diameter was determined for each sample using the laserscan technology method. The diameter is estimated by measuring four hundred clean fibers to determine an average (mean). In addition, the variation within a sample is determined. For each individual ram and type of sample, a histogram illustrates the variation. The horizontal axis indicates microns and the vertical axis shows the number of fibers from the total fibers measured which were a specific diameter. A narrow distribution pattern indicates relative fleece uniformity. The standard deviation (std. dev.) and coefficient of variation (CV) are given to provide numerical indications of the variation. A fleece sample with a small CV should be considered more uniform than one with a large CV (CV = std.dev./mean fiber dia.).

Staple Length: Staple length was determined by measuring length at the shoulder, side, and britch. Values were adjusted (less 1/8") for the stubble remaining after the initial shearing and an average calculated from these three sites.

Clean Wool: Clean wool was determined from the laboratory scoured clean yield estimates on side samples. Analytical procedures meet ASTM standards.

Face and Body Skin Fold Scores: Scores were determined by averaging subjective scores from a three person committee selected by the Ram Test committee. Scores were assigned from 1 to 4 for each trait. The lower the value the more open faced or freedom from skin folds.

Average Daily Gain: Average daily gain was calculated by dividing the total gain by the number of days in the test period (140 d).

Index: The index utilized the following formula established by the Texas and Wyoming Ram tests and the approved index for the American Rambouillet Sheep Association's register of merit program (ROM). (Revised July 8, 1993)

Index = 60(Average daily gain in pounds) + 4.0(365-day adjusted staple length in inches up to 5.5 inches) + 4(365-day adjusted clean wool in pounds) ± fiber diameter and variability points according to the following schedule:

Fiber Diameter (micron) of side:

3(22-actual microns) = + points up to 9

3(actual microns-22) = - points up to -6

Variability:

22.0 +/- actual Coefficient Variation x 1.25 up to a maximum of +/- 5 points

Index Ratios: To compare one ram with another an index ration was calculated by the following formula. The average index ratio for all rams is 100; an individual with an index ratio of 130 would be 30% higher than the average.

Actual Ram Index

Ram Index Ratio = 100

X Average Ram Index Value

The top 30% of the registered Rambouillet rams as indicated by index are eligible for the Certified Ram Classification. In addition to the above requirement, a ram must meet acceptable standards from the standpoint of body type, amount of body skin folds, freedom from anatomical weaknesses and wool defects, including extremely hairy britch or excessive amount of belly type wool. All certified rams must have a minimum of 4.0 in staple length, 9 lbs clean wool, a core wool grade of 23.77 microns or less, a maximum of 2.7 face cover score, and must have gained at least 0.55 lbs/d on test.

Carcass Merit: At the end of the test, fat cover and ribeye area were measured at the 12-13th rib by real-time ultrasound. This information is not included in the index. However, these measures may help producers identify rams with superior carcass merit. Ribeye area is a good indicator of overall muscling; rams with larger ribeyes would be expected to be more muscular compared to those with smaller ribeyes. More muscular individuals would be expected to exhibit high growth rate relative to those with less muscularity. Fat cover is an indicator of maturity (i.e. frame size). Those rams carrying less fat (finish) would likely be later maturing, or perhaps younger than those with greater amounts of fat cover.

RESULTS and DISCUSSION

The 2013 Dakota Ram Test proved successful with 49 rams, including 3 breeds, enrolled in the test from 14 producers across the Midwest including: North Dakota, South Dakota, Wyoming, and Minnesota. Below are tables presenting the data from Rambouillet breeders. Other breeds were not included in the index. The final index results table includes rams that are eligible for certificates of merit from the Dakota Ram test. Three rams were in the top 30%, but were not eligible for the certificate of merit. Two of these three rams were too coarse to be eligible and the third had an injured ankle.

IMPLICATIONS

As the 2014 Dakota Ram Test begins, it is showing to be increasingly promising. More producers from outside the region are enrolling in the test and more rams from other breeds are also showing interest. With these new interests in mind, an index for Columbia rams needs to be adapted for their use in the test for adequate comparison among the breed. The National Sheep Improvement Plan along with Ram Tests like this one can have a significant genetic impact on programs throughout the region.

Table 1. Growth and Performance Results

TID	Owner	Breed	FID	Premise ID	Scrapie ID	Reg. #	B Date	BT	H/P	Gene	B Wt	F Wt	Gain	ADG
8	Veit Rambouillet	Ramb	1339	SD2115	0336	996509	4/1/13	S	P	RR	123	271	148	1.06
47	Erk, Paul	Ramb	B0910	SD1257	06274	996488	5/2/13	S	P	RR	123	248	125	0.89
25	McGivney, Ian	Ramb	83	00EDZKF	0083	996322	3/24/13	TW	H	RR	156	275	119	0.85
48	Erk, Paul	Ramb	B0818	SD1257	06272	996483	4/15/13	S	P	RR	138	272	134	0.96
1	Cook Sisters	Ramb	5315	SD1359	0410	996424	4/15/13	S	H	RR	122	263	141	1.01
26	Forbes, Jim	Ramb	2500	WYBT	9621	996408	4/18/13	TW	H	RR	119	244	125	0.89
2	Cook Sisters	Ramb	5304	SD1359	0412	996421	4/12/13	S	H	QR	132	256	124	0.89
28	Forbes, Jim	Ramb	2498	WYBT	9619	996409	4/12/13	TW	H	RR	116	242	126	0.90
9	Veit Rambouillet	Ramb	1280	SD2115	0337	996512	3/22/13	TW	P	QR	121	276	155	1.11
49	Erk, Paul	Ramb	B0759	SD1257	06202	996481	2/14/13	S	P	RR	152	273	121	0.86
29	Forbes, Jim	Ramb	2499	WYBT	9620	996403	4/9/13	TW	H	RR	108	240	132	0.94

Table 2. Wool Performance Results

TID	Owner	GR FL (#)	GR 365-d (#)	Yield CWFP (%)	CL FL 365-d (#)	STL (365-d)	Belly (1,2,3)	Face (1,2,3,4)	Skin (1,2,3,4)	Core micron	Core Spin	Fleece Adj Dia	Fleece Adj Var
8	Veit Rambouillet	10.0	26.1	46.77	12.19	4.52	1.0	2.5	1.0	21.23	64	2.31	1.13
47	Erk, Paul	12.2	31.7	45.20	14.32	5.21	1.0	2.0	1.0	22.25	62	-0.75	0.87
25	McGivney, Ian	12.4	32.3	47.85	15.47	5.48	1.0	1.0	1.0	23.71	60	-5.13	0.38
48	Erk, Paul	10.8	28.2	44.72	12.59	4.43	1.0	2.0	1.0	22.57	62	-1.71	4.75
1	Cook Sisters	9.3	24.2	49.36	11.97	5.21	2.0	1.0	1.0	22.39	62	-1.17	-0.50
26	Forbes, Jim	11.4	29.7	47.59	14.14	4.78	1.0	1.0	1.0	22.69	62	-2.07	0.00
2	Cook Sisters	10.5	27.2	48.70	13.27	4.08	1.0	1.0	1.0	21.17	64	2.49	-0.25
28	Forbes, Jim	9.5	24.6	52.98	13.05	4.69	1.0	1.0	1.0	22.46	62	-1.38	1.13
9	Veit Rambouillet	9.1	23.6	44.16	10.42	4.52	1.0	1.0	1.0	22.45	62	-1.35	-0.13
49	Erk, Paul	11.8	30.8	42.25	13.00	4.95	1.0	1.0	1.0	22.71	62	-2.13	3.13
29	Forbes, Jim	9.2	23.9	49.92	11.91	4.43	1.0	1.0	1.0	21.70	64	0.90	0.38

Table 3. Final Index Results – Certified Rams

TID	Owner	SC (cm)	Index	Ratio
8	Veit Rambouillet	36.0	133.71	116%
47	Erk, Paul	37.0	131.83	115%
25	McGivney, Ian	31.0	130.02	113%
48	Erk, Paul	37.0	128.56	112%
1	Cook Sisters	37.0	127.49	111%
26	Forbes, Jim	31.0	127.20	111%
2	Cook Sisters	33.0	124.79	109%
28	Forbes, Jim	35.0	124.73	109%
9	Veit Rambouillet	38.0	124.71	109%
49	Erk, Paul	40.0	124.66	109%
29	Forbes, Jim	28.0	123.21	107%

Effects of lasalocid and diet particle size on feedlot performance, carcass traits, and nutrient digestibility in feedlot lambs[1]

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The objective of this research was to determine the influence of diet particle size and lasalocid on growth performance, carcass characteristics, and N balance in feedlot lambs. Lasalocid fed lambs had an increase in HCW. Additionally, there was an interaction of particle size and use of ionophores for ADG, loin eye area, and % boneless closely trimmed retail cuts (%BCTRC). Loin eye area was greatest for WCL and GCNL. A second study was conducted utilizing the same treatments to evaluate N balance in 16 crossbred wethers. Nitrogen balance was not affected by treatment. Our results indicate that HCW in lambs fed lasalocid was increased while particle size had no major impact on feedlot performance, carcass traits, or N digestibility.

INTRODUCTION

In the Northern Great Plains, lambs are commonly fed whole corn accompanied by a market lamb pellet through self-feeders during the growing-finishing phase. However, as evidenced in the cattle industry, when feeding high energy and low roughage diets acidosis can become a health problem resulting in a decrease in performance and an increase in morbidity and mortality (Elam, 1976).

Research in cattle has shown the effectiveness of ionophores for increasing feed efficiency and decreasing the incidence of acidosis in high grain diets (Jacques et al., 1987). Additionally, in sheep, researchers have reported the ability of ionophores to improve rate of gain, organic matter and crude protein digestion, and the absorption of N (Funk et al., 1986; Horton, 1980; Ricke et al., 1984). However, monensin is not currently labeled for use in sheep (FDA, 2005). The ionophore lasalocid is approved for use in sheep (FDA, 2003) and has been shown to increase total tract organic matter digestibility in finishing lambs (80 vs. 76.4%; Funk et al., 1986) fed a 65% concentrate diet. With the exception of the previous trial, little data exists describing the effects of lasalocid in lamb finishing rations.

Grinding the diet can increase digestibility, intake, and performance of livestock (Kerley, et al., 1985). However, in the lamb finishing industry it is generally advised to leave feeds whole, as the cost of grinding usually exceeds the performance benefits of feeding a ground ration (Stanton et al., 2006). Additionally, when feeds are ground lambs tend to select larger particles (Reynolds and Lindahl, 1960), potentially resulting in reduced DM intake and/or failure to eat a complete diet. Grinding feeds can increase the rate of digestion, therefore decreasing total digestibility (Reynolds and Lindahl, 1960) and potentially resulting in more cases of acidosis (Gressley, et al., 2011).

To our knowledge, limited research has evaluated the effects of particle size and ionophores in sheep. Our hypothesis was that lambs fed ground rations and lasalocid would have the greatest performance in the feedlot and improved nutrient digestibility when compared to lambs fed rations that weren't ground or rations without lasalocid. Our specific objectives were to determine the influence of lasalocid and particle size on growth performance, carcass characteristics, and N balance in lambs consuming a finishing ration.

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PROCEDURES

All procedures were approved by the Animal Care and Use Committee of North Dakota State University (protocol # A13041). This study was conducted at the NDSU Hettinger Research Extension Center in Hettinger, ND.

Feedlot Study

Animals and Diets. At 2 wk of age, tails were docked, males were castrated, and all lambs were vaccinated for *Clostridium perfringens* types C and D and tetanus (CD-T; Bar Vac CD/T; Boehringer Ingelheim, Ridgefield, CT). Lambs were weaned and vaccinated with CD-T again at approximately 60 d of age and d -1 (4 mo. of age) of the trial. Lambs were allowed free choice access to a commercial lamb creep pellet (16% CP) from birth to weaning. Lambs were adapted to an 80% corn and 20% commercial market lamb pellet diet (DM basis; Table 1) following weaning. One hundred sixty crossbred (Suffolk x Rambouillet) wether and ewe lambs (68 ± 0.2 lb BW; approximate 90 d of age) were stratified by BW and sex (80 wethers and 80 ewes) and randomly assigned to 1 of 16 outdoor pens (10 lambs/pen). Pens were assigned randomly to 1 of 4 treatments, with pen serving as the experimental unit (*n* = 4 pens/ treatment). Treatments were: whole corn with lasalocid (**WCL**), whole corn without lasalocid (**WCNL**), ground corn with lasalocid (**GCL**), or ground corn without lasalocid (**GCNL**; Table 1). Lambs receiving lasalocid (20 g/ton of market lamb pellet, Bovatec, Alpharma Inc., Bridgewater, NJ) received the basal feedlot ration with lasalocid included in the market lamb pellet starting on d 0. A factorial arrangement of treatments was applied in a completely randomized design to evaluate the outlined objectives.

Ground diets were ground through a 1.27 cm screen (Gehl Mix-All, Model 170, Gehl, West Bend, WI). Diets were mixed and provided by the same mixer-grinder and offered ad libitum via bulk feeders (48.6-cm bunk space/lamb). Lambs had continuous access to clean, fresh water and shade. Study diets were balanced to be equal to or great than CP and energy (NE) requirements (NRC, 2007). The rations were formulated to have a minimum Ca:P ratio of 2:1. Feeders were checked daily and cleaned of contaminated feed. Lambs were observed daily to monitor health and treated when necessary.

Data Collection Procedures. The study was divided into four periods. Lambs were weighed on 2 consecutive d at the initiation (d -1 and 0) and end (d 111 and 112) of the trial; single day weights were taken on d 33, 57, and 85 and used to assist in evaluation of morbidity. Ration and feed ingredient samples from the bulk feeders were taken at the beginning of each period and dried at 131°F for 48 h to determine DM and ration nutrient composition.

Trained personnel collected carcass data after a 24-h chill (temperature < 35.6°F and humidity near 100%). Carcass data collected included HCW, leg score, conformation score, fat depth (over the 12th rib), body wall thickness, loin eye area, flank streaking, quality grade, and yield grade, and % boneless closely trimmed retail cuts (**%BCTRC**; Savell and Smith, 2000).

Nitrogen Balance Study

Animals and Treatments. Sixteen Suffolk x Rambouillet wethers (88.2 ± 3.7 lbs BW; approximate age = 90 d) were used in completely random design. Wethers were weighed on d 0 and 1, stratified by weight, and allotted randomly to treatments (*n* = 4 wethers/treatment) as described in the feedlot trial. Lambs were assigned randomly to individual metabolism crates on d 1. Wethers were housed in an enclosed room with lighting from approximately 0730 to 2000 h. Lambs were adapted to diets (Table 1) and processed as outlined in the previous study, but lambs were also given an injection of vitamins A, D and E on d 1 of the trial. Rations were provided daily at 0830 h at 130% of the average daily intake for the previous 5 d. Feed refusals from the previous day were determined before feeding. Water troughs were cleaned and refilled daily after feeding.

Data Collection Procedures. The experimental period was 21 d. Dry matter intake was determined on d 14 to 20. Additionally, samples of corn, pellets, and ration were collected on d 14 to 20 and dried at 131°F for 48 h. Wethers were fitted with fecal collection bags on d 11. Total fecal and urine output were collected on d 15 to 21. A subsample of each daily fecal sample (7.5% of total, wet basis) was dried at 131°F for 96 h for calculation of fecal DM. Urine was collected via stainless steel funnel beneath the lamb, with total urine output collected. Sufficient 6 *N* HCL (100 mL) was added daily to urinals to maintain urine pH < 3. Total daily urine output was recorded and urine was composited daily by wether (10% of total; wet basis) and stored at 39°F. Approximately 288 g of urine were collected from each urine subsample and stored at 39°F. On d 15 to 21, 10 mL of blood were collected via jugular venipuncture 4 h after feeding using vaccutainers (VWR International). Blood was cooled at 39°F for 2 h and centrifuged (3,640 × *g*, 59˚F, 20 min), and serum was harvested and stored (-4°F).

Dried fecal samples were ground through a Wiley mill (2-mm screen) and composited by lamb. Daily samples of corn, pellets and ration were composited for the collection period, and orts were composited by lamb on an equal weight basis (20%; as-fed basis). Feed, orts, and fecal samples were analyzed for DM, ash, NDF, and ADF as described previously in the feedlot study. Feed, orts, fecal, and urine samples were analyzed for N as described previously in the feedlot study. Concentration of N in feed, orts, fecal, and urine samples was used to calculate daily N intake and excretion from feed, ort, feces, and urine weights. Nitrogen excretion (fecal N + urinary N) was subtracted from N intake (feed N – ort N) to calculate N balance (g N/lb BW basis).

RESULTS AND DISCUSSION

Feedlot Study

Feedlot Performance. Results for feedlot lamb growth, carcass characteristics and mortality are reported in Table 2. There were no interactions among treatments for final BW, feed offered, G:F, mortality, HCW, leg score, conformation score, fat depth, body wall thickness, flank streaking, quality or yield grade, and dressing percentage ($P \geq 0.06$). However, there was an interaction of particle size and use of ionophores for ADG ($P = 0.05$), loin eye area ($P < 0.001$), and BCTRC ($P = 0.004$). While an interaction was observed for ADG, upon comparison of means no differences were observed among treatments ($P > 0.05$). . Numerically the WCL fed lambs had the highest ADG, and this difference in BW gain could be relevant from a producer standpoint, with a difference of 5.3 lbs over the 120 d finishing period when comparing WCL vs. WCNL or GCL. Lending further evidence to the benefit of whole corn diets including lasalocid, we observed a tendency for an interaction ($P = 0.06$) between particle size and ionophores for final BW, where WCL fed lambs tended to be heavier than the other lambs by up to 0.33 lbs. Erickson et al. (1988 and 1989) conducted two trials in lambs evaluating particle size in finishing rations. Erickson et al. (1989) reported reducing particle size (whole vs. ground in corn-based diets) had no effect on ADG or G:F in feedlot lambs. However, Erickson et al. (1988) also reported a tendency for lambs fed whole grain diets to have heavier final BW, which is similar to the tendencies we observed for final BW.

Erickson et al. (1988 and 1989) conducted two trials in lambs evaluating particle size in finishing rations. Erickson et al. (1989) reported reducing particle size (whole vs. ground in corn-based diets) had no effect on ADG or G:F in feedlot lambs. However, Erickson et al. (1988) also reported a tendency for lambs fed whole grain diets to have heavier final BW, which is similar to the tendencies we observed for final BW.

Carcass Characteristics. There were no interactions among treatments for HCW, leg score, conformation score, fat depth, body wall thickness, flank streaking, quality or yield grade, and dressing percentage ($P \geq 0.06$). However, there was an interaction between particle size and ionophores for loin eye area ($P < 0.001$) and % BCTRC ($P = 0.004$). Loin eye area was greatest ($P < 0.05$) for WCL and GCNL, with GCL intermediate. However, GCNL had the greatest ($P < 0.05$) %BCTRC. Additionally, lambs fed lasalocid had heavier HCW (3%; $P = 0.05$) compared to those fed diets without lasalocid. No additional effects were observed for the rest of the carcass traits in relation to particle size or ionophore inclusion ($P \geq 0.06$). The research that has been conducted evaluating particle size in grain based finishing rations in lambs supports our findings that reducing particle size has minimal effects on carcass traits. Erickson et al. (1988) reported that lambs fed whole vs. ground corn had no difference in HCW and leg score, however lambs had higher yield grades and thicker fat depths when fed whole grains vs. ground. Reynolds and Lindahl (1960) reported that lambs tend to not consume finely ground feeds and sort through feed to select larger particles and secondly, that grinding increases the rate of digestion, therefore decreasing total digestibility. Additionally a previous trial at this lab, similar to our research, fed lambs coarse rolled corn with lasalocid had higher dressing percentage when compared to lambs not receiving lasalocid, however lasalocid did not affect any other carcass characteristics (Rupprecht et al., 1992).

While performance and carcass data evaluating particle size and ionophores is limited, research is available addressing the biological affects of ionophores. Ionophores appear to alter the movement of certain ions across biologic membranes, which, in the rumen, results in an alteration of microflora (NRC, 2007). Feeding lasalocid and monensin may also exert a possible N-sparing effect by inhibition of ruminal amino acid deamination (Schelling et al., 1978; Poos et al., 1979). In vitro production of amino-N decreased linearly with increasing levels of monensin in research reported by Whetstone et al. (1981) which suggests a decrease in rate of proteolysis. In a study by Paterson et al. (1983), rumen propionate was increased and the acetate to propionate ratio was decreased when lasalocid was fed to lambs. The addition of lasalocid to a low ruminal N degradable feed resulted in more rapid weight gain than without lasalocid; however, when lambs were fed soybean meal with or without lasalocid, lasalocid actually slowed the rate of gain (Paterson et al., 1983). These results indicate that lasalocid can effectively increase propionate production in the rumen, which explains the tendency for higher growth performance of the lambs fed WCL diets in the current trial. However, GCNL fed lambs had similar growth performance to WCL fed lambs, which is quite interesting. A possible explanation for the similar performance is due to a smaller particle size which led to an increase in overall digestibility for the GCNL fed lambs; although, this is speculation and was not tested in the current trial. The most interesting note in this trial, is WCNL fed lambs numerical reduction in performance compared to the three other treatments. Lasalocid is most likely needed to increase propionate production with this whole grain diet to attain the increased performance seen in the other treatments. In the current trial, GCNL fed lambs did have greater %BCTRC, however these lambs also had increased loin eye area, although statistically similar to WCL, which could have driven the increase in %BCTRC. Interestingly, the current trial showed that particle size also affected loin eye area ($P = 0.008$), while prior research in ground vs. whole grains has shown no effect of diet processing on loin eye area (Erickson et al., 1988; Erickson et al., 1989).

Nitrogen Balance Study

There were no interactions or main affects among treatments for DMI, N intake, N balance, or serum urea-N concentration (Table 3; $P \geq 0.18$), however, there was a day effect ($P = 0.0018$) for serum urea-N concentration. Days 1, 2, and 3 were generally lower than days 4 to 6 ($P < 0.05$; data not shown). There is conflicting research on particle size and its effects on N digestion, N balance, and serum urea-N concentration. Although there was no particle size affect ($P \geq 0.22$) in the current trial, previous research by Kerley et al. (1985) reported that N digestion was increased in lambs fed 6.5, 5.4 and 0.8 mm particle size corncob diets, while the 1.4 mm diet was decreased. The 1.4 mm diet also had higher fecal N loss when compared to the other diets. Other research by Perez-Torres et al. (2011) reports no differences in DM or OM intake or digestibility in diets that differ in particle size, agreeing with results from the current trial. However, the addition of lasalocid did decrease ($P = 0.01$) fecal N excretion. This is similar to findings by Ricke et al. (1984), in which lasalocid treated lambs also had decreased fecal N excretion when compared to lambs fed monensin or no ionophore. Varying results exist on lasalocid's effects on N digestibility, with some reporting it increases N digestibility (Paterson et al., 1983; Ricke et al., 1984), while other report that it remains unaffected (Funk et al., 1986) with N balance also appearing to remain unaffected (Funk et al., 1986). Ricke et al., (1984) also reports that lasalocid-fed lambs had less fecal N loss and therefore higher N retentions, which could be reflective of increased digestibility. The differences in findings could be due to the different types of collection, ranging from N balance trials, to in situ techniques.

IMPLICATIONS

Grinding lamb finishing rations containing 80% corn and 20% market lamb pellet had no beneficial, or negative, impact on lamb growth performance, mortality, or carcass traits. However, including lasalocid in rations containing whole corn and market lamb pellet may result in an increase in average daily gain, final body weight, and carcass weight. Additional research is needed to further quantify the benefits of grinding rations with feed ingredients of differing particle size (i.e. combing corn and dried distillers grains), as well as the impacts of ionophores in non-traditional feedlot rations.

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Table 1. Ingredient and nutritional composition of diets fed to lambs fed differing particle sizes of corn and market lamb pellets with or without lasalocid (DM basis)

	Treatments[1]			
Item	WCNL	WCL	GCNL	GCL
Ingredient, %				
Corn	80	80	80	80
Market lamb pellet[2]	20	20	20	20
Nutrient composition, %				
DM	96.4	96.3	96.0	96.7
CP	19.6	18.7	17.7	17.2
NDF	16.4	15.4	14.4	15.7
ADF	5.3	4.8	4.5	5.3

[1]Treatments: WCNL= whole corn and market lamb pellet without lasalocid (Bovatec, Alpharma Inc., Bridgewater, NJ); WCL= whole corn and market lamb pellet with lasalocid; GCNL= ground corn and market lamb pellet without lasalocid; GCL= ground corn and market lamb pellet with lasalocid.
[2]Market lamb pellet contained 38% CP, 4.25% Ca, 0.6% P, 3.5% salt, 3.0 ppm Se, 24,000 IU/lb vitamin A, 2,400 IU/lb vitamin D, and 60 IU/lb vitamin E with treatments WCNL and GCNL having no lasalocid and WCL and GCL containing 20 g/ton of lasalocid.

Table 2. Effects of lasalocid and particle size on lamb growth performance, carcass characteristics, and mortality

	Treatment[1]					*P*-value[3]		
Item	WCNL	WCL	GCNL	GCL	SEM[2]	PS	ION	PS*ION
Initial BW, lb	68.78	69.00	67.90	69.00	0.22	---	---	---
Final BW, lb	151.46	157.41	153.44	152.34	1.54	0.34	0.17	0.06
ADG, lb/d	0.57[a]	0.62[a]	0.60[a]	0.57[a]	0.02	0.76	0.73	0.05
Feed offered, lb DM • $head^{-1}$ • d^{-1}	5.56	5.89	5.73	5.89	0.15	0.58	0.14	0.57
G:F	0.10	0.10	0.11	0.10	0.004	0.59	0.47	0.23
Mortality, %	0	5	2.5	5	2.39	0.61	0.14	0.61
HCW, lb	74.3	78.0	75.0	75.6	1.06	0.37	0.05	0.16
Leg score[4]	11.5	11.7	11.5	11.6	0.13	0.06	0.14	0.94
Conformation score[4]	11.7	11.9	11.8	11.8	0.10	0.85	0.24	0.51
Fat depth, cm[5]	0.73	0.61	0.66	0.74	0.06	0.60	0.72	0.11
Body wall thickness, cm	2.53	2.55	2.51	2.63	0.08	0.73	0.42	0.54
Loin eye area, cm^2	19.6[a]	21.1[bc]	22.0[c]	20.7[b]	0.31	0.008	0.79	<0.001
Flank streaking[6]	375	389	366	376	9	0.27	0.22	0.89
Quality grade[4]	11.7	11.8	11.6	11.6	0.09	0.10	0.43	0.88
Yield grade[7]	3.28	2.81	3.01	3.30	0.22	0.61	0.70	0.11
BCTRC, %[8]	46[a]	47[a]	47[b]	46[a]	0.18	0.06	0.24	0.004
Dressing, %	49	50	49	50	0.39	0.80	0.10	0.85

[1]Treatments: WCNL= whole corn and market lamb pellet without lasalocid (Bovatec, Alpharma Inc., Bridgewater, NJ); WCL= whole corn and market lamb pellet with lasalocid; GCNL= ground corn and market lamb pellet without lasalocid; GCL= ground corn and market lamb pellet with lasalocid.
[2]$n = 4$.
[3]PS= particle size of diet and ION= ionophores.
[4]Leg score, conformation score and quality grade: 1= cull to 15= high prime.
[5]Fat depth and yield grades.
[6]Flank streaking: 100 to 199= practically devoid; 200 to 299= traces; 300 to 399= slight; 400 to 499= small; 500 to 599= modest.
[7]Yield grade= 0.4 + (10 × fat depth).
[8] BCTRC= boneless closely trimmed retail cuts, % = [49.936- (0.0848 × HCW, lb) – (4.376 × 0.3937 × fat depth, cm) – (3.53 × 0.3937 × body wall thickness, cm) + (2.456 × 0.155 × loin eye area, cm^2)].
[a,b,c]Means within a row with different superscripts differ ($P < 0.05$).

Table 3. Effects of lasalocid and particle size of feed on N intake, excretion, balance, and serum urea-N concentration in lambs

	Treatment[1]					*P*-value[3]		
Item	WCNL	WCL	GCNL	GCL	SEM[2]	PS	ION	PS*ION
Daily DMI, g/ kg BW	38.43	36.99	66.16	37.97	12.9	0.29	0.28	0.32
Daily N intake, g/ kg BW	1.06	0.94	1.11	1.04	0.06	0.26	0.18	0.69
Daily N excretion, g/ kg BW								
Fecal	0.23	0.14	0.21	0.16	0.01	0.87	0.01	0.45
Urinary	0.05	0.04	0.05	0.05	0.004	0.23	0.97	0.25
Daily N Balance, g/ kg BW	0.78	0.76	0.84	0.83	0.05	0.22	0.76	0.99
Serum urea-N[4], m*M*	10.29	10.11	10.87	10.37	0.53	0.50	0.65	0.77

[1]Treatments: WCNL= whole corn and market lamb pellet without lasalocid (Bovatec, Alpharma Inc., Bridgewater, NJ); WCL= whole corn and market lamb pellet with lasalocid; GCNL= ground corn and market lamb pellet without lasalocid; GCL= ground corn and market lamb pellet with lasalocid.

[2]$n = 4$.

[3]PS= particle size of the diet and ION= ionophores.

[4]*P*-values for serum urea-N: day ($P = 0.0018$) and treatment × day ($P = 0.33$).

Mortality Composting: Proper Disposal Methods to Manage Mortalities in the Sheep Flock

M.A. Berg

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INTRODUCTION

Natural disasters, diseases and accidents can all contribute to livestock death losses. Animal mortalities in North Dakota must be disposed of within 36 hours of death using 1 of the 4 approved methods: rending, incineration, burial or composting. Although historically done, carcass abandonment is strongly discouraged. Proper carcass disposal ensures air, water, and soil quality are maintained and the potential for spreading disease is decreased.

PROCEDURES

Composting mortalities is a relatively simple process that can typically be done with materials that are already present on the farm.

In a typical flock, the majority of sheep mortalities likely occur during lambing. Composting these losses would be an excellent management option. Because lambing mortalities are small in size, a layered pile system is best. Heat will be maintained during cold months and land area will be used effectively. A source of carbon material such as straw or old hay will be needed to create a base layer. Additionally, core material such as manure or spoiled silage, as well as cover material such as straw, old hay or sawdust will be needed. Each farm will have different material sources available, thus there is not a single "recipe" that is best. Use the following guidelines for composting lambing mortalities to get you started.

- Do not place the windrow, pile or bin in a floodplain, in a low area where water gathers during spring's melt or heavy rain, or on a sandy or other porous surface.
- Start with 2 feet of base material in a windrow, pile or bin-type setup (Figure 1).
- Place the carcasses on top of the base. Make sure the carcasses do not touch. Have at least 1 foot of base material between the perimeter of the carcass and the edge of the base.
- Cover the carcasses with 6 to 8 inches of core material.
- Either layer more carcasses on top of the core material or if all of the mortalities fit in one layer, cover the entire pile or windrow with 2 feet of cover material. The cover material should be placed on the top and sides, no part of the carcasses should be showing. A good cap on the pile will keep predators out and seal in heat.
- When additional carcasses need to be added to the windrow, pile, or bin; layer them on top of the cover material, cover with additional core material and add more cover material to the top (Figure 2). calculate application rates.

- During cold weather composting, make sure the completed windrow, pile or bin is at least 4 feet tall. This will maintain proper heating and prevent the pile from freezing.
- Leave the windrow, pile or bin undisturbed to keep heat sealed in during the very cold winter months. Small carcasses will completely breakdown within 2-4 months and temperatures should reach above 130 degrees Fahrenheit. For lamb carcasses even the bones will decay during this process. Note: larger carcasses (ewe) will take longer to decay and may require aeration, after 2-4 months, to reintroduce oxygen for the process to continue properly.
- The final compost product can be used as the core material to start a new mortality composting process or can be used as a fertilizer on crops applied at agronomic rates. A sample should be sent to a commercial laboratory for a nutrient analysis to properly calculate application rates.

More information can be found by watching the eXtension Livestock and Poultry Environmental Learning Center's video series at http://tinyurl.com/ktghhlw or visiting www.ag.ndsu.edu/lem. If you have questions or would like help setting up a windrow, pile or bin-type mortality composting system, please contact Mary.Berg@ndsu.edu or 701-652-2951.

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Figure 1. Bin-type mortality compost system with a 2-foot carbon base prepared for mortalities.

Figure 2. Bin-type mortality compost system with several layers of moralities and core material.

FLOCK CALENDAR OUTLINE

The following guidelines are neither inclusive nor intended to fit every sheep operation. Each operation is different, therefore, each "calendar event" should be tailored to each flock's needs.

PRIOR TO BREEDING

1. Bag and mouth ewes and cull those that are not sound.
2. Replace culled ewes with top-end yearlings or ewe lambs.
3. Keep replacement ewes lambs on growing rations.
4. Evaluate sires:
   A. Be sure they are vigorous, healthy and in good breeding condition.
   B. Rams should be conditioned at least a month before breeding season. Flush rams in poor condition.
   C. Allow at least two mature rams (preferably three) or four buck lambs per 100 ewes.
5. Flush ewes:
   A. One pound grain/day two to five weeks before breeding (usually 17 days).
   B. If ewes are over-conditioned, the effect of flushing will be lessened.
6. Vaccinate ewes for vibriosis and enzootic abortion (EAE).
7. Identify all ewes and rams with ear tags, paint brands or tattoos.

BREEDING

1. The ovulation rate of a ewe tends to be lower at the first part of the breeding season. Vasectomized or teaser rams run with ewes through the first heat period tend to stimulate then and increase the ovulation rate at the second heat period.
2. Use a ram marking harness or painted brisket to monitor breeding. Soft gun grease with a paint pigment mixed in works well for painting the brisket. A color sequence of orange, red and black is recommended with colors being changed every 17 days.
3. Leave rams in NO LONGER than 51 days (35 days is more desirable).
   A. An exception may be with ewe lambs. Allowing them four cycles or 68 days may be beneficial.
4. Remove rams from ewes after the season (don't winter rams with ewes).

PRIOR TO LAMBING (First 15 weeks)

1. Watch general heath of ewes. If possible sort off thin ewes and give extra feed so they can catch up.
2. Feed the poor quality roughage you have on hand during this period, saving better for lambing.
3. An exception to the above is feeding pregnant ewe lambs. They should receive good quality roughage and grain (about 20 percent of the ration) during this period.

LAST SIX WEEKS BEFORE LAMBING

1. Trim hooves and treat for internal parasites.
2. Six to four weeks before lambing feed 1/4 to 1/3 pound grain/ewe/day.
3. Shear ewe before lambing (with highly prolific ewes at least a month before is preferred). Keep feeding schedule regular and watch weather conditions immediately after shearing (cold).
4. Vaccinate ewe for enterotoxaemia.
5. Control lice and ticks immediately after shearing.
6. Four weeks before lambing increase grain to 1/2 to 3/4 pound/ewe/day (usually done immediately after shearing.
7. Give A-D-E preparations to ewes if pastures and/or roughage are or have been poor quality.
8. Feed selenium-vitamin E or use an injectable product if white muscle is a problem. Caution DO NOT use both.
9. Check facilities and equipment to be sure everything is ready for lambing.
10. Two weeks before lambing increase grain to 1 pound/ewe/day.

LAMBING

1. Be prepared for the first lambs 142 days after turning the rams in with the ewe, even though the average pregnancy period is 148 days.
2. Watch ewes closely. Extra effort will be repaid with more lambs at weaning time. Saving lambs involves a 24-hour surveillance. Additional help at this time is money well spent.
3. Pen a ewe and lambs in lambing pen (jug) after lambing, not before.
4. Grain feeding the ewe during the first three days after lambing is not necessary.
5. Be available to provide assistance if ewes have trouble lambing.
6. Disinfect lamb's naval with iodine as soon after birth as possible.
7. Be sure both teats are functional and lambs nurse as soon as possible.
8. Use additional heat sources (heat lamps, ect) in cold weather.
9. Brand ewes and lambs with identical numbers on same side. Identify lambs with ear tags, tattoos or both.
10. Turn ewes and lambs out of jug as soon as all are doing well (one to three days).
11. Bunch up ewes and lambs in small groups of four to eight ewes and then combine groups until they are a workable size unit.
12. Castrate and dock lambs as soon as they are strong and have a good start (two days to two weeks of age). Use a tetanus toxoid if tetanus has been a problem on the farm (toxoids are not immediate protection, it takes at least ten days for immunity to build).
13. Vaccinate lambs for soremouth at one to two weeks of age if it has been a problem in the flock.
14. Provide a place for orphaned lambs. Make decision on what lambs to orphan as soon after birth as possible for best success. Few ewes can successfully nurse more than two lambs.

END OF LAMBING TO WEANING

1. Feed ewes according to the number of lambs sucking. Ewes with twins and triplets should receive a higher plane of nutrition.
2. Provide creep feed for lambs (especially those born during the winter and early spring).
3. Vaccinate lambs for overeating at five weeks and seven weeks of age.

WEANING

1\. Wean ewes from lambs, not lambs from ewes. If possible, remove ewes from pen out of sight and sound of lambs. If lambs have to be moved to new quarters, leave a couple of ewes with them for a few days to lead the lambs to feed and water locations.

2\. Lambs should be weaned between 50 and 60 days of age when they weigh at least 40 pounds and are eating creep and drinking water. The advantage of early weaning is that the ewe's milk production drops off to almost nothing after eight weeks of lactation.

2\. Grains should be removed from the ewe's diet at least one week prior to weaning and low quality roughage should be fed. Restriction of hay and water to ewes following weaning lessens the chance of mastitis to occur. Poorer quality roughage should be fed to the ewes for at least 10-14 days following weaning.

3\. Handle the ewes as little as possible for about 10 days following weaning. Tight udders bruise easily. If possible, bed the area where the ewes will rest heavily with straw to form a soft bed for the ewes to lay on.

WEANING TO PRE-BREEDING

1. If ewes go to pasture, treat for internal parasites.
2. Feed a maintenance ration to the ewes. Put ewe lambs that lambed back on a growing ration once they have quit milking.
3. Adjust ewes condition so they can be effectively flushed for next breeding season. Don't get ewes too fat prior to breeding.

REARING LAMBS ARTIFICIALLY (ORPHANS)- MANAGEMENT TIPS

Within 2 to 4 hours after birth, decide which lambs among those from multiple births you should remove. Look for the weaker, or smaller ones to choose for artificial rearing. It is important to make the decision early. Relatively weak lambs remaining with ewes can experience more stress than those reared artificially. Consider the following tips:

- It is essential that newborn lambs receive colostrums milk. Cow's colostrums will work if ewe's milk is not available. Do not dilute with water or warm too quickly if colostrums is frozen.
- Lambs should be removed from sight and hearing distance of ewes.
- Provide a warm, dry , draft-free area to start lambs.
- Use a good milk replacer that is 30% fat and at least 24% protein. Each lamb will require from 15 to 20 pounds of replacer to weaning.
- Lambs may require some assistance the first day or two to teach them to nurse on whatever feeding device is used.
- Start on nurser quickly, young lambs start easier.
- Self feed cold milk replacer after lambs are started. Milk replacers should be mixed with warm water for best results and then cooled down. Lambs feed cold milk well with less problems from scours and other digestive distrubances. Cold milk keeps better too.
- There is a Formaldehyde solution commercially avaliable that retards bacterial growth in milk (1cc/gallon milk).
- Hang a light over the milk replacer feeding device and dry ration feeder.
- Avoid placing young lambs with older lambs, as they may be pushed aside and may not be able to obtain the milk replacer. Remember that lambs nursing ewes drink 25 to 40 times per 24 hours. Best results have been obtained when lambs are fed in groups of 3 to 4 initially. After lambs are successfully trained, they can be handled in groups of 25.
- Inject lambs in the first few days with Iron Dextran, Vitamin A-D-E, and Selenium-Vitamin E. At 15 days of age, vaccinate for overeating (Colostridum perfringen type C & D).
- Provide lambs with a high-quality creep feed as soon as possible. Provide ample fresh water in front of lambs at all times. Do not feed hay or oats the first three week after weaning, as it encourages bloat. Caution! Do not feed leafy alfalfa until two weeks after weaning, as it encourages bloat.
- Wean lambs abruptly at 21-30 days of age. When to wean depends upon whether lambs are eating creep feed and drinking water. Newly weaned lambs will go back wards for several days. Don't be alarmed, they will make compensating gains later on.

Making a difference

NDSU EXTENSION SERVICE

NORTH DAKOTA STATE UNIVERSITY

Reclamation in the Bakken

The Situation

Activity in the Bakken Oil Field, including well pad development, product movement and pipeline installation, has led to increased oil and brine spills on both grazing and prime farmland. This has not only impacted soil health and agricultural production, but also rangeland and wildlife. Due to the speed and intensity of the oil development, there is little information for landowners and those in industry on reclamation approaches in response to these activities. Additionally, science-based support for the development of state-level regulations is highly desired by regulatory agencies.

Extension Response

In 2013, NDSU Extension co-hosted the First Annual North Dakota Reclamation Conference with Dickinson State University, the Society for Range Management and BKS Environmental Consulting. Due to the interest and high attendance (150 people), a second conference was organized in 2014. Over 220 people attended this 2-day event, which included a trade show with up to 20 vendors. We are in the process of planning the 3rd annual conference to be held in February of 2015. This is the primary outlet for information within the state. Additionally, an Extension circular was released on Successful Reclamation of Lands (R1728; led by Sedivec).

Research and Extension faculty on main-campus have started working on various industry funded projects on brine and oil spill reclamation, including the Tesoro pipeline oil spill in Tioga, ND.

Impacts

The attendance of the 1st and 2nd Annual Reclamation Conferences (370 people) indicates the importance of this specific topic to North Dakotans. Evaluations indicated information presented was very useful, especially when we covered regulations, science and case studies for the specific topics of water management, soil health, seeding and reclamation in general. In general, there was an 8-14% increase in knowledge of these four topics after attending the 2014 workshop.

Research and Extension efforts currently underway on the Tesoro project will result in prime farmland reclamation approaches along with landowner support programs.

Feedback

"This workshop was needed in this part of the state, I'm hoping to get more farmers there in 2015"
– *producer/rancher*

"Excellent program" - *researcher*

Contacts

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Dr. Kevin Sedivec, Extension Range Specialist, Fargo, ND 58108, kevin.sedivec@ndsu.edu; 701-231-7647

AES Collaborators: Drs. Frank Casey, Aaron Daigh, Tom DeSutter, and Ryan Limb.

2014 Presentations, Outreach and Publications

Christopher Schauer, Hettinger REC Director and Animal Scientist

Presentations and Outreach

Feeding the ewe and ram with Dried Distillers Grains
K-State Sheep Producer Day
March 8, 2014

Using Dried Distillers Grains to effectively grow and finish lambs
K-State Sheep Producer Day
March 8, 2014

What is NSIP and how can it help your sheep operation?
K-State Sheep Producer Day
March 8, 2014

Effects of forage level in finishing diets on feedlot performance and carcass quality
Hettinger REC Beef Day
March 12, 2014

Rambouillet Ram Test Results.
Ram Test Field Day, Hettinger, ND
March 15, 2014

Using Pedigree Wizard for NSIP
Ram Test Field Day, Hettinger, ND
March 15, 2014

Using Pedigree Wizard for NSIP
NSIP School, Highmore, SD
April 10, 2014

Effects of forage level in finishing diets on feedlot performance and carcass quality
Sustainable Ag Conference, Sitting Bull College, Fort Yates, ND
April 25, 2014

Entering data into NSIP
NSIP Webinar
May 28, 2015

Sheep Nutrition for Beginners
Starter Flock Sheep School, Hettinger, ND
September 20, 2014

NDSU Shearing School
Hettinger, ND
November 22-24, 2014

NDSU and ASI Wool Classing School
Hettinger, ND
November 22-24, 2014

Publications

Crane, A.R., R.R. Redden, P.B. Berg, and **C.S. Schauer***. 2014. Effects of diet particle size and lasalocid on feedlot performance, carcass traits, and N balance in feedlot lambs. Sheep & Goat Res. J. 29:17-23.

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Benjamin Geaumont, Hettinger REC Research Assistant Professor, Wildlife and Range Science

Presentations

i. **Geaumont, B.A.** 2014. Prairie Dogs, Ecological Drivers? South Dakota Invasive Species Management Association, Rapid City, SD.
ii. **Geaumont, B.A.**, C.S. Schauer, and R. Maddock. 2014. Renewal on the Standing Rock Sioux Reservation: Land, Cattle, Beef and People. 2014 NDSU Extension and Agricultural Research Station Fall Conference, Fargo, ND.
iii. **Geaumont, B.A**., A. Lipinski, K. Sedivec, and R. Limb. 2014. Prairie dogs, livestock, and grasslands birds: who influences who? Sustainable Ag. Conference, Sitting Bull College, Ft. Yates, ND.
iv. Lipinski, A., K.K. Sedivec, R. Limb, and **B.A. Geaumont**. 2014. Community interactions: grassland birds, prairie dogs, and rangeland vegetation. Range, Soils and Beef Day. Hettinger, ND.
v. Kral, K.C., K.K. Sedivec, **B. Geaumont**, A.L. Gearhart, and R. Limb. 2014. Effects of early spring wildfire on crested wheatgrass dominated pasturelands and rangelands of South Dakota. Society for Range Management. Orlando, FL, USA.
vi. Lipinski, A., K.K. Sedivec, and **B.A. Geaumont**. 2014. A study on the interactions among rangeland vegetation, black-tailed prairie dog colonies, and the spatial distribution and diversity of grassland avifauna in northern South Dakota. Society for Range Management. Orlando, FL, USA.
vii. Stackhouse, J.W., and **B.A. Geaumont**. 2014. Range improvements and forage quality. Eureka, CA.
viii. **Geaumont, B.A.** 2014. Talking with animals. 4-H youth activity day. Hettinger, ND.

Workshops Co-Organized

i. ND Reclamation-What is Successful Reclamation

Second annual workshop was attended by 250 people. Served on 4 member board

ii. ND Chapter of the Society for Range Management – Endangered Species Workshop

The purpose of this workshop was to inform participants about the current state of endangered and threatened species in North Dakota. Additionally, the workshop was intended to provide private landowners with information regarding endangered species that may help them deal with future issues as they pertain to the management of their lands. Attendance +125.

iii. Range, Soils, and Beef Days

This workshop combined Beef Days and the Soil Health and Land Management Workshops. Each year this workshop is developed to cover a variety of issues as they relate to agriculture in southwestern North Dakota. The 2014 event focused on fire, alfalfa weevil and the interactions among birds, prairie dogs and livestock.

Attendance +34.

Publications

i. Chatterjee, A., **B. Geaumont**, T. DeSutter, D.G. Hopkins, and M. Rakkar. 2014. Rapid shifts in soil organic carbon mineralization within sodic landscapes. Arid Land Research and Management 29:255-263.

ii. Lipinski, A., R. Limb, K. Sedivec, and **B. Geaumont**. 2014. Grassland bird, rangeland vegetation and prairie dogs on grazed mixed-grass prairie. 2014 NDSU Beef Report: AS1736.

John Rickertsen, Hettinger REC Research Agronomist

Presentations and Outreach

New Varieties Update

West River Breeders, Reeder, ND

January 21, 2014

New Varieties and Research Update

Hettinger County Crop Imp. Asso., Regent, ND

February 11, 2014

New Varieties and Research Update

Taylor Farm Institute, Taylor, ND

February 11, 2014

Best Management Practices for Winter Wheat

Best of the Best in Wheat Research and Marketing

Hettinger, ND

February 14, 2014

Booth & Poster

Area 4 SCD Research Results Conference

February 3, 2014

Hettinger REC Crop Tour
Hettinger, ND
July 8, 2014

Small Grain Varieties
Bowman County Crop Tour, Scranton, ND
July 16, 2014

Small Grain Varieties
USDA-NGPRL Friends and Neighbors Day, Mandan, ND
July 17, 2014

Small Grain Varieties
Hettinger County Crop Tour, Regent, ND
July 29, 2014

Carinata Research Results
Ag Horizons Conference, Pierre, SD
December 3, 2014

New Varieties and Research Updates
31st Western Dakota Crops Day, Hettinger, ND
December 18, 2014

Publications

Nleya, T., and Rickertsen, J.R. 2014. Winter Wheat Response to Planting Date under Dryland Conditions. Agronomy Journal. 2014. 106:915–924. doi:10.2134/agronj13.0417

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North Dakota Hard Winter Wheat Variety Trial Results for 2014. October 2014. NDSU Extension Service circular A1196-14.

North Dakota Canola Variety Trial Results for 2014 and Selection Guide - A1124-14. October 2014. NDSU Extension Service circular A1124-14.

North Dakota Hard Red Spring Wheat Variety Trial Results for 2014. November 2014. NDSU Extension Service circular A574-14.

North Dakota Durum Wheat Variety Trial Results for 2014. November 2014. NDSU Extension Service circular A1067-14.

North Dakota Barley, Oat and Rye Variety Trial Results for 2014. November 2014. NDSU Extension Service circular A1049-14.

North Dakota Dry Pea Variety Trial Results for 2014. November 2014. NDSU Extension Service circular A1469-14.

North Dakota and South Dakota Sunflower Hybrid Trial Results for 2014. December 2014. NDSU Extension Service circular A652-14.

North Dakota Soybean Variety Trial Results for 2014. December 2014. NDSU Extension Service circular A842-14.

North Dakota Corn Hybrid Trial Results for 2014. December 2014. NDSU Extension Service circular A793-14.

North Dakota Dry Bean Variety Trial Results for 2014. December 2014. NDSU Extension Service circular A654-14.

31st Annual Western Dakota Crops Day Research Report. December 2014. NDSU Hettinger Research Extension Center Ag. Report No. 31.

2014 Advisory Board Meeting Minutes

Advisory Board Meeting
Hettinger Research Extension Center
February 20, 2014

Board members present included: Kat Weinert, Denise Andress, Chuck Christman, Lyle Warner, Julie Kramlich, Dennis Sabin, Justin Freitag, Cole Ehlers, Terry West, Dean Wehri, Wade Henderson, Jeremy Huether, Matt Neiderman and Tom DeSutter. Special guests included: Tim Faller and Gerald Sturn. Staff present included: Chris Schauer, John Rickertsen, Ben Geaumont and Cassie Dick.

After a noon lunch, the meeting was called to order by Chairman Dean Wehri at 12:45 and introductions were given.

Dean Wehri called for a motion to approve the minutes from the previous meeting. Chuck Christman motioned to approve the minutes, Kat Weinert seconded and the motion to approve the minutes from the previous meeting passed, no opposing.

Dean Wehri called for any additions or changes to the agenda, Chris Scahuer asked about switching a couple of scientists' presentations to allow for time needs. Dean Wehri called for a motion to approve and accept the agenda changes. Chuck Christman motioned to approve and accept the changes, Kat Weinert seconded and the motion passed, no opposing.

Directors and Legislative report- Chris Schauer (handout given)

1. Requesting brain-storming from the board for a new Strategic Plan
2. Upcoming weed scientist interviews
3. Position opening for wildlife/range technician closing soon
4. Agronomy/Range lab plans can be looked at, getting going with the build this spring
5. Station struggles to find housing for workers

Wildlife and Range report- Ben Geaumont (handout given)

1. Slide show "Today's Issues from a Wildlife and Rangeland Scientist's Perspective"
2. Suggestions requested from board for new/needed research topics

Animal Science report- Chris Schauer (handout given)

1. Slide show "Animal Science: Livestock Issues for the Next Five Years"
2. Suggestions requested from board for new/needed research topics

Agronomy report- John Rickertsen (handout given)

1. Slide show "Agronomy Program"
2. Suggestions requested from board for new/needed research topics

Strategic plan

1. 2010-2014 plan- will be examined, see how it was handled and if it was successful or not
2. A calendar has been established for input for the upcoming strategic plan
3. Hettinger staff looking to board members and county agents for input, research needed, anything different for the future and ideas

Elections of members
Julie Kramlich and Denise Andress have both completed two, three years terms for a maximum amount of years on the board. Kat Weinert, Chuck Christman and Lyle Warner have served one, three year term and are eligible to serve another term.

Dean Wehri asked for nominations to fill the two positions that are left open from Julie Kramlich and Denise Andress leaving. Julie Kramlich nominated Duaine Marxen, County Agent in Hettinger County. Julie Kramlich said Duaine Marxen is willing to serve on the board. Matt Niederman nominated Ethan Andress to be on the board. Matt Niederman pointed out that it would be nice to have a veterinarian due to potential upcoming changes with livestock vaccinations. Chris Schauer will check with Ethan to see if he is interested.

Cole Ehlers nominated Kat Weinert, Chuck Christman and Lyle Warner to continue serving on the board for a final three year term. Dean Wehri asked each member if they were willing to serve another term on the Hettinger Advisory Board, all members agreed to serve another term. Wade Henderson motioned to cease discussion and nominate the three members to another term, Terry West seconded, all members approved, no opposing. Kat Weinert, Chuck Christman and Lyle Warner will serve another term.

Dean Wehri will no longer be able to serve as Chair, Cole Ehlers serves as vice chair and accepted the promotion to chair the board, Dean Wehri then called for a motion for nominations for a vice chair. Chuck Christman nominated Kat Weinert, Lyle Warner seconded. Kat Weinert accepted the nomination. All members approved with no opposing. Kat Weinert will serve as the new vice chair for the board.

Open discussion
Tom DeSutter- funding for Ben Geaumont's projects? Ben stated that he has about 50% grant success and is search smaller grants right now because he has enough large grants that provide a lot of work
Lyle Warner- SBARE is asking for more funding from the legislation for REC's
Denise Andress- national funding available for pollination issues
Wade Henderson- Need for more information about fires for western ND
Dennis Sabin- Rumors about prairie dog town, let people know what is happening. Advertise upcoming events in Corson County News to reach the people in that area

The next Advisory Board Meeting will take place July 8th in conjunction with the Crop Tours.

Meeting adjourn at 2:45 pm.

Advisory Board Meeting
Hettinger Research Extension Center
July 8, 2014

Board members present: Tom DeSutter, Wade Henderson, Cole Ehlers, Dean Wehri, Terry West, Jeremy Fordahl, Justin Freitag, Jeremy Huether, Matt Neiderman, Kat Weinert, Lyle Warner and Duaine Marxen. Special guest: Gerald Sturn. Staff present: Chris Schauer, Ben Geaumont, John Rickertsen, Alison Crane and Cassie Dick.

After a noon lunch the meeting was called to order at 12:40 by Chairman Cole Ehlers.

Cole Ehlers called for a motion to approve the minutes from the last previous meeting. Terry West motioned to approve the minutes, Wade Henderson seconded. The motion was approved, the minutes passed, no opposing.

Cole Ehlers called for a motion to approve the agenda. Chris Schauer had some adjustments due to time issues. Dean Wehri motioned to approve and accept the change to the agenda, Tom DeSutter seconded. The agenda and change was approved, passed, no opposing.

Chris Schauer introduced the two new board members, Duaine Marxen, county agent in Hettinger County and not present was Dr. Ethan Andress, veterinary in Hettinger.

Director's Report- Chris Schauer (handout given)

1. Staffing- Two new employees hired: Daniel Graham, Wildlife and Range Tech and Caleb Dalley, Weed Scientist. A technician for the weed science program will be hired later in the year
2. Agronomy/range lab- making progress on site, should be done this winter
3. Next biennium- list of initiatives (handout given) Gerald Sturn spoke on Extension
4. Infrastructure
5. Strategic Plan- staff will meet once Caleb Dalley is on staff, asked board members for suggestions

Agronomy Report- John Rickertsen (handout given)

1. Good year for trials last year and looks like there is a good start for this year's trials
2. Current research projects
3. Off station plots include: Scranton, Regent, New Leipzig and Mandan
4. Asking for strategic plan ideas and field day suggestions

Animal Science Report- Chris Schauer (handout given)

1. 2010-2014 Strategic plan progress and asking for suggestion for next strategic plan
2. Current research projects
3. Graduate Students: Alison Crane, Ph.D. student and two interns for the summer

Wildlife and Range Report- Ben Geaumont (handout given)

1. Staff: two MS students Wyatt Mack and Matt Danzel and hired full time technician Dan Graham
2. Current Research projects
3. Upcoming field day for prairie dog project
4. Strategic Plan, asking for suggestions for needed projects

Strategic Plan

1. All scientists presented ideas for the upcoming strategic planning. Once the new weed scientist, Caleb arrives all will sit down with suggestions from the board and put together a new outline for the board

Open Discussion and suggestions for field days

1. Continued need for cover crops, forage value, mixtures that work
2. Calf finishing- use of less grain
3. Anogesics/less stress
4. Land owner rights for grazing, water, fencing around oil well sites
5. Tiling for field drainage issues/point source water pollution

Next Meeting: Crops Day, July 2015

Meeting adjourned at 2:45 pm.

2014 Personnel

Hettinger Research Extension Center

Christopher Schauer	Director/ Animal Science
Benjamin Geaumont	Research Assistant Professor/ Wildlife and Range
John Rickertsen	Associate R/E Center Specialist/ Agronomy
Caleb Dalley	Assistant R/E Center Specialist/ Research Weed Scientist
Daniel Graham	Wildlife and Range Technician
Terri Lindquist	Finance Paraprofessional
Cassie Dick	Administrative Secretary
Don Stecher	Manager of Ag Operations
Nels Olson	Research Technician/ Agronomy
David Pearson	Research Technician/ Shepherd
Donald Drolc	Research Technician/Livestock
Clint Clark	Research Technician/Beef Herdsman
Stephanie Schmidt	Research Technician

Range and Wildlife Graduate Students
Amanda Lipinski
Wyatt Mack

Animal Science Graduate Students
Alison Crane

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: John White, Derrick Stecher, McKinsey Jahner, Kayla Chadwick, Tyler Ruff, Devin Faller, Leah Nelson, Nick Allen, Jessica Jaeckel and Stephen Thiltges.

Advisory Board Members

Cole Ehlers, Chair	Hettinger, ND	Dennis Sabin	Morristown, SD
Dean Wehri	Mott, ND	Lyle Warner	Baldwin, ND
Ethan Andress	Hettinger, ND	Wade Henderson	Lodgepole, SD
Chuck Christman	Lemmon, SD	Jeremy Huether	Mott, SD
Justin Freitag	Scranton, ND	Duaine Marxen	Mott, ND
Terry West	Hettinger, ND	Jeremy Fordahl	Hettinger, ND
Kat Weinert	Hettinger, ND	Tom DeSutter	Fargo, ND
Matt Neiderman	Morristown, SD	Rodney Howe	Hettinger, ND

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