North Dakota State University

Hettinger Research Extension Center

2011 Annual Report

NDSU | HETTINGER
RESEARCH EXTENSION CENTER

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NORTH DAKOTA **AGRICULTURE EXPERIMENT STATION**

Hettinger Research Extension Center

HREC Research in Brief

- Integrated crops, livestock, range, and applied economics 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
- Land transfer patterns in SW North Dakota over the past 20 years

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NDSU
HETTINGER
Research Extension Center

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 agricultural economist and 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 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 agri-business and applied economics. 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 applied economics.

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

- Began a multi-agency and discipline research project evaluating the reclamation of grazing lands inhabited by prairie dogs on the Standing Rock Sioux Reservation.
- Started new project evaluating 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, Livestock, Range and Economics

- 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, telemetry of upland chicks, and land transfer patterns in the region during the past 20 years.

- 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.

ECONOMICS

- Evaluation of opportunities and constraints created by changing land ownership patterns in the Northern Great Plains.

- Expanding Ruminant Livestock Production in the Northern Great Plains: An Assessment of Resources, Opportunities and Constraints.

OUTREACH

- Conduct annually the HREC Beef Day, Sheep School, Shearing School, Wool Classing School, Carcass Ultrasound School, Crops Tours, Crops Day, and Sportsmen's Night Out.

- Published “Importance of Range Monitoring” video.

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

- In the past two years, published 8 refereed journal articles, 24 proceedings and abstracts, and co-authored over $3 million in grants and contracts directly at the Hettinger REC.

HREC Research Faculty

Dr. Christopher Schauer, Director & Animal Scientist
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Mr. Eric Eriksmoen, Agronomist
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Mr. Dan Nudell, Ag Economist
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Dr. Benjamin Geaumont, Wildlife and Range Scientist
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NDSU HETTINGER Research Extension Center

2011 Growing Conditions
Hettinger Research Extension Center

The fall of 2010 was ideal for winter wheat establishment with an abundance of rainfall in September followed by warm and dry conditions in October. There was an above normal amount of snowfall and accumulations greater than one foot throughout most of the winter months. The last spring snow storm dropped 8 inches of snow on April 20. Cold and wet conditions prevailed through the end of May resulting in only 50% of the wheat acres being planted and many of those acres being mudded in causing poor and uneven stands. Continued periods of wet weather through June caused soils to become almost fully saturated, resulting in many fields being left unplanted. These wet conditions caused small grain plants to develop small shallow root systems resulting in pale looking nitrogen deficient seedlings. This condition would later prove to be tremendously detrimental when those crops were at the critical seed forming growth stage and were hit with hot temperatures during the last 2 weeks of July. Weakened plants also became more susceptible to a plethora of diseases issues. An early infection of foliar diseases (tan spot and septoria) was widespread but was generally controlled by judicious use of fungicides. Wheat streak mosaic virus was common in winter wheat and to a lesser degree in some spring wheat. Symptoms ranged from mild to severe with some fields being destroyed to stop its spread to adjacent fields. Barley yellow dwarf, transmitted by aphids, was also very common in all small grain crops and varied in severity but was generally mild to moderate. Bacterial leaf streak was widespread in most wheat fields and was presented with symptoms of dead leaf tissue on the flag leaf which was uncontrolled with fungicides. Fusarium head blight (scab) was commonly observed in low water saturated portions of fields. Wheat stem sawfly infestations appear to be dwindling with the widespread use of tolerant varieties and an explosion of naturally occurring sawfly parasitoids. Grasshopper populations appear to be increasing in both numbers and infested acres. Overall, the wheat crop was very disappointing with commonly reported yields of 10 to 20 bushels per acre and test weights in the low 50's.

Late season crops tended to develop and produce quite well despite being planted later than normal. Early maturing corn varieties accumulated enough heat units to mature prior to a killing frost and sunflower yields were generally higher than average.

Most trials at the Hettinger Research Center were grown under a no-till cropping system. The predominant soil type is classified as a silty loam. Small grain trials were typically planted into field pea stubble and broadleaf crop trials were typically planted into spring wheat stubble. Residual soil fertility levels were determined and fertilizer was applied according to specific yield goals for each crop. Urea (46-0-0) was the primary nitrogen fertilizer source and was applied with a no-till drill prior to planting. Monoammonium phosphate (11-52-0) was typically applied directly with the seed during planting. All legume crops were treated with granular *rhizobia* inoculant during seeding.

HRSW, durum and barley trials were treated post-emergence for both wild oats and for broadleaf weeds (kochia, Russian thistle and wild buckwheat). Most broadleaf crops were treated with a pre-emergence burn down and with a post-emergence herbicide for grassy weeds and broadleaf weeds when possible. All small grain trials were treated with an insecticide to control aphids and with a fungicide at the 3 leaf stage to control foliar diseases and again at heading to control fusarium head blight.

Weather Data Summary - Hettinger

Frost Free Days

	28°F	32°F	Normal 32°F
Date of Last Frost	May 5	May 15	May 18
Date of First Frost	September 22	September 4	September 20
Frost Free Days	**140**	**112**	**125**

Precipitation

Precipitation (inches)	2006 – 07	2007 – 08	2008 - 09	2009 – 10	2010 – 11	56 Year Average
Sept. – Dec.	3.15	1.26	6.23	4.66	4.80	3.36
Jan. – March	2.18	0.87	5.16	1.16	2.84	1.50
April	1.09	0.98	1.10	1.76	2.31	1.61
May	5.97	4.01	1.38	3.73	4.61	2.64
June	3.04	4.08	3.53	2.93	3.39	3.32
July	1.62	1.23	2.20	3.68	1.85	2.04
August	3.65	1.75	3.47	2.41	2.30	1.71
Total	**20.70**	**14.18**	**23.07**	**20.27**	**22.10**	**16.18**

Air Temperature

Average Temp. F°	2007	2008	2009	2010	2011	56 Year Average
April	40.2	40.1	38.2	44.8	39.4	42.7
May	56.2	52.0	52.0	50.0	50.2	53.8
June	62.7	59.7	58.8	62.0	62.0	63.1
July	75.4	71.1	64.6	67.6	71.3	70.1
August	68.8	70.0	63.0	68.6	65.3	68.8
September	60.9	56.6	62.6	56.3	56.9	57.8

Growing Degree Units - Corn

Growing Degree Units (50-86)	2007	2008	2009	2010	2011	39 Year Average
May	272	207	265	210	161	260
June	452	346	344	393	358	417
July	672	606	458	536	631	584
August	533	579	461	547	555	537
September	353	340	421	278	347	316
Total	2282	2078	2006	2032	2052	2114

Agronomy Department
Hettinger Research Extension Center

Eric Eriksmoen - Agronomist
Rick Olson – Research Specialist
Caitlin Pearson and Krista Cella - Seasonal Labors

2011 Field Research Projects

Drill Strips. HRSW, durum, barley and oat.
Drill strips are grown to increase seed of individual varieties and experimental cultivars for future use in research trials at the research center and are utilized by the NDSU Dept. of Cereal Science for grain quality analysis. These non-replicated strips are also used for demonstration purposes during summer field tours. Status: **Ongoing.**

Variety Trials. HRSW, durum, barley, oat, HRWW, canola, corn, dry bean, flax, winter rye, safflower, sunflower, soybean, lentil, dry pea, winter triticale, spring triticale, chickpea, winter dry pea, winter canola, tame mustard, camelina, crambe, buckwheat and winter spelt.
These trials are composed of established and experimental varieties and are used to determine agronomic and seed quality parameters of individual varieties. The information is used by farmers to assist them with variety selection and by plant breeders to determine adaptation of elite experimental lines for release to the general public. These trials are typically an extension of collaborative projects with public and private plant breeders, the NDSU Dept. Plant Science and other NDSU Research Centers. Status: **Ongoing**.

Breeder Nurseries. HRSW, HRWW, HWSW, barley, oat, corn, canola, field pea and lentil.
These trials are composed of experimental cultivars that are being developed by public and private plant breeders. The information being generated from these trials is used to assist plant breeders in determining cultivar adaptation and performance of agronomic traits (plant height, insect resistance, etc.) used in variety development. These are cooperative projects with the NDSU Dept. Plant Science (HRSW, oat, corn canola, field pea and lentil), USDA-ARS (HRWW, barley and HRSW) and Monsanto (canola and white wheat). Status: **Ongoing**.

Canola Seeding Date Trial. This trial was established to evaluate the effects of seeding dates on seed quality and yield with an emphasis on later seeding dates. Similar trials conducted in the past have established the need to plant this crop in early to mid-April for optimal yield, but the effects of later seeding dates is not entirely understood. The information is used by farmers and by the insurance industry to assist them with understanding the potential risks of late seeding. The trial is being coordinated by the NDSU Dept. of Plant Sciences and is being funded by the Northern Canola Growers Assn. Status: **Completed.**

Optimizing the Identification and Development of High-yielding Spring Wheats with Resistance to Wheat Stem Sawfly. 19 cultivars at 3 locations.
This trial was composed of commercial and experimental cultivars developed to resist sawfly infestations. The objectives of the trial were to expand the knowledge base of sawfly, variety

and environmental interactions relating to stem solidity, stem infestation and timing of infestations. The trials were seeded into a natural sawfly infested areas near Hettinger, Scranton and Regent. The information is used to assist in the development of integrated pest management strategies for western North Dakota. This is a cooperative project with the NDSU Dept. of Plant Sciences and the NDSU Dept. of Entomology and was funded by SBARE. Status: **Completed.**

Variations in Physiological Response of Solid-stemmed Spring Wheat Cultivars Across Diverse Growing Environments. 10 cultivars.
The objective of the trial was to determine the effects of environment on pith expression (stem solidity) of 10 wheat varieties. The information is used to assist in the understanding of environmental conditions on stem solidity, a key factor in developing sawfly resistance. This is a cooperative project with the NDSU Dept. of Entomology and Ag. Canada. Status: **Ongoing.**

Oat Kernel Quality Trial. 10 cultivars.
This trial was conducted to identify and better understand specific kernel quality characteristics of selected commercial and experimental cultivars. The information is used to assist the NDSU Dept. of Cereal Sciences in the identification and development of specific oat kernel quality characteristics. This is a cooperative project with the NDSU Dept. Plant Science. Status: **Completed**.

Dormant Seeded Safflower Trial, 4 cultivars seeded in the fall and spring.
This trial is designed to evaluate safflower that is seeded in the late fall prior to freeze up and comparing it with a typical spring seeding. This trial has been conducted for several years with promising results. Weed control strategies will need to be developed to correspond with this practice. The information is used by scientist to assist them in developing this cropping practice and to assess associated risks. This is an HREC lead project. Status: **Completed.**

Cover Crop Trial on Sunflower. This trial was designed to observe agronomic and yield differences of sunflower that was inter-seeded with a field pea or lentil cover crop. The information is used by scientist to assist them in developing this as a cropping practice and to assess associated risks. This is an HREC lead project. Status: **Completed.**

Foliar Disease Evaluations in Spring Wheat and Durum. These evaluations were conducted to document varietal tolerance/sensitivity to foliar diseases. The information will assist growers in determining varietal susceptibility to several commonly occurring diseases. Status: **Ongoing**

Fall Seeded Broadleaf Crops Trial, 6 crops, 8 cultivars.
This trial was composed of established varieties of 6 different species (pennycress, winter camelina, juncea, winter canola, spring canola and a winter x spring cross canola) to determine adaptation as a potential fall seeded broadleaf crop. The information is used by scientists and plant breeders to determine adaptation of various varieties and crops. Status: **Ongoing**.

Off Station Variety Trials, Scranton, Regent, New Leipzig, Selfridge and Mandan.
Twelve hard red spring wheat varieties, eight durum varieties, six barley varieties and six oat varieties were tested for yield, agronomic and quality factors at five southwestern North Dakota locations. Field pea and HRWW variety trials were also located at Mandan. The trials are used

for demonstration purposes during the annual field tours and to enhance the data base on variety adaptation. The information is used by growers to assist them with variety selection. These trials are located in farmer fields and are cooperative projects with the NDSU and SDSU Extension Services, the ARS Northern Great Plains Research Lab, Ducks Unlimited and Pulse USA. Status: **Ongoing**.

National Phenology Network, cloned Syringa chinensis lilac.
This study involves the observation and collection of biological information such as bud formation, flowering and leaf senescence based on a standard phenological clock (lilac). This is a cooperative project with the Dept. of Geography, Univ. of WI - Milwaukee. Status: **Ongoing.**

Chemical Weed Control Trials. 26 trials.
Trials were conducted to determine the effectiveness of various herbicides and herbicide combinations at controlling various grass and broadleaf weeds in spring wheat, winter wheat, safflower, field pea and lentil. The information will be used by producers for herbicide tank mix selection and by manufacturers for tank mix and application guidelines. Most trials are cooperative projects with private chemical companies and the NDSU Dept. of Plant Sciences. Status: **Ongoing**.

NDAWN and NOAA Weather Monitoring.
The Hettinger REC agronomy dept. is responsible for daily collection and transmission of weather data to the National Oceanic and Atmospheric Administration and for the maintenance of the North Dakota Ag. Weather Network weather station. Status: **Ongoing.**

Evaluation of Perennial Herbaceous Biomass Crops (Switchgrass).
This trial was established to document the appropriate grass species, harvest methods, production practices and economics in the production of perennial biomass stands. The trial was reseeded this year after very poor stand establishment in past years caused by drought. The information will assist in the feasibility of biomass production for conversion to bio-energy. This trial is being coordinated by the NDSU Central Grasslands REC, Streeter and is being funded by the ND Natural Resources Trust. Status: **Ongoing.**

2011 Hard Red Spring Wheat Variety Trial at Hettinger

Variety	Days to Head	Plant Height	Test Weight	Grain Protein	----- Grain Yield ----- 2009	2010	2011	Average Yield 2 yr	3 yr
	*	inches	lbs/bu	%	------------- Bushels per acre -------------				
Sabin	64	32	57.9	15.8	44.2	92.7	47.5	70.1	61.5
Reeder	64	33	55.9	15.7	45.3	86.1	49.4	67.8	60.3
Tom	64	35	56.9	15.6	41.7	81.2	44.7	63.0	55.9
Velva	66	33	55.8	15.3	41.1	77.4	49.0	63.2	55.8
Jenna	67	33	56.5	15.5	45.0	73.4	48.9	61.2	55.8
Blade	66	33	57.3	15.8	47.6	77.0	40.5	58.8	55.0
SY605CL	62	35	55.5	15.8	42.2	70.2	51.7	61.0	54.7
Brennan	64	31	57.1	15.5	37.6	74.7	49.9	62.3	54.1
Howard	64	35	55.4	15.7	41.8	72.2	46.1	59.2	53.4
Brick	62	36	59.0	15.4	30.4	80.8	47.7	64.2	53.0
Brogan	65	32	55.8	15.9	41.3	72.7	44.6	58.6	52.9
Breaker	65	33	57.8	15.9	37.6	76.3	44.2	60.2	52.7
Prosper	67	33	55.7	15.8	38.3	78.2	40.0	59.1	52.2
Steele-ND	65	33	55.5	16.1	39.2	78.9	38.6	58.8	52.2
Kuntz	65	33	54.3	15.1	33.5	83.5	39.4	61.4	52.1
ND901CL	66	36	56.3	16.5	40.3	76.5	38.9	57.7	51.9
Samson	64	30	56.3	15.2	37.6	64.0	53.2	58.6	51.6
Barlow	64	35	56.7	16.0	37.2	68.9	45.5	57.2	50.5
Kelby	63	31	57.3	15.9	33.7	67.2	49.9	58.6	50.3
Vantage	68	32	60.3	17.3	44.1	67.4	37.8	52.6	49.8
Mott	68	35	58.0	16.6	39.0	70.0	39.3	54.6	49.4
Faller	66	33	55.9	15.8	36.5	68.8	38.0	53.4	47.8
Alsen	65	31	55.4	16.6	31.9	78.3	32.1	55.2	47.4
RB07	64	31	55.2	16.4	42.4	63.6	35.8	49.7	47.3
Fryer	66	35	54.8	15.8	35.6	69.6	35.8	52.7	47.0
Briggs	62	35	55.3	15.8	36.5	58.4	43.3	50.8	46.1
Choteau	66	30	51.4	16.4	31.1	75.6	27.9	51.8	44.9
Glenn	63	35	59.2	16.1	31.5	62.5	39.5	51.0	44.5
Edge	64	30	55.8	15.8		76.9	48.5	62.7	
Select	62	35	55.5	16.0		74.9	44.7	59.8	
WB Digger	64	34	52.0	15.6		80.3	38.6	59.4	
SY Soren	63	30	55.4	16.0			48.8		
WB Mayville	63	30	51.6	16.0			41.6		
SY Tyra	65	30	52.7	15.1			39.0		
O'Neal	67	33	53.1	15.9			36.0		
Rollag	64	30	56.5	16.3			35.2		
WB Gunnison	63	32	53.2	15.3			30.3		
Trial Mean	65	33	55.8	15.8	38.1	75.4	42.1	--	--
C.V. %	1.0	4.7	1.4	1.6	16.4	6.6	6.6	--	--
LSD 5%	1	2	1.3	0.4	8.7	7.0	4.5	--	--
LSD 1%	1	3	1.7	0.5	11.5	9.1	5.9	--	--

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

Planting Date: May 2 Harvest Date: August 15
Seeding Rate: 1.1 million live seeds / acre (approx. 1.6 bu/A).
Previous Crop: 2008 & 2009 = field pea, 2010 = HRSW.
Note: The 2009 trial sustained moderate hail damage. The 2011 trail sustained heat stress and moderate infections of bacterial leaf blight and barley yellow dwarf causing lower test weights and grain yields.

2011 Hard Red Spring Wheat Variety Trial at Scranton

Cooperator: Justin Freitag, Scranton

Variety	Plant Height	Test Weight	Grain Protein	----- Grain Yield ----- 2009	2010	2011	Average Yield 2 yr	3 yr
	inches	lbs/bu	%	------------- Bushels per acre -------------				
Conventional Varieties								
Barlow	33	56.7	16.2	74.6	54.4	34.5	44.4	54.5
Faller	31	54.8	16.3	62.0	59.9	28.0	44.0	50.0
Reeder	31	54.8	16.1	52.4	64.3	29.2	46.8	48.6
Steele-ND	33	56.5	16.6	58.2	55.6	30.1	42.8	48.0
Glenn	31	60.8	16.8	47.1	60.5	27.8	44.2	45.1
RB07	28	57.7	16.4		62.6	33.0	47.8	
Velva	32	54.9	16.1		58.7	31.5	45.1	
Sabin	29	58.3	16.6			35.5		
Prosper	33	55.0	16.2			28.9		
Select	31	58.2	15.4			29.9		
Sawfly Tolerant Varieties								
Mott	32	58.2	16.5	64.3	61.3	34.3	47.8	53.3
Vida	31	55.0	15.5	54.9	66.4	28.8	47.6	50.0
Choteau	29	55.1	16.1	53.0	66.8	21.2	44.0	47.0
AC Lillian	33	53.0	17.6	47.3	61.5	22.3	41.9	43.7
SY Tyra	27	55.1	15.5			29.4		
WB-Gunnison	30	55.5	15.5			22.6		
O'Neal	31	54.1	16.4			22.4		
Blends*								
Blend 1	32	56.6	16.7			28.3		
Blend 2	32	56.3	16.3			28.4		
Blend 3	28	54.3	16.2			24.5		
Blend 4	33	56.4	15.9			31.0		
Trial Mean	31	56.0	16.2	60.9	58.2	28.7	--	--
C.V. %	4.5	1.5	1.3	11.2	5.2	5.2	--	--
LSD 5%	2	1.2	0.3	9.8	4.4	2.1	--	--
LSD 1%	3	1.5	0.4	13.3	5.9	2.8	--	--

*1 = Choteau + Steele-ND, 2 = Mott + Steele-ND, 3 = Mott + O'Neal, 4 = Mott + Vida.

Planting Date: May 5
Harvest Date: August 23
Seeding Rate: 1.1 million live seeds / acre (approx. 1.6 bu/A).
Previous Crop: 2008, 2009 & 2010 = HRSW.
Note: The 2011 trial sustained heat stress and moderate infections of bacterial leaf streak and barley yellow dwarf causing lower test weights and grain yields.

2011 Hard Red Spring Wheat Variety Trial at Regent

Cooperators: August and Perry Kirschmann, Regent

Variety	Plant Height	Test Weight	Grain Protein	----- Grain Yield ----- 2009	2010	2011	Average Yield 2 yr	3 yr
	inches	lbs/bu	%	------------- Bushels per acre -------------				
Conventional Varieties								
Faller	31	57.0	16.4	70.6	48.0	34.3	41.2	51.0
Steele-ND	33	58.5	17.2	65.0	49.2	30.8	40.0	48.3
Barlow	33	58.0	17.0	61.6	47.3	30.4	38.8	46.4
Reeder	31	56.2	16.5	55.0	42.9	37.2	40.0	45.0
Glenn	31	59.5	17.2	60.5	48.3	27.0	37.6	45.3
Velva	33	55.2	16.6		49.3	34.9	42.1	
RB07	28	58.1	17.4		47.6	35.2	41.4	
Select	31	59.0	16.6			35.4		
Sabin	29	56.9	17.0			32.7		
Prosper	33	57.9	16.6			30.0		
Sawfly Tolerant Varieties								
Mott	32	58.6	16.5	58.1	51.5	33.8	42.6	47.8
Vida	32	55.4	16.3	58.4	49.2	30.7	40.0	46.1
Choteau	29	55.4	16.7	52.7	43.4	26.0	34.7	40.7
AC Lillian	34	53.7	18.1	49.1	39.9	21.8	30.8	36.9
SY Tyra	27	58.5	16.3			33.8		
WB Gunnison	30	56.8	16.1			31.7		
O'Neal	31	55.2	16.4			25.4		
Blends*								
Blend 1	32	58.1	17.0			31.7		
Blend 2	32	57.8	17.2			32.6		
Blend 3	31	55.0	16.4			24.0		
Blend 4	33	57.2	16.6			31.5		
Trial Mean	31	57.1	16.7	65.1	8.2	31.2	--	--
C.V. %	4.3	1.3	1.3	4.9	6.0	5.4	--	--
LSD 5%	2	1.0	0.3	4.4	4.0	2.4	--	--
LSD 1%	3	1.3	0.4	5.8	4.8	3.1	--	--

*1 = Choteau + Steele-ND, 2 = Mott + Steele-ND, 3 = Mott + O'Neal, 4 = Mott + Vida.

Planting Date: May 5
Harvest Date: August 23
Seeding Rate: 1.1 million live seeds / acre (approx. 1.6 bu/A).
Previous Crop: 2008, 2009 & 2010 = HRSW.
Note: The 2011 trial sustained heat stress and moderate infections of bacterial leaf streak and barley yellow dwarf causing lower test weights and grain yields.

2011 Hard Red Spring Wheat Variety Trial at New Leipzig

Cooperator: Jan Sprecher, New Leipzig

Variety	Plant Height	Test Weight	Grain Protein	----- Grain Yield ----- 2008	2010	2011	Average Yield 2 yr	3 yr
	inches	lbs/bu	%	------------- Bushels per acre -------------				
Glenn	35	57.7	17.2	17.5	43.3	13.5	28.4	24.8
Steele-ND	34	53.2	16.8	17.7	41.3	15.2	28.2	24.7
Faller	34	52.6	16.6	15.3	43.3	15.6	29.4	24.7
Mott	37	55.6	17.2		46.3	23.6	35.0	
RB07	30	53.8	17.0		50.4	19.7	35.0	
Velva	33	52.5	16.2		47.8	17.1	32.4	
Barlow	35	52.1	17.0		44.7	15.6	30.2	
Sabin	33	54.3	17.3			23.2		
Select	35	55.5	16.3			22.2		
Prosper	32	53.6	16.7			15.7		
SY Tyra	27	51.9	15.6			14.2		
WB Gunnison	32	50.7	16.0			10.3		
Trial Mean	33	53.6	16.7	18.5	45.0	17.1	--	--
C.V. %	2.7	1.4	1.1	7.4	6.1	9.0	--	--
LSD 5%	1	1.1	0.2	2.0	3.9	2.2	--	--
LSD 1%	2	1.5	0.3	NS	5.3	3.0	--	--

NS = no statistical difference between varieties.

Planting Date: May 5 Harvest Date: August 22
Seeding Rate: 1.1 million live seeds / acre (approx. 1.6 bu/A).
Previous Crop: 2008, 2009 & 2010 = HRSW.
Note: The 2011 trial sustained heat stress and moderate infections of bacterial leaf streak and barley yellow dwarf causing lower test weights and grain yields.

2011 Hard Red Spring Wheat Variety Trial at Selfridge

Cooperator: Nick Vollmuth, Selfridge

Variety	Plant Height	Test Weight	Grain Protein	----- Grain Yield ----- 2009	2010	2011	Average Yield 2 yr	3 yr
	inches	lbs/bu	%	------------- Bushels per acre -------------				
Barlow	35	51.9	16.9	50.9	43.3	33.3	38.3	42.5
Faller	36	50.4	16.4	52.5	41.1	32.7	36.9	42.1
Mott	37	49.7	17.4	50.9	45.3	26.7	36.0	41.0
Steele-ND	33	50.4	16.7	52.4	38.2	30.4	34.3	40.3
Glenn	36	53.6	17.1	45.7	42.4	31.6	37.0	39.9
Velva	35	49.0	16.6		44.8	30.6	37.7	
RB07	36	50.5	17.0		42.8	30.3	36.6	
Sabin	33	51.9	17.2			36.4		
Select	35	52.9	16.1			34.5		
Prosper	37	49.7	16.7			33.7		
SY Tyra	29	46.9	15.6			26.5		
WB Gunnison	30	47.3	16.2			16.2		
Trial Mean	35	50.3	16.7	50.0	43.0	30.2	--	--
C.V. %	4.0	1.8	1.3	9.3	6.1	6.4	--	--
LSD 5%	2	1.6	0.4	6.7	3.8	3.3	--	--
LSD 1%	3	2.1	0.5	9.0	5.1	4.5	--	--

Planting Date: May 6 Harvest Date: August 22
Seeding Rate: 1.1 million live seeds / acre (approx. 1.6 bu/A).
Previous Crop: 2008 = sunflower, 2009 & 2010 = HRSW.
Note: The 2011 trial sustained heat stress and moderate infections of bacterial leaf streak and barley yellow dwarf causing lower test weights and grain yields.

2011 Hard Red Spring Wheat Varieties in the West River Region - Combined Means

Variety	Days to Head*	Plant Height	Seeds / Pound	Test Weight	Grain Protein	----- Grain Yield ----- 2009	2010	2011	Average Yield 2 yr	3 yr
		inches	#	lbs/bu	%	------------- Bushels per acre -------------				
Mott	66	33	19,027	56.1	16.5	58.1	48.4	33.8	41.1	46.8
Barlow	62	33	17,877	55.5	16.3	56.6	49.2	34.1	41.6	46.6
Faller	64	32	17,576	53.9	15.9	59.6	46.8	31.1	39.0	45.8
Steele-ND	64	32	18,337	54.7	16.4	53.1	47.7	29.8	38.8	43.5
Glenn	62	33	18,258	56.9	16.5	48.9	45.8	30.7	38.2	41.8
RB07	62	30	20,562	54.5	16.5		50.4	31.1	40.8	
Sabin	63	31	18,685	55.9	16.3			36.5		
Velva	64	32	18,263	53.1	15.8			34.9		
Prosper	65	32	17,584	54.4	16.0			31.7		
# of Locations	2	9	3	9	9	10	11	9	20	30

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

Locations: 2011 = Hettinger, Dickinson, Scranton, Regent, New Leipzig, Selfridge, Hannover, Glen Ullin & Ralph, SD.
2010 = Hettinger, Dickinson, Scranton, Regent, New Leipzig, Selfridge, Mandan, Hannover, Glen Ullin, Ralph, SD & Bison, SD.
2009 = Hettinger, Dickinson, Scranton, Regent, Selfridge, Mandan, Hannover, Glen Ullin, Ralph, SD & Bison, SD.

2011 Sawfly Variety Trial at Hettinger

Variety	Days to Head	Plant Height	Test Weight	Grain Protein	----- Grain Yield ----- 2008	2010	2011	Average Yield 2 yr	3 yr
	**	inches	lbs/bu	%	------------- Bushels per acre -------------				
Sawfly Tolerant Varieties									
Vida	62	29	55.6	15.6	35.7	60.6	21.5	41.0	39.3
Mott	65	31	58.1	17.0	26.9	62.2	22.9	42.6	37.3
Choteau	64	30	55.8	16.6	20.9	60.7	14.9	37.8	32.2
AC Lillian	66	32	55.9	17.8	25.4	50.7	18.2	34.4	31.4
SY Tyra	62	25	54.6	15.4			19.6		
O'Neal	64	28	53.6	16.3			16.4		
WB Gunnison	62	27	54.0	15.8			13.0		
AP04S0514-1-12	64	28	55.8	15.8			21.9		
Blends*									
Blend 1	63	31	54.7	16.6			22.1		
Blend 2	62	31	55.2	16.6			21.9		
Blend 3	66	28	53.8	16.2			16.7		
Blend 4	66	30	56.3	15.8			21.2		
Conventional Varieties									
Reeder	62	30	55.3	16.5	25.3	64.4	25.3	44.8	38.3
Steele-ND	61	32	54.4	16.6	24.2	65.0	22.4	43.7	37.2
Glenn	60	31	59.0	16.8	25.6	56.3	22.7	39.5	34.9
Durum Wheat									
Grenora	66	32	53.3	16.3	27.7	65.8	19.7	42.8	37.7
Mountrail	66	33	53.7	16.4	23.9	63.9	22.1	43.0	36.6
Alkabo	66	32	55.2	16.1	23.2	61.3	20.0	40.6	34.8
Divide	66	33	54.7	16.5	18.9	60.0	21.5	40.8	33.5
Trial Mean	64	30	55.2	16.3	24.7	59.6	20.2	--	--
C.V. %	1.6	3.8	1.4	0.8	10.7	4.1	9.0	--	--
LSD 5%	1	2	1.1	0.2	4.4	3.6	2.6	--	--
LSD 1%	2	2	1.5	0.2	5.9	4.6	3.4	--	--

*1 = Choteau + Steele-ND, 2 = Mott + Steele-ND, 3 = Mott + O'Neal, 4 = Mott + Vida.
** Days to Head = the number of days from planting to head emergence from the boot.

Planting Date: May 9
Harvest Date: August 23
Seeding Rate: 1.1 million live seeds / acre (approx. 1.6 bu/A).
Previous Crop: 2007 = durum, 2009 = canola, 2010 = HRSW.
Note: The 2011 trial sustained moderate infections of barley yellow dwarf and bacterial leaf streak causing low test weights and grain yields. There was a very low incidance of wheat stem sawfly. The 2008 trial sustained severe late season heat and moisture stress.

2011 Durum Variety Trial at Hettinger

Variety	Days to Head	Plant Height	Test Weight	Grain Protein	----- Grain Yield ----- 2009	2010	2011	Average Yield 2 yr	3 yr
	*	inches	lbs/bu	%	------------- Bushels per acre -------------				
Wales	66	38	55.8	15.2	48.1	85.4	39.0	62.2	57.5
Westhope	66	38	55.7	14.8	49.6	79.8	43.1	61.4	57.5
Maier	67	34	54.5	16.0	52.3	80.4	34.4	57.4	55.7
AC Commander	67	29	54.0	15.1	51.7	81.7	33.5	57.6	55.6
DG Max	66	39	56.8	15.7	50.6	77.2	39.0	58.1	55.6
Mountrail	67	38	54.4	15.0	50.7	81.4	34.5	58.0	55.5
Dilse	67	37	53.3	16.4	49.8	79.3	34.7	57.0	54.6
Grande D'oro	66	38	56.0	15.0	50.0	77.0	36.2	56.6	54.4
Lebsock	66	37	55.9	15.0	51.1	77.4	33.7	55.6	54.1
Alkabo	67	37	55.5	14.8	52.0	75.5	34.8	55.2	54.1
Ben	66	37	55.9	15.2	48.0	76.2	37.2	56.7	53.8
Grenora	66	35	53.3	15.2	48.4	77.6	34.6	56.1	53.5
Pierce	67	39	56.7	15.0	46.7	75.6	35.9	55.8	52.7
AC Navigator	68	30	54.3	15.2	52.6	77.9	26.4	52.2	52.3
Divide	67	38	55.2	15.7	46.9	77.5	30.5	54.0	51.6
DG Star	65	36	53.6	15.9	43.6	74.9	32.8	53.8	50.4
Strongfield	67	37	53.1	16.5	43.0	79.5	28.0	53.8	50.2
Tioga	68	38	54.3	16.0	47.7	74.8	28.1	51.4	50.2
Rugby	64	39	55.2	14.9	33.1	71.8	40.1	56.0	48.3
Alzada	64	32	51.8	15.5	39.4	74.6	28.9	51.8	47.6
CDC Verona	67	39	52.8	15.6		80.5	35.2	57.8	
WB Belfield	62	27	52.7	14.8			32.7		
Trial Mean	66	37	55.4	15.0	48.6	79.8	37.7	--	--
C.V. %	1.1	5.1	1.8	2.0	7.2	4.4	5.7	--	--
LSD 5%	1	3	1.4	0.4	4.9	4.9	3.0	--	--
LSD 1%	1	4	1.9	0.6	6.4	6.5	4.0	--	--

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

Planting Date: May 2
Harvest Date: August 18
Seeding Rate: 1.25 million live seeds / acre (approx. 2.2 bu/A).
Previous Crop: 2008 & 2010 = field pea, 2009 = canola.
Note: The 2009 trial sustained moderate hail damage. The 2011 trial sustained heat stress and a moderate infection of barley yellow dwarf causing lower test weights and grain yields.

2011 Durum Variety Trial at Scranton

Cooperator: Justin Freitag, Scranton

Variety	Plant Height	Test Weight	Grain Protein	----- Grain Yield ----- 2009	2010	2011	Average Yield 2 yr	3 yr
	inches	lbs/bu	%	------------- Bushels per acre -------------				
Grenora	33	53.8	15.8	68.3	54.0	31.9	43.0	51.4
Mountrail	33	55.4	15.8	63.6	51.1	33.5	42.3	49.4
Alkabo	34	56.8	15.7	62.4	49.9	31.4	40.6	47.9
Tioga	36	56.7	15.5	59.7	50.5	32.9	41.7	47.7
Divide	34	56.4	16.2	63.9	44.9	32.1	38.5	47.0
Maier	34	55.5	16.2			32.1		
Trial Mean	34	55.7	15.8	62.8	50.3	32.3	--	--
C.V. %	4.3	1.6	1.2	3.1	4.0	4.1	--	--
LSD 5%	2	1.4	0.3	2.9	3.0	NS	--	--
LSD 1%	NS	1.8	0.4	4.0	4.2	NS	--	--

NS = no statistical difference between varieties.

Planting Date: May 5
Harvest Date: August 23
Seeding Rate: 1.25 million live seeds / acre (approx. 2.2 bu/A).
Previous Crop: 2008, 2009 & 2010 = HRSW.
Note: The 2011 trial sustained heat stress and a moderate infection of bacterial leaf streak causing lower test weights and grain yields.

2011 Durum Variety Trial at Regent

Cooperators: August and Perry Kirschmann, Regent

Variety	Plant Height	Test Weight	Grain Protein	----- Grain Yield ----- 2009	2010	2011	Average Yield 2 yr	3 yr
	inches	lbs/bu	%	------------- Bushels per acre -------------				
Grenora	30	54.2	15.2	66.1	48.7	25.6	37.2	46.8
Mountrail	31	55.2	14.7	64.5	47.6	26.3	37.0	46.1
Tioga	34	55.8	14.6	63.8	48.7	23.7	36.2	45.4
Alkabo	31	57.0	14.3	62.3	45.9	26.9	36.4	45.0
Divide	34	56.1	14.8	60.7	45.8	26.9	36.4	44.5
Maier	30	55.3	15.2			25.6		
Trial Mean	32	55.8	14.7	63.2	47.4	27.3	--	--
C.V. %	3.4	1.8	1.9	4.3	4.8	6.9	--	--
LSD 5%	2	1.5	0.4	NS	NS	2.8	--	--
LSD 1%	2	NS	0.6	NS	NS	3.8	--	--

NS = no statistical difference between varieties.

Planting Date: May 5
Harvest Date: August 23
Seeding Rate: 1.25 million live seeds / acre (approx. 2.2 bu/A).
Previous Crop: 2008, 2009 & 2010 = HRSW.
Note: The 2011 trial sustained heat stress and a moderate infection of bacterial leaf streak causing lower test weights and grain yields.

2011 Durum Varieties in the West River Region - Combined Means

Variety	Days to Head*	Plant Height	Seeds / Pound	Test Weight	Grain Protein	----- Grain Yield ----- 2009	2010	2011	Average Yield 2 yr	3 yr
						------------- Bushels per acre -------------				
		inches	#	lbs/bu	%					
Mountrail	69	34	--	55.1	15.2	61.5	61.6	32.7	47.2	51.9
Grenora	68	33	14,608	53.8	15.4	60.7	55.6	33.1	44.4	49.8
Divide	69	36	15,821	54.9	15.5	59.6	53.1	33.5	43.3	48.7
Alkabo	68	34	15,232	56.0	14.8	57.5	51.6	32.7	42.2	47.3
Tioga	69	36	14,375	54.8	15.2		54.7	33.3	44.0	
Maier	68	34	--	54.0	15.8			33.1		
# of Locations	5	6	2	6	4	9	9	6	15	24

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

Locations: 2011 = Hettinger, Scranton, Regent, Hannover, Glen Ullin & Ralph, SD.
2009 & 2010 = Hettinger, Dickinson, Scranton, Regent, Mandan, Hannover, Glen Ullin, Ralph, SD & Bison, SD.

2011 Barley Variety Trial at Hettinger

Variety	Days to Head	Plant Height	BYD**	Test Weight	Grain Protein	----- Grain Yield ----- 2009	2010	2011	Average Yield 2 yr	3 yr
	*	inches	%	lbs/bu	%	------------- Bushels per acre -------------				
2 Row Varieties										
Haxby	64	35	100	43.1	13.2	78.8	115.5	82.1	98.8	92.1
Conlon	59	34	0	42.9	13.7	74.9	196.4	80.9	93.6	87.4
Pinnacle	62	35	80	41.1	12.7	79.6	113.3	59.4	86.4	84.1
CDC Copeland	68	37	100	41.1	13.5	70.6	107.3	63.4	85.4	80.4
Rawson	63	36	70	41.4	12.6	66.0	106.7	66.7	86.7	79.8
AC Metcalfe	67	33	90	41.9	14.4	68.0	102.6	56.8	79.7	75.8
Lilly	65	29	70	39.1	13.4		126.7	81.6	104.2	
Conrad	68	32	50	50.7	13.7			71.1		
6 Row Varieties										
Tradition	62	34	60	40.3	12.6	71.4	117.4	91.1	104.2	93.3
Lacey	64	35	80	41.8	13.1	77.1	111.9	84.1	98.0	91.0
Rasmusson	63	34	60	40.5	12.8	72.1	110.8	84.3	97.6	89.1
Celebration	64	35	100	37.9	14.2	81.7	106.1	70.2	88.2	86.0
Quest	62	38	80	39.9	13.4	60.5	109.1	72.3	90.7	80.6
Stellar-ND	64	33	60	38.9	13.4	64.8	113.5	61.7	87.6	80.0
Innovation	62	35	90	39.9	12.3		110.8	89.4	100.1	
Trial Mean	63	34	59	40.5	12.8	74.2	113.8	76.6	--	--
C.V. %	1.6	5.7	--	1.6	2.7	11.3	4.7	6.8	--	--
LSD 5%	1	3	--	0.9	0.5	11.8	7.6	7.4	--	--
LSD 1%	2	4	--	1.2	0.7	15.7	10.2	9.8	--	--

* Days to Head = the number of days from planting to head emergence from the boot.
** BYD: Percent of flag leaves infected with barley yellow dwarf virus.

Planting Date: May 2 — Harvest Date: August 8
Seeding Rate: 750,000 live seeds / acre (approx. 1.4 bu/A).
Previous Crop: 2008 = hrsw, 2009 & 2010 = field pea.
Note: The 2009 trial sustained moderate hail damage.

2011 Barley Variety Trial at Scranton

Cooperator: Justin Freitag, Scranton

Variety	Plant Height	Test Weight	Grain Protein	----- Grain Yield ----- 2009	2010	2011	Average Yield 2 yr	3 yr
	inches	lbs/bu	%	------------- Bushels per acre -------------				
2 Row Types								
Rawson	31	42.8	12.1	72.9	87.8	54.4	71.1	71.7
Pinnacle	31	41.4	12.3	91.1	72.9	30.0	51.4	64.7
6 Row Types								
Stellar-ND	29	41.4	12.8	108.2	91.8	56.0	73.9	85.3
Innovation	29	41.4	12.4			56.7		
Quest	31	40.1	12.9			54.6		
Trial Mean	30	41.4	12.5	92.7	84.8	50.3	--	--
C.V. %	4.3	3.0	1.3	3.5	5.1	3.1	--	--
LSD 5%	NS	NS	0.2	4.9	6.7	2.4	--	--
LSD 1%	NS	NS	0.3	6.8	9.4	3.4	--	--

NS = no statistical difference between varieties.

Planting Date: May 5 — Harvest Date: August 23
Seeding Rate: 750,000 live seeds / acre (approx. 1.4 bu/A).
Previous Crop: 2008, 2009 & 2010 = HRSW.
Note: The 2011 trial sustained heat stress and a moderate infection of barley yellow dwarf causing lower test weights and grain yields.

2011 Barley Variety Trial at Regent

Cooperators: August and Perry Kirschmann

Variety	Plant Height	Test Weight	Grain Protein	----- Grain Yield ----- 2009	2010	2011	Average Yield 2 yr	3 yr
	inches	lbs/bu	%	------------- Bushels per acre -------------				
2 Row Types								
Rawson	29	45.0	12.4	97.4	76.9	43.6	60.2	72.6
Pinnacle	32	46.0	12.8	92.5	83.8	39.5	61.6	71.9
Conlon	27	43.6	13.3	101.3	76.4	33.5	55.0	70.4
6 Row Types								
Stellar-ND	28	42.6	13.8	88.0	72.2	39.2	55.7	66.5
Innovation	26	42.2	12.7			42.4		
Quest	28	42.4	13.3			42.2		
Trial Mean	28	43.6	13.0	92.8	77.8	40.1	--	--
C.V. %	4.9	1.7	2.2	3.8	3.9	6.6	--	--
LSD 5%	2	1.1	0.4	6.3	4.6	4.0	--	--
LSD 1%	3	1.6	0.6	9.0	6.3	5.5	--	--

Planting Date: May 5 Harvest Date: August 23
Seeding Rate: 750,000 live seeds / acre (approx. 1.4 bu/A).
Previous Crop: 2008, 2009 & 2010 = HRSW.
Note: The 2011 trial sustained heat stress and a moderate infection of barley yellow dwarf causing lower test weights and grain yields.

2011 Barley Variety Trial at Selfridge

Cooperator: Nick Vollmuth

Variety	Plant Height	Test Weight	Grain Protein	----- Grain Yield ----- 2009	2010	2011	Average Yield 2 yr	3 yr
	inches	lbs/bu	%	------------- Bushels per acre -------------				
2 Row Types								
Rawson	33	37.0	12.5	76.1	89.8	52.5	71.2	72.8
Conlon	28	42.1	13.7	76.9	76.6	58.8	67.7	70.8
Pinnacle	31	39.4	12.7	63.4	74.2	44.6	59.4	60.7
6 Row Types								
Stellar-ND	33	38.4	13.9	71.4	83.1	50.3	66.7	68.3
Quest	35	37.5	13.6			43.4		
Innovation	34	36.6	13.4			37.9		
Trial Mean	32	38.5	13.3	76.6	81.7	47.9	--	--
C.V. %	4.3	2.7	3.5	7.4	4.3	10.4	--	--
LSD 5%	3	1.9	0.8	8.6	5.3	9.0	--	--
LSD 1%	4	2.7	NS	11.8	7.3	12.9	--	--

NS = no statistical difference between varieties.

Planting Date: May 6 Harvest Date: August 22
Seeding Rate: 750,000 live seeds / acre (approx. 1.4 bu/A).
Previous Crop: 2008 = sunflower, 2009 & 2010 = HRSW.
Note: The 2011 trial sustained heat stress and a moderate infection of barley yellow dwarf causing lower test weights and grain yields.

2011 Barley Varieties in the West River Region - Combined Means

Variety	Days to Head*	Plant Height	Seeds / Pound	Test Weight	Grain Protein	% Plump	----- Grain Yield ----- 2009	2010	2011	Average Yield 2 yr	3 yr
		inches	#	lbs/bu	%	>6/64	------------- Bushels per acre -------------				
2 Row Types											
Rawson	66	30	12,302	40.9	12.5	94	79.7	69.2	54.6	61.9	67.8
Pinnacle	62	30	12,973	41.1	12.5	92	83.5	69.6	49.6	59.6	67.6
Conlon	60	28	12,786	43.0	13.3	95	80.0	67.3	49.1	58.2	65.5
6 Row Types											
Stellar-ND	62	29	13,130	39.5	13.4	95	82.4	69.6	52.5	61.0	68.2
Innovation	61	29	14,613	40.0	12.8	94			61.1		
Quest	62	31	15,069	39.4	13.3	90			57.3		
# of Locations	2	8	3	8	8	3	10	10	7	17	27

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

Locations: 2011 = Hettinger, Dickinson, Scranton, Regent, Selfridge, Hannover, Glen Ullin & Ralph, SD.
2010 = Hettinger, Scranton, Regent, New Leipzig, Selfridge, Mandan, Hannover, Glen Ullin, Ralph, SD & Bison, SD.
2009 = Hettinger, Dickinson, Scranton, Regent, New Leipzig, Mandan, Hannover, Glen Ullin, Ralph, SD & Bison, SD.

2011 Oat Variety Trial at Hettinger

Variety	Days to Head	Plant Height	Lodging	Test Weight	----- Grain Yield ----- 2009	2010	2011	Average Yield 2 yr	3 yr
	*	inches	0-9**	lbs/bu	------------- Bushels per acre -------------				
Furlong	70	37	1	32.1	98.5	154.7	122.7	138.7	125.3
AC Pinnacle	70	35	0	32.9	98.5	159.6	117.5	138.6	125.2
CDC Minstrel	67	34	0	32.8	101.9	154.9	112.1	133.5	123.0
Stallion	67	37	3	32.7	91.3	151.2	120.6	135.9	121.0
Newburg	66	40	4	32.3	87.1	152.7	122.9	137.8	120.9
Killdeer	66	30	2	31.7	97.0	151.0	113.7	132.4	120.6
Monida	70	35	0	28.1	97.1	153.3	102.9	128.1	117.8
Souris	67	31	0	33.3	82.1	155.9	113.5	134.7	117.2
Rockford	66	38	2	36.2	90.6	145.8	113.5	129.6	116.6
Leggett	68	34	1	31.7	94.9	154.4	95.4	124.9	114.9
Beach	66	35	1	34.8	80.5	149.0	113.9	131.4	114.5
Morton	67	42	0	33.7	61.4	135.7	112.1	123.9	103.1
Jerry	66	33	0	34.2	70.2	133.8	92.0	112.9	98.7
CDC Dancer	70	36	0	30.3	75.0	145.9	67.7	106.8	96.2
Otana	67	41	0	26.6	72.9	139.6	67.2	103.4	93.2
Hytest	64	38	1	34.6	66.9	121.9	70.2	96.0	86.3
HiFi	68	36	2	31.8	85.9	140.1	103.8	81.3	82.8
Shelby 427	62	36	3	35.5		142.2	127.5	134.8	
Naked (hulless) Varieties									
Buff	62	36	1	36.8	57.7	103.2	114.5	108.8	91.8
Stark	70	39	2	36.1	59.5	95.8	90.9	93.4	82.1
Streaker	63	39	4	42.3		114.2	81.1	97.6	
Paul	71	35	1	40.3			47.1		
Trial Mean	67	36	1	33.5	85.1	143.8	104.1	--	--
C.V. %	1.1	5.1	55	3.7	9.8	5.8	4.1	--	--
LSD 5%	1	2	1	1.7	11.8	11.7	6.0	--	--
LSD 1%	1	3	2	2.3	15.6	15.5	7.9	--	--

* Days to Head = the number of days from planting to head emergence from the boot.
** Lodging: 0 = none, 9 = lying flat on the ground.

Planting Date: May 3
Harvest Date: August 9
Seeding Rate: 750,000 live seeds / acre (approx. 1.7 bu/A).
Previous Crop: 2008 = hrsw, 2009 = mustard, 2010 = field pea.
Note: The 2009 trial sustained moderate hail damage. The 2011 trail was moderately infected with barley yellow dwarf causing lower test weights and grain yields.

2011 Winter Wheat Variety Trial - Continuously Cropped - No-till — Mandan

Cooperator: USDA-ARS, Northern Great Plains Research Lab., Mandan

This trial was partially funded by Ducks Unlimited, Bismarck

	------ No Foliar Fungicide ------				-------- Foliar Fungicide*--------							
Variety	Plant Ht	Test Weight	Grain Pro	Grain Yield	Plant Ht	Test Weight	Grain Pro	Grain Yield	Grain Yield 2009	Grain Yield 2010	Average Yield 2 yr	Average Yield 3 yr
	inch	lbs/bu	%	bu/A	inch	lbs/bu	%	------------ bushels per acre ------------				
Decade	34	50.6	12.9	25.0	33	51.4	12.9	30.0	92.3	49.6	39.8	57.3
Overland	33	50.5	12.3	22.8	35	52.9	12.5	34.0	84.4	51.4	42.7	56.6
Lyman	33	--	13.4	14.7	35	52.2	13.7	25.8	87.5	47.3	36.6	53.5
Millennium	39	49.9	12.4	17.6	36	52.9	12.3	33.0	77.7	51.1	42.0	53.9
Art	33	49.4	12.8	20.7	32	51.9	13.1	31.9	80.4	44.7	38.3	52.3
Peregrine	34	51.9	12.6	19.3	34	52.1	12.8	22.7	86.0	44.5	33.6	51.1
Boomer	36	--	13.0	9.6	33	50.1	13.6	22.1	81.8	48.3	35.2	50.7
Wesley	32	--	13.5	12.6	32	48.8	13.8	19.6	81.7	50.1	34.8	50.5
Hawken	31	48.7	12.7	17.1	26	50.4	13.8	20.1	83.2	45.9	33.0	49.7
Darrell	37	--	13.0	13.7	33	50.9	13.3	21.9	77.1	48.9	35.4	49.3
Radiant	39	--	12.1	13.6	36	51.5	12.6	20.6	85.7	38.4	29.5	48.2
Accipiter	36	--	12.6	13.5	36	51.6	12.5	19.2	80.8	44.4	31.8	48.1
Jerry	33	--	13.5	9.3	35	50.0	13.7	19.7	76.3	47.0	33.4	47.7
Falcon	34	--	13.2	13.7	36	51.1	12.3	23.9	78.7	40.7	32.2	47.8
Striker	28	--	13.3	11.1	32	51.5	13.2	22.4	74.0	41.4	31.9	45.9
Yellowstone	34	--	13.0	2.7	32	46.8	13.3	11.4	75.7	47.5	29.4	44.9
Carter	31	--	13.4	12.0	33	50.5	13.7	19.5		40.0	29.8	
SY Wolf	29	52.3	11.7	31.9	33	51.7	12.7	32.2				
SY503CL2	31	--	13.2	16.0	33	52.3	12.2	31.2				
Expedition	33	48.2	12.8	18.3	34	52.0	13.2	29.4				
WB Matlock	32	--	13.3	13.8	34	52.9	13.8	21.4				
Ideal	33	50.1	12.6	17.4	34	51.8	12.4	31.5				
Trial Mean	33	49.6	12.9	15.4	33	51.1	13.1	23.5	81.3	45.1	--	--
C.V. %	--	--	--	--	6.4	1.9	2.7	24.2	7.1	15.4	--	--
LSD .05	--	--	--	--	4	1.6	0.6	9.3	8.1	9.8	--	--
LSD .01	--	--	--	--	4	2.1	0.8	12.4	10.8	12.9	--	--

*Foliar fungicides: 5 oz/A Stratego applied on June 4 (jointing) and 8.2 oz/A Prosaro on July 1 (flowering).

Planting Date: September 28, 2010
Harvest Date: August 22, 2011
Seeding Rate: 1 million live seeds / acre (approx. 1.4 bu/A).
Previous Crop: hrsw.
Note: The 2011 trial sustained severe foliar and head disease infestations. The 2010 trial sustained significant nitrogen deficiency causing relatively poor yields.

2011 Winter Rye Variety Trial at Hettinger

Variety	Winter Survival	Plant Height	Test Weight	----- Grain Yield ------ 2010	2011	Avg.
	%	inches	lbs/bu	-- bushels per acre --		
Dakold	92	52	47.5	105.1	103.2	104.2
Hancock	92	52	51.4	92.9	93.1	93.0
Spooner	78	52	50.1	73.8	82.5	78.2
Aroostok	94	55	50.3	66.3	73.6	70.0
Wheeler	97	58	48.3	53.2	43.9	48.6
Rymin	1	46	43.7	59.3	30.1	44.7
Boreal	98	60	50.1		71.8	
Abrazzi Wrens	95	52	51.3		62.5	
Trial Mean	74	53	48.6	79.1	73.5	--
C.V. %	10	5.1	1.8	4.1	4.2	--
LSD 5%	11	4	1.3	4.7	4.5	--
LSD 1%	14	5	1.7	6.3	6.0	--

Planting Date: September 20, 2010
Harvest Date: August 1, 2011
Seeding Rate: 1 million live seeds / acre
Previous Crop: 2009 = hrsw, 2010 = field pea.

2011 Safflower Variety Trial at Hettinger

Variety	Days to Bloom	Plant Height	Oil Content	Test Weight	------ Seed Yield ------ 2009	2010	2011	Avg. Yield 2 year	3 year
	*	inches	%	lbs/bu	------------- pounds per acre --------------				
Linoleic Types									
Cardinal	90	36	41.4	34.6	1958	3015	1607	2311	2193
Finch	89	34	39.4	34.1	1566	2444	1785	2114	1932
NutraSaff	89	34	43.7	45.0	986	2458	938	1698	1461
Oleic Types									
Hybrid 1601	89	35	43.0	34.1	2073	3361	1791	2576	2408
Hybrid 9049	86	33	39.2	33.1	1663	3184	2100	2642	2316
MonDak	89	33	36.9	35.5	1947	2831	2078	2454	2285
Montola 2003	89	30	39.0	35.3	1813	2898	2057	2478	2256
Trial Mean	88	34	38.9	36.4	1568	2793	1777	--	--
C.V. %	0.8	4.0	4.4	4.0	10.0	5.3	8.0	--	--
LSD 5%	1	2	2.5	2.1	226	212	207	--	--
LSD 1%	1	3	3.4	2.8	304	285	280	--	--

* Days to Bloom = the number of days from planting to 10% bloom.

Planting Date: May 3
Harvest Date: September 9
Seeding Rate: 300,000 live seeds / Acre (approx. 22 lbs/A).
Previous Crop: 2008 = hrsw, 2009 = oat, 2010 = barley.

2011 Winter Triticale Variety Trial at Hettinger

Variety	Winter Survival	Heading Date	Plant Height	Test Weight	----- Grain Yield ----- 2009	2010	2011	Average Yield 2 yr	3 yr
	%	June	inches	lbs/bu	------------ Bushels per acre ------------				
NE426GT	64	18	46	43.8	84.2	116.0	88.9	102.4	96.4
Pika	85	14	52	46.7	41.2	107.2	79.1	93.2	75.8
Boreal	45	20	58	42.1	36.4	91.6	91.5	91.6	73.2
Trical 102	60	20	52	41.3			67.3		
Bobcat	78	20	49	41.4			68.8		
Trial Mean	66	19	51	43.1	63.4	104.9	79.1	--	--
C.V. %	26	7.3	1.7	3.3	5.8	4.5	9.1	--	--
LSD 5%	26	2	1	2.2	5.5	8.1	11.1	--	--
LSD 1%	NS	3	2	3.0	7.5	12.3	15.5	--	--

NS = no statistical difference between varieties.

Planting Date: September 20, 2010
Harvest Date: August 1, 2011
Seeding Rate: 1 million live seeds / acre
Previous Crop: 2008 & 2009 = hrsw, 2010 = field pea.
Note: The 2009 trial sustained moderate hail damage.

2011 Spring Triticale Variety Trial at Hettinger

Variety	Days to Head	Plant Height	Test Weight	----- Grain Yield ----- 2009	2010	2011	Average Yield 2 yr	3 yr
	*	inches	lbs/bu	------------- Bushels per acre -------------				
Trical 2700	69	46	46.2	53.2	102.8	24.2	63.5	60.1
Champion	64	48	49.4	37.5	107.0	25.7	66.4	56.7
Wapiti	64	48	48.7	40.1	104.0	22.5	63.2	55.5
Laser	64	47	47.4	33.2	98.3	22.8	60.6	51.4
Marvel	66	45	43.1	29.2	88.5	12.2	50.4	43.3
Trical 141	71	47	45.5			20.8		
Merlin	63	40	41.3			18.1		
AC Uhmia	65	39	48.4			17.2		
Trial Mean	66	45	46.3	40.9	100.9	20.4	--	--
C.V. %	0.9	4.4	1.7	18.1	2.8	10.0	--	--
LSD 5%	1	3	1.2	11.1	4.3	3	--	--
LSD 1%	1	4	1.6	15.4	6	4.1	--	--

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

Planting Date: May 3
Harvest Date: August 23
Seeding Rate: 1 million live seeds / acre
Previous Crop: 2008 = field pea, 2009 = hrsw, 2010 = field pea.
Note: The 2009 trial sustained moderate hail damage. The 2011 trial sustained a moderate infectection of bacterial leaf streak causing low test weights and grain yields.

2011 Flax Variety Trial at Hettinger

Variety	Days to Bloom	Plant Height	Test Weight	----- Seed Yield ----- 2008	2009	2011	Average Yield 2 yr	3 yr
	*	inches	lbs/bu	------------- Bushels per acre -------------				
York	63	21	56.3	13.4	40.8	28.8	34.8	27.7
CDC Arras	64	21	54.7	12.4	42.0	26.5	34.2	27.0
Prairie Grand	62	22	56.0	11.6	40.1	27.5	33.8	26.4
Prairie Thund	63	22	56.1	8.2	42.0	28.2	35.1	26.1
Carter**	63	20	--	11.3	40.6	24.1	32.4	25.3
Nekoma	62	21	56.6	11.2	39.1	25.1	32.1	25.1
Prairie Blue	63	22	55.7	9.5	39.4	26.4	32.9	25.1
Lightning	62	21	56.0	12.3	39.3	23.3	31.3	25.0
CDC Bethum	63	22	55.3	10.1	41.1	23.4	32.2	24.9
CDC Sorrel	64	23	55.6	10.4	39.8	24.3	32.0	24.8
Hanley	61	21	55.8	9.6	40.2	24.7	32.4	24.8
Pembina	62	21	55.6	11.6	37.9	23.4	30.6	24.3
Webster	63	23	56.0	11.1	34.5	27.1	30.8	24.2
Shape	63	24	54.9			24.2		
Trial Mean	63	22	55.7	10.5	39.2	25.6	--	--
C.V. %	1.0	8.0	1.1	11.8	6.9	10.2	--	--
LSD 5%	1	NS	0.9	1.8	3.8	3.7	--	--
LSD 1%	1	NS	1.1	2.4	5.1	NS	--	--

* Days after planting. ** Yellow seed type.
NS = no statistical difference between varieties.

Planting Date: May 3 Harvest Date: August 24
Seeding Rate: 40 lbs/A
Previous Crop: 2007 & 2008 = HRSW, 2010 = Barley.
Note: The 2008 trial sustained severe late season heat and moisture stress.

2011 Crambe Variety Trial at Hettinger

Variety	Days to Bloom	Duration of Bloom	Days to Mature	Plant Height	Lodging	Test Weight	----- Seed Yield ----- 2009	2010	2011	Average Yield 2 yr	3 yr
	*	days	*	inches	0 - 9**	lbs/bu	------------ Pounds per acre ------------				
Meyer	52	21	82	44	0	26.9	1550	2669	1612	2140	1944
BelAnn	56	22	89	43	2	26.6	1802	2582	1305	1944	1896
Westhope	53	21	84	42	0	25.9		2851	1729	2290	
Trial Mean	54	21	85	43	1	26.4	1722	2700	1549	--	--
C.V. %	0.9	2.3	0.0	1.6	149	1.7	14.6	4.6	6.2	--	--
LSD 5%	1	1	1	1	NS	0.8	NS	NS	167	--	--
LSD 1%	1	NS	1	2	NS	NS	NS	NS	253	--	--

* Days after planting. ** Lodging: 0 = none, 9 = lying flat on ground.
NS = no statistical difference between varieties.

Planting Date: May 3 Harvest Date: August 8
Seeding Rate: 25 lbs/A
Previous Crop: 2008 = field pea, 2009 = oat, 2010 = HRSW.
Note: The 2009 trial sustained moderate hail damage.

2011 Oil Type Sunflower Variety Trial at Hettinger

		Oil Type	Days to	Days to	Plant	Test	Oil	----- Seed Yield -----			Average Yield	
Brand	Hybrid	& Traits	Bloom	Mature	Height	Weight	Content	2009	2010	2011	2 yr	3 yr
		*	**	**	inches	lbs/bu	%	------------ Pounds per acre ------------				
Triumph	s678	NS,SS	74	121	50	25.7	37.6	1914	2528	1644	2086	2029
Seed	s668	NS,SS	76	110	46	24.8	35.9		2791	1726	2258	
	s673	NS,SS	78	110	45	24.1	37.2			1543		
	s870HCL	HO,CL,SS	76	111	46	24.0	37.4			1487		
Mycogen	8H449CLDM	HO,CL,DM	72	110	67	26.5	37.5	2798	2404	1631	2018	2278
Seeds	8D481	NS	73	110	67	25.2	33.7	1817	1784	2389	2086	1997
	8D310	NS	68	108	62	24.1	33.0	2290	1694	1550	1622	1845
	8N421CLDM	NS,CL,DM	72	109	59	24.2	35.8			1401		
Genosys	8037	HO,CL,DM	71	102	66	28.3	33.4		1993	1272	1628	
	9319	NS,DM	71	110	67	25.1	35.5			1794		
	9008	NS,DM	73	110	64	24.8	33.7			1560		
Syngenta	3480NS/CL/DM	NS,CL,DM	72	105	63	23.7	36.7	2111	2505	1912	2208	2176
Seed	3845HO	HO,EX	70	106	51	26.0	37.4	2320	2160	1719	1940	2066
	7120HO/DM	HO,DM	66	110	51	24.8	37.1	1635	1979	1578	1778	1731
	3733NS/DM	NS,DM	70	107	56	24.5	37.7			2264		
	3495NS/CL/DM	NS,CL,DM	73	106	66	26.4	36.4			1927		
	3995NS/SU	NS,EX	71	103	62	22.3	34.5			1778		
	4596HO/DM	HO,DM	69	112	67	27.7	36.2			1711		
	3733NS/DM coated	NS,DM	70	108	59	23.8	36.3			1707		
	NX82758	NS,CL,DM	70	110	58	21.7	34.7			1630		
	3158NS/CL/DM	NS,CL,DM	71	106	61	24.3	36.0			1569		
	NX01162	NS,CL,DM	70	104	65	21.6	31.9			1440		
	3990NS/CL/DM	NS,CL,DM	73	104	65	24.7	36.1			1353		
Proseed	E-22CL		68	112	67	26.0	34.2			1748		
	E-14		70	109	75	24.2	34.0			1543		
	E-21CL		71	110	71	22.9	34.2			1420		
	E-10		73	109	70	21.3	33.6			1385		
Pioneer	P63ME80	NS,EX	69	110	72	24.5	35.6			1843		
Hi-Bred	P63ME70	NS,EX	71	107	68	21.9	37.3			1670		
Int'l	P63HE60	HO,EX	72	106	70	24.4	34.8			1442		
Integra	724NSCL	NS,CL	70	106	59	24.0	34.6		1544	1220	1382	
Seed	756NSCL	NS,CL	71	106	66	26.6	35.0			1664		
	IX10-94	NS,EX	71	108	56	24.5	35.5			1660		
Elite	Pacific	HO	72	111	67	21.6	34.8			2058		
Seeds	Biba	Convent	70	105	62	24.0	37.0			1799		
	Pomar	Convent	72	108	72	22.9	36.0			1659		
	Balistic CL	HO,CL	71	112	73	24.6	35.6			1580		
	Ethic	HO	72	110	69	22.9	36.5			1205		
Croplan	460 ENS	NS,EX	70	109	58	23.3	36.3		2736	1911	2324	
Genetics	559 CLDMRNS	NS,CL,DM	71	110	69	25.2	36.9		2458	2175	2316	
	442 ENS	NS,EX	70	103	60	23.4	36.9			1691		
	548 CLDMRNS	NS,CL,DM	69	106	52	25.5	36.6			1437		
Seeds	Badger	Convent,CL	67	105	58	25.0	34.4			2134		
2000	Durango	NS,EX,DM	76	108	56	23.6	35.1			1770		
	Falcon	NS,EX,DM	72	105	53	23.7	35.6			1767		
	Torino	NS,CL	73	106	56	25.9	35.8			1537		
	Camaro DMR	NS,CL,DM	72	103	65	24.7	35.2			1352		
	x9822 DMR	HO,CL,DM	70	108	52	24.5	35.7			1345		

continued

Brand	Hybrid	Oil Type & Traits	Days to Bloom	Days to Mature	Plant Height	Test Weight	Oil Content	----- Seed Yield ----- 2009	2010	2011	Average Yield 2 yr	3 yr
		*	**	**	inches	lbs/bu	%	------------ Pounds per acre ------------				
Maturity Checks												
Early	Falcon		72	105								
Medium	Mycogen 8N270		66	104								
Late	Croplan 378 HO		69	110								
Trial Mean			71	108	62	24.4	35.6	2040	2169	1658	--	--
C.V. %			1.8	1.6	4.9	4.0	3.5	14.6	12.8	8.1	--	--
LSD 5%			2	2	4	1.3	1.7	405	389	188	--	--
LSD 1%			2	3	6	1.8	2.3	536	514	249	--	--

* Oil Type and Traits: NS = NuSun, HO = high oleic, Convent = conventional oil, CL = Clearfield,
EX = Express herbicide tolerant, DM = downy mildew resistant, SS = short stature.

** Days to Bloom / Mature: The number of days from planting to 10% bloom / physiologic maturity.

Planting Date: June 6 | Harvest Date: September 9
Seeding Rate: 19,000 seeds / acre | Row Spacing: 30"
Previous Crop: HRSW | Soil Type: loam

2011 Roundup Ready Canola Variety Trial at Hettinger

Brand	Variety	Type	Days to Bloom	Duration of Bloom	Days to Mature	Plant Height	Lodging	Test Weight	Oil Content	Seed Yield
		*	**	days	**	inches	0 - 9***	lbs/bu	%	lbs/A
Proseed	Sprinter	H,ws	52	27	96	54	0	58.2	41.3	1193
Croplan	HyCLASS 940	H	51	19	85	44	2	53.2	43.2	1842
	HyCLASS 988	H	53	20	94	47	1	51.8	44.5	2142
	HyCLASS 955	H	52	18	89	42	3	53.0	45.9	2140
Monsanto	DKL 30-42	H	50	20	85	39	2	52.8	43.4	2106
	DKL 72-40	H	52	17	89	39	3	53.1	45.7	1955
Cargill	08H1134	H	54	18	94	41	2	52.8	44.2	1898
	07H874	H	55	16	90	43	0	52.3	43.1	2322
	V2035	H	54	18	90	41	3	53.8	45.4	1825
Mycogen	1012RR	H	57	18	94	49	0	55.6	42.8	2130
	1014RR	H	57	18	93	46	0	54.2	43.2	1964
	G152936H	H	55	16	89	44	1	52.4	44.4	2084
	G152951H	H	57	18	94	50	0	54.8	43.1	1963
BrettYoung	6070RR	H	50	20	89	42	2	51.6	44.1	2417
	6040RR	H	56	16	86	45	1	52.5	43.4	1937
	BY11-860	H	62	21	88	45	2	51.3	43.0	1902
Integra	7121R	H	52	20	88	46	2	53.6	41.4	1719
	7150R	H	50	19	87	41	3	52.6	44.5	1951
	7152R	H	52	18	88	41	2	52.5	43.6	2002
TCI	Heara	O,E	52	21	85	38	0	49.2	39.6	813
	Rodin	H,E	52	25	92	48	0	53.2	40.8	1642
Trial Mean			53	19	89	44	1	53.0	43.5	1858
C.V. %			0.9	2.9	2.1	8.3	56	1.6	2.7	7.3
LSD 5%			1	1	3	5	1	1.2	1.7	189
LSD 1%			1	1	4	7	2	1.6	2.2	255

* Type: ws = winter x spring cross, H = hybrid, O = open pollinated, E = high euricic acid rapeseed.

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

Planting Date: May 3 | Harvest Date: August 9 | Previous Crop = HRSW

2011 Camelina Variety Trial at Hettinger

Variety	Days to Bloom	Days to Mature	Plant Height	Lodging	Test Weight	Oil Content	----- Seed Yield ----- 2008	2010	2011	Average Yield 2 yr	3 yr
	*	*	inches	0 - 9**	lbs/bu	%	------------ Pounds per acre ------------				
Ligena	56	86	31	1	45.6	35.8	1136	2835	1352	2094	1774
Galena	56	84	31	0	48.5	37.7	899	2584	1576	2080	1686
Calen	57	86	32	0	45.4	35.2	903	2786	1136	1961	1608
Robinson	56	83	31	1	47.6	35.0	832	2481	1439	1960	1584
Blaine Creek	56	84	32	0	50.3	36.9	733	2370	1317	1844	1473
Suneson	56	83	31	2	50.8	37.3	828	2215	1083	1649	1375
Trial Mean	56	85	32	1	48.2	36.7	886	2545	1412	--	--
C.V. %	1.0	1.1	3.8	151	3.2	3.8	13.0	7.3	7.8	--	--
LSD 5%	1	1	NS	NS	2.2	NS	168	279	159	--	--
LSD 1%	NS	2	NS	NS	3.0	NS	226	386	215	--	--

NS = no statistical difference between varieties.
* Days after planting.
** Lodging: 0 = none, 9 = lying flat on ground.

Planting Date: May 3
Harvest Date: August 8
Seeding Rate: 6 lbs/A
Previous Crop: 2007 = HRSW, 2009 = durum, 2010 = HRSW.
Note: The 2008 trial sustained late season heat and moisture stress.

2011 Tame Mustard Variety Trial at Hettinger

Variety	Days to Bloom	Duration of Bloom	Days to Mature	Plant Height	Lodging	Test Weight	----- Seed Yield ----- 2008	2010	2011	Average Yield 2 yr	3 yr
	*	days	*	inches	0 - 9**	lbs/bu	------------ Pounds per acre ------------				
Yellow Types											
Andante	46	24	84	39	1	51.7	681	2274	1736	2005	1564
AC Pennant	45	24	83	39	1	51.8	510	2117	1595	1856	1407
Ace	46	24	85	40	1	51.1	452	2255	1472	1864	1393
Tilney	46	24	84	38	1	52.3	619	2182	1291	1736	1364
Oriental Type											
Forge	51	27	87	53	1	51.3	1137	2535	1399	1967	1690
Brown Type											
Common	50	28	87	42	0	51.6	1208	2443	1477	1960	1709
Trial Mean	47	25	85	42	1	51.6	825	2332	1495	--	--
C.V. %	0.8	2.9	0.8	6.4	71	1.8	21.8	6.2	5.8	--	--
LSD 5%	1	1	1	4	NS	NS	267	213	130	--	--
LSD 1%	2	2	1	6	NS	NS	365	292	180	--	--

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

Planting Date: May 3 Harvest Date: August 8
Seeding Rate: 610,000 pls/A (approx. Yellow = 12 lbs/A, Brown and Oriental = 6 lbs/A).
Previous Crop: 2007 = HRSW, 2009 = durum, 2010 = HRSW.
Note: The 2008 trial sustained severe heat and moisture stress.

2011 Field Pea Variety Trial at Hettinger

Variety	Brand	Days to Bloom	Duration of Bloom	Days to Mature	Plant Height	Lodging	1000 Seed wt	Protein Content	Test Weight	Seed Yield 2009	Seed Yield 2010	Seed Yield 2011	Avg. Yield 2 year	Avg. Yield 3 year
		*	days	*	inches	0 - 9**	grams	%	lbs/bu	bushesl per acre				
Yellow Types														
CDC Golden	Alt. Seed Str.	63	14	88	19	8	199	25.3	64.6	40.8	64.4	60.9	62.6	55.4
Agassiz	Meridian Seed	63	15	89	22	6	228	25.7	65.8	43.4	53.7	58.6	56.2	51.9
Midas	Pulse USA	64	12	87	21	8	168	25.2	65.0	39.6	53.5	58.5	56.0	50.5
Korando	Pulse USA	61	14	86	18	8	243	25.4	63.2	31.2	51.5	64.4	58.0	49.0
DS Admiral	Pulse USA	63	14	86	21	6	211	25.3	63.9	33.8	50.3	59.8	55.0	48.0
Gunner	Paulson Pr. Seed	62	15	88	21	7	197	25.1	64.4			60.1		
Vegas	JB Farms	62	14	87	24	7	196	25.4	66.4			59.5		
Green Types														
SW Arcadia	Pulse USA	62	12	86	19	9	176	25.6	64.3	42.1	52.2	51.3	51.8	48.5
K2	Pulse USA	62	14	88	22	7	180	25.1	64.2	37.9	47.4	55.4	51.4	46.9
Majoret	Pulse USA	64	12	89	20	8	193	25.9	64.8	34.9	49.3	46.3	47.8	43.5
Cruiser	Pulse USA	62	15	89	19	8	193	25.3	63.6	36.1	48.0	44.0	46.0	42.7
CDC Striker	Alt. Seed Str.	64	12	89	20	8	199	26.2	64.7	25.3	46.0	47.0	46.5	39.4
Shamrock	Legume Matrix	66	11	92	23	5	212	25.2	64.1			51.0		
Trial Mean		62	14	88	22	6	201	25.7	64.7	34.9	52.1	55.5	--	--
C.V. %		1.0	5.6	1.0	16.3	14.4	6.6	1.5	2.5	7.7	6.1	4.9	--	--
LSD 5%		1	1	1	5	1	19	0.5	NS	3.8	4.5	3.9	--	--
LSD 1%		1	1	2	NS	2	25	0.7	NS	5.0	6.1	5.1	--	--

* Days to Bloom & Mature = the number of days from planting to 10% bloom and physiological maturity.
** Lodging: 0 = none, 9 = lying flat on ground.

Planting Date: April 29
Seeding Rate: 330,000 live seeds / Acre.

Harvest Date: August 8
Previous Crop: 2008 = durum, 2009 & 2010 = HRSW.

2011 Lentil Variety Trial at Hettinger

Variety	Days to Bloom	Days to Mature	Plant Height	Lodging	1000 Seed wt.	Test Weight	------ Seed Yield ------ 2009	2010	2011	Avg. Yield 2 year	3 year
	*	*	inches	0 - 9**	grams	lbs/bu	-------------- pounds per acre ---------------				
Large Green Types											
Pennell	60	84	11	3.2	64.6	60.8	1530	1128	1551	1340	1403
CDC Greenland	62	87	11	5.5	57.8	62.6	1724	872	1254	1063	1283
Riveland	60	87	10	6.2	66.4	61.3	1186	743	1010	876	980
Medium Green Type											
CDC Richlea	62	86	11	6.5	51.6	64.1	1434	1154	1463	1308	1350
Small Green Types											
CDC Viceroy	62	85	11	3.2	31.0	66.9	1822	1446	1710	1578	1659
Essex	62	87	10	7.2	39.0	65.5			1252		
Small French Green Type											
CDC Lemay	60	84	9	5.8	30.6	67.4	1424	1570	1140	1355	1378
Medium Red Type											
CDC Red Rider	61	85	11	4.2	43.8	65.9	1782	1663	1984	1824	1810
Small Red Types											
CDC Rouleau	61	86	10	1.0	41.4	66.7	1822	1749	1656	1702	1742
CDC Redberry	60	86	12	0.0	43.6	66.5	1592	1390	1870	1630	1617
Extra Small Red Type											
CDC Rosetown	62	84	10	5.2	27.2	68.0	1749	1498	1711	1604	1653
Spanish Brown Type											
Morena	62	87	11	2.2	32.6	68.9			1260		
Trial Mean	61	85	10	5.1	40.8	65.6	1512	1321	1484	--	--
C.V. %	1.4	1.1	9.5	32	6	1.3	11.9	11.8	6.9	--	--
LSD 5%	1	1	1	2.3	3.4	1.2	257	226	144	--	--
LSD 1%	2	2	2	3.1	4.5	1.6	344	305	192	--	--

* Days to Bloom & Mature = the number of days from planting to 10% bloom and physiological maturity.
** Lodging: 0 = none, 9 = lying flat on ground.

Planting Date: May 3
Harvest Date: August 11
Seeding Rate: 550,000 live seeds / Acre.
Previous Crop: 2008 = durum, 2009 & 2010 = HRSW.

2011 Clearfield Lentil Variety Trial at Hettinger

Variety	Days to Bloom	Days to Mature	Plant Height	Lodging	Test Weight	------ Seed Yield ------ 2009	2010	2011	Avg. Yield 2 year	3 year
	*	*	inches	0 - 9**	lbs/bu	-------------- pounds per acre ---------------				
Large Green Type										
CDC Improve-CL	58	92	14	1.2	59.9	1918	1432	1722	1577	1691
Medium Green Type										
CDC Impress-CL	58	87	11	6.5	58.8	2249	1543	1760	1652	1851
Small Red Types										
CDC Maxim-CL	58	89	12	0.0	64.3	2234	2255	1874	2064	2121
CDC Impact-CL	59	88	12	1.8	66.5	1645	1593	1841	1717	1693
Extra Small Red Types										
CDC Imperial-CL	58	85	12	3.2	63.2	2035	2290	1620	1955	1982
CDC Impala-CL	60	88	13	4.0	65.9	1939	2215	1712	1964	1955
Trial Mean	59	88	12	2.8	63.1	2003	1888	1755	--	--
C.V. %	0.6	0.8	3.4	25	1.3	9.9	6.6	4.6	--	--
LSD 5%	1	1	1	1.0	1.5	299	189	122	--	--
LSD 1%	1	1	1	1.4	2.1	414	261	169	--	--

* Days to Bloom & Mature = the number of days from planting to 10% bloom and physiological maturity.
** Lodging: 0 = none, 9 = lying flat on ground.

Planting Date: May 4
Harvest Date: August 11
Seeding Rate: 550,000 live seeds / Acre.
Previous Crop: 2008 = durum, 2009 & 2010 = HRSW.

2011 Chickpea Variety Trial at Hettinger

Variety	Fungicide	Days to Bloom	Ascochyta	Test Weight	Seeds per lb	Seed Size 10 mm	Seed Size 9 mm	Seed Size 8 mm	Seed Yield 2008	Seed Yield 2009	Seed Yield 2011	Avg. Yield 2 yr	Avg. Yield 3 yr
	*	**	0-9***	lbs/bu		%			Pounds per Acre				
Large Kaboli Types													
Sawyer	treated	67	0.3	53.3	1161	6	12	19	1774	798	1090	944	1221
	untreated	66	2.0	--	1706	0	0	2			203		
Sierra	treated	68	0.3	38.1	1636	5	12	13	1933	287	457	372	892
	untreated	68	4.0	--	--	0	0	0			0		
Dylan	treated	64	1.3	38.3	3122	0	2	7	1933	199	145	172	759
	untreated	63	5.0	--	--	0	0	0			0		
Troy	treated	68	0.3	38.2	2533	1	2	7	1468	172	192	182	611
	untreated	68	5.3	--	--	0	0	0			0		
Small Kaboli Types													
B-90	treated	67	0.0	55.0	1648	0	0	1	2314	2024	1029	1526	1789
	untreated	66	1.0	55.7	2191	0	0	0			970		
CDC Frontier	treated	66	0.0	58.0	1512	0	4	19	2112	1750	1106	1428	1656
	untreated	65	1.0	55.3	1671	0	1	14			1219		
CDC Luna	treated	63	0.3	55.0	1353	0	8	23		1281	1114	1198	
	untreated	63	1.0	40.5	2558	0	0	7			331		
Desi Types													
CDC Anna	treated	67	0.3	53.0	2333	0	0	1	2311	1895	1692	1794	1966
	untreated	65	1.3	53.0	3153	0	0	0			617		
Trial Mean		66	3.0	54.6	1912	2	5	11	1920	943	777	--	--
C.V. %		2.2	15.8	3.1	28.8	114	73	36	8.8	22	35	--	--
LSD 5%		1	0.3	1.1	284	1	1	2	245	300	130	--	--

* Fungicide treatments: 5 oz/A Proline on June 17, June 29 and July 28.
** Days to Bloom = the number of days from planting to 10% bloom.
*** Ascochyta blight rating: 0 = none, 9 = completely dead plants.

Planting Date: May 3
Harvest Date: September 6
Seeding Rate: 175,000 live seeds / Acre.
Previous Crop: HRSW

2011 Dry Bean Variety Trial at Hettinger

Variety	Days to Bloom	Plant Height	1000 Seed wt.	Test Weight	Seed Yield 2009	Seed Yield 2010	Seed Yield 2011	Avg. Yield 2 year	Avg. Yield 3 year
	*	inches	grams	lbs/bu	pounds per acre				
Pinto									
Lapaz	60	23	251	53.9	1889	1995	1916	1956	1933
Lariat	55	18	240	54.8	1540	2122	2068	2095	1910
Maverick	53	21	229	52.2	1808	1987	1791	1889	1862
Stampede	55	22	251	53.7	1745	1559	1914	1736	1739
Sonora	54	23	199	53.9		2076	1999	2038	
Medicine Hat	53	26	208	53.7		2066	1532	1799	
Windbreaker	54	27	275	52.2		1942	1645	1794	
Santa Fe	55	24	208	53.7		1295	2150	1722	
Galeena	55	25	224	56.8			1958		
Navy									
Avalanche	55	25	174	55.8	1474	1556	1549	1552	1526
Vista	60	20	190	57.0	1401	1611	1370	1490	1461
Ensign	55	25	164	55.1	1207	1380	1401	1390	1329
HMS Medalist	55	23	150	59.0		1447	1253	1350	
Skyline	57	22	166	56.8			1326		
Black									
Zorro	60	24	180	56.0	1413	2043	1573	1808	1676
Jaguar	60	23	154	50.7	1341	1768	1833	1800	1647
Eclipse	60	22	144	57.5	1343	1784	1707	1746	1611
Loreto	60	25	180	48.4		1227	1502	1364	
Small Red									
Merlot	56	21	217	48.5	675	1589	1496	1542	1253
Pink									
Sedona	60	22	268	--	803	838	612	725	751
Trial Mean	57	23	207	54.2	1378	1640	1656	--	--
C.V. %	1.6	23	9.7	3.3	10.6	6.1	7.5	--	--
LSD 5%	1	NS	28	2.5	208	165	177	--	--
LSD 1%	2	NS	38	3.3	276	222	235	--	--

* Days to Bloom = the number of days from planting to 10% bloom.
NS = no statistical difference between varieties.

Planting Date: May 26
Harvest Date: September 12
Seeding Rate: 100,000 live seeds / Acre (approx. 60 lbs/A).
Previous Crop: 2008 = hrsw, 2009 = barley, 2010 = oat.

2011 Soybean Variety Trial at Hettinger

Brand	Variety	Maturity Group	Plant Height	Test Weight	------ Seed Yield ------ 2009	2010	2011	Avg. Yield 2 year	3 year
			inches	lbs/bu	-------------- bushels per acre ---------------				
Roundup Ready									
Proseed	P2 11-50	0.5	28	53.9			43.5		
	P2 11-10	0.4	26	51.8			38.9		
Syngenta Seed	S08-A2	0.8	27	53.9			38.0		
	S06-W2	0.6	29	53.5			36.7		
	S10-G7	1.0	26	54.3			34.0		
Seeds 2000	2051 RR2Y	0.5	24	53.5			41.1		
	2082 RR2Y	0.8	27	54.7			32.3		
Integra Seed	79020 R	0.2	23	52.2			37.8		
	20100 R2Y	0.1	26	54.4			37.5		
Conventional									
NDSU	Sheyenne	0.8	25	54.5	28.1	33.1	35.8	34.4	32.3
	Ashtabula	0.4	26	54.1	23.2	28.2	43.9	36.0	31.8
	Cavalier	00.7	24	55.7	21.9	26.6	37.8	32.2	28.8
	ProSoy	0.8	27	53.4	19.1	25.9	38.0	32.0	27.7
	Traill	00.0	26	55.0	21.5	26.6	34.3	30.4	27.5
Trial Mean			26	53.9	22.8	26.8	37.7	--	--
C.V. %			4.7	0.9	9.6	9.2	3.4	--	--
LSD 5%			2	0.7	3.4	3.7	1.8	--	--
LSD 1%			2	1.0	4.7	5.0	2.4	--	--

Planting Date: May 17 Harvest Date: September 26
Seeding Rate: 150,000 live seeds / Acre. Row Spacing: 30"
Previous Crop: 2008 = hrsw, 2009 = barley, 2010 = oat.

2011 Tame Buckwheat Variety Trial at Hettinger

Variety	Days to Bloom	Test Weight	----- Seed Yield ----- 2008	2010	2011	Average Yield 2 yr	3 yr
	*	lbs/bu	------------- Pounds per acre -------------				
Manor	40	35.2	762	1917	1317	1617	1332
Koma	42	36.2	765	1688	1453	1570	1302
Koto	41	36.6		1385	1178	1282	
Trial Mean	41	36.0	726	1663	1316	--	--
C.V. %	1.6	4.6	15.3	6.6	5.4	--	--
LSD 5%	NS	NS	NS	191	124	--	--
LSD 1%	NS	NS	NS	289	187	--	--

* Days after planting.
NS = no statistical difference between varieties.

Planting Date: May 26 Harvest Date: September 12
Seeding Rate: 700,000 live seeds/A
Previous Crop: 2007 = HRSW, 2009 = oat, 2010 = barley.
Note: The 2008 trial sustained late season heat and moisture stress.

2011 Winter Wheat Varietal Response to Foliar Applied Fungicides Mandan

Cooperator: USDA-ARS, Northern Great Plains Research Lab., Mandan
This trial was partially funded by Ducks Unlimited, Bismarck
Observations by Brandi Herauf, IPM Scout, Dickinson Res. Ext. Center

	Untreated						Treated*					
	Tan Spot		Septoria		Bac Blight		Tan Spot		Septoria		Bac Blight	
Variety	Inc	Sev	Inc	Sev	Inc	Sev	Inc	Sev	Inc	Sev	Inc	Sev
	% Flag Leaf											
Jerry	40	1	100	95	0	0	90	2	20	50	50	1
Decade	10	1	100	100	0	0	80	1	30	10	90	20
Falcon	20	20	100	95	0	0	30	1	20	20	90	40
Accipiter	60	2	60	80	40	10	70	1	10	50	70	10
Peregrine	80	10	80	80	40	10	90	2	0	0	70	20
Expedition	0	0	100	100	0	0	20	1	40	80	50	10
Darrell	10	1	100	95	10	5	50	1	20	50	90	20
Lyman	0	0	100	100	0	0	70	1	40	40	50	5
SD05118-1	40	10	70	85	10	50	90	2	20	80	90	60
Millennium	0	0	100	100	0	0	80	1	40	90	60	60
Wesley	30	1	100	95	10	60	60	1	10	100	70	40
Overland	0	0	100	100	0	0	60	1	20	40	70	20
Yellowstone	20	1	100	95	0	0	80	2	60	50	40	20
Carter	10	1	70	100	10	80	60	1	60	60	40	5
Boomer	10	1	100	100	0	0	60	1	20	20	50	10
Striker	0	0	100	100	0	0	40	1	30	10	50	10
WB Matlock	0	0	100	100	0	0	80	1	70	30	20	40
Hawken	10	1	90	100	10	2	30	1	70	90	60	10
Art	0	0	100	100	0	0	50	1	40	80	60	10
SY Wolf	60	2	40	20	40	50	100	1	40	10	50	60
Radiant	50	20	60	50	30	20	100	2	0	0	90	30
AP503CL2	0	0	100	100	0	0	40	1	10	100	80	10
PST-44	70	20	70	60	40	20	50	1	0	0	90	70
PST-45	60	5	70	60	30	3	50	1	40	60	50	50
PST-46	30	1	20	5	100	50	60	1	10	5	80	50

*Foliar fungicides: 5 oz/A Stratego applied on June 4 (jointing) and
8.2 oz/A Prosaro applied on July 1 (flowering).

Inc = percentage of flag leaves showing infection.
Sev = percentage of flag leaf surface infected with disease.

Date of Observation: July 21, 2011 Previous Crop: hrsw.

2011 Evaluation of Diseases on Hard Red Spring Wheat Varieties at Hettinger

Evaluations by Brandi Herauf, IPM Crops Scout, Dickinson Res. Ext. Center

	Tan Spot		Septoria		Fusarium (scab)		Leaf Rust		Untreated		---- Treated** ----	
Variety	Inc*	Sev*	Inc	Sev	Inc	Sev	Inc	Sev	Test wt.	Yield	Test wt.	Yield
	%	%	%	%	%	%	%	%	lbs/bu	bu/A	lbs/bu	bu/A
RB07	60	1	100	2	0	0	0	0	53.5	30.0	55.2	35.8
Sabin	40	1	100	5	0	0	0	0	59.2	29.9	57.9	47.5
Faller	80	5	100	10	0	0	0	0	56.7	31.9	55.9	38.0
Prosper	50	2	60	10	0	0	0	0	57.5	23.2	55.7	40.0
Velva	40	1	100	5	0	0	40	2	55.1	42.4	55.8	49.0
Barlow	100	2	70	5	0	0	30	1	57.6	41.8	56.7	45.5
Steele-ND	70	3	100	3	0	0	30	1	56.1	35.9	55.5	38.6
Glenn	60	5	100	50	0	0	20	1	60.6	32.3	59.2	39.5
Select	40	5	90	60	0	0	0	0	57.1	43.3	55.5	44.7
SY Tyra	100	5	100	10	0	0	0	0	53.9	32.7	52.7	39.0
Mott	50	1	60	5	10	50	100	3	58.7	34.6	58.0	39.3
WB Gunnison	0	0	100	90	0	0	0	0	55.9	26.7	53.2	30.3
Brick	10	1	100	80	0	0	0	0	58.9	40.3	59.0	46.7
Briggs	20	1	100	5	0	0	0	0	56.6	39.7	55.3	43.3
Rollag	60	3	100	20	0	0	0	0	57.3	31.6	56.5	35.2
Howard	90	3	100	60	0	0	20	1	55.8	43.1	55.4	46.1
Alsen	70	3	100	90	10	2	0	0	56.2	27.3	55.4	32.1
Jenna	70	2	100	10	0	0	0	0	57.7	41.1	56.5	48.9
Brennan	80	2	100	5	0	0	10	1	57.3	44.5	57.1	49.9
Choteau	30	2	100	30	0	0	0	0	52.9	26.0	51.4	27.9
Kelby	40	1	100	10	0	0	0	0	58.1	46.4	57.3	49.9
Kuntz	80	2	100	10	40	50	20	1	54.2	37.5	54.3	39.4
Fryer	60	1	100	2	0	0	40	2	55.3	31.9	54.8	35.8
Vantage	70	1	100	5	20	60	60	1	60.3	36.3	60.3	37.8
ND901CL	70	4	100	5	0	0	60	1	56.9	34.5	56.3	38.9
AP605CL	70	5	100	4	0	0	0	0	56.3	47.3	55.5	51.7
Reeder	100	5	100	80	0	0	100	5	55.1	43.7	55.9	49.4
Tom	100	3	100	5	0	0	0	0	56.7	40.8	56.9	44.7
Breaker	90	5	100	10	0	0	20	1	59.1	45.2	57.8	44.2
Blade	90	3	100	5	0	0	0	0	58.2	41.8	57.3	40.5
Samson	80	3	100	5	0	0	40	1	55.3	47.6	56.3	53.2
Brogan	80	3	100	10	0	0	0	0	55.9	41.5	55.8	44.6
WB Digger	30	5	90	20	0	0	20	4	52.7	37.2	52.0	38.6
WB Mayville	0	0	100	98	0	0	0	0	51.6	36.6	51.6	41.6
Edge	60	2	100	5	0	0	60	5	56.4	44.7	55.8	48.5
SY Soren	60	1	100	5	0	0	0	0	55.5	43.9	55.4	48.8
O'Neal	10	1	100	95	0	0	80	3	53.2	35.6	53.1	36.0
						Trial Mean			56.3	38.8	55.8	42.1

*Incidence = percentage of plants with disease.

*Severity = percentage of flag leaf surface or seed head with disease.

**Fungicide Treatments: 8 oz/A Pyraclostrobin (Headline) on June 7 (3 leaf) & 4 oz/A Tebuconazole (Onset) on July 6 (heading).

Date of Observation: July 28

Planting Date: May 2

Previous Crop: HRSW

2011 Evaluation of Diseases on Durum Wheat Varieties at Hettinger

Evaluations by Brandi Herauf, IPM Crops Scout, Dickinson Res. Ext. Center

	Tan Spot		Septoria		Untreated		---- Treated** ----	
Variety	Inc*	Sev*	Inc	Sev	Test wt.	Yield	Test wt.	Yield
	%	%	%	%	lbs/bu	bu/A	lbs/bu	bu/A
Maier	100	3	80	40	55.9	31.3	54.1	35.4
Mountrail	80	2	100	30	56.1	32.4	53.8	35.2
Divide	100	2	100	20	55.8	28.1	55.1	31.4
Alkabo	90	5	100	30	57.1	32.4	55.0	35.6
Grenora	40	1	100	5	53.8	29.2	53.2	36.4
Tioga	50	1	90	10	55.4	25.8	54.0	28.9
Lebsock	20	1	100	40	57.5	33.2	55.4	33.9
Pierce	30	1	100	70	57.4	34.2	56.5	36.4
DG Max	70	1	100	50	57.4	33.4	56.6	40.9
Westhope	40	2	100	40	57.2	38.6	55.2	44.6
Alzada	0	0	100	80	53.2	26.6	51.4	29.7
Strongfield	40	2	90	70	54.0	27.5	52.8	28.2
AC Commander	20	1	100	40	54.0	29.1	54.0	35.0
AC Navigator	30	1	100	40	55.7	26.5	53.8	26.4
WB-Belfield	0	0	100	95	53.3	30.0	52.5	33.6
Wales	0	0	100	40	55.2	30.4	56.0	41.9
CDC Verona	10	10	100	40	53.4	34.5	52.7	35.5
Grande D'oro	50	3	100	20	55.3	33.9	56.3	37.0
DG Star	30	1	90	20	54.1	31.7	53.5	33.2
Rugby	20	1	100	60	54.5	36.2	55.4	41.4
Ben	40	1	100	30	54.8	34.3	56.2	38.1
Dilse	60	1	60	30	53.0	30.1	53.5	36.2
Trial Mean					55.8	34.8	55.3	38.7

*Incidence = percentage of plants with disease.
*Severity = percentage of flag leaf surface with disease.
**Fungicide Treatments: 8 oz/A Pyraclostrobin (Headline) on June 7 (3 leaf) & 4 oz/A Tebuconazole (Onset) on July 6 (heading).

Date of Observation: July 28
Planting Date: May 2
Previous Crop: HRSW

2011 Evaluation of Barley Yellow Dwarf on Barley and Oat Varieties at Hettinger

Evaluations by Brandi Herauf, IPM Crops Scout, Dickinson Res. Ext. Center

Barley	
Variety	Incidence
2 Row Types	
Conlon	0
Rawson	70
Pinnacle	80
AC Metcalfe	90
CDC Copeland	100
Haxby	100
Lilly	70
Conrad	50
6 Row Types	
Stellar-ND	60
Quest	80
Innovation	90
Lacey	80
Tradition	60
Celebration	100
Rasmusson	60

Oat	
Variety	Incidence
Paul	50
HiFi	20
Shelby 427	60
Stallion	10
Killdeer	60
CDC Dancer	50
CDC Minstrel	40
Rockford	20
AC Pinnacle	20
Streaker	30
Hytest	10
Otana	0
Newburg	0
Buff	0
Monida	0
Souris	10
Jerry	30
Morton	20
Leggett	30
Furlong	0
Stark	0
Beach	0

Incidence = percentage of plants with disease.
Date of Observation: July 28

2011 PrePare/Sierra Control of Bromes in Spring Wheat

Eric Eriksmoen, Hettinger, ND

Pre-plant (PP) treatments were applied on May 8 to 3 leaf downy brome (dobr) with 52° F, 69% RH, cloudy sky and east wind at 3 mph. 'Mott' HRSW was seeded no-till on May 16. Post-emergence (POST) treatments were applied on June 8 to 3 leaf wheat, heading downy brome, tillering Japanese brome (jabr), 2 leaf wild oat (wiot) and 1 leaf Persian darnel (peda) with 56° F, 58% RH, cloudy sky and southeast wind at 5 mph. Treatments were applied with a tractor mounted CO_2 propelled plot sprayer delivering 10 gpa at 30 psi through PK-01E80 nozzles to a 5 foot wide area the length of 10 by 28 foot plots. The soil is classified as a silt-loam with a pH of 6.2 and OM of 3.2%. The trial was a randomized complete block design with three replications. Weed populations for downy brome, Japanese brome, wild oat and Persian darnel were 2, 4, 0.5 and 0.75 plants per square foot, respectively. Plots were evaluated for crop injury on June 8, June 14, June 20, June 30 and July 18, and for weed control on June 30, July 18 and August 16. The trial was harvested on August 20.

			App.	- June 30 -		--------- July 18 ----------				---- August 16 -----			Test	Grain
	Treatment	Product rate	Timing	jabr	peda	inj	wiot	jabr	peda	jabr	dobr	peda	weight	yield
		oz/A		------------				% control				------------	lbs/bu	bu/A
1	Untreated			0	0	0	0	0	0	0	0	0	53.8	12.7
2	PrePare+AMS+NIS	0.3+1.5lb+0.25%	PP	73	0	0	0	90	0	98	17	0	58.0	25.9
3	PrePare+AMS+T'down Total	0.3+1.5lb+24	PP	93	0	0	0	98	0	98	93	0	58.2	25.5
4	PrePare+AMS+NIS fb Sierra + Basic Blend	0.3+1.5lb+0.25% 0.35 + 1%	PP POST	91	0	0	99	96	10	99	81	0	57.5	25.2
5	PrePare+AMS+T'down Total fb Sierra + Basic Blend	0.3+1.5lb+24 0.35 + 1%	PP POST	98	0	0	99	99	10	98	92	0	58.1	26.9
6	PrePare+AMS+NIS fb Sierra + Basic Blend	0.3+1.5lb+0.25% 0.5 + 1%	PP POST	80	10	0	99	90	10	99	53	0	57.9	28.1
7	PrePare+AMS+T'down Total fb Sierra + Basic Blend	0.3+1.5lb+24 0.5 + 1%	PP POST	99	10	0	99	99	17	99	98	0	58.1	29.6
8	Rimfire Max + Basic Blend	3 + 1%	POST	96	0	0	99	93	7	99	70	0	57.9	25.7
	C.V. %			13	321	0	0	7	192	2	29	0	1.5	13.8
	LSD .05			18	NS	NS	1	10	NS	2	32	NS	1.5	6.1

NS = no statistical difference between treatments

Summary

Crop injury was not observed. All herbicide treatments provided excellent season long control of Japanese brome. Pre-plant treatments alone (trts 2 & 3) did not provide any residual control of wild oats, but the addition of Sierra applied post-emergence provided excellent control of wild oats. The addition of Touchdown Total to pre-plant treatments significantly enhanced downy brome control. None of the treatments controlled Persian darnel.

2011 Valent Winter Wheat Herbicide Trial

Eric Eriksmoen, Hettinger, ND

Pre-plant (PP) treatments were applied on September 21, 2010 with 59^o F, 64% RH, partly cloudy sky and east wind at 6 mph. 'AP503CL2' HRWW was seeded no-till on September 28. Fall post-emergence (FPOST) treatments were applied on October 13, 2010 with 55^o F, 30% RH, cloudy sky and southwest wind at 2 mph. Treatments were applied with a tractor mounted CO_2 propelled plot sprayer delivering 10 gpa at 30 psi through PK-01E80 nozzles to a 5 foot wide area the length of 10 by 28 foot plots. The soil is classified as a silt-loam with a pH of 6.2, OM of 3.2% and 85% hrsw residual ground cover. The trial was a randomized complete block design with four replications. The trial had a pre-plant burndown application of 24 oz/A Roundup WeatherMax on September 12, 2010 and an application of 12 oz/A Huskie herbicide + 8 oz/A Headline fungicide on June 4, 2011 to control broadleaf weeds and foliar diseases. Plots were evaluated for crop injury on October 22, 2010 and on May 19, 2011, and the trial was harvested on August 5, 2011.

	Treatment	Product rate	App. Timing	10/22 inj	5/19 inj	Test weight	Grain yield
		oz/A		%*	%**	lbs/bu	bu/A
1	Untreated			0	0	--	11.2
2	Valor SX	2.0	PP	0	12	--	7.9
3	Fierce	3.0	PP	0	35	52.2	26.7
4	PrePare + NIS	0.3 + 0.25%	PP	0	5	52.6	22.7
5	Valor SX	2.0	FPOST	2	0	57.0	20.6
6	Valor SX + Harm Ext + NIS	2.0 + 0.6 + 0.25%	FPOST	10	0	54.1	17.5
7	Everest + NIS	0.6 + 0.25%	FPOST	3	18	57.3	30.0
8	PowerFlex + Basic Blend	3.5 + 1%	FPOST	4	50	53.7	27.8
9	Valor SX fb PowerFlex + Basic Blend	2.0 3.5 + 1%	PP FPOST	1	22	53.8	27.4
10	Fierce fb PowerFlex + Basic Blend	3.0 3.5 + 1%	PP FPOST	3	28	55.0	35.5
	C.V. %			133	168	4.1	31.5
	LSD .05			4	NS	NS	10.4

NS = no statistical difference between treatments
*Crop injury on October 22, 2010 = % leaf speckling
*Crop injury on May 19, 2011 = % crop stunting

Summary

Fall crop injury symptoms were leaf speckling and observations were generally minor with the exception Valor SX + Harmony Extra which was quite obvious. Crop stunting was observed in the spring and was generally quite evident but inconsistent with most treatments. Grain yields did not correspond to injury symptoms but were more related to weed control (data not collected).

2011 Bayer Winter Wheat Herbicide Trial

Eric Eriksmoen, Hettinger, ND

Pre-plant (PP) treatments were applied on October 6, 2010 to 3 leaf downy brome (dobr) with 54^o F, 55% RH, sunny sky and southwest wind at 5 mph. ‘AP503CL2’ HRWW was seeded no-till on October 11. Spring treatments (SPOST) were applied on May 19, 2011 to tillering wheat, tillering downy brome and 2 leaf Japanese brome (jabr) with 46^o F, 80% RH, cloudy sky and northeast wind at 3 mph. Wild oats (wiot) had not yet emerged. Treatments were applied with a tractor mounted CO_2 propelled plot sprayer delivering 10 gpa at 30 psi through PK-01E80 nozzles to a 5 foot wide area the length of 10 by 28 foot plots. The soil is classified as a silt-loam with a pH of 6.2, OM of 3.2% and 85% hrsw residue ground cover. The trial was a randomized complete block design with four replications. The trial had an application of 12 oz/A Huskie herbicide + 8 oz/A Headline fungicide on June 4, 2011 to control broadleaf weeds and foliar diseases. Weed populations for downy brome, Japanese brome and wild oats were 20, 2 and 0.25 plants /ft^2 respectively. Plots were evaluated for crop injury on May 19, June 1, June 22 and July 18, and were evaluated for weed control on May 19, June 22 and July 18. The trial was harvested on August 5.

				------ May 19 ------			6/22	---------- July 18 ----------				Test	Grain
	Treatment	Product rate	Timing	inj	stand	dobr	dobr	inj	dobr	jabr	wiot	weight	yield
		oz/A		%	%	-------------- Percent Control --------------						lbs/bu	bu/A
1	R’up Weather Max + AMS	16 + 17lbs	PP	0	54	92	84	0	82	20	0	51.6	25.2
2	R’up W. Max + Olympus + AMS	16 + 0.6 + 17lbs	PP	0	58	94	91	0	95	79	0	52.9	30.2
3	R’up W. Max + Olympus + AMS	16 + 0.9 + 17lbs	PP	0	60	91	89	0	91	94	0	53.1	33.2
4	R’up W. Max + PrePare + AMS	16 + 0.3 + 17lbs	PP	0	50	96	84	0	88	38	0	52.6	31.7
5	R’up W. Max + Olympus + AMS fb Olympus + NIS	16 + 0.6 + 17lbs 0.6 + 0.5%	PP SPOST	0	70	95	99	0	99	99	55	52.4	31.7
6	R’up W. Max + Olympus + AMS fb Rimfire Max + MSO	16 + 0.6 + 17lbs 3 + 20	PP SPOST	0	69	95	97	0	98	96	58	52.4	33.2
7	R’up W. Max + PrePare + AMS fb Everest + NIS	16 + 0.3 + 17lbs 0.3 + 0.5%	PP SPOST	0	78	90	91	0	94	97	70	53.0	36.8
	C.V. %			0	28	4	5	0	5	21	34	2.2	20.1
	LSD .05			NS	NS	NS	6	NS	7	24	13	NS	NS

NS = no statistical difference between treatments

Summary

Crop injury was not observed. All herbicide treatments with the exception of Roundup alone (trt1) provided good season long control of downy brome. Pre-plant treatments 1, 2 and 3 provided marginal activity on Japanese brome and no activity on wild oats. Sequential treatments (trts 5, 6 & 7) provided excellent season long control of both downy brome and Japanese brome and provided some activity on wild oats.

2011 Broadleaf Weed Control with Starane Flex in Spring Wheat

Eric Eriksmoen, Hettinger, ND

‘Mott’ HRSW was seeded no-till on May 16. Treatments were applied on June 16 to 4 ½ leaf wheat, 1 inch kochia (kocz), 1 inch Russian thistle (ruth) and 4 inch wild buckwheat (wibw) with 54^{o} F, 80% RH, clear sky and east wind at 6 mph. Treatments were applied with a tractor mounted CO_2 propelled plot sprayer delivering 10 gpa at 30 psi through PK-01E80 nozzles to a 5 foot wide area the length of 10 by 28 foot plots. The soil is classified as a silt-loam with a pH of 6.2 and OM of 3.2%. The trial was a randomized complete block design with four replications. Weed populations for kochia, Russian thistle and wild buckwheat were 6, 3 and 2 plants per square foot, respectively. Plots were evaluated for crop injury on June 20, June 22, July 1, July 16 and August 11, and for weed control on July 1, July 16 and August 11. The trial was harvested on August 20.

			6/22	------------ July 1 -----------				7/16	--------- August 11 ---------				Test	Grain
	Treatment	Product rate	inj	inj	kocz	ruth	wibw	tamu	kocz	ruth	wibw	plet	weight	yield
			------------------------------ Percent control									--------------------------------	lbs/bu	bu/A
1	Untreated		0	0	0	0	0	0	0	0	0	0	54.9	22.3
2	Starane Flex	13.5	0	0	88	65	88	99	88	77	94	99	57.0	27.3
3	Starane Flex + MCPA est	13.5 + 8.6	0	0	90	62	92	99	88	80	94	99	55.8	25.4
4	Starane Flex + 2,4-D est	13.5 + 8.6	1	0	89	64	90	99	94	90	94	99	56.9	26.4
5	Affinity TM + MCPA + NIS	0.6+13+0.25%	2	0	61	75	90	99	66	92	92	99	57.0	24.2
6	Huskie + AMS	11 + 0.5 lb	2	0	55	66	52	99	76	82	10	99	56.5	25.3
	C.V. %		142	0	29	37	23	0	19	21	10	0	3.0	9.1
	LSD .05		NS	NS	28	30	23	1	20	22	10	1	NS	NS

NS = no statistical difference between treatments

Summary

Crop injury was relatively minor and diminished quickly. All herbicide treatments provided good season long kochia control except for Affinity TM (trt 5) and Huskie (trt 6). Starane Flex + 2,4-D (trt 4) and Affinity TM were the only treatments that provided good season long control of Russian thistle. All herbicide treatments provided excellent season long control of wild buckwheat except for Huskie. All herbicide treatments provided excellent control of tansy mustard (tamu) and prickly lettuce (plet).

2011 Syngenta Wild Oat Control in Spring Wheat

Eric Eriksmoen, Hettinger, ND

'Mott' HRSW was seeded no-till on May 16. Post-emergence (POST) treatments were applied on June 17 to 4 ½ leaf wheat, heading downy brome (dobr), Japanese brome (jabr) in the boot stage, 4 leaf wild oat (wiot), tillering foxtail barley (fxba) and 4 leaf Persian darnel (peda) with 44^{o} F, 94% RH, cloudy sky and north wind at 9 mph. Treatments were applied with a tractor mounted CO_2 propelled plot sprayer delivering 10 gpa at 30 psi through PK-01E80 nozzles to a 5 foot wide area the length of 10 by 28 foot plots. The soil is classified as a silt-loam with a pH of 6.2 and OM of 3.2%. The trial was a randomized complete block design with four replications. The trial was sprayed with 12 oz/A Huskie herbicide + 8 oz/A Headline fungicide on June 4 to control broadleaf weeds and foliar diseases. Weed populations for downy brome, Japanese brome, wild oat, foxtail barley and Persian darnel were 1, 1, 0.25, 0.5 and 1 plants per square foot, respectively. Plots were evaluated for crop injury on June 22, July 1, July 16 and July 29, and for weed control on July 16, July 29 and August 14. The trial was harvested on August 20.

			------ July 16 ------			-------------- July 29 --------------					---- August 14 -----			Test	Grain
	Treatment	Product rate	jabr	dobr	fxba	inj	jabr	dobr	fxba	wiot	jabr	dobr	peda	weight	yield
		oz/A	---------------------------------- Percent Control										----------------------------------	lbs/bu	bu/A
1	Untreated		0	0	0	0	0	0	0	0	0	0	0	57.9	23.7
2	Exp	8.2	0	0	0	0	0	0	0	99	0	0	99	60.0	25.7
3	Rimfire Max + Basic Blend	3.0 + 1%	94	55	45	0	96	72	40	99	97	56	99	59.0	28.5
4	Wolverine	27.2	0	0	0	0	0	0	7	99	0	0	0	59.4	29.1
5	Puma	10.6	0	0	5	0	0	0	7	99	0	0	0	59.1	25.0
6	Goldsky + AMS + NIS	16+1.5lb+0.5%	95	95	20	0	96	90	40	99	98	93	50	59.6	31.1
7	Everest + Basic Blend	0.75 + 1%	91	0	20	0	99	12	40	99	99	18	0	59.3	29.8
	C.V. %		5	18	212	0	4	45	129	--	4	65	--	1.0	8.9
	LSD .05		3	6	NS	NS	3	16	NS	--	3	23	--	0.9	4

NS = no statistical difference between treatments

Summary

Crop injury was not observed. All herbicide treatments provided excellent season long control of wild oats, although populations in this study were minimal and isolated to one replication. Exp and Rimfire Max treatments provided excellent control of Persian Darnel. Rimfire Max, Goldsky and Everest treatments provided excellent season long control of Japanese brome and marginal control of foxtail barley. Goldsky was the only treatment to provide acceptable season long control of downy brome.

2011 BASF Clearfield Spring Wheat Trial

Eric Eriksmoen, Hettinger, ND

'ND901CL' HRSW was seeded no-till on May 9. Treatments were applied on June 8 to 4 leaf wheat and to 2 leaf volunteer RR canola (vcan), 1 inch kochia (kocz), 1 inch Russian thistle (ruth), 1 inch common mallow (cmal), 4 inch wild buckwheat (wibw) and tillering Japanese brome (jabr) with 45^o F, 91% RH, cloudy sky and north wind at 10 mph. Treatments were applied with a tractor mounted CO_2 propelled plot sprayer delivering 10 gpa at 30 psi through PK-01E80 nozzles to a 5 foot wide area the length of 10 by 28 foot plots. The soil is classified as a silt-loam with a pH of 6.2 and OM of 3.2%. The trial was a randomized complete block design with three replications. 8 oz/A Headline fungicide was applied on June 18 to control foliar diseases. Weed populations for volunteer canola, kochia, Russian thistle, common mallow, wild buckwheat and Japanese brome were 4, 6, 3, 2, 4 and 0.75 plants per square foot, respectively. Plots were evaluated for crop injury on June 14 and for weed control on June 22 and July 18. The trial was harvested on August 20.

			6/14	June 22						July 18					Test	Grain
	Treatment	Product rate	inj	vcan	wibw	kocz	ruth	dand	cmal	wibw	plet	kocz	vcan	jabr	weight	yield
		oz/A	Percent control												lbs/bu	bu/A
1	Untreated		0	0	0	0	0	0	0	0	0	0	0	0	55.6	19.7
2	Beyond + MSO	4 + 20	0	90	47	25	98	53	90	0	0	10	99	99	55.8	26.5
3	Beyond + MSO	6 + 20	1	93	50	30	95	37	90	0	17	17	99	--	54.6	24.0
4	Beyond+Bronate+NIS	4+16+0.25%	1	93	95	40	88	47	88	93	50	99	99	99	55.5	28.3
5	Beyond+Bronate+NIS	6+16+0.25%	0	88	85	63	95	60	90	90	50	99	99	99	55.0	27.0
6	Beyond+WideMatch+NIS	4+12+0.25%	1	92	47	80	93	67	85	93	99	93	99	99	55.6	27.4
7	Wolverine	27.2	5	95	93	60	99	63	70	83	--	99	90	0	56.3	25.3
8	Everest 2.0+WideMatch+ MCPA ester + Basic Bl.	0.75 + 12 + 8 + 1%	0	90	60	90	95	52	12	93	--	99	96	99	54.5	25.8
9	Axial XL + WideMatch + MCPA ester	16.5 + 12 + 8	4	90	67	90	67	80	27	93	--	99	99	0	55.9	24.1
	C.V. %		67	3	15	40	8	43	15	12	106	16	4	0	3.1	6.2
	LSD .05		1	4	16	37	11	38	16	12	NS	19	6	1	NS	2.7

NS = no statistical difference between treatments

Summary

Crop injury was relatively minor and diminished quickly. All herbicide treatments provided excellent season long control of volunteer canola. Beyond alone treatments (trts 2 & 3) were relatively ineffective at controlling wild buckwheat and kochia, however, the addition of Bronate or WideMatch to these treatments provided excellent season long control of these weeds. All herbicide treatments with the exception of Axial XL (trt 9) provided good control of Russian thistle. All herbicide treatments provided marginal control of dandelion (dand). Beyond treatments (trts 2 – 6) were the only treatments to provide good to excellent control of common mallow. Beyond + WideMatch (trt 6) provided excellent control of prickly lettuce (plet) although observations were not conclusive for all treatments. As would be expected, Wolverine (trt 7) and Axial XL (trt 9) had no efficacy on Japanese brome.

2011 Broadleaf Weed Control with Supremacy in Spring Wheat

Eric Eriksmoen, Hettinger, ND

'Mott' HRSW was seeded no-till on May 16. Treatments were applied on June 16 to 4 ½ leaf wheat, 1 inch kochia (kocz), 1 inch Russian thistle (ruth) and 4 inch wild buckwheat (wibw) with 54^{o} F, 80% RH, clear sky and east wind at 6 mph. Treatments were applied with a tractor mounted CO_2 propelled plot sprayer delivering 10 gpa at 30 psi through PK-01E80 nozzles to a 5 foot wide area the length of 10 by 28 foot plots. The soil is classified as a silt-loam with a pH of 6.2 and OM of 3.2%. The trial was a randomized complete block design with four replications. Weed populations for kochia, Russian thistle and wild buckwheat were 4, 3 and 2 plants per square foot, respectively. There was also a scattered amount of prickly lettuce (plet) present. Plots were evaluated for crop injury on July 1 and July 29, and for weed control on July 29 and August 11. The trial was harvested on August 18.

			7/1	---- July 29 ----					---- August 11 ----				Test	Grain
	Treatment	Product rate	inj	inj	kocz	ruth	wibw	plet	kocz	ruth	wibw	plet	weight	yield
			---- Percent control ----										lbs/bu	bu/A
1	Untreated		0	0	0	0	0	0	0	0	0	0	54.9	24.1
2	Supremacy + NIS	4.0 + 0.25%	0	0	81	87	98	99	74	84	97	99	56.5	26.7
3	Supremacy + NIS	5.0 + 0.25%	0	0	94	97	93	99	93	96	98	99	56.9	26.8
4	Supremacy + NIS	6.0 + 0.25%	0	0	93	99	96	99	96	98	96	99	56.6	25.3
5	Supremacy + MCPA est	5.0 + 12	0	0	94	94	90	93	88	99	90	99	56.0	24.7
6	Supremacy + 2,4-D est	5.0 + 12	0	0	95	99	98	96	98	99	97	99	57.0	25.5
7	Supremacy + Bronate	5.0 + 16	0	0	87	99	90	65	93	99	96	88	56.5	25.8
8	Exp + NIS	5.0 + 0.25%	0	0	96	94	94	94	98	96	94	99	56.5	27.5
9	WideMatch + MCPA est	16 + 12	0	0	91	99	94	93	94	98	96	99	56.0	26.6
10	Starane Flex + NIS	13.5 + 0.25%	0	0	99	97	85	99	97	94	85	99	56.3	26.5
11	Huskie	11	0	0	82	88	20	99	91	99	62	99	55.8	26.0
	C.V. %		0	0	10	9	17	7	11	8	16	1	2.2	3.9
	LSD .05		NS	NS	12	12	19	9	14	11	19	1	NS	1.5

NS = no statistical difference between treatments

Summary

Crop injury was not observed. All herbicide treatments provided good season long control of kochia and Russian thistle except for the 4 oz/A rate of Supremacy (trt 2) which provided only marginal control of those weeds. All herbicide treatments provided good season long control of wild buckwheat except for Huskie (trt 11). All herbicide treatments provided excellent control of prickly lettuce.

2011 BASF Clearfield Lentil System Trial

Eric Eriksmoen, Hettinger, ND

'CDC Maxim' lentil was seeded no-till on May 9. Pre-emergence treatments (PRE) were applied on May 19 with 42^o F, 86% RH, cloudy sky and northeast wind at 3 mph. Post-emergence treatments (POST) were applied on June 15 to 8 node (4") lentil, 4 leaf volunteer Roundup Ready canola (vcan), 1 inch kochia (kocz), 2 inch Russian thistle (ruth), 4 inch wild buckwheat (wibw), Japanese brome (jabr) in the boot and heading downy brome (dobr) with 73^o F, 41% RH, clear sky and north wind at 2 mph. Treatments were applied with a tractor mounted CO_2 propelled plot sprayer delivering 10 gpa at 30 psi through PK-01E80 nozzles to 5 foot wide by 28 foot long plots. The soil is classified as a silt-loam with a pH of 6.2 and OM of 3.2%. The trial was a randomized complete block design with four replications. Weed populations for volunteer canola, kochia, Russian thistle, wild buckwheat, Japanese brome and downy brome were 6, 2, 0.25, 3, 3 and 2 plants per square foot, respectively. There was also a scattered amount of prickly lettuce (plet), tansy mustard (tmus) and volunteer spring wheat (vhrs) present. Plots were evaluated for crop stand establishment on June 3, for crop injury on June 1 and June 15, and for weed control on June 15, July 1, July 18 and August 11. The trial was harvested on August 16.

	Treatment	Product rate	App. timing	6/15 inj	Crop stand	July 18 wibw	July 18 tamu	July 18 jabr	July 18 vhrs	August 11 kocz	August 11 ruth	August 11 vcan	August 11 plet	Test weight	Seed yield
		oz/A		%	#/9' row	Percent Control								lbs/bu	lbs/A
1	Untreated			0	106	0	0	0	0	0	0	0	0	56.3	1174
2	Roundup Original fb Clethodim	32 4	PRE POST	2	106	58	0	99	96	97	94	0	74	59.9	1560
3	R'up + Prowl H_2O fb Clethodim	32 + 48 4	PRE POST	2	108	58	0	99	98	98	97	0	70	61.0	1685
4	R'up+Prowl H_2O+Sharpen fb Clethodim	32+48+0.75 4	PRE POST	8	106	50	23	99	92	98	94	0	76	60.7	1658
5	R'up fb Beyond	32 4	PRE POST	8	83	88	99	99	94	96	99	97	95	61.6	1660
6	R'up + Prowl H_2O fb Beyond	32 + 48 4	PRE POST	14	106	94	99	99	99	96	99	99	92	61.2	1871
7	R'up+Prowl H_2O+Sharpen fb Beyond	32+48+0.75 4	PRE POST	6	100	97	99	99	97	98	99	99	99	60.4	1603
8	R'up + Sharpen fb Beyond	32 + 0.75 4	PRE POST	10	95	97	99	99	99	90	97	99	93	60.3	1887
	C.V. %			64	16	12	17	0	6	4	4	3	19	2.0	5.5
	LSD .05			6	NS	12	13	1	7	5	5	2	22	1.8	132

NS = no statistical difference between treatments

Summary

Selected data is shown above. Crop injury consisted of leaf chlorosis and stunting which was quite evident with several treatments but did not correlate to seed yields. None of the pre-emergence treatments provided adequate season long control of wild buckwheat or prickly lettuce, however, treatments which also had a post-emergence application of Beyond herbicide had good to excellent control of these weeds. Beyond treatments also provided excellent season long control of tansy mustard and volunteer canola. All herbicide treatments provided excellent season long control of grassy weeds, kochia and Russian thistle.

2011 Field Pea Tolerance to Lorox DF Herbicide

Eric Eriksmoen, Hettinger, ND

'Majoret' green field pea was seeded no-till on May 9. Treatments were applied just prior to crop emergence on May 19 with 60^{o} F, 68% RH, cloudy sky and east wind at 10 mph. Treatments were applied with a tractor mounted CO_2 propelled plot sprayer delivering 10 gpa at 30 psi through PK-01E80 nozzles to 5 foot wide by 28 foot long plots. The soil is classified as a silt-loam with a pH of 5.9 and OM of 2.6%. The trial was a randomized complete block design with four replications. The trial was sprayed with 16 oz/A Poast herbicide on June 10 to control grassy weeds and 4 oz/A Raptor Herbicide on June 24 to control common mallow. Plots were evaluated for stand establishment on June 3, date of 10% bloom and lodging just prior to harvest. The trial was harvested on August 8.

	Treatment	Product rate	Stand	10% bloom	Lodging	1000 KWT	Test weight	Seed yield
		oz/A	#/9' row	July	0-9*	grams	lbs/bu	bu/A
1	Untreated		40	3	6	197	64.1	47.7
2	Lorox DF	16	37	4	6	205	66.1	47.7
3	Lorox DF	32	37	3	5	205	64.7	50.4
4	Lorox DF	48	38	4	6	210	63.9	48.3
	C.V. %		17	15	10	6	3.5	6.4
	LSD .05		NS	NS	NS	NS	NS	NS

NS = no statistical difference between treatments

Summary

Crop injury was not observed at any time throughout the growing season. Agronomic characteristics including stand establishment, flowering date and crop lodging, and seed characteristics including kernel weight, test weight and yield showed no adverse effects from any of the application rates of Lorox DF.

Impacts of arginine on ovarian function and reproductive performance at the time of maternal recognition of pregnancy in ewes

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Reproductive performance is the largest determinant of income in the sheep flock. The objective of the current study was to determine if supplementation with the amino acid arginine surrounding the time of maternal recognition of pregnancy enhances ovarian function and reproductive performance in ewes. Recently arginine supplementation strategies have proven to be a suitable method to enhance reproductive loss in livestock creating a more profitable enterprise for the producer.

INTRODUCTION

As a precursor for nitric oxide, polyamines, and proteins, the amino acid arginine plays a vital role in metabolism and reproduction (Wu and Morris, 1998). Supplemental arginine has been reported to increase the number of live piglets born per sow (Mateo et al., 2007). Furthermore, pregnant rats supplemented with arginine throughout gestation exhibited an increase in embryonic survival and litter size (Zeng et al., 2008). Recently at NDSU we observed increased ovarian blood flow, serum progesteron and fetal number, despite similarities in ovulation rate, in ewes injected with L-arginine during the first 15 d post-breeding. Collectively, these studies suggest that reproductive efficiency can be enhanced via supplementation with arginine.

In sheep, embryonic and fetal deaths during pregnancy account for 25 to 50% of the total number of fertilized ova (Dixon et al., 2007). Most embryonic loss has been reported to occur before d 18 (Quinlivan, 1966). Only a small percentage of embryos are inherently non-viable in the ewe (Wilmut et al., 1986), which would suggest that the majority of early embryonic losses can be prevented.

Communication between the embryo and the maternal system must be established following conception to ensure normal development of the embryo. Maternal recognition of pregnancy in sheep occurs around d 13 following ovulation. During this critical period, the conceptus elongates from a blastocyst to a filamentous form, which produces interferon tau that is responsible for preventing the development of the endometrial luteolytic mechanism (Spencer and Bazer, 2002). The presence of interferon tau allows for maintenance of the CL, which is the primary structure responsible for progesterone production during early pregnancy in sheep.

The objective of this study was to determine the effects of arginine supplementation surrounding the time of maternal recognition of pregnancy on ovarian hemodynamics, early reproductive loss and lamb birth weight in Rambouillet ewes.

PROCEDURES

Rambouillet ewes of a similar body weight and age were randomly assigned to one of two groups: control (**CON**; n = 47) and L-arginine (**ARG**; n = 47). All ewes received a CIDR device for 12 d. Following CIDR removal a single injection of PG-600 was given to help initiate follicular development and ensure ovulation. Thereafter, ewes were exposed to fertile rams. From d 9 to d 14 postestrus ewes received L-arginine HCl (equivalent to 27 mg of L-arginine/kg of BW) or saline (CON) intravenously once daily. Daily blood samples were obtained (n = 10 ewes/subgroup) immediately after treatment (0 h) to assess progesterone (P4) concentrations and at -0.5, 0, 0.5, 1, 2, 4, 6 and 8 h on d 10 to determine circulating concentration of arginine in response to treatment. Ovarian hemodynamics (d 12) was determined with color Doppler ultrasonography (n = 10 ewes/subgroup) and reproductive losses (d 25, 45 and 65; n = 94) were determined using B-mode ultrasonography techniques.

RESULTS

On d 10 of pregnancy, serum concentrations of arginine (nmol/mL) were elevated in a subset of ewes (n=10 ewes/treatment group) ewes injected with arginine vs. CON ewes at 0 ($P < 0.001$), 0.5 ($P < 0.001$), 1 ($P < 0.001$), 2 ($P < 0.001$) and 4 h ($P < 0.001$), but were similar ($P \geq 0.70$) at -0.5, 6, and 8 h (Figure 1). Metabolites of arginine, ornithine and citrulline were measured. On d 10, ornithine levels were elevated in ARG vs. CON ewes at 0.5 ($P < 0.03$), 1 ($P < 0.001$), 2 ($P < 0.001$), 4 ($P < 0.001$), 6 h ($P < 0.001$) and 8 h ($P < 0.02$). However there was no effect on circulating serum citrulline concentration ($P \geq 0.09$).

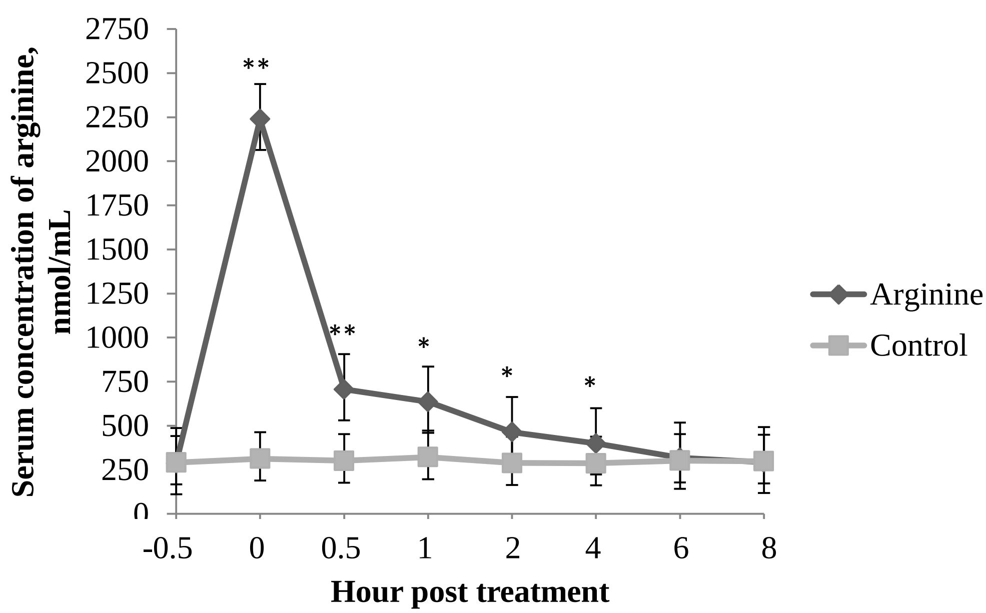

Figure 1. Effects of injectable L-arginine on serum arginine concentration (nmol/mL) on Day 10 in Rambouillet ewes (**$P = 0.001$; *$P < 0.001$) from d 9 to 14 of the estrous cycle.

Carotid artery and ovarian hemodynamics were measured on d 12 with Doppler ultrasonography on a subset of ewes (n=10 ewes/treatment group). There were no differences in pulsatility index in those ewes treated with arginine vs. control in the ovarian hilus ($P \geq 0.49$). When measuring the vasculature surrounding the CL, there was no effect of arginine treatment compared with control ($P \geq 0.51$). Similar to the pulsatility index, resistance index was also not influenced with arginine treatment in the ovarian hilus or in the CL ($P \geq 0.49$ and $P \geq 0.51$; respectively). Despite similarities in CL in the subset of ewes blood sampled (ARG; 1.69 ± 0.12 and CON; 1.67 ± 0.16 CL/ewe; $P > 0.05$), CON ewes had greater serum progesterone concentration (ng/mL) compared with ARG on d 9 (6.11 ± 0.27 vs. 5.30 ± 0.15 respectively; $P < 0.02$) and 10 (6.50 ± 0.40 vs. 5.06 ± 0.21 respectively; $P < 0.005$) but similar for the remaining treatment period ($P \geq 0.06$) .

Treatment with arginine influenced pregnancy rate (ARG, 55%, n=47 and CON, 30%, n=47; $P \leq 0.02$), despite treatment similarities in pregnant ewes in CL number at d 25 in ARG ewes vs. CON (Table 1). As pregnancy progressed to d 45, a similar number of embryos were observed between ARG and CON ewes, with pregnancy rate remaining greater in ARG (ARG, 47% vs. CON, 26%; $P \leq 0.03$; Table 1). By d 65 of pregnancy, the ewes continued to maintain similar embryos in ARG ewes vs. CON (Table 1). Pregnancy rate was also greater ($P \leq 0.02$) at d 65 in ARG (47%) compared with CON (23%) ewes.

Table 1. Effects of L-arginine on number of corpora lutea and embryos

	Arginine[a]			Control[b]			
Item/ewe	Mean	SEM	n	Mean	SEM	n	*P*- value[c]
No. Corpora lutea	1.69	0.12	26	1.67	0.13	15	0.42
No. Embryos d 25	1.62	0.12	26	1.53	0.16	15	0.33
No. Embryos d 45	1.45	0.14	22	1.50	0.15	12	0.41
No. Embryos d 65	1.50	0.14	22	1.45	0.16	11	0.42

[a] Arginine, 27 mg/kg BW injectable arginine.
[b] Control, saline.
[c] *P*-value for F-test for treatment.

A total of 32 (n=47) and 16 (n=47) lambs were born from ewes exposed to rams on synchronized estrous in CON vs. ARG, respectively. Ewes treated with ARG gave birth to a similar number of lambs when compared with CON (1.78 ± 0.17 vs. 1.60 ± 0.27 respectively; $P < 0.58$). Average lamb birth weights (lb) did not differ between treatment groups (8.5 ± 0.44 vs. 9.0 ± 0.58 respectively; $P < 0.24$).

DISCUSSION

In the present study, pregnancy rate was greater in those ewes treated with injectable arginine when compared to control ewes. However, the overall pregnancy rates were lower than expected throughout the study. Ewes utilized were bred out of season and only those whom were mounted by a fertile ram following the synchronized estrous period were used for this study. This may be a justifiable reason for the overall low pregnancy rates across treatment groups.

In the current study, ewes treated with injectable L-arginine surrounding the time of maternal recognition of pregnancy (d 9 to 14) had enhanced pregnancy rates, increased circulating serum arginine and ornithine concentration, and elevated vascular resistance in peripheral blood flow. Arginine is important for many biological functions, including the synthesis of nitric oxide (Gouge et. al., 1998; Manser et. al., 2004). It may be reasonable to hypothesize that treatment with arginine at or slightly before the time of maternal recognition of pregnancy in the ewe may have enhanced the survival of the embryo during early embryogenesis through its role in polyamine and nitric oxide synthesis. Nitric oxide and polyamines may have directly enhanced embryonic cellular proliferation and differentiation to ensure proper embryonic survival.

Progesterone is important for histotropic nutrition of the early embryo and suppression of the luteolytic mechanism (Lamming et al., 1989). In the present study, ewes treated with arginine had lower concentrations of progesterone relative to control ewes on d 9 and 10 of gestation, but were similar for the remaining treatment period. The lower levels of progesterone in arginine treated ewes may be due to an increase in metabolic clearance rate of steroids within the liver. Several studies have shown that low levels of progesterone can lead to a greater incidence of embryonic loss in sheep, and ultimately result in decreased ewe productivity (Dixon et. al., 2007). However, this finding was not observed in the current study. In fact, ARG treated ewes actually had greater pregnancy rates when compared to CON ewes.

IMPLICATIONS

In summary, treatment with arginine surrounding the time of maternal recognition of pregnancy may have prevented pregnancy loss in some ewes. Despite similarities in total CL and embryo numbers, overall pregnancy rate was increased in ewes treated with arginine. The enhanced pregnancy rate may have been due to arginine supplementation creating a more ideal uterine environment for the maintenance of embryos. During the early stages of embryogenesis, the supplemental arginine could have rescued weaker embryos entering the early stages of regression through its role in nitric oxide and polyamine synthesis. Nitric oxide and polyamines may have directly enhanced embryonic cellular proliferation and differentiation to ensure and promote proper embryonic survival.

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Effects of maternal metabolizable protein supplementation during the last 50 days of gestation on ewe and offspring performance and carcass characteristics[1]

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The objectives of this trial were to determine the effects of maternal metabolizable protein supplementation in ewes during the last 50 days of gestation on offspring performance and carcass characteristics.

[1]This project was supported by National Research Initiative Competitive Grant no. 2009-35206-05276 from the USDA National Institute of Food and Agriculture. The authors would like to thank David Pearson, Donald Drolc, Donald Stecher, Tammi Neville, and James Kirsch for their assistance in conducting this trial. Partial support for this research was provided by the USDA-ARS Northern Great Plains Research Laboratory, Mandan, ND Specific Cooperative Agreement No. 58-5445-7-315.

SUMMARY

Supplementation of energy and/or protein to ruminants during gestation has become vital in programming the fetus for increased growth and performance throughout life. Therefore, we hypothesized that ewes on the restricted metabolizable protein (MP) diets would have reduced performance during the last 50 days of gestation, and therefore would have smaller lambs at birth. Secondly, we hypothesized that the lambs from ewes maintained on the restricted MP diets would have reduced feedlot performance and carcass characteristics. Two hundred ninety-five multiparous ewes were stratified by weight, body condition score, and expected lambing date into one of three dietary treatments: CON: 100% of the MP requirement, MED: 80% of CON, and LOW: 60% of CON (NRC, 2007) during the last 50 days of gestation. Ewe initial BW, final BW pre-partum, change in BCS during gestation, and BW change at lambing were not different ($P \geq 0.26$) between dietary treatments. Ewes maintained on the CON and MED diets had a greater ($P < 0.0001$) increase in BW change compared with the ewes maintained on the LOW diet. At lambing, the LOW and MED ewes had a greater ($P = 0.007$) reduction in change in BCS compared with the CON ewes. Three hour milk production and lamb weaning weight were not affected ($P \geq 0.65$) by ewe maternal MP supplementation. Maternal dietary treatment did not affect ($P \geq 0.13$) initial BW, final BW, ADG, feed efficiency, carcass weight, dressing percentage, LM area, back fat thickness, body wall thickness, leg score, conformation score, flank streaking, quality grade, and yield grade of wethers in the feedlot. Wethers from ewes on the LOW treatment had increased ($P = 0.01$) DMI compared with wethers from ewe on the MED treatment. The wethers from ewes supplemented with CON tended ($P = 0.10$) to have decreased days on feed in the feedlot compared with wethers from ewes supplemented with MED. Percent boneless, closely trimmed, retail cuts was increased ($P = 0.04$) in wethers from ewes maintained on the CON diet compared with wethers from ewes fed the LOW and MED diets. The tendency for wethers from the CON fed ewes to have reduced days on feed as well as the increased percentage of retail cuts suggests that those wethers were programmed in utero to have increased performance and carcass characteristics. These data suggest that ewes fed at 60% of MP

requirements can still maintain pregnancy by becoming more efficient in partitioning nutrients to the fetus and mobilizing body reserves.

INTRODUCTION

Crude protein is supplemented during late gestation to cows and ewes to maintain body condition in dams as well as dam body weight (Martin et al., 2007; Swanson et al., 2008). By maintaining body weight and body condition the dam has more nutrient reserves to be utilized in maintaining pregnancy and growth of the fetus. However, very little research has evaluated supplementation of metabolizable protein (MP**)** during late gestation. Gestation length has also been shown to be reduced in cows fed severely restricted diets during early gestation compared with cows supplemented with adequate energy and CP (Long et al., 2010).

In many studies, birth weight was found not to be affected by dam supplementation or nutrient restriction (Anthony et al., 1986; Long et al., 2010; Martin et al., 2007; and Stalker et al., 2006). However, Swanson et al. (2008) observed that ewes fed diets meeting 60 and 140% of requirements of the early gestational ewe gave birth to heavier lambs than those ewes fed a diet meeting 100% of requirements of the early gestational ewe. Although birth and weaning BW was not significant due to maternal dietary restriction, those steers from cows fed a restricted diet had increased BW at the beginning and end of the feedlot phase (Long et al., 2010). However, these increased BW did not carry over into the carcass characteristics (Long et al., 2010). However, Ford et al. (2007) observed an increase in ultrasonography back fat in lambs from ewes fed a restricted diet during early to mid-gestation, once again yielding conflicting results on the effect of maternal supplementation during late gestation on progeny performance.

Therefore, we hypothesized that ewes on a restricted MP diets would have reduced performance during the last 50 days of gestation, and therefore would have smaller lambs at birth. We also hypothesized that the lambs from ewes maintained on the restricted MP diets would have reduced feedlot performance and carcass characteristics.

PROCEDURES

Ewes. Two hundred ninety-five multiparous ewes were stratified by weight, body condition score, and expected lambing date into one of three dietary treatments (Table 1): LOW: 60% of CON; MED: 80% of CON; and CON: 100% of the MP requirements of a ewe baring twins during the last 4 weeks gestation (NRC, 2007). Ewes were moved into a total confinement barn with a total of 21 pens (7 pens/dietary treatment) and acclimated to the CON diet for 7 d prior to starting dietary treatments. Ewes were supplemented with their respective treatment once daily at 0800 h. Supplementation was determined by the average body weight of the pen and fed according to NRC (2007) requirements. Ewes were given two hours to consume the supplement then low-quality forage (2.92% CP and 60.00% TDN; fescue hay) was offered. Ewes were weighed and body condition scored on two consecutive days at the beginning (d 0 and 1) and end (lambing) and once every 14 d during the treatment period. Supplement intake was adjusted for increases or decreases in body weight at every weigh day. Once ewes had lambed, the ewes and lambs were maintained in a common group on a lactation ration until weaning.

Lambs. Lambs were weighed and tagged within 24 h of birth, as well as gender, lambing difficulty, and lamb vigor recorded. Milk production was evaluated (Benson et al., 1999) utilizing ewes bearing singletons (LOW: n = 15 and MED and CON: n = 16) at an average 23 d of age. Lambs were removed from their ewes for three hours. After the three hour withdrawl, lambs were allowed to suckle until they quit suckling. Once done suckling, lambs were removed from the ewes for another three hours. Lambs were then weighed prior to being allowed to suckle again. Then lambs were allowed to suckle until they were done suckling. Once done suckling the lambs were weighed.

Lambs were weaned at an average of 69 ± 5 d of age. At weaning all lambs were placed into a common pen for a period of 20 d to acclimate to a feedlot diet. Following adaptation, wethers were allotted randomly by maternal dietary treatment and blocked by weight into a heavy or light weight pen per treatment (2 pens/treatment and 6 pens total). Wethers were weighed on two consecutive days at the beginning (d 0 and 1) and end of the feedlot period (d 109 and 110 and d 143 and 144). The d 109 and 110 wethers included all wethers meeting or exceeding at least 69 kg BW and the d 143 and 144 wethers included the remaining wethers. Once every 28 d during the feedlot period wethers were weighed. Wethers were fed ad libitum (85% corn, 15% commercial market lamb pellet; Table 2) via bulk feeders and had access to fresh water. At the end of the feedlot period, lambs were transported to Iowa Lamb Corporation in Hawarden, IA or the Department of Animal Science Meat Lab at North Dakota State University in Fargo, ND for harvest and carcass data collection.

***Statistical analysis*.** Ewe performance, lamb weigh-suckle-weigh, and wether feedlot performance and carcass characteristics were analyzed using the MIXED procedure of SAS (SAS Inst. Inc., Cary, NC). The model for included the main effects of treatment, ewe pen, and the interaction between the two. If the interaction was found to be clearly not significant ($P >$ 0.30), it was removed from the model. The data are presented as least squares means (LSmeans) ± SEM. Significance was set at $P \leq 0.05$ and tendencies at $P \leq 0.10$.

RESULTS AND DISCUSSION

Ewe performance. Initial BW, initial BCS, and final BW pre-partum were not different ($P \geq$ 0.26, Table 3) among dietary treatments. This was expected due to the randomized allotment. However, Swanson et al. (2008) observed a reduction in final post-partum BW of ewes fed a restricted diet of 60% of NRC (1985) energy requirements during the last 50 day of gestation compared with ewes fed 100 or 140% of energy requirements. Similar to the results observed by Swanson et al. (2008), Ford et al. (2007) observed an increase in pre-partum BW of ewes fed at 100% of NRC (1985) energy requirements for the early gestational ewe compared with those ewes restricted to 50% of requirements for the early gestational ewe during early to mid-gestation. Change in body condition score during the last 50 days of gestation was not affected ($P = 0.59$) by maternal MP supplementation. Although BW was not affected by dietary treatment, ewes maintained on the CON and MED diets had a greater ($P < 0.001$) increase in BW compared with the ewes maintained on the LOW diet. Stalker et al. (2006) observed similar results with cows supplemented during gestation maintaining BW compared with cows receiving no supplement during gestation. Cows supplemented with CP during the last trimester of gestation maintained BW and BCS compared with cows not supplemented (Martin et al., 2007).

The reduction in BW in the LOW ewes may indicate that those ewes had to utilize body reserves to maintain pregnancy on a restricted diet and therefore lost more weight during gestation due to the lack of nutrients being fed. There were no difference (*P* = 0.35) in BW change at lambing because of maternal MP supplementation. Cows restricted to 81% of CP requirements had decreased BW and BCS within 24 h post-calving compared with cows fed 141% of CP requirements (Anthony et al., 1986). The final pre-partum BCS tended (*P* = 0.09) to be increased in the MED ewes compared with the LOW ewes. At lambing, the LOW and MED ewes had reduced (*P* = 0.001) BCS compared with CON ewes. The LOW and MED ewes had a greater (*P* = 0.007) reduction in change in BCS compared with the CON ewes. This would be explained by the reduced BCS at lambing for the restricted (LOW and MED) ewes. Increased BCS change in the restricted (LOW and MED) ewes may be indicative of using body reserves to maintain pregnancy during the last 50 days of gestation. The LOW ewes gained less weight and had increased loss in body condition during the last 50 days of gestation, which suggests that those ewes may have mobilized more body reserves to maintain pregnancy.

Offspring. Milk production and lamb weaning weight was not affected ($P \geq 0.65$, Table 4) by ewe dietary treatment. Calves from cows supplemented with CP during gestation had increased weaning weights and ADG from birth to weaning compared with calves from non-supplemented cows (Stalker et al., 2006). There was a maternal dietary treatment by birth type interaction for birth weight ($P < 0.001$). As litter size increased the CON ewes gave birth to heavier lambs than those ewes fed the MED diet. In contrast, birth weights of lambs from ewes maintained on 60 and 140% of NRC (1985) energy requirements for the early gestational ewe were reduced compared with lambs from ewes maintained on 100% of NRC energy requirements for the early gestational ewe (Swanson et al., 2008). However, birth weights of calves born to cows supplemented with CP during gestation were not different compared with calves born to non-supplemented cows (Anthony et al., 1986; Stalker et al., 2006; Martin et al., 2007). Heifers from cows receiving CP supplementation during the last trimester tended to have increased weaning weights and 205 d adjusted weaning weights (Martin et al., 2007). The increased birth weight of lambs born to ewes on the LOW diet may also indicate a mobilization of body reserves or the ewes becoming more efficient in partitioning nutrients between themselves and the fetus during the last 50 days of gestation to maintain pregnancy.

Maternal dietary treatment did not affect ($P \geq 0.13$, Table 4) initial and final BW, ADG, feed efficiency, carcass weight, dressing percentage, LM area, back fat thickness, body wall thickness, leg score, conformation score, flank streaking, quality grade, and yield grade of wethers during the finishing phase. Back fat thickness measured via real-time ultrasonography was increased in lambs from ewes restricted to 50% of NRC (1985) energy requirements for the early gestational ewe compared with lambs from ewes maintained on 100% of NRC requirements for the early gestational ewe (Ford et al., 2007). Supplementation of CP during gestation to cows did not affect ADG, DMI, feed efficiency, or carcass characteristics in steer calves in the feedlot (Stalker et al., 2006). However, in the current study, wethers from ewes on the LOW treatment had increased (*P* = 0.01) DMI compared with wethers from ewe on the MED treatment. In contrast to the current study, Martin et al. (2007) observed an increase in DMI in heifers from cows supplemented with CP during late gestation and fed hay during early lactation compared with cows that were pasture grazed during early lactation. The wethers from ewes supplemented with CON tended (*P* = 0.10) to have decreased days on feed in the feedlot compared with wethers from ewes supplemented with MED. Long et al. (2010) observed that calves from restricted fed cows had increased 425 days of age and both beginning and ending finishing BW compared with calves from cows fed adequately. However, the feedlot performance did not carry over to all of the carcass characteristics. Percent boneless, closely trimmed retail cuts was increased ($P = 0.04$) in wethers from ewes maintained on the CON diet compared with wethers from ewes fed the LOW and MED diets.

IMPLICATIONS

The data from the current study suggest that ewes can be fed at 60% of MP requirements (but adequate in CP and energy) and maintain pregnancy by becoming more efficient in partitioning nutrients to the fetus and mobilizing body reserves. The lambs from the ewes fed restricted MP diets may be programmed to be more efficient in partitioning nutrients for growth as well. However, this efficiency does not carry over to the majority of carcass characteristics of the lambs.

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Table 1. Ingredients and nutrient composition of diets fed to ewes from d 100 of gestation until lambing

	Diet[1]		
Item	LOW	MED	CON
Ingredient, %			
Corn	18.50	15.00	5.00
Dried Distiller's Grains	7.00	20.00	30.00
Soyhulls	9.50	—	—
Trace Mineral	0.49	0.49	0.49
Fescue Hay	64.51	64.51	64.51
Nutrient Composition			
DM, %	88.75	89.34	89.68
CP, % of DM	13.16	20.21	25.13
NDF, % of DM	31.03	30.73	39.79
ADF, % of DM	15.69	7.45	10.49

[1]Maternal dietary treatment: LOW: 60% of CON, MED: 80% of CON, and CON: 100% of the metabolizable protein requirement met during the last 50 days of gestation.

Table 2. Ingredient and nutrient composition of diets fed to wethers[1] during the feedlot phase

Item	Ingredient
Ingredient, %	
Whole Corn	85.0
Commercial Market Lamb Pellet[2]	15.0
Nutrient Composition	
DM	89.06
NDF, % of DM	15.54
ADF, % of DM	3.76
CP, % of DM	15.19

[1]Wethers born to ewes fed: LOW: 60% of CON, MED: 80% of CON, and CON: 100% of the metabolizable protein requirement met during the last 50 days of gestation.

[2]Commercial Market Lamb Pellet contained: 200 g/ton Chlortetracycline; 38.0% CP; 3.75-4.75% Ca; 0.6% P; 3.0-4.0% salt; 1.2 ppm Se; 24,000 IU/lb Vitamin A; 2,400 IU/lb Vitamin D; and 95 IU/lb Vitamin E.

Table 3. Effects of metabolizable protein level during the last 50 days of gestation on ewe performance

	Maternal Dietary Treatment[1]				
Item	LOW	MED	CON	SEM[2]	*P*-Value[3]
Initial BW, lb	143	143	144	2.4	0.98
Final BW pre-partum, lb	159	162	165	2.9	0.26
Weight Change, lb					
Gestation	15[b]	20[a]	21[a]	0.9	<0.001
Lambing	-28	-25	- 26	1.3	0.35
BCS					
Initial	2.9	2.9	2.9	0.03	0.64
Final pre-partum	2.9	3.0	2.9	0.03	0.09
Lambing	2.7[b]	2.8[b]	2.9[a]	0.04	0.001
BCS change					
Gestation	-0.01	0.03	0.03	0.04	0.59
Lambing	-0.18[a]	-0.20[a]	0.02[b]	0.04	0.007

[1]Maternal dietary treatment: LOW: 60% of CON, MED: 80% CON, and CON: 100% of the metabolizable protein requirement met during the last 50 days of gestation.

[2]Greatest SEM presented (n = 99 for LOW, n = 98 for MED and CON).

[3]*P* - value for the F test of the mean.

[a,b]Means within a row that lack a common superscript differ ($P \leq 0.05$; LSmeans).

Table 4. Effects of metabolizable protein level fed to ewes during the last 50 days of gestation on lamb performance

	Maternal Dietary Treatment[1]				
Item	LOW	MED	CON	SEM[2]	*P*-Value[3]
Birth Weight[4], lb	9.4	8.3	9.2	0.4	0.03
3 h milk production, lb	0.3	0.3	0.3	0.1	0.65
Weaning weight, lb	39.6	38.6	38.0	3.9	0.94

[1]Maternal dietary treatment: LOW: 60% of CON, MED: 80% of CON, and CON: 100% of the metabolizable protein requirement met during the last 50 days of gestation.

[2]Greatest SEM presented.

[3]*P* - value for the F test of the mean.

[4]Maternal dietary treatment x Birth Type of $P < 0.001$.

[a,b]Means within a row that lack a common superscript differ ($P \leq 0.05$; LSmeans).

Table 5. Effects of maternal metabolizable protein supplementation on feedlot performance and carcass characteristics of wethers

	Maternal Dietary Treatment[1]				
Item	LOW	MED	CON	SEM[2]	*P* - value[3]
Initial Weight, lb	65	60	67	4	0.31
Final Weight, lb	154	150	147	3	0.17
Average Daily Gain, lb/d	0.7	0.7	0.7	0.03	0.20
Days on Feed, d	127	133	123	4	0.10
G:F, lb gain: lb DMI	0.2	0.2	0.2	0.01	0.46
Dry matter intake, lb/hd/d	3.3[a]	3.2[b]	3.3[ab]	0.04	0.01
Carcass Weight, lb	79.8	76.9	75.6	1.6	0.14
Dressing Percentage, %	51.8	51.2	51.4	0.4	0.53
LM area, in^2	2.8	2.7	2.7	0.1	0.94
Back fat thickness, in	0.3	0.3	0.3	0.02	0.27
Body wall thickness, in	1.1	1.1	1.1	0.04	0.72
Leg score[4]	12	12	12	0.2	0.83
Conformation Score[4]	12	12	12	0.2	0.64
Flank Streaking[5]	362	365	395	13.5	0.13
Quality Grade[4]	12	12	12	0.1	0.29
Yield Grade	3.3	3.5	3.2	0.3	0.54
BCTRC, %[6]	44.8[b]	44.9[b]	48.3[a]	1.1	0.04

[1]Maternal dietary treatment: LOW: 60% of CON, MED: 80% of CON, and CON: 100% of the metabolizable protein requirement met during the last 50 days of gestation.

[2]Greatest SEM presented (n = 31 for LOW, n = 33 for MED, and n = 24 for CON).

[3]*P* - value for the F test of the mean.

[4]Leg score, conformation score, and quality grade: 1 = cull to 15 = $Prime^+$.

[5]Flank streaking: 100-199 = practically devoid; 200-299 = traces; 300-399 = slight; 400-499 = small; 500-599 = modest.

[6]Percent boneless, closely trimmed, retail cuts (% BCTRC) = [49.936 – (0.0848 × 2.204 × Hot Carcass Weight, kg) – (4.376 × 0.393 × 12^{th} rib fat thickness, cm) – (3.53 × 0.393 × body wall thickness, cm) + (2.456 × 0.155 × LM area, cm^2)].

[a,b]Means within a row that lack a common superscript differ ($P \leq 0.05$; LSmeans).

Effects of graded levels of zeranol implants on feedlot performance, carcass characteristics, and incidence of prolapse and mortality in lambs[1]

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The objective of this research was to determine the feasibility of implanting feedlot lambs with increasing amounts of zeranol. Previous research demonstrated increased growth performance in lambs implanted with zeranol, but also indicated a risk for increased incidence of prolapse resulting in increased mortality. If lamb feedlot operations could increase average daily gain and decrease days on feed, considerable increases in profitability could be obtained.

[1]Partial support for this research was provided by the USDA-ARS Northern Great Plains Research Laboratory, Mandan, ND Specific Cooperative Agreement No. 58-5445-7-315. *Disclaimer: Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the U. S. Department of Agriculture.* The authors would like to thank David Pearson, Donald Drolc and Donald Stecher for their assistance in conducting this trial.

SUMMARY

The objective of this research was to compare the growth performance and carcass characteristics of feedlot lambs implanted with four levels of zeranol. One hundred forty four crossbred lambs (65 ± 10 lbs) were placed into sixteen feedlot pens and finished according to treatment in a 116 day finishing study. Treatments included: 1) **0** (no implant), 2) **12** (12 mg zeranol implant), 3) **24** (24 mg zeranol implant), and 4) **36** (36 mg zeranol implant). Lambs were implanted with zeranol (Ralgro®, Schering-Plough) according to treatment on day 0. All treatments received the same 84.7% corn and 15.3% market lamb pellet (DM basis) ration ad libitum. The feedlot study ended on d 116, and lambs were harvested day 118. Carcass data was collected 24 hr post-chill. There were no differences between treatments for body weight, ADG, DMI, and G:F ($P \geq 0.33$). Carcass characteristics also were not affected by treatment ($P \geq 0.07$). However, 24 and 36 treatment groups had increased incidence of prolapse ($P = 0.03$) compared to lambs implanted with 0 and 12 mg. Lambs from treatment groups 24 and 36 also had increased percent mortality ($P = 0.04$) compared to 0 lambs, with 12 being intermediate. No differences ($P \geq 0.07$) between treatments for growth and carcass characteristics were observed. The increased cost and labor associated with implanting lambs and treating prolapses, as well as the monetary loss from lamb death, indicate implanting lambs with zeranol is economically impractical.

INTRODUCTION

Zeranol has been shown to improve growth performance in lambs when implanted with 12 mg once (Field et al., 1993; Salisbury et al., 2007; and Stultz et al., 2001) or more than once (Hufstedler et al., 1996 and Nold et al., 1992). Most research indicates zeranol does not alter carcass characteristics (Arnsperger et al., 1976; Hutcheson et al., 1992; Olivares and Hallford, 1990; and Salisbury et al., 2007), although some studies report conflicting results (Field et al., 1993; Stultz et al., 2001; and Wiggins et al., 1979). Zeranol has also been implicated in increased incidence of prolapse (Arnsperger et al., 1976 and Salisbury et al., 2007), resulting in decreased use of zeranol in the United States. However, it has been estimated that as many as half of market lambs fed in Mexico are implanted with zeranol (G. Amaya, 2010). Research by Eckerman et al. (2010) compared lambs raised conventionally and implanted with 36 mg zeranol to lambs managed using naturally raised guidelines. Results showed conventional lambs had increased growth performance, but also had increased incidence of prolapse and mortality.

Our objective for this study was to determine the effects of graded amounts of zeranol on lamb feedlot performance and carcass characteristics, as well as incidence of prolapse and mortality. The hypothesis tested was lambs implanted with greater amounts of zeranol would have improved growth performance, without altering carcass quality or increasing incidence of prolapse or mortality.

PROCEDURES

Animal Management and Treatments. All experimental protocols were approved by the North Dakota State University Animal Care and Use Committee. At two weeks of age, tails were docked, males castrated, and all lambs were vaccinated for *clostridium perfringens* types C and D, as well as for tetanus (Bar Vac CD-T, Boehringer Ingelhein, Ridgefield, CT). Lambs were vaccinated with CD-T again at 60 d of age and d -1 of the study. One hundred forty four spring-born crossbred lambs (wethers and ewes, 65 ± 10 lbs) were stratified by weight and sex. Within stratification, lambs were assigned randomly to treatment: 0, 12, 24, or 36 mg zeranol implant. Treatments were applied in a completely randomized design to evaluate the outlined objectives.

Lambs were implanted according to treatment on d 0 with Ralgro® (Schering-Plough Animal Health Corp., Union, NJ). Lambs were then moved to 16 feedlot pens (n = 4). Each pen represented one experimental unit and contained 9 lambs. Lambs were offered feed ad-libitum via bulk feeders and had continuous access to clean, fresh water. Lambs had access to shade and were observed daily to monitor health. All lambs received the same ration: 84.7% corn and 15.3% market lamb pellet (DM basis, Table 1). Lambs were treated with antibiotics as necessary. Lambs which rectally or vaginally prolapsed were treated using techniques best-suited for each situation, including the use of sutures, oxytetracycline, and general antibiotics.

Experimental Periods and Sampling Procedures. The study was divided into four periods, consisting of 28, 28, 26, and 34 d, respectively. Lambs were weighed two consecutive days at initiation (d -1 and 0) of the trial and after the third and fourth period. Single day weights were taken on d 28 and 56, with two day weights taken d 81 and 82 as well as d 115 and 116. Thirty lambs (minimum 140 lbs) were harvested on d 84 at Iowa Lamb Corporation in Hawarden, IA.

Ninety six lambs (minimum 125 lbs) were harvested on d 118 at Iowa Lamb Corporation. Carcass data were collected 24 h post chill by trained university personnel.

Bulk feeders were emptied at the end of each period, with weight and samples of refusals collected to determine period DMI. Ration and feed ingredient samples (approximately 0.44 lb) were collected every 28 d, dried at 55°C for 48 h to determine DM, and analyzed for ADF, NDF, N, and OM at the North Dakota State University Animal Science Nutrition Laboratory.

Statistics. Lamb performance data were analyzed as a completely randomized design using the MIXED procedure of SAS (SAS Inst. Inc., Cary, NC) with pen serving as experimental unit. Carcass data were analyzed with missing data points from underweight lambs not included in the data set, with pen serving as experimental unit. Repeated measures was used to analyze period effects for BW, ADG, G:F, and DMI. The model included treatment, day, and day x treatment interaction. The covariance structure used was First Order Ante-dependence. Other structures were tested but First Order Ante-dependence was the best fit. Data are presented as least squares means with differences considered significant at $P \leq 0.05$.

RESULTS AND DISCUSSION

No differences were observed between treatments for body weight gain or ADG (Table 2, $P \geq 0.64$). Feed intake and feed efficiency were not different between treatments ($P \geq 0.33$). This is similar to some of the previous research that found no effect of zeranol implant on ADG (Field et al., 1993; Nold et al., 1992; and Wiggins et al., 1976) or feed efficiency (Wiggins et al., 1976). However, the majority of the research indicates implanting feedlot lambs with 12 mg zeranol increases ADG (Arnsperger et al., 1976; Hutcheson et al., 1992; Salisbury et al., 2007; Stultz et al., 2001; Wiggins et al., 1979; and Wilson et al., 1972) and feed efficiency (Field et al., 1993; Olivares and Hallford, 1992; and Stultz et al., 2001). Previous research also indicates feed efficiency can be improved by implanting lambs twice with 12 mg zeranol (Nold et al., 1992) and both feed efficiency and ADG can be improved by implanting lambs with 12 mg of zeranol three or more times (Hufstedler et al., 1996). However, Hufstedler et al. (1996) also observed decreased dressing percentage and increased carcass maturity in lambs repeatedly implanted.

There were no differences ($P \geq 0.07$) in carcass characteristics in lambs implanted with graded levels of zeranol. This is in accordance with most research, although some studies have indicated zeranol can alter carcass characteristics. Stultz et al. (2001) observed increased carcass weights in lambs implanted with 12 mg of zeranol compared to control lambs, most likely resulting from increased live weights at the termination of the study. It was also observed that implanted lambs had increased ribeye area compared to nonimplanted lambs. Field et al. (1993) examined the effects of 12 mg zeranol implants in rams and wethers, and found zeranol caused increased fat depth in implanted wethers. However, no other differences in carcass characteristics were observed. Another study analyzing the effects of re-implanting lambs found lambs implanted at birth and weaning, and lambs implanted at 55 and 98 d of age, had increased leg score compared to lambs that received no implants (Nold et al., 1992). However, Wiggins et al. (1979) observed decreased dressing percentage in implanted lambs, which was a factor of increased gastrointestinal tract weight. Again, no other carcass characteristics were significantly altered by the use of 12 mg zeranol implants. The aforementioned research would suggest that while zeranol could potentially alter carcass characteristics, the effects are minimal.

The major effects observed in the present study were the increased percent prolapse (P = 0.03) in the 24 and 36 mg implant groups compared to the 12 mg and control group. The increased percent prolapse subsequently resulted in increased percent mortality (P = 0.04) in 24 and 36 treatments compared to 0 treatment lambs. This high incidence of morbidity likely caused lambs implanted with 24 and 36 mg zeranol to have decreased growth performance compared to what was expected. Lambs that were treated for prolapse often went off feed and gained little or no weight. Only two of the previously mentioned studies (Salisbury et al., 2007 and Arnsperger et al., 1976) reported complications of prolapse resulting from zeranol implants. Even the studies examining the use of 2, 3, or more implants did not report any incidences. Annotative information suggests as much as 50% of Mexican feeder lambs are implanted with zeranol (G. Amaya, 2010), but feedlot operations do not experience the rate of prolapse that was observed in the present study. However, research by Arnsperger et al. (1976) resulted in increased incidence of rectal and vaginal prolapses in lambs raised on feedlot rations. The high incidence of prolapse in the study by Arnsperger et al. (1976) did not appear to hinder the growth performance of the lambs, as we believe the case to be in the present study. Despite the prolapses, implanted lambs in studies by Arnsperger et al. (1976) still had increased ADG compared to nonimplanted lambs. Another study observed 5 and 20% percent vaginal prolapse in lambs implanted once and twice, respectively, with control lambs having no prolapses (non-significant, Salisbury et al., 2007). However, in that study implanted lambs still had increased ADG and feed efficiency compared to control lambs.

The rations of the studies by Arnsperger et al., (1976) and Salisbury et al. (2007), as well as the present study, utilized high concentrate feedlot rations. In contrast, many Mexican feedlots use lower concentrate rations (G. Amaya, 2010), which could be the cause of the decreased incidence of prolapse. Arnsperger et al. (1976) noted that lambs implanted with zeranol and raised on pasture did not experience the high rate of prolapse observed in the feedlot lambs. Salisbury et al. (2007) hypothesized that the combination of zeranol causing uterine muscle contraction and grain finishing causing increased fat deposition around the tail led to the increased incidence of vaginal prolapse. As such, high concentrate diets could be implicated in contributing to increased incidence of prolapse.

IMPLICATIONS

The increased incidence of prolapse and mortality observed in lambs implanted with 24 or 36 mg of zeranol, without increased growth performance or carcass characteristics, indicate the use of high doses of zeranol implants are not practical on conventional lamb feedlot settings that utilize high concentrate rations. The increased labor associated with implanting lambs and treating prolapses, in addition to the cost of implants and death loss, prevent the use of zeranol implants from being economically feasible in lamb feedlot operations. However, there is the possibility that zeranol could be beneficial to producers raising lambs on pasture or range. Zeranol could provide improved growth performance to lambs that would otherwise underperform on lower quality forage. This aspect of zeranol use should be further examined, but the use of zeranol implants in feedlot lambs is not recommended.

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Table 1. Ingredient and nutritional composition of diet fed to feedlot lambs

Item	Diets
Ingredient	DM basis
Whole Corn, %	84.7
Market Lamb Pellet[1], %	15.3
Nutrient composition	
CP, %	13.12
Ash, %	4.59
NDF, %	13.47
ADF, %	3.41

[1]Market Lamb Pellet contained: 0.22 g/kg chlortetracycline, 38% CP, 4.25% Ca, 0.6% P, 3.5% salt, 1.2 mg/kg Se, 52,920 IU/kg Vitamin A, 5,292 IU/kg Vitamin D, and 209 IU/kg Vitamin E.

Table 2. Effects of graded levels of zeranol on lamb growth performance, carcass characteristics, and health

	Treatment[1]					
Item	0	12	24	36	SEM[2]	*P* – value[3]
Body Weight[4], lb						
d 0	65	65	66	66	2.2	0.81
d 28	88	89	89	91	2.2	0.79
d 56	109	109	108	111	2.2	0.83
d 84	128	126	124	125	2.2	0.57
d 112	142	143	143	145.5	2.2	0.98
ADG[5], $lb \cdot d^{-1}$	0.74	0.73	0.71	0.67	0.04	0.52
Intake[6], lb $DM \cdot hd^{-1} \cdot d^{-1}$	3.75	3.70	3.84	3.84	0.11	0.94
G:F[7]	0.22	0.22	0.21	0.20	0.01	0.33
HCW, lb	74.9	74.1	73.6	73.2	1.28	0.81
Leg Score[8]	11.8	12.0	12.0	12.3	0.18	0.31
Conformation Score[8]	11.5	12.0	12.0	12.0	0.14	0.07
Fat Depth, in[9]	0.98	0.98	1.08	1.03	0.03	0.14
Body Wall Thick, in	0.29	0.30	0.33	0.30	0.02	0.62
Ribeye Area, in^2	2.75	2.68	2.53	2.55	0.08	0.17
Flank Streaking[10]	378.75	355.75	376.25	352.00	10.94	0.25
Quality Grade[8]	12.3	12.0	12.0	12.0	0.1	0.43
Yield Grade[11]	3.25	3.38	3.70	3.40	0.24	0.62
BCTRC, %[12]	45.58	45.43	44.70	45.05	0.36	0.35
Dress, %	50.73	50.73	50.83	50.25	0.40	0.74
Prolapse, %	2.78[a]	5.55[a]	24.98[b]	27.75[b]	6.31	0.03
Mortality, %	0.00[a]	5.55[ab]	11.10[b]	13.88[b]	3.10	0.04

[1]Treatments: 0 (0 mg zeranol implant), 12 (12 mg zeranol implant), 24(24 mg zeranol implant), 36 (36 mg zeranol implant).
[2]Standard Error of Mean; n = 4.
[3]*P* – value for F-tests of mean.
[4]*P*-values for body weight TRT ($P = 0.90$), Pd ($P < 0.001$) TRT x Pd ($P = 0.49$).
[5]*P*-values for ADG TRT ($P = 0.52$), Pd ($P < 0.001$) TRT x Pd ($P = 0.61$).
[6]*P*-values for Intake TRT ($P = 0.94$), Pd ($P < 0.001$) TRT x Pd ($P = 0.71$).
[7]*P*-values for G:F TRT ($P = 0.33$), Pd ($P < 0.001$) TRT x Pd ($P = 0.24$).
[8]Leg score, conformation score, and quality grade: 1 = cull to 15 = high prime.
[9]Adjusted fat depth and yield grades.
[10]Flank streaking: 100-199 = practically devoid; 200-299 = traces; 300-399 = slight; 400-499 = small; 500-599 = modest.
[11]Yield Grade = 0.4 + (10 x adjusted fat depth, in).
[12]Boneless closely trimmed retail cuts, % = (49.936 – (0.0848 x Hot Carcass Weight, lb.) - (4.376 x Fat Depth, in.) – (3.53 x BW, in.) + (2.456 x Ribeye Area, in^2)).

Sulfur balance in lambs fed increasing concentrations of distillers dried grains with solubles[1]

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Sulfur balance of lambs fed increasing concentrations of DDGS was evaluated. Lambs fed 60% DDGS consumed 54% more water, excreted 300% more urine, and 480% more S in urine than lambs fed no DDGS. Understanding that S excretion increased with increasing dietary S concentrations explains, in part, why S toxicity did not occur.

[1]Partial support for the research and dried distillers grains plus solubles was provided by Dakota Gold Research Association, Sioux Falls, SD. Additionally, partial support for this research was provided by the North Dakota State Board of Agricultural Research and Education Research Fund – Animal Agriculture and Hay Committee. Any opinions, findings, conclusionts, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of Dakota Gold Research Association.

SUMMARY

Feeding increased concentrations of distillers dried grains with solubles (**DDGS**) has been implicated as a cause of S toxicity in ruminants. Elucidating the mechanism by which dietary S causes polioencephalomalacia (**PEM**) is of importance to the livestock feeding industry. Our hypothesis was that lambs fed increased concentrations of DDGS will increase S excretion to avoid toxicity. The objective of this study was to evaluate the effects of increasing dietary concentration of DDGS on S balance in lambs. Distillers dried grains inclusion did not affect DMI (3.0 ± 0.15 lb/hd/d; $P = 0.25$). Sulfur intake from feed and water, as well as S excretion in feces and urine increased linearly ($P \leq 0.009$) with increasing DDGS inclusion. Sulfur balance increased linearly ($P = 0.02$) with increasing inclusion of DDGS in finishing diets. Increasing concentration of DDGS in the diet increased S intake, excretion, and H_2S concentrations but did not result in the occurrence of PEM. This research suggests that substantial amounts of S contained within DDGS are excreted by the ruminant animal.

INTRODUCTION

Feeding increased concentrations of distillers dried grains with solubles (**DDGS**) to ruminants has been avoided due to risks of S toxicity and concerns about animal performance. High S diets can cause polioencephalomalacia (**PEM**) in ruminants (Gould, 1998). Feeding 60% DDGS can cause dietary S content to exceed the maximum tolerable level (0.3% S; NRC, 2005). However, research has demonstrated that lambs fed 60% DDGS (> 0.55% S) did not develop PEM (Neville et al., 2010) and performed similar to those fed lesser concentrations of DDGS (Schauer et al., 2008). Schauer et al. (2008) and Neville et al. (2010) provide an opportunity for increased utilization of DDGS in lamb finishing rations. Our hypothesis was that lambs fed increased concentrations of DDGS would increase excretion of S to avoid toxicity. The objective of this study was to evaluate the effects of increasing dietary concentration of DDGS on S balance in lambs.

MATERIALS AND METHODS

All animal care and handling procedures were approved by the North Dakota State University Animal Care and Use Committee prior to the initiation of the research.

Animals and Treatments. Sixteen western white-faced wether lambs (80.9 ± 5.1 lb) were utilized in a completely random design to evaluate the effects of increasing dietary concentration of DDGS on S balance and ruminal H_2S gas concentrations in lambs. Treatments were based on increasing concentrations of DDGS in the final finishing diet and included: 1) 0% DDGS, 2) 20% DDGS, 3) 40% DDGS, and 4) 60% DDGS. Treatment diets were formulated to meet or exceed CP and Cu requirements; NE was formulated for a lamb gaining 0.88 lb/d (NRC, 2007; Table 1). The dietary treatments were formulated to provide minimum Ca to P ratio of 1.5:1, and ammonium chloride (0.5%, DM basis) was added to all diets to aid in the prevention of urinary calculi. Thiamin was included in all diets at a concentration which would provide 150 mg/hd daily based on 3.0 lb estimated DMI.

Sulfur Balance. Lambs were adapted to stainless steal metabolism crates for 10 d prior to a 10 d collection period. Following adaptation, lambs were fitted with fecal collection bags. Urine was collected in plastic buckets. Feed intake was recorded daily, with daily adjustments made to target ad libitum intake (10% feed remaining daily). Feed refusals were weighed and sub-sampled daily. Water intake was calculated by subtracting any unconsumed water from water offered. Daily water samples were collected and analyzed (Stearns DHIA, Sauk Centre, MN) for sulfate (93 mg/L). Feed, ort, and fecal samples were dried using a forced-air oven (55°C; The Grieve Corporation, Round Lake, IL) for 48 h. Dried samples were ground using a Wiley Mill (Arthur H. Thomas Co., Philadelphia, PA) to pass a 2 mm screen. Samples were composited within lamb across the 10 d collection period. Samples were analyzed for S by a commercial laboratory (Midwest Laboratories, Omaha, NE).

RESULTS AND DISCUSSION

Sulfur Balance. In our study, level of dietary DDGS inclusion did not affect DMI (3.0 ± 0.15 lb/hd daily; $P = 0.25$; Table 2). Sulfur intake from feed and water, as well as S excretion in feces and urine increased linearly ($P \leq 0.009$) with increasing DDGS in the diet. Lambs fed 60% DDGS had water intakes 54% greater than those fed no DDGS ($P < 0.01$). Increased water intake resulted in an increase of 300% in urine volume and a 480% increase in urine S excretion ($P < 0.01$) compared to lambs fed no DDGS. Given the water intake and urine output data, ad libitum access to low sulfate water may be key to preventing S toxicity when high amounts of DDGS are fed. Sulfur balance increased linearly ($P = 0.004$) with increasing inclusion of DDGS in finishing diets. However, true S balance is not reported as the total volume of eructated H_2S, as well as S accumulation in wool and muscle were not measured. It is likely that substantial amounts of S were excreted via rumen gases through eructation. Therefore, further research is needed to quantify S excretion via H_2S gas and eructation.

CONCLUSIONS

Increasing concentration of DDGS in the diet increased S intake and excretion but did not result in the occurrence of PEM. Understanding that S excretion increased with increasing dietary S concentrations explains, in part, why S toxicity did not occur. The present study along with previous research at our institution has demonstrated that feeding up to 60% dietary DDGS concentrations is possible without affecting lamb health or performance if free access to low sulfate water is provided.

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Table 1. Ingredient and nutritional composition of diets fed to lambs

	Diet[1]			
Item	0% DDGS	20% DDGS	40% DDGS	60% DDGS
Ingredient, %	DM basis			
Alfalfa Hay	15.00	15.00	15.00	15.00
Corn	81.38	61.38	41.38	21.38
DDGS[2]	0.00	20.00	40.00	60.00
Ammonium Chloride	0.5	0.5	0.5	0.5
Limestone	2.25	2.25	2.25	2.25
Lasalocid[3]	0.085	0.085	0.085	0.085
TM package[4]	0.78	0.78	0.78	0.78
Copper Sulfate	0.002	0.002	0.002	0.002
Thiamin	0.011	0.011	0.011	0.011
Nutrient composition (analyzed)				
CP, %	14.0	19.4	22.0	24.7
NDF, %	23.7	27.6	30.6	31.8
ADF, %	10.1	11.0	11.1	11.5
S, %	0.22	0.52	0.70	0.84
Ca, %	1.72	1.64	1.35	1.16
P, %	0.50	0.65	0.77	0.81
Cu, ppm	19	19	15	17
Zn, ppm	59	95	90	73
Thiamin[5], ppm	70.8	67.2	55.5	51.5

[1] Diets were balanced to meet or exceed requirements set by (NRC, 2007). Treatments based on distillers dried grains with solubles inclusion: 1) 0% DDGS, 2) 20% DDGS), 3) 40% DDGS, 4) 60%DDGS.
[2] Distillers dried grains with solubles.
[3] Lasalocid (Bovatec 68, Alpharma Inc., Fort Lee, NJ).
[4] Trace Mineral (TM) package contained: 11.7% Ca, 10.0% P, 14% salt, 0.1% K, 0.1% Mg, 20 ppm Co, 100 ppm I, 2,450 ppm Mn, 50 ppm Se, 2,700 ppm Zn, 300,000 IU/lb Vitamin A, 30,000 IU/lb Vitamin D_3, and 600 IU/lb Vitamin E.
[5] Formulated based on estimated feed intake of 3 lb/d, amount of supplemental thiamin provided, and corrected for thiamin contained in remaining feed ingredients.

Table 2. Intake, excretion, and sulfur balance of lambs fed increasing concentrations of distillers dried grains with solubles

	Treatment[2]						*P*-Value[4]	
Item[1]	0% DDGS	20% DDGS	40% DDGS	60% DDGS	SEM[3]	*P*-value	Linear	Quadratic
Intake								
Feed, kg	1.3	1.5	1.4	1.3	0.07	0.25	0.68	0.06
S, mg	2,487.5	6,076.2	7,429.4	9,029.6	816.6	<0.001	<0.001	0.25
Water, L	3.1	3.5	3.7	4.8	0.28	0.006	<0.001	0.31
S, mg	94.8	109.4	115.7	148.9	8.7	0.006	0.001	0.31
Total S, mg	2,582.4	6,185.6	7,545.1	9,178.4	815.8	<0.001	<0.001	0.25
Excretion								
Fecal, kg	0.20	0.23	0.27	0.25	0.02	0.17	0.06	0.33
S, mg	761.4	947.6	1112.1	1130.5	90.6	0.05	0.009	0.37
Urine, L	0.59	0.85	1.1	2.4	0.3	0.008	0.002	0.12
S, mg	674.9	2,370.8	3,236.0	3,945.1	268.8	<0.001	<0.001	0.09
Total S, mg	1,436.3	3,318.4	4,348.0	5,075.6	344.5	<0.001	<0.001	0.12
Sulfur Balance, mg	1,146.1	2,867.2	3,197.1	4,102.8	568.0	0.02	0.004	0.49

[1] 1 kg = 2.205 lbs
[2] DDGS = Distillers dried grains with solubles.
[3] n = 4.
[4] *P*-value for linear and quadratic effects of increasing concentration of DDGS in diet.

Effects of calf weaning method on calf stress, hormone concentration, growth performance and carcass ultrasound characteristics*

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*Partial support for this research was provided by the U.S. Department of Agriculture- Agricultural Research Service Northern Great Plains Research Laboratory, Mandan, N.D. Specific Cooperative Agreement No. 58-5445-7-315. *Disclaimer: Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author (s) and do not necessarily reflect the view of the U.S. Department of Agriculture.* The authors would like to thank Don Stecher and Donald Drolc for their assistance in conducting this trial.

The study objective was to determine the effects of conventional weaning versus two-step weaning on calf stress, hormone concentration, growth performance and carcass ultrasound characteristics on growing crossbred calves. These results suggest that two-step weaning may alleviate some stress compared with conventional weaning; however, feed efficiency for calves in the traditional weaning treatment was superior to the two-phase treatment.

Summary

Crossbred steer and heifer calves (n= 71) were stratified by body weight (BW) and allotted randomly to one of two weaning treatments (TRT): conventional weaning (CON) or two-step weaning (2P) in a completely randomized design. Blood samples were collected concurrently with rectal temperature assessment on days -7, -6, -4, 0, 1, 3, 7 and 10 relative to weaning (day 0) for determination of plasma cortisol and haptoglobin concentrations. A subset of calves (n = 12; six calves per TRT) were fitted with human pedometers to measure steps taken before and after weaning.

On day 0, calves were allotted by TRT and sex to one of 12 feedlot pens (six pens per TRT) for a 65-day background period. Calves were fed a growing diet [11.5 percent crude protein (CP), 4.08 Mcals net energy gain (NEg); dry-matter (DM) basis] for a 2.2-pound average daily gain (ADG). Calf age at weaning and initial BW averaged 160 • } 2 days and 526 • } 8 pounds for both treatments, respectively.

Calf BW and dry-matter intake (DMI) during backgrounding were similar ($P \geq 0.10$) across TRT; however, treatment by sex interactions occurred for ADG and gain-to-feed ratios (G:F; $P = 0.001$ and $P = 0.01$, ADG and G:F, respectively). Furthermore, CON G:F from day 0 to 65 was greater than 2P G:F (0.19 vs. 0.15; $P = 0.05$).

Haptoglobin absorbance was similar ($P \geq 0.10$) for weaning method. Concentrations of cortisol and pedometer steps recorded tended to be effected by a TRT by day interaction ($P < 0.10$). Carcass ultrasound characteristics did not differ ($P \geq 0.15$) for weaning method.

These results suggest that two-step weaning may alleviate some stress compared with conventional weaning; however, feed efficiency for calves in the traditional weaning TRT was superior to the two-phase treatment.

Introduction Conventional weaning, defined as the sudden removal of a calf from its dam and mother’s milk (Haley et. al, 2005), is the traditional weaning method used by most cattle producers. It can be a very stressful experience for young calves because during weaning, calves experience loss of maternal contact, new diets and novel social environments, as well as transportation to new housing facilities (Enriques et al., 2010). Weaning initiates behavioral and physiological responses indicative of distress that are unfavorable to beef production and animal welfare (Lefcourt and Elasser, 1995; Stookey et al., 1997; Krebs et al., 2010), causing morbidity and mortality at feedlot arrival (Loerch and Fluharty, 1999).

Two-step weaning, a weaning alternative using anti-suckling nose tags, has been reported to reduce stress during the weaning process (Carter et al., 2010). The process allows calves to remain with their mothers, adjusting to milk removal prior to physical separation (Loberg et al., 2007). Little research, however, has evaluated how weaning stress influences carcass characteristics during the growing period. We hypothesized that the two-step weaning method would reduce calf stress and improve calf growth and carcass characteristics compared with conventional weaning.

Materials and Methods
All animal care and handling procedures were approved by the North Dakota State University Institutional Animal Care and Use Committee prior to the initiation of this study.

The experiment was conducted at the North Dakota State University Hettinger Research Extension Center’s (HREC) Southwest Feeders feedlot and two-319 acre pasture locations. One pasture was 2.5 miles south of Hettinger (Clement) and the other was five miles west of Hettinger (Fitch).

The Clement and Fitch pastures housed 36 and 35 cow-calf pairs, respectively. Seventy-one crossbred steer (n = 36) and heifer (n = 35) calves were used in this study (day -7 to 65). Before weaning, cow-calf pairs grazed the respective pastures containing similar vegetation and portable wind breaks. Two creep feeders, with oat grain as creep feed, were placed on the pastures 65 days before weaning.

All calves were gathered; vaccinated for respiratory, clostridial, *H. Somnus* and Mannheimia diseases; and weighed 33 days before weaning to obtain preweaning calf BW. On day -7, cow-calf pairs were gathered on respective pastures, with calves stratified by preweaning BW and allotted randomly to one of two weaning treatments (TRT): traditional weaning (CON) or two-step weaning (2P).

Anti-suckling nose tags (flexible, one-piece plastic tags; QuietWean nose tags, JDA Livestock Innovations Ltd., Saskatoon, Canada), were placed into the nostrils of the 2P calves. The tags were monitored to ensure retention; any calf that lost its nose tag had another one inserted. The tags remained in the 2P calves’ nostrils for seven days, and all calves remained on pasture with their dams until conventional weaning (d 0).

On day 0, cow-calf pairs were gathered on the respective pastures; calves were separated from their dams, loaded into livestock trailers and transported to the feedlot. Calves were weighed and bled, pedometer measures were recorded and ultrasound carcass characteristics were measured. Calves were allotted by TRT and sex to one of 12 feedlot pens (six pens per TRT; five or six calves per pen) for a 65-day background period. Calf age at weaning and initial BW averaged 160 •} 2 days and 526 •} 8 pounds, respectively.

During the first four days in the feedlot, calves had free-choice access to grass hay, plain salt blocks and water in automatic electrically heated fence-line water fountains. On days 2 and 3, oat grain (21.3 pounds per pen; DM basis) was off ered. On day 3, calves were fed a growing diet (4.8 pounds per calf; 11.5 percent CP, 4.08 Mcal of NEg; DM basis) in the form of a totally mixed ration (TMR); the diet consisted of ground mixed hay, corn, barley, oat silage, a custom calf pellet containing RumensinR (200 milligrams per pound, as fed), deccoxR (569 milligrams per pound, as fed) medicated crumbles and calcium carbonate at 53.9, 16.5, 11.5, 9.9, 5.9, 1.7 and 0.6 percent, respectively (DM basis). The TMR was fed once daily (9 a.m.) from days 4 through 65, with adjustments to intake made daily.

Data measures (calf BW, blood samples, rectal temperatures, pedometer and ultrasound measures) were collected before calf feeding on collection days. All calves were bled via the jugular vein relative to weaning (day 0) for plasma cortisol and haptoglobin concentrations.

A subset of calves (n = 12; six calves per TRT) were fitted with human pedometers (GOsmart Tri-Axis pocket pedometer, model HJ-303, Omron Healthcare Inc., Bannockburn, Ill.) on day -7 to measure steps taken before and after weaning. The pedometers were placed in plastic zipper-top bags to protect them from moisture. Bags were fastened securely to the inside of the calf's left rear leg (below the hock and above the fetlock) with veterinary wrap and duct tape, and checked regularly for signs of swelling, discomfort or pain.

On day 10, pedometers were removed from the calves. On day 0 and 65 of the background period, back fat thickness, ribeye area, rump fat thickness and intramuscular fat percentages were measured via real-time ultrasonography, and marbling scores were calculated from intramuscular fat percentages.

Calves were checked daily for signs of illness during the weaning and backgrounding periods. On day 14, all calves were revaccinated for respiratory, clostridial, *H. Somnus* and Mannheimia diseases; dewormed; and implanted with a Ralgro® implant (36 milligrams zeranol). During the background period, diet samples were collected weekly from each pen at feed delivery, composited, dried in a forced-air oven and ground for nutritional analysis by a commercial laboratory (Midwest Laboratories, Omaha, Neb.).

Results and Discussion

Feedlot performance: Calf BW averaged 710 • } 16.7 pounds, with 189 • } 11.2 pounds gained ($P >$ 0.10; Table 1) at the end of the 65-day backgrounding period. Average daily gain was similar ($P = 0.10$) across TRT during backgrounding despite CON calves having a numerically higher ADG than 2P calves (3.08 vs. 2.64 pounds per day, CON vs. 2P calves, respectively). Dry-matter intakes averaged 16.2 • } 0.6 pounds per day; however, feed efficiency (gain:feed) was greater ($P = 0.05$) for CON than 2P calves (0.19 vs. 0.15, CON vs. 2P, respectively; Table 1) at the conclusion of the study.

Hormone concentrations and physiological measures: When animals undergo stress, fear, flight, infection, physical trauma and malignancy, these external and internal processes will alter an animal's hormonal balance. Hormones are the chemical messengers to the animal's body tissues and organs; these messengers (hormones) regulate specific metabolic body processes, whereby they either can stimulate or retard (prevent) life activities.

Cortisol, a hormone from the adrenal cortex that causes liver glycogen and blood sugar stores to increase as part of the "flight or fight" response, is the primary biological marker used to measure stress or fear in animals. Another physiological reaction that can result from these internal or external stressors is the acute-phase response. This response stimulates increased production and mobilization of leukocytes (the white blood cells responsible for ingesting infectious microorganisms), and fever, as well as changes in tissue metabolism and circulating levels of acute-phase proteins.

Haptoglobin, one of the acute-phase proteins, is a glycoprotein produced by the liver that binds to freed hemoglobin resulting from infection or tissue injury. The goal of this complex series of reactions is to prevent ongoing tissue damage, isolate and destroy infectious organisms, and activate repair processes necessary to restore the animal’ s normal body functions (Baumann and Gauldie, 1994).

In our study, we measured cortisol and haptoglobin concentrations as indicators of weaning stress. Haptoglobin absorbance did not show a sex ($P = 0.93$) or TRT-by-sex interaction ($P = 0.81$), but a day effect ($P < 0.002$) was observed (Figure 1).

Both TRT groups had elevated plasma haptoglobin absorbance occurring on day 10.

Although cortisol concentrations were not affected by TRT ($P = 0.13$), we found a tendency ($P = 0.06$) for a treatment-by-day interaction for cortisol (Figure 2). Peak cortisol concentrations for 2P (52.7 nanograms per millilitre, or ng/ml) occurred on day -4, 72 hours post nose tag insertion, while peak cortisol concentrations for CON (43.6 ng/ml) occurred on day -6, 24 hours after the calves first were handled.

Generally, plasma cortisol concentrations spike immediately following a stress (Lefcourt and Elasser, 1995).

Except for receiving preweaning shots, none of the calves were acclimated to human handling before this study. Grandin (1998) reported that an animal that has not been acclimated to human handling and restraint in a squeeze chute will have more fear stress when it is restrained and handled than one that has been habituated to human contact and trained to handling procedures.

A tendency was noted for a treatment by-day effect ($P = 0.09$) in the number of pedometer steps recorded (Figure 3). The 2P calves took more steps per day by day -4 (754 vs. 526 steps, 2P vs. CON, respectively) because the 2P calves were unable to suckle, relying on pasture forages and creep feed for their daily nutrition. Conversely, CON calves took more steps per day by day 3 (460 vs. 162 steps, CON vs. 2P, respectively).

Ultrasound measures: Carcass ultrasound characteristics did not differ ($P \geq 0.16$; Table 2) for weaning method. Back fat and rump fat thickness changes were similar ($P \geq 0.94$), averaging 0.025 • } 0.01 inch and 0.02 • } 0.01 inch for CON and 2P calves at the end of backgrounding. Ribeye area, intramuscular fat percentage and marbling scores were not statistically different ($P \geq 0.73$).

Implications

As the cattle industry comes under increased scrutiny from its consumers and outside entities, who demand the industry utilize more animal-friendly production methods, cattle producers must consider less stressful, more humane methods of weaning calves than conventional weaning. These results suggest that two-step weaning may alleviate some stress compared with conventional weaning; however, feed efficiency for calves in the traditionally weaned TRT was superior to the two-phase treatment. Continued evaluation of two-step weaning is necessary.

Table 1. Effect of weaning method on calf growth performance.

Item	Treatment[1] CON	2P	SEM[2]	P – value[3]
No. head	36	35	–	–
No. pens	6	6	–	–
Initial weight, lbs.	521	530	8.4	0.99
Final weight, lbs.	708	711	16.7	0.99
Weight gained, lbs.	194	183	11.2	0.53
DMI, lbs./day	15.6	16.7	0.6	0.19
ADG, lbs./day	3.08	2.64	0.2	0.10
Gain:feed, lbs./lbs.	0.19	0.15	0.01	0.05

[1]Treatments: CON = conventionally weaned calves; 2P = two-step weaned calves.
[2]Standard error of mean; n = 6.
[3]*P*-values for *F*- test of treatment.

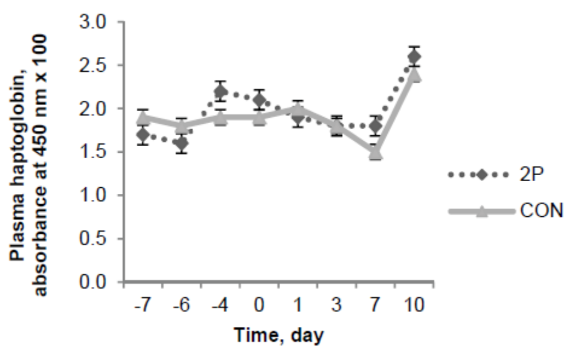

Figure 1. Effect of weaning method on plasma haptoglobin concentration (absorbance at 450 nm x 100; ±SEM). Effects of treatment (*P* = 0.69), day (*P* = 0.002) and treatment x day (*P* = 0.43).

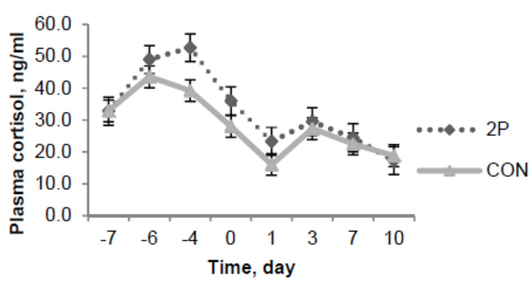

Figure 2. Effect of weaning method on plasma concentration of cortisol (ng/ml; ±SEM). Effects of treatment (*P* = 0.13), day (*P* < 0.001) and treatment x day (*P* = 0.06).

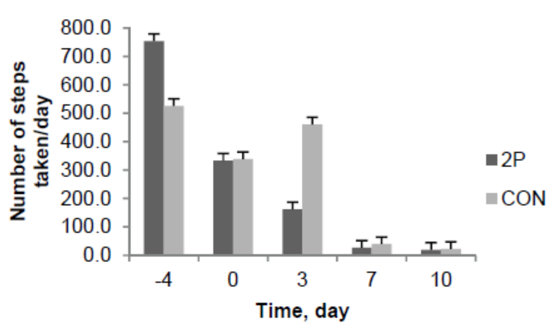

Figure 3. Effect of weaning method on number of steps taken per day (±SEM). Effects of treatment (*P* = 0.91), day (*P* = 0.03) and treatment x day (*P* = 0.09).

Table 2. Change in real-time ultrasound carcass characteristics during the background period.

	Treatment[1]			
Item	CON	2P	SEM[2]	P – value[3]
No. head	36	35	-	-
No. pens	6	6	-	-
Ribeye area, in.2	1.83	2.17	0.17	0.16
Back fat thickness, in.	0.03	0.02	0.01	0.94
Rump fat thickness, in.	0.02	0.02	0.01	0.96
Intramuscular fat, %	0.95	0.90	0.11	0.74
Marbling score[4]	0.75	0.71	0.08	0.73

[1]Treatments: CON = conventionally weaned calves; 2P = two step weaned calves.
[2]Standard error of mean; n = 6.
[3]P-values for F- test of treatment.
[4]Marbling score was calculated from intramuscular fat percentages.

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Protein Supplementation of Low-Quality Forage: Effects of Amount and Frequency on Intake, Nutrient Digestibility, and Performance[1]

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When providing supplemental CP to ruminants consuming low-quality forage at extended intervals, such as once every 10 days, it is possible for managers to maintain acceptable forage intake, digestibility of nutrients, and cow performance by reducing the amount, and cost, of supplement provided.

Summary
Three experiments were conducted to evaluate the effect of amount and frequency of crude protein (CP) supplementation on ruminants consuming low-quality forage. Treatments were arranged in a 2 × 3 factorial design (two levels of CP provided daily, once every 5 days, or once every 10 days) with an unsupplemented control. The greater level of CP was estimated to meet ruminal requirements for degradable intake protein and the lower level was 50% of the greater level. Soybean meal (SBM) was used as the CP supplement. Seven steers (661 ± 20 lb; Experiment 1) and 7 wethers (68 ± 1 lb; Experiment 2) were used in duplicate 4 × 7 incomplete Latin square designed experiments to determine the influence of treatments on nutrient intake and digestion. Experimental periods were 30 days with feed and digesta collected on d 19 through 28 and day 21 through 30, respectively, for estimation of nutrient digestibility.

Eighty-four cows (1,231 ± 9 lb; 4.8 ± 0.04 body condition score; BCS) in the last third of gestation were used in Experiment 3 to evaluate treatment effects on weight and body condition score (BCS) change. Treatments were evaluated using the following contrasts: 1) Control vs CP supplementation, 2) Full CP vs Half CP, 3) linear effect of supplementation frequency, 4) quadratic effect of supplementation frequency, 5) Interaction of linear effect of supplementation frequency and level of CP, and 6) Interaction of quadratic effect of supplementation frequency and level of CP.

Hay intake by steers increased ($P = 0.03$) with CP supplementation but only tended to increase ($P = 0.08$) with Full CP compared with Half CP. In contrast, hay and total intake by lambs was not affected ($P > 0.25$) by CP supplementation. Interestingly, a linear effect of CP amount × supplementation frequency interaction for both hay and total intake was noted for steers ($P = 0.02$) and a tendency was noted for lambs ($P < 0.09$), with intake decreasing a greater amount from daily to once every10 days with Full CP supplementation compared with little to no reduction with Half CP.

Diet digestibility by steers tended ($P = 0.10$) to be greater with CP supplementation and was increased ($P < 0.01$) by lambs. This, with the intake data, resulted in a greater quantity of nutrients available for utilization by the animal with CP supplementation.

Efficiency of CP utilization by lambs was greater with CP supplementation but was not altered by amount of supplement ($P = 0.94$) or supplementation frequency ($P > 0.92$). In addition, plasma urea was greater with CP supplementation ($P < 0.01$) and for Full CP compared with Half CP ($P \leq 0.02$) in both steers and lambs.

Cow pre- and post-calving weight and BCS change was improved with CP supplementation ($P \leq 0.03$). Likewise, pre- and post-calving weight change and pre-calving BCS change were improved ($P \leq 0.01$) with Full CP compared with Half CP. However, the change in pre-calving weight and BCS was less as supplementation frequency decreased for Half CP compared with Full CP ($P = 0.01$).

These data suggest that reducing the amount of supplemental CP, when supplementation intervals are greater than 5 or 6 days, can be a management tool to maintain acceptable levels of intake, digestibility, and cow performance while reducing supplement cost.

Introduction

Production of beef cattle is consistently the number two agriculture commodity in Oregon. Consequently, raising cattle is the largest generator of livestock value in Oregon and is dominated by commercial cow/calf production with over 500,000 producing females located in the state. Most cattle spend their entire lives, except for the final 4 to 6 months in the feedlot, grazing standing forage or consuming hay. Forage quality is usually sufficient to support normal levels of production early in the growing season; however, as forages mature they increase in fiber content, decrease in CP, and decrease in digestibility. As a result, many cattle in Oregon and the western United States consume low-quality forage (< 6% CP) from late summer through winter and require some form of supplementation to maintain desired levels of performance.

Protein supplementation of low-quality forage has been shown to increase cow weight gain and BCS, forage intake and digestibility, and can improve reproductive performance. However, winter supplementation can be very expensive. Winter feed costs in the intermountain west often total $150 to 250 per cow per year. In addition to actual supplement costs, winter supplementation includes other expenses such as the labor, time, and equipment associated with supplement delivery. In contrast to other areas of North America, winter feed costs represent an economic disadvantage and could substantially threaten the economic future of the beef industry in this region.

Decreasing the frequency of protein supplementation is one management practice that can decrease labor and time costs by greater than 80% compared with daily supplementation. Ruminants have the ability to recycle excess absorbed nitrogen back to the rumen; therefore, recycling of absorbed nitrogen may support ruminal fermentation between times of supplementation. Consequently, research has shown that protein supplements can be fed at infrequent intervals and still maintain acceptable levels of performance (Hunt et al., 1989; Huston et al., 1999; Bohnert et al., 2002); however, data is limited comparing the effects of altering the amount of protein provided at infrequent intervals on forage intake and digestibility, animal performance, and efficiency of protein use.

It is possible that ruminants consuming low-quality forage may be able to adapt to infrequent supplementation of CP by increasing their ability to recycle nitrogen, thereby improving efficiency of CP use. We hypothesize that as the supplementation interval increases ruminants will become more efficient in their use of supplemental CP. As a result, we should be able to provide LESS total CP and maintain performance comparable to more frequent supplementation of MORE total CP. This will not only save time and labor, but will decrease the amount and cost of supplement provided to beef cows consuming low-quality forage, and therefore increase economic returns of Oregon's beef producers (Table 1).

Materials and Methods

Experiment 1. Seven ruminally cannulated Angus x Hereford steers (661 ± 22 lb) were used in a 4 × 7 incomplete Latin square design and housed in individual pens within an enclosed barn with continuous lighting. Steers were provided continuous access to fresh water and a low-quality cool season hay (Chewings fescue grass seed straw; 2.9% CP). A trace mineralized salt mix was provided daily. Treatments were arranged in a 2 × 3 factorial design with 2 levels of CP provided daily, once every 5 days, or once every 10 days with an unsupplemented control (daily, 5-day, and 10-day treatments, within CP level, received the same total amount of CP over a 10-day period). The greater level of CP was estimated to meet ruminal requirements for degradable intake protein and the lower level was 50% of the greater level. Soybean meal (SBM; 51.4% CP) was placed directly into the rumen via the ruminal cannula for supplemented treatments.

Experimental periods were 30 d, with intake measured beginning d 19 and concluding d 28. On day 11 (day of supplementation for all treatments except for control) and day 20 (day before supplementation for all treatments except for control), treatment effects on ruminal indigestible fiber fill were determined by manually removing the contents from each steer's reticulo-rumen 4 h after feeding. Feces were collected on days 21 to 30.

On days 21 and 30, ruminal fluid was collected by suction strainer immediately prior to feeding and at 3, 6, 9, 12, 18, and 24 hours postfeeding. Ruminal fluid pH was measured immediately after collection.

Data were analyzed as an incomplete 7 × 4 Latin square. The model for intake and digestibility data included period and treatment. The model for samples collected at fixed times included period, treatment, time, and treatment × time. Contrast statements were: 1) Control vs CP supplementation, 2) Full vs Half CP, 3) linear effect of supplementation frequency, 4) quadratic effect of supplementation frequency, 5) Interaction of linear effect of supplementation frequency and level of CP, and 6) Interaction of quadratic effect of supplementation frequency and level of CP.

Experiment 2. Seven wethers (68 ± 1 lb) were used in a 4 × 7 incomplete Latin square design. Lambs were provided continuous access to fresh water and a low-quality cool season hay (Chewings fescue grass seed straw; 4.9% CP). A trace mineralized salt mix was provided daily.

Treatments were arranged in a 2 × 3 factorial design (two levels of CP provided daily, once every 5 days, or once every 10 days) with an unsupplemented control. The greater level of CP was estimated to meet the CP requirement of a 66 lb lamb gaining 0.44 lb/day; the lower level was 50% of the greater level. Soybean meal (SBM; 49.9% CP) was used as the CP supplement and was offered to lambs immediately prior to hay feeding.

Experimental periods were 30 d, with intake measured beginning d 19 and concluding d 28. Feces and urine were collected on days 21 to 30. In addition, blood samples were collected on days 21 to 30 for analysis of plasma urea.

Data were analyzed as an incomplete 7 × 4 Latin square. The model for intake and digestibility data included period and treatment. The model for plasma urea included period, treatment, day, and treatment × day. The same contrasts described in Experiment 1 were used to evaluate treatment effects.

Experiment 3. Eighty-four cows (1231 ± 9 lb; 4.8 ± 0.04 BCS) in the last third of gestation were stratified by age, body condition score, and weight and assigned randomly within stratification to the treatments described in Experiment 1 using a Randomized Complete Block design. Soybean meal was used as the source of supplemental CP (51.7% CP). The cows were then sorted by treatment and allotted randomly to 1 of 21 pens. The greater level of CP was, on a daily basis, 0.525 lb CP/hd and the lower level was 50% of the greater level.
Supplements were provided through calving. Cows had continuous access to water, salt, and a vitamin/mineral mix. They were offered ad libitum access to low-quality grass seed straw (2.4% CP) at 0800 daily.

Cow weight and BCS were measured every 14 days until calving and within 24 hours after calving. In addition, calf weights were obtained within 24 hours of birth.

Data were analyzed as a Randomized Complete Block. The model included block, treatment, and Block × treatment. The same contrasts described in Experiment 1 were used to evaluate treatment effects.

Results
Experiment 1. Hay ($P = 0.03$) and total ($P < 0.01$) intake increased with CP supplementation; however, we noted a linear effect of CP amount × supplementation frequency interaction ($P = 0.02$) for both hay and total intake, with intake decreasing almost 17% from daily to once every10 days with Full CP supplementation compared with essentially no reduction with Half CP (Table 2). Digestibility was not altered by CP supplementation ($P = 0.10$) but it increased quadratically ($P < 0.01$) as the supplementation interval increased. Fiber digestibility (neutral detergent fiber) was not affected by treatments ($P > 0.12$).
Ruminal particulate fill was not affected by treatments on the day all supplements were provided ($P > 0.31$; Table 3); however, when only daily supplements were provided, ruminal particulate fill was greater ($P = 0.03$) with CP supplementation. Also, ruminal particulate passage rate was increased with CP supplementation ($P > 0.03$).

A day × treatment interaction ($P < 0.01$) was noted for plasma urea (Figure 1); however, after evaluating the nature of the responses we decided to provide the day × treatment figure and discuss overall treatment means. Plasma urea increased with CP supplementation ($P < 0.01$; Table 2) and was greater with Full CP compared with Half CP ($P < 0.01$).

Ruminal pH decreased linearly as supplementation frequency decreased ($P < 0.01$) when all supplements were provided; however no affect was noted when only daily supplements were provided ($P > 0.22$).

A time × treatment interaction ($P < 0.01$) was noted for ruminal ammonia when all supplements were provided (Figure 2); however, after evaluating the nature of the responses we decided to provide the time × treatment figure and discuss overall treatment means. Ruminal ammonia increased with CP supplementation when all supplements were provided and was greater with Full CP compared with Half CP ($P < 0.01$). However, a linear effect of CP amount × supplementation frequency interaction ($P = 0.02$) was observed with ruminal ammonia increasing 400% from daily to once every10 days with Full CP supplementation compared with approximately 300% with Half CP (Table 3; Figure 2). When only daily supplements were provided, we noted no CP supplementation effect ($P = .44$) or difference between Full CP and Half CP ($P = .64$); nevertheless, ruminal ammonia decreased as supplementation frequency decreased ($P < 0.01$).

Experiment 2. Hay and total intake were not affected ($P > 0.25$) by CP supplementation. However, similar to Experiment 1, a tendency for a linear effect of CP amount × supplementation frequency interaction ($P \leq 0.09$) was noted for both hay and total intake, with intake decreasing over 30% from daily to once every10 days with Full CP supplementation compared with less than 10% with Half CP (Table 4).

Digestibility was increased 19% with CP supplementation ($P < 0.01$) and also increased ($P = 0.04$) as the supplementation interval increased. No difference in digestibility was noted between Full CP and Half CP ($P = 0.28$). As with intake, fiber digestibility (neutral detergent fiber) was increased ($P = 0.02$) almost 10% with CP supplementation. Also, fiber digestibility increased 11% as supplementation frequency decreased from daily to once every 10 days with Full CP compared with a 3% decrease with Half CP ($P = 0.04$).

Crude protein intake increased with CP supplementation ($P < 0.01$), for Full CP compared with Half CP ($P < 0.01$), and decreased as supplementation interval increased ($P = 0.04$). Digestibility of CP was increased greater than 300% with CP supplementation ($P < 0.01$), 21% greater for Full CP compared with Half CP ($P < 0.01$), and decreased as supplementation interval increased ($P = 0.01$).

The efficiency of CP use, measured as the quantity of digested CP retained in the body, was increased with CP supplementation ($P < 0.01$) but was not affected by amount of supplemental CP ($P = 0.94$) or supplementation frequency ($P > 0.92$) (Table 4).

As with Experiment 1, a day × treatment interaction ($P < 0.01$) was noted for plasma urea (Figure 3); however, after evaluating the nature of the responses we decided to provide the day × treatment figure and discuss overall treatment means. Plasma urea increased with CP supplementation ($P < 0.01$; Table 4) and was greater with Full CP compared with Half CP ($P = 0.03$).

Experiment 3. Pre- and Post-calving weight change by cows was improved with CP supplementation ($P < 0.03$) and for Full CP compared with Half CP ($P < 0.02$; Table 5). However, both pre- and post-calving weight change were negatively affected as supplementation frequency decreased ($P < 0.01$). It is of interest to note that there was less pre-calving weight change as supplementation frequency decreased from daily to once every 10 days for Half CP compared with Full CP ($P = 0.01$). Calf birth weight was not affected by treatment ($P > 0.19$).

Similar to our observations with cow body weight, pre- and post-calving change in BCS was improved with CP supplementation ($P < 0.03$). Also, pre-calving BCS change was improved with Full CP compared with Half CP ($P < 0.01$; Table 5) but negatively affected as supplementation frequency decreased ($P = 0.02$). Also, as with cow weight change, there was less pre-calving BCS change as supplementation frequency decreased for Half CP compared with Full CP ($P = 0.05$).

Conclusions
Reducing the amount of supplemental CP provided to ruminants consuming low-quality forages, when supplementation intervals are greater than 5 or 6 days, can be a management tool to maintain acceptable levels of intake, digestibility, and cow performance while reducing supplement cost.

Acknowledgements
This research study was funded by the Oregon Beef Council and the Agricultural Research Foundation. We would like to thank Lynn Carlon, Tony Runnels, Aaron Kennedy, Skip Nyman, Maria Reis, Felipe Sanches, and Flavia Cooke for their assistance in this study.

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Figure 1. Effect of protein amount and supplementation frequency on plasma urea nitrogen in steers. Columns from left to right for each treatment represent day 1, 2, 3, 4, 5, 6, 7, 8, 9, and 10 of a 10-day supplementation period, respectively. Treatments were: Control; D = 0.133% of body weight/day of soybean meal (SBM); 5D = 0.665% of body weight of SBM once every 5 days; 10D = 1.33% of body weight of SBM once every 10 days; 50% D = 50% of the D treatment; 50% 5D = 50% of the 5D treatment; 50% 10D = 50% of the 10D treatment. Each column with an S below it represents a supplementation day.

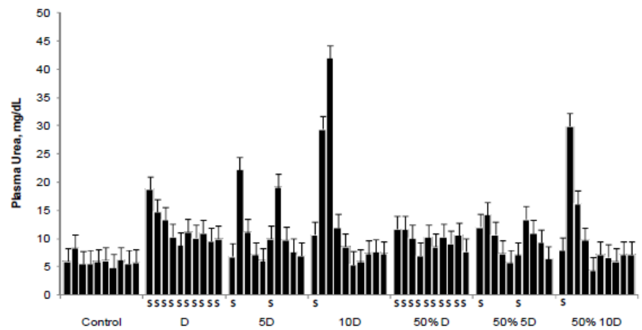

Figure 2. Effect of protein amount and supplementation frequency on steer ruminal ammonia N the day all supplements were provided. Columns from left to right for each treatment represent 0, 3, 6, 9, 12, 18, and 24 hours post-feeding, respectively. Treatments were: Control; D = 0.133% of body weight/day of soybean meal (SBM); 5D = 0.665% of body weight of SBM once every 5 days; 10D = 1.33% of body weight of SBM once every 10 days; 50% D = 50% of the D treatment; 50% 5D = 50% of the 5D treatment; 50% 10D = 50% of the 10D treatment.

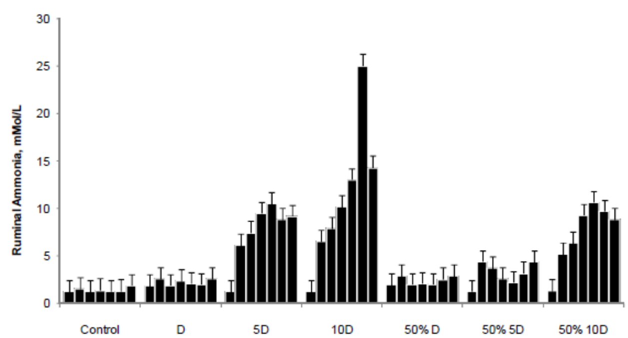

Figure 3. Effect of protein amount and supplementation frequency on plasma urea nitrogen in lambs. Columns from left to right for each treatment represent day 1, 2, 3, 4, 5, 6, 7, 8, 9, and 10 of a 10-day supplementation period, respectively. Treatments were: Control; D = 0.133% of body weight/day of soybean meal (SBM); 5D = 0.665% of body weight of SBM once every 5 days; 10D = 1.33% of body weight of SBM once every 10 days; 50% D = 50% of the D treatment; 50% 5D = 50% of the 5D treatment; 50% 10D = 50% of the 10D treatment. Each column with an S below it represents a supplementation day.

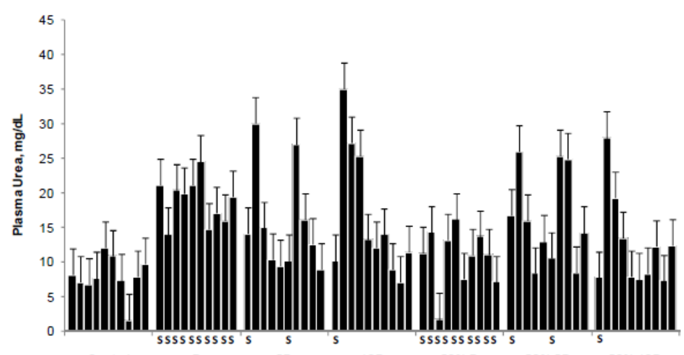

Table 1. Estimated cost of treatments over a 30-day Period. One pound of soybean meal (SBM), daily, was used as the basis to compare all other treatments.

	1 pound of Soybean Meal/head			1/2 pound of Soybean Meal/head		
	Daily	5 Days	10 Days	Daily	5 Days	10 Days
Fuel Cost ($)[a]	360.00	72.00	36.00	360.00	72.00	36.00
Labor Cost($)[b]	630.00	126.00	63.00	630.00	126.00	63.00
Supplement Cost ($)[c]	1,485.00	1,485.00	1,485.00	742.50	742.50	742.50
Total Cost ($)	2,475.00	1,683.00	1,584.00	1732.50	940.50	841.50
Labor/Fuel Cost Reduction	0	80%	90%	0	80%	90%
Supplement Cost Reduction	0	0	0	50%	50%	50%
Total Cost Reduction	0	32%	36%	30%	62%	66%
Total Benefit ($)	0	792.00	891.00	742.50	1,534.50	1633.50

[a] Fuel costs calculated as 3 gallons/supplementation day at $4.00/gallon
[b] Labor calculated as 2.5 hours/supplementation day at $8.40/hour
[c] Assuming 300 cow herd; cost of $330/ton

Table 2. Effect of CP amount (soybean meal; SBM) and supplementation frequency on intake, diet digestibility, and plasma urea in steers

	Treatment[a]								P-Value[c]					
	Con	D	5D	10D	50% D	50% 5D	50% 10D	SEM[b]	Con vs Supp	Full vs Half	L Freq	Q Freq	L Freq vs Amt	Q Freq vs Amt
Hay intake, % body weight	1.61	1.96	1.92	1.62	1.76	1.70	1.75	0.075	0.03	0.08	0.02	0.52	0.02	0.14
SBM intake, % body weight	0.000	0.133	0.133	0.133	0.067	0.067	0.067							
Total Intake, % body weight	1.61	2.10	2.05	1.76	1.83	1.77	1.81	0.075	< 0.01	< 0.01	0.02	0.52	0.02	0.14
Diet Digestibility, %	45.0	45.8	44.7	48.6	45.7	45.1	47.3	0.86	0.10	0.57	< 0.01	< 0.01	0.39	0.34
NDF Digestibility, %	48.2	47.5	46.2	49.0	47.8	47.4	48.5	1.03	0.64	0.68	0.26	0.12	0.69	0.48
Plasma Urea, mg/dL	6.0	11.8	10.7	13.6	9.7	9.7	10.2	0.72	<0.01	<0.01	0.10	0.07	0.38	0.16

[a] CON = control; D = 0.133 % body weight/day of SBM; 5D = 0.665% body weight of SBM once every 5 days; 10D = 1.33% body weight of SBM once every 10 days; 50% D = 50% of the D treatment; 50% 5D = 50% of the 5D treatment; 50% 10D = 50% of the 10D treatment.
[b] n = 4.
[c] Con vs Supp = control vs supplemented treatments; Full vs Half = full vs half amount of CP; L Freq = linear effect of supplementation frequency; Q SF = quadratic effect of supplementation frequency; L Freq vs Amt = interaction of the linear effect of supplementation frequency and amount of CP; Q Freq vs Amt = interaction of the quadratic effect of supplementation frequency and amount of CP.

Table 3. Ruminal particulate fill and ammonia concentration on the day of supplementation for all supplemented treatments and, other than daily treatments, the day before supplementation in steers

	Treatment[a]								P-value[c]					
	Con	D	5D	10D	50% D	50% 5D	50% 10D	SEM[b]	Con vs Supp	Full vs Half	L Freq	Q Freq	L Freq vs Amt	Q Freq vs Amt
Day of Supplementation	1.61	1.96	1.92	1.62	1.76	1.70	1.75	0.075	0.03	0.08	0.02	0.52	0.02	0.14
Particulate Fill, % BW	0.90	1.02	1.07	0.99	0.95	0.89	0.89	0.04	0.20	< 0.01	0.30	0.63	0.77	0.25
Particulate Passage rate, %/h	1.92	2.03	1.97	1.87	2.02	2.18	1.99	0.126	0.50	0.31	0.44	0.38	0.58	0.48
pH	6.7	6.7	6.6	6.4	6.9	6.6	6.6	0.09	0.33	0.07	0.01	0.66	0.90	0.22
Ammonia, mMol/L	1.4	2.2	7.6	11.2	2.4	3.1	7.4	0.78	<0.01	<0.01	<0.01	0.52	0.02	0.07
Day Before Supplementation														
Particulate Fill, % BW	0.97	1.09	1.01	1.02	0.95	0.91	0.90	0.06	0.85	0.02	0.34	0.55	0.88	0.75
Particulate Passage rate, %/h	1.54	1.92	2.01	1.77	1.86	1.91	1.97	0.144	0.03	0.90	0.92	0.52	0.38	0.52
pH	6.7	6.7	6.9	6.8	6.8	6.8	6.9	0.06	0.25	0.54	0.23	0.51	0.79	0.25
Ammonia, mMol/L	1.1	2.0	1.2	0.8	1.5	1.2	1.1	0.24	0.44	0.64	<0.01	0.38	0.10	0.81

[a] CON = control; D = 0.133 % body weight/day of soybean meal (SBM); 5D = 0.665% of body weight of SBM once every 5 days; 10D = 1.33% of body weight of SBM once every 10 days; 50% D = 50% of the D treatment; 50% 5D = 50% of the 5D treatment; 50% 10D = 50% of the 10D treatment.
[b] n = 4.
[c] Con vs Supp = control vs supplemented treatments; Full vs Half = full vs half amount of CP; L Freq = linear effect of supplementation frequency; Q SF = quadratic effect of supplementation frequency; L Freq vs Amt = interaction of the linear effect of supplementation frequency and amount of CP; Q Freq vs Amt = interaction of the quadratic effect of supplementation frequency and amount of CP.

Table 4. Effect of CP amount (soybean meal; SBM) and supplementation frequency on intake and diet digestibility by lambs

	Treatment[a]								P-Value[c]					
	Con	D	5D	10D	50% D	50% 5D	50% 10D	SEM[b]	Con vs Supp	Full vs Half	L Freq	Q Freq	L Freq vs Amt	Q Freq vs Amt
Hay intake, % body weight	1.88	2.16	1.95	1.40	2.02	1.93	1.87	0.173	0.97	0.45	0.02	0.60	0.08	0.52
SBM intake, % body weight	0.000	0.280	0.280	0.280	0.140	0.140	0.140							
Total Intake, % body weight	1.88	2.44	2.23	1.68	2.16	2.07	2.01	0.173	0.26	0.80	0.02	0.60	0.09	0.54
Diet Digestibility, %	37.4	40.6	45.7	49.6	43.5	43.5	43.5	1.98	<0.01	0.28	0.04	0.86	0.04	0.87
NDF Digestibility, %	42.2	43.6	46.9	48.6	46.0	45.7	44.7	1.39	0.02	0.43	0.19	0.64	0.04	0.86
CP Intake, % body weight	0.092	0.240	0.230	0.205	0.165	0.165	0.160	0.0092	<0.01	<0.01	0.04	0.54	0.12	0.75
CP Digestibility, %	12.2	49.5	58.4	65.8	45.5	48.9	48.4	3.40	<0.01	<0.01	0.01	0.67	0.07	0.85
Efficiency of CP Use, %[d]	-461	22	18	4	12	2	7	120	<0.01	0.94	0.92	0.99	0.96	0.95
Plasma Urea, mg/dL	9.0	18.9	15.4	16.5	11.7	16.4	12.4	1.73	<0.01	0.03	0.63	0.51	0.39	0.04

[a] CON = control; D = 0.280% of body weight/day of SBM; 5D = 1.4% of body weight of SBM once every 5 days; 10D = 2.8% of body weight of SBM once every 10 days; 50% D = 50% of the D treatment; 50% 5D = 50% of the 5D treatment; 50% 10D = 50% of the 10D treatment.
[b] n = 4.
[c] Con vs Supp = control vs supplemented treatments; Full vs Half = full vs half amount of CP; L Freq = linear effect of supplementation frequency; Q SF = quadratic effect of supplementation frequency; L Freq vs Amt = interaction of the linear effect of supplementation frequency and amount of CP; Q Freq vs Amt = interaction of the quadratic effect of supplementation frequency and amount of CP.
[d] Measured as the quantity of digested CP retained in the body.

Table 5. Effect of CP amount (soybean meal; SBM) and supplementation frequency on performance of cows in the last third of gestation

	Treatment[a]								P-Value[c]					
	Con	D	5D	10D	50% D	50% 5D	50% 10D	SEM[b]	Con vs Supp	Full vs Half	L Freq	Q Freq	L Freq vs Amt	Q Freq vs Amt
Body Weight														
Initial, lb	1240	1241	1217	1231	1175	1260	1250	24.5	0.66	0.93	0.17	0.47	0.08	0.10
Pre-Calving[d], lb	1216	1311	1270	1227	1199	1265	1264	28.3	0.16	0.22	0.73	0.45	< 0.01	0.47
Post-Calving[e], lb	1085	1179	1113	1115	1080	1123	1106	23.9	0.17	0.09	0.44	0.91	0.07	0.12
Pre-Calving Change, lb	-23	70	53	-4	24	6	15	12.7	<.001	0.01	< 0.01	0.76	0.01	0.11
Post-Calving Change, lb	-155	-62	-104	-116	-95	-137	-143	15.1	< 0.01	< 0.01	<.001	0.18	0.87	0.90
BCS														
Initial	4.8	4.8	4.8	4.8	4.8	4.8	4.9	0.07	0.49	0.66	0.73	0.51	0.76	0.47
Pre-Calving	4.4	4.9	4.8	4.6	4.6	4.6	4.6	0.10	0.02	0.05	0.08	0.97	0.06	0.51
Post-Calving BCS	4.1	4.6	4.6	4.4	4.5	4.4	4.4	0.09	<.001	0.34	0.14	0.61	0.21	0.51
Pre-Calving BCS	-0.4	0.1	0.0	-0.3	-0.2	-0.2	-0.3	0.09	0.027	< 0.01	0.02	0.53	0.05	0.90
Post-Calving BCS	-0.6	-0.2	-0.3	-0.5	-0.4	-0.4	-0.5	0.11	0.009	0.26	0.13	0.38	0.40	0.96

[a] CON = control; D = 1.02 lb/head of SBM daily; 5D = 5.1 lb/head of SBM once every 5 days; 10D = 10.2 lb/head of SBM once every 10 days; 50% D = 50% of the D treatment; 50% 5D = 50% of the 5D treatment; 50% 10D = 50% of the 10D treatment.
[b] n = 4.
[c] Con vs Supp = control vs supplemented treatments; Full vs Half = full vs half amount of CP; L Freq = linear effect of supplementation frequency; Q SF = quadratic effect of supplementation frequency; L Freq vs Amt = interaction of the linear effect of supplementation frequency and amount of CP; Q Freq vs Amt = interaction of the quadratic effect of supplementation frequency and amount of CP.
[d] Measured within 14 days prior to calving.
[e] Measured within 24 hours after calving.

The Importance of Maintaining Structure to Ring-necked Pheasant and Waterfowl Production in the Upper Great Plains

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Introduction

Privately owned lands serve a crucial role in maintaining wildlife populations. Perhaps that is because approximately 60 percent of the land in the United States is privately owned (Lubowski et al. 2006). While many private landowners are aware that how they use their lands will impact wildlife, some private landowners are looking for ways to maintain wildlife populations at increased levels for both aesthetic and economical purposes. In recent years, expenditures associated with hunting have boosted many local economies as well as benefiting private landowners (Benson, 1989; Das and Rainey, 2009). As such, landowners who are concerned with both agriculture and wildlife on their lands continue to search for land uses that will remain profitable with respect to agriculture, but will also benefit wildlife species of interest. For an agricultural land use to be acceptable to wildlife it must result in land that provides at least one requirement for a given wildlife species. The following paper will focus on the ability of various land uses to provide "structure" for ring-necked pheasant (*Phasianus colchicus*) and a variety of upland nesting waterfowl species during the nesting season in the Upper Great Plains.

Defining Structure

Managing wildlife populations often requires managers and landowners to be concerned with meeting all requirements of a given wildlife species throughout the entire year. For example, ring-necked pheasant generally occupy a relatively small home range (Hill, 1985; Whiteside and Guthery, 1983), so it is not difficult to imagine that one landowner may own all of the land that an individual pheasant will occupy throughout its entire life cycle. As such, the land base will need to provide suitable habitat throughout all four seasons. In contrast, upland nesting waterfowl may return to the Northern Great Plains to raise young and then return south for the winter months. Thus it is important to provide suitable nesting and brood rearing habitat for waterfowl in the Upper Great Plains, but not necessarily habitat for the rest of the year. The production period for ring-necked pheasant and waterfowl, similar to livestock, is a very critical time for maintaining or growing populations and poor production can often result in significant reductions in population levels. While landowners and managers can provide habitat crucial for production, weather can also play a role in how successful a nesting season will be with respect to ring-necked pheasant and waterfowl production (Snyder 1984). However, since managers generally have little control over the weather, it is beneficial for landowner managers to provide high quality habitat that will facilitate high production rates under ideal climatic conditions.

Numerous wildlife studies have evaluated the characteristics that occur around nests of upland nesting bird species (Camp and Best, 1994; Duebbert and Kantrud, 1974; Fondell and Ball 2004). While structure can include species composition, for the purpose of this paper we will define structure as the height and density (visual obstruction) of the vegetation that occurs immediately at the nest bowl. Ring-necked pheasant and most species of upland nesting waterfowl initiate nesting prior to the on-set of heavy new growth, therefore, residual structure maintained from previous years growth is often thought to be an important attribute of nesting cover (Snyder 1984). Management agencies and scientist often employ the Robel pole (Robel et al. 1970) to gain visual obstruction readings (VOR) as a means to measure structure or residual cover. While the Robel pole was initially constructed to correlate the weight of vegetation to vegetation height and density (Robel et al. 1970), it has been used extensively by wildlife managers and researchers in rangeland management and studies of numerous wildlife species (Fondell and Ball, 2004; Snyder 1984).

Land Use, Structure, and Ring-necked Pheasant and Waterfowl Production

Fondell and Ball (2004) reported higher densities of mallard (*Anus platyrhynchos*), northern shoveler (*A. clypeata*), cinnamon teal (*A. cyanoptera*), gadwall (*A. strepera*), and ring-necked pheasant in ungrazed plots versus those grazed in Montana. Grazing tended to reduce available structure and in return reduced the number of acceptable nesting sites. However, within grazed and ungrazed plots waterfowl and ring-necked pheasant generally selected sites for nesting that were similar to one another from within a wide range of structure which could be found in each plot. This may suggest that ring-necked pheasant and waterfowl have a threshold level of structure required for nesting; when structure values dip below this unknown level at a particular micro-site, is no longer suitable as nesting cover. However, this also implies that it is not a requirement for 100% of the landscape to be at the threshold level, as a patchwork of suitable habitat intermixed with below threshold VOR’s may still provide the needed structure to initiate nesting. VOR at ring-necked pheasant nests averaged 9.45 inches, while VOR at mallard, northern shoveler, cinnamon teal, and gadwall nests averaged 10.23, 9.05, 8.66, and 11.81 inches; respectively (Fondell and Ball 2004).

Ring-necked pheasant and waterfowl generally select areas of permanent cover as nest sites, however, in some regions of the United States winter wheat has been found to provide the majority of available nesting cover for ring-necked pheasants (Snyder 1984). In northeastern Colorado, Snyder (1984) reported higher VOR’s for winter wheat stubble and new growth (3.25 inches) compared to perennial grass stands (1.85 inches) over a three year period. Ring-necked pheasant initiated a total of 88 nests in green wheat, old stubble, and new stubble, with 14 nests initiated in undisturbed cover. While wheat stubble and new growth was attractive to ring-necked pheasant, perhaps due to the increased availability of structure, farming practices associated with winter wheat production and predation lowered the success rate (49%) of nests below that which occurred for nests found in undisturbed cover (64%).

Beginning in 1986 and continuing today, Conservation Reserve Program (CRP) grasslands have provided a secure source of nesting cover for many grassland birds (Reynolds et al., 1994). CRP enrollment peaked in 2007 at approximately 36.7 million acres and has declined since (United States Department of Agriculture, 2011). CRP participation has been substantial in the Upper Great Plains, but with increasing returns on crop production as well as limited federal budgets, CRP enrollment in the Great Plains has declined across the Upper Great

Plains since 2007 (United States Department of Agriculture, 2011), and the trend is expected to continue.

The North Dakota State University Hettinger Research Extension Center evaluated the ability of a multiple land use management system to produce both agricultural and wildlife outputs on lands previously enrolled in CRP. Two, 640 acre blocks of land formally enrolled in CRP were used for the research sites. We randomly applied a 320 acres season long grazing pasture to each block which was grazed from approximately 1 June until 1 January by 32 to 38 cow calf pairs. We randomly assigned 80 acres of each block to a one-cutting hay production system with forage generally being harvested in late June or early July. Eighty acres of no-till barley was planted on each block annually and was baled in mid-July with another 80 acres planted to corn which was left standing and grazed from 1 January until 15 April. Our final land use consisted of leaving 80 acres within each block idle in an attempt to maintain wildlife habitat in the form of continued CRP enrollment.

We located and monitored nests of upland nesting waterfowl and ring-necked pheasant from 2007 to 2010 on the post-CRP lands. Upon locating a nest, we collected a Robel pole reading (VOR) immediately north of the nest bowl to determine vegetation structure being selected for by nesting ring-necked pheasant and waterfowl. We collected Robel pole readings (VOR) at random sites to access differences within each land use between nest sites and random locations. For the purpose of this paper, the VOR gathered at each nest bowl was considered a "used" site versus those VORs collected at random points which were considered "available" sites.

From 2007 to 2010, we monitored 142 ring-necked pheasant nests and 229 nests belonging to waterfowl. Common waterfowl species nesting on the research blocks include mallard, gadwall, northern shoveler, and northern pintail (*A. acuta*). Ring-necked pheasant and waterfowl primarily selected areas of permanent cover as nest sites with densities of pheasant nests ranging from a high of 16 nests/250 acres in idle land to a low of 0 nests/250 acres in no-till corn (Table 1). Similarly, densities of waterfowl nests were highest in idle land (24 nests/250 acres) and lowest in no-till barley (0 nests/250 acres; Table 2).

Table 1. Ring-necked pheasant nest density and success on Post-Conservation Reserve Program lands

Treatments	**Nest Density (Nests/250 Acres)** ***P = 0.009****	**Nest Success (Mayfield)** ***P = 0.21***
No-till Barley	0^{b}	NA
No-till Corn	0^{b}	NA
Hay	4^{ab}	NA
Season Long Pasture	8^{a}	33
Idle	16^{a}	46

[*] values with different superscripts are significantly different

Approximately 32 percent of all ring-necked pheasant nests were abandoned throughout the time of our research trial and were not included for calculating nest success. We did not have enough active nests to allow us to calculate Mayfield (1969) nest success for ring-necked pheasant in hay, no-till corn, and no-till barley treatments. We were unable to calculate Mayfield nest success for waterfowl in the no-till corn and no-till barley land uses due to lack of nesting attempts. Although not significant, ring-necked pheasant nests experienced a higher Mayfield success rate in idle land use over those that were initiated in season long pastures (Table 1). In contrast, nest success was slightly greater, although not significant, in season long pastures over idle lands for waterfowl nests (Table 2).

Table 2. Waterfowl nest density and success on Post-Conservation Reserve Program lands

Treatments	**Nest Density (Nests/250 Acres)** ***P = 0.001****	**Nest Success (Mayfield)** ***P = 0.42***
No-till Barley	0^{c}	NA
No-till Corn	0.7^{c}	NA
Hay	7^{b}	30
Season Long Pasture	13^{ab}	56
Idle	24^{a}	51

* values with different superscripts are significantly different

Due to the presence of few nests in the no-till barley, no-till corn, and hay, we were only able to compare nest sites to available sites with respect to VOR in the season long pastures and idle lands for both ring-necked pheasant and ducks. Unit odds ratios indicated that nest sites of ring-necked pheasant within the season long pastures had greater structure than available sites (odds ratio ≥3.50; Table 3). Visual obstruction readings or structure averaged 7.8 inches at nest sites and 4.2 inches at available sites. Unit odds ratios indicate that nest sites of ring-necked pheasant within idle lands had greater structure (8.7 inches) than available sites (7.1 inches; odds ratio ≥2.10; Table 3).

Waterfowl tended to select nest sites with greater structure than was found at random available sites within the season long pastures (odds ratio ≥4.45; Table 4). Similarly, waterfowl nest sites had greater structure within idle lands than occurred at available sites (odds ratio ≥ 1.95). Structure at waterfowl nest sites averaged 9.1 inches and 10.0 inches in season long pastures and idle lands, respectively. In contrast, structure at available sites averaged 4.5 inches in season long pastures and 7.9 inches in idle lands.

Table 3. Univariate tests, unit odds ratios (UOR) and 95% confidence intervals (95% CI) from logistic regressions comparing structure at nest sites versus random points for ring-necked pheasant				
Treatment	X^2	*P* value	UOR[a]	95% CI
Season Long	46.93	<.0001	3.49	2.44-5.00
Idle	7.35	0.0067	2.099	1.23-3.59
[a] UOR ≥ 1 indicates a positive relationship				

Table 4. Univariate tests, unit odds ratios (UOR) and 95% confidence intervals (95% CI) from logistic regressions comparing structure at nest sites versus random points for waterfowl				
Treatment	X^2	*P* value	UOR[a]	95% CI
Season Long	70.33	<.0001	4.45	3.14-6.31
Idle	8.65	0.0033	1.95	1.25-3.03
[a] UOR ≥ 1 indicates a positive relationship				

Management to Provide Structure for Nesting Ring-necked Pheasants and Waterfowl

Based on our findings, regardless of land use, managers and landowners must be aware of retaining structure on their lands during the initiation of nesting by ring-necked pheasant and waterfowl. Our data further support previous findings that when available, pheasants and ducks prefer to nest in areas of permanent cover. However, based on findings by Snyder (1984), where permanent cover is not an option ring-necked pheasant will nest in winter wheat providing structure is available. In contrast to winter wheat stubble, based on our findings, barley stubble generally does not provide the required structure during nest initiation to facilitate nesting by ring-necked pheasant. Our findings suggest the importance of leaving some areas of increased structure following the completion of grazing by livestock. While the density of ring-necked pheasant and waterfowl nests was greater in idle lands over those grazed in a season long system, birds did continue to search out areas of higher structure as nest sites suggesting the importance of maintaining areas of higher structure for production of ring-necked pheasant and upland nesting waterfowl.

Implications

Private landowners are increasingly concerned with wildlife populations that occur on their lands. As such, landowners must be aware of a species needs throughout its time on their lands. The nesting season is a critical time for populations of ring-necked pheasant and waterfowl throughout the Upper Great Plains. Maintaining areas of higher structure appears to influence the density of ring-necked pheasant and waterfowl nests which may occur on the various land uses that tend to occur on private lands. With respect to livestock production, the goal for a landowner that is concerned with livestock production and ring-necked pheasant and waterfowl production should be to maintain a patchwork of areas within pastures that contain high structure. It is important to maintain some structure at the end of the grazing season as those areas of higher structure are likely the ones that will be selected as nest sites by birds in the spring. Our data demonstrates that ring-necked pheasant and waterfowl production is compatible with a proper grazing program, albeit at reduced rates, provided residual vegetation is maintained as structure following the completion of the grazing system. However, tradeoffs may exist between maximizing livestock or wildlife production.

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Potential Economic Effects of Post-CRP Land Management in Southwest North Dakota

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Abstract

The uncertain future of the Conservation Reserve Program has created substantial interest for agricultural producers, rural businesses, community leaders, sportsmen, and wildlife organizations. Many regions of the upper Great Plains have participated heavily in the CRP as evidenced by program acreage reaching land enrollment limits; however, current enrollment and re-enrollment criterion are expected to substantially reduce CRP acreage in many parts of the Great Plains. The divergence of interests between pursing post-CRP lands for agricultural production versus retaining the wildlife habitat and wildlife populations supported on CRP lands presents land owners and agricultural producers with important land management decisions over the next several years. This research examines the regional economic implications of post-CRP land use among traditional agricultural uses, wildlife production, and multiple-use practices. Of particular interest is whether multiple-use management on post-CRP lands can produce similar returns to landowners and producers as traditional land uses, and determine the effects of multiple-use management on post-CRP lands on regional economic output. A multiple-use system implemented on post-CRP lands based primarily on beef grazing while producing corn and barley for forage and retaining a portion of acreage in dedicated wildlife habitat would not compete economically with other conventional land uses. The net change in gross receipts within the regional economy from agricultural uses of post-CRP lands exceeded lost recreational expenditures in all scenarios evaluated.

Key words: North Dakota, Conservation Reserve Program, Recreation, Agriculture, Land Management

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Potential Economic Effects of Post-CRP Land Management in Southwest North Dakota

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Introduction

The Conservation Reserve Program (CRP) is one of several long-term land retirement programs over the last half century that have been an integral part of U.S. farm policy. The primary focus of the program, when enacted in 1985, was to retire marginal and erodible crop land, provide income stability to landowners, bolster supply control efforts, and increase land- and water-based conservation benefits. Subsequent rounds of Federal legislation have emphasized greater environmental and wildlife benefits, reduced average payment rates, and changed enrollment criteria. Despite these changes, the program has remained popular with North Dakota landowners.

Large-scale, long-term land retirement programs produce, to varying degrees, negative effects on those businesses and economic sectors that provide agricultural inputs and services. However, the CRP, by creating substantial wildlife habitat, has helped bolster upland bird, waterfowl, and big game populations and those growing wildlife populations in the 1990s have contributed to increased consumptive and non-consumptive wildlife-based recreation. The net economic effects of decreased agricultural activity and increased recreational activity associated with the CRP have not been thoroughly examined in the United States; although those effects were estimated and discussed for North Dakota in 2002 (Bangsund et al. 2002).

Substantial CRP acreage is scheduled for expiration over the next several years. Questions surrounding the rural economic effects of returning CRP lands to agricultural production have again been raised. After a decade of increased wildlife populations and increased recreational activity associated with the CRP, the issue of multiple use has been proposed as a means to retain some wildlife benefits while providing agricultural revenues to landowners. This paper is part of a larger research effort to examine multiple-use of post CRP lands, post CRP land management objectives of local and non-local land owners, and the potential regional economic effects of post CRP land management.

Procedure

The approach in this study was to examine the differences in regional economic activity between land enrolled in the CRP and various post-CRP land use alternatives. Regional economic activity included changes in revenues and expenditures from agricultural and recreational sources.

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Estimating the changes to regional economic activity involved subtracting the CRP contract payments from the economic activity generated under alternative uses for post-CRP lands. In the case of crop and hay production, the economic activity was based on gross revenues, of which a substantial portion represented production outlays and the remainder represented returns to unpaid labor, management, equity, and land. For lands returning to grazing production, the non-feed expenditures and net returns from an expansion of the region's cow-calf herd were included in the analysis. It was assumed that other feedstocks were already produced in the region and would not count towards a change in regional economic activity. For land dedicated to multiple-use, all expenditures and returns from cow-calf production were included, as well as expenditures for forage production. Net returns were not estimated for forage production in the multiple-use system since all forages produced were matched to an increase in cow-calf operations. Therefore, forage production expenses were charged against the cow calf operation.

Another change in regional economic activity was recreational expenditures for pheasant, deer, and waterfowl hunting. The loss of CRP was expected to have negative effects on hunting participation levels, which in turn would result in less hunting-based expenditures in the regional economy.

Methods

The analysis simulated the changes in regional economic activity for acreage leaving the CRP and for changes in hunting-based expenditures over a ten-year period from 2010 through 2019. The changes in regional economic activity were estimated annually, although the changes in each year included estimating changes for acreage released in prior years.

Study Region

Geographic focus for this paper was a 12-county region in western North Dakota (Figure 1). The 12-county region was part of a larger research effort involving field trials (Geaumont 2009; Sebesta 2010), land ownership patterns (Nudell 2011), and landowner attitudes and issues relating to post-CRP land management (Hodur 2011).

Agricultural Effects

Agricultural use of post-CRP lands included crop production, hay production, and grazing. Multiple use of post-CRP lands included livestock grazing, hay production, and forage production from various annual crops, combined with idled land for wildlife production. Gross revenues, production expenses, and net returns for crop production, hay production, grazing, and multiple-use were projected from 2010 through 2019.

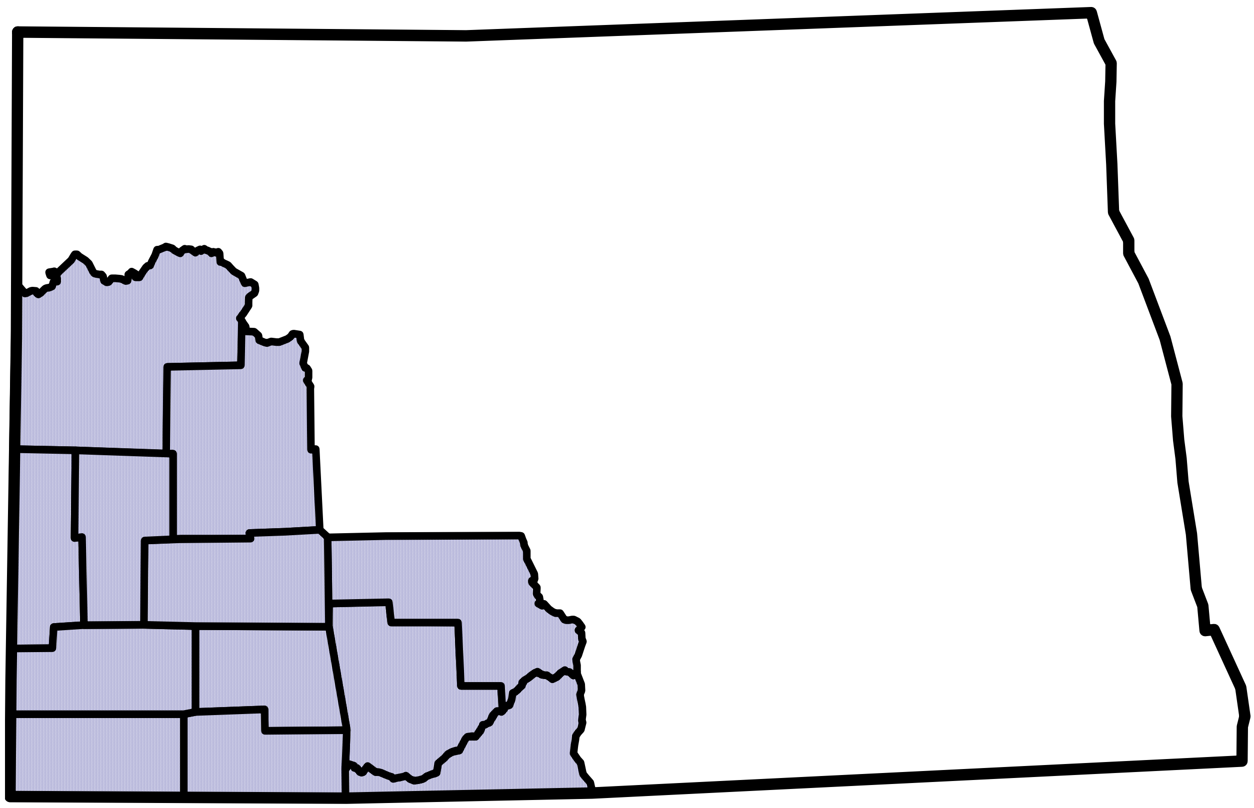

Figure 1. Study Region

Forecasted production expenses, future price expectations, and anticipated future crop yields were used to project net returns for CRP lands returning to crop production. Crops composing 3 percent or more of the region's crop mix over the 2005-2009 period were modeled, and included spring wheat, durum wheat, alfalfa, barely, corn, and sunflowers (North Dakota Agricultural Statistics Service 2010). Future projections of revenues and expenses also were made for post CRP lands placed into hay production or used for grazing. For lands returning to grazing production, the non-feed expenditures and net returns from an expansion of the region's cow-calf herd was included in the analysis. It was assumed that other feedstocks were already produced in the region and would not count towards a change in regional economic activity.

Regression analysis was used on enterprise budget data from 1993 through 2009 to estimate trends in crop yields and expenses (North Dakota Farm and Ranch Business Management 2010). Regression equations were used to project future yields for crops and grass hay. Five-year averages were used when time trends for yields and expenses were not statistically significant. Future crop prices were obtained from Haugen et al. (2011). Future crops were expected to receive government payments per acre equal to the five-year average from 2005 through 2009.

A cow-calf enterprise model was developed using trends for production expenses, calving rates, weaning weights, and other key parameters of cow-calf production based on data for 200-head cow-calf operations in Southwest North Dakota from 1993 through 2009 (North Dakota Farm and Ranch Business Management 2010). Trends in production parameters, future price expectations, and trends in production expenses were used to project net returns from cow-calf enterprises.

Recreational Effects

Projected changes in participation levels for pheasant hunting, deer hunting, and waterfowl hunting were used to estimate changes in recreational expenditures associated with post-CRP land use in the study region. Data on hunter numbers for the study region were obtained from the North Dakota Game and Fish Department (2010). Expenditures by pheasant, waterfowl, and deer hunters were obtained from Bangsund and Leistritz (2003) and adjusted for inflation using the Consumer Price Index.

CRP created wildlife habitat, which resulted in increased wildlife populations (Figure 2). Over the history of the program, hunter participation increased in North Dakota as wildlife populations increased. Reduction in CRP acreage is expected to have the opposite effect on wildlife populations. A key consideration is how hunting participation might be affected under the premise that a loss of CRP acreage eliminates or greatly reduces wildlife populations. Hunter participation in pheasant hunting, the primary hunting activity in the study region, appears to follow bird populations over the last 10-years of the CRP (Figure 3).

Three relationships were postulated to model changes in hunting participation associated with losses of wildlife habitat. Since post-CRP lands could be used in a capacity that retains wildlife habitat, the relationships were based on changes in permanent cover expressed as percentage of 2009 CRP acreage in the study region. The degree of loss in wildlife habitat was a function of post-CRP land management. As wildlife habitat is lost, hunter participation was modeled to also decrease based on a percentage of the average number of hunters in the study region from 2007 through 2009 (Figure 4).

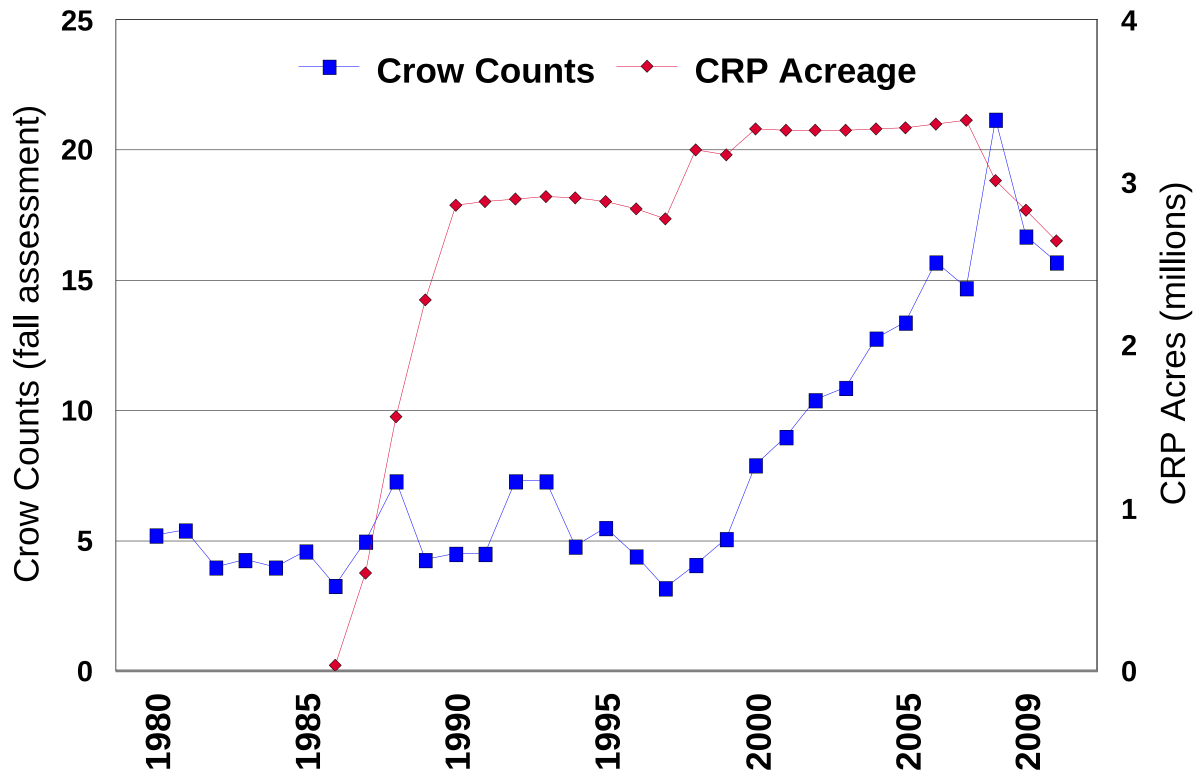

Figure 2. CRP and Pheasant Populations, North Dakota, 1980 to 2009

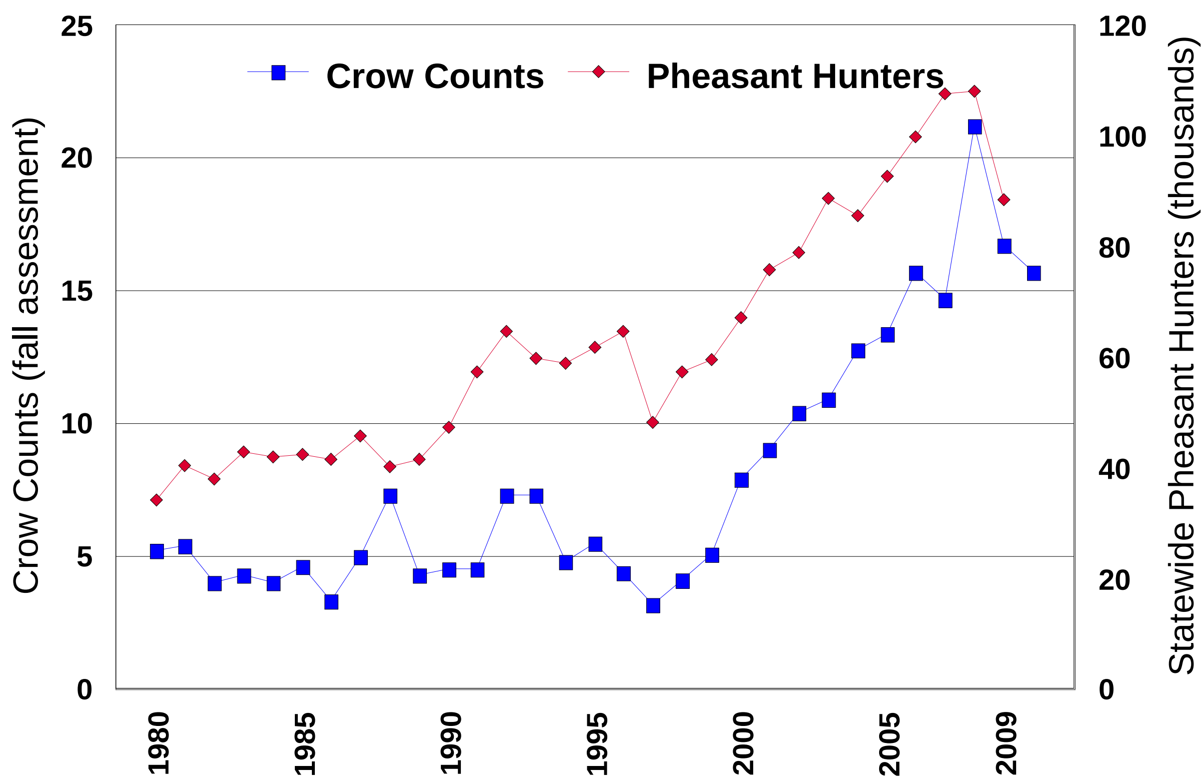

Figure 3. Pheasant Populations and Hunter Participation, North Dakota, 1980 to 2009

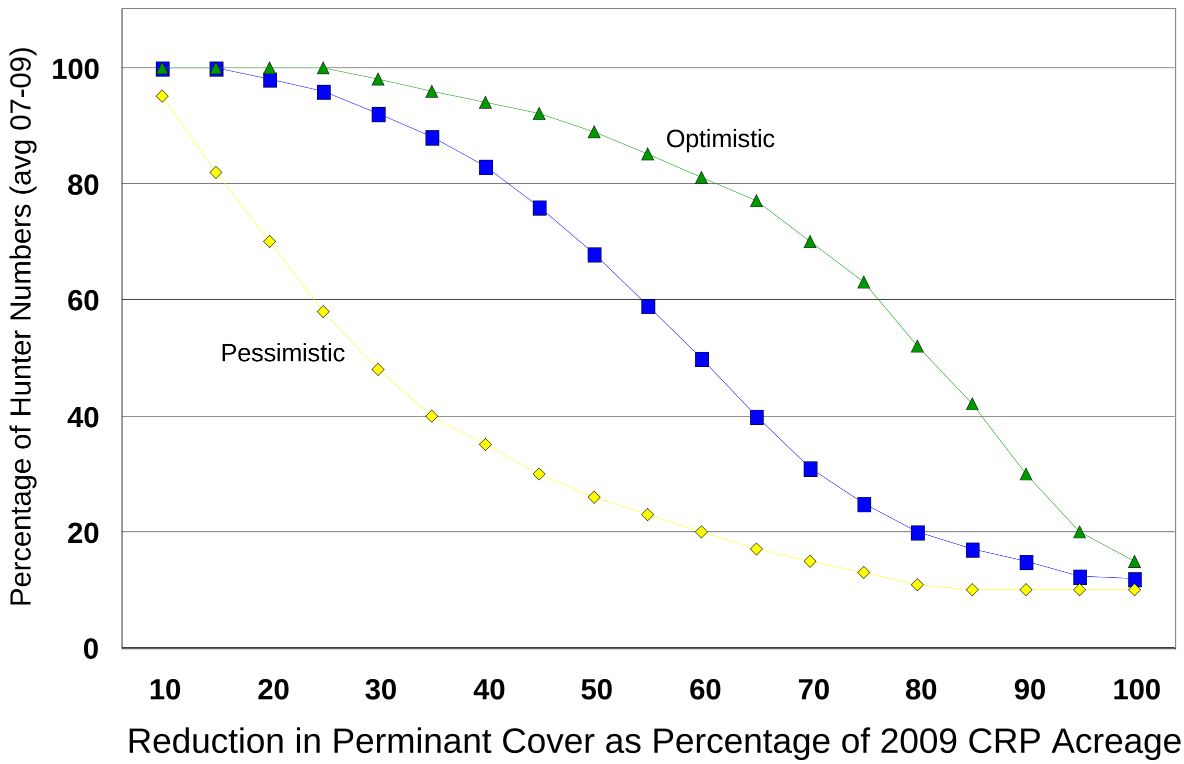

Figure 4. Hunter Participation Response (postulated) to Loss of Conservation Reserve Program Lands, Study Region.

Post-CRP Land Use

Three potential scenarios were examined for post-CRP land use in the study region. The first situation is that all land leaving the CRP would return to crop production. Anecdotal evidence suggests that the majority of land that has came out of the program in recent years is returning to crop production. The second scenario is that post-CRP lands would be managed in multiple-use systems similar to those of the research field trials (Geaumont 2009). In the multiple-use system, 50.4 percent of the land was summer grazed, 24.8 percent was planted to forage crops (corn and barley), 12.4 percent was used for grass hay production, and the remaining 12.4 percent was left in grass for wildlife habitat. The third scenario uses data obtained from a survey of CRP contract holders in North Dakota in 2002 (Hodur et al. 2002). In that survey, CRP contract holders in Adams, Bowman, and Hettinger Counties indicated that land leaving the program would be used for crops (66.7 percent of land), hay (17.4 percent), grazing (10.4 percent), and permanent cover (5.4 percent).

Rate of Loss of CRP Acreage

Considerable uncertainty exists over the future scope and size of the Conservation Reserve Program. Rising commodity prices, federal budget concerns, potentially changing enrollment criteria, and a scheduled new farm bill in 2012 could all influence the future composition of the CRP. A new general sign-up was offered in 2010, the first general enrollment since 2006, in an attempt to address the loss of approximately 4.4 million acres that were scheduled to expire on September 30, 2010 (Farm Service Agency 2011). The result of sign-up number 39 was that net loss of CRP acreage was less than scheduled acreage expirations. Another general sign-up in the beginning months of 2011 was designed to address the potential loss of 14.2 million acres of CRP scheduled to expire in the fall of 2011. In 2010, about 57 percent of the CRP acreage expiring was gained back with new enrollments in the study counties (Farm Service Agency 2011). As a result of the new general sign-ups it is possible that the CRP will not lose acreage as precipitously as forecasted prior to the implementation of new general sign-ups. To account for the uncertainty over the change in program acreage, two scenarios were modeled (Figure 5).

The first scenario reduces CRP acreage in the study counties assuming no additional or new contract acreage. This scenario uses existing contract expirations as the rate of loss of CRP acreage. The second scenario assumes future CRP acreage reductions will be less than contract expirations, and the rate of loss will be approximate to that observed in the general sign-up number 39 (i.e., 57 percent of expiring acreage was added back to the CRP) (Figure 5).

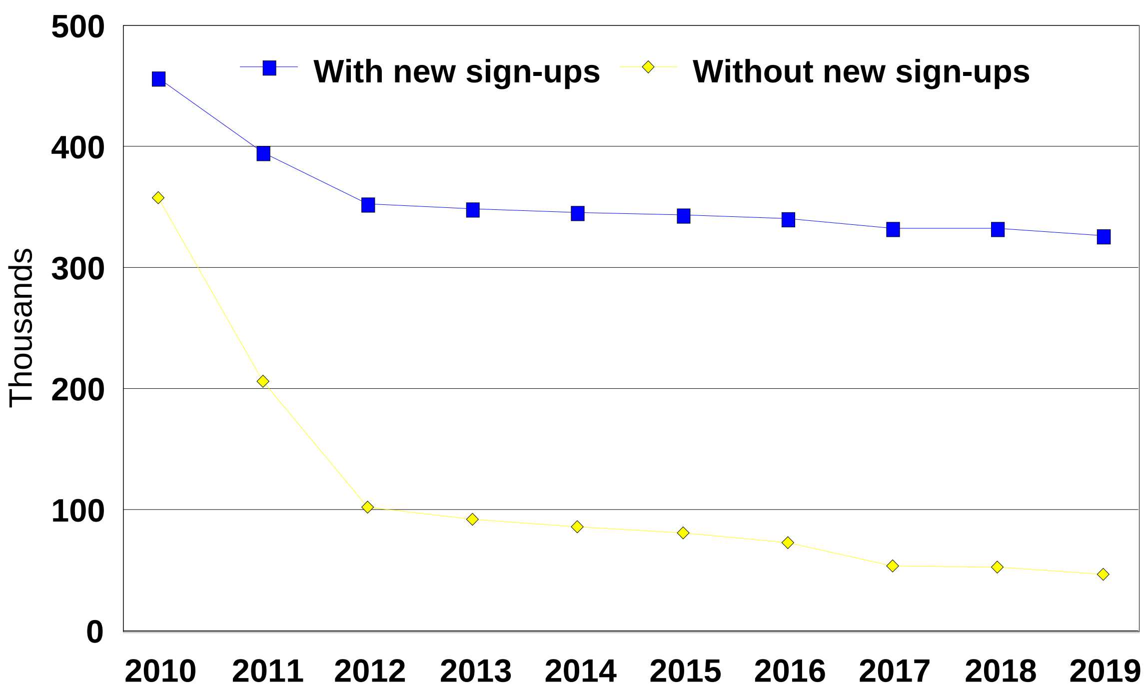

Figure 5. Projected Regional Conservation Reserve Acreage in Study Counties, 2010 Through 2019

Results

The goal of this work was to provide a brief examination of the economic viability of multiple-use of post-CRP lands and examine the regional economic effects of alternative uses of post-CRP lands. The economics of multiple-use were based on producer net returns, whereas the analysis of regional economic effects focused on changes in gross receipts to the region.

Multiple Use of Post-CRP Lands

The economic analysis of multiple-use of post-CRP lands was limited to evaluating a grazing dominated production system described by Geaumont (2009). The ratio of land use in the grazing system was 50.4 percent summer grazed, 24.8 percent forage crops (corn and barley), 12.4 percent grass hay production, and the remaining 12.4 percent left in grass for wildlife habitat. Cattle stocking rates, based on a 640-acre tract, ranged from 30 to 37 cow-calf pairs. Using projections from a 200-head cow herd, the gross revenue per cow was estimated at $696 per year over a five-year period (2010 through 2014). Excluding feed costs, variable and fixed expenses were estimated to be $126 and $64 per cow, respectively, over the five-year period. Net returns, without feed expenses, were estimated at $505 per cow. By comparison, the average annual net return without feed expenses for the 2005 through 2009 period (five-year historic average based on producer enterprise data) was estimated at $333 per cow.

Adjustments to crop production expenditures were made to account for the use of corn and barley as forage for the cow herd. Corn was unharvested, and left standing for the cows to graze/forage for three months after being removed from grazing grass. Also over this period, the cows were allowed to graze the barley stubble. Therefore, harvest, drying, hauling, and some pesticide and crop insurance expenses were eliminated from the production costs for corn. Similar adjustments were made to enterprise budgets for barley. Production expenses were projected at $131 per acre for corn and $109 per acre for barley over the 2010 through 2014 period. Grass hay production was estimated at $30 per acre over the period. Grazing expenses, excluding any development expenses for fencing and water, were estimated at $1.53 per acre. Land charges were excluded from the corn, barley, grass hay, and grazing expenses.

The multiple-use grazing system could be expected to produce $17,668 in revenues from the cow-calf pairs for the 640-acre tract.[2] The expenses for the corn, barley, hay, and grazing were estimated at $21,123, which would produce a negative net return of ($3,455). One of the goals of the multiple-use system was to retain wildlife producing capacities and that hunting-related incomes would be an important consideration in the adoption of a multiple-use system. In order for the multiple-use system to provide returns equal to those likely available from crop production, assuming the entire 640-acre tract was planted to crops, hunting revenues (i.e., leases, fee hunting) would have to exceed $40,000 per year or be equivalent to $63 per acre.

[2]While the stocking rates for the field trials varied from 30 to 37 cow-calf pairs, this analysis assumed 35 cow-calf pairs.

Hunting revenues for landowners/producers are unlikely to provide sufficient additional revenue for multiple-use grazing systems to compete with crop production[3]. Therefore, it is unlikely to expect multiple-use grazing systems, as structured in this study, to be adopted in any meaningful scale on post-CRP land by land owners or producers in the study region.

An additional thought on the multiple-use system in this study was that corn and barley are simply too expensive to be used as dedicated grazing forage for beef cow production. Both crops are considerably more expensive per acre than hay for forage for beef cattle. The multiple-use concept would have benefitted from the sale of grain from the corn and barley stands, or the use of other cash crops within the grazing system to provide some additional revenues to the producer/landowner. Perhaps a system that relied more on aftermath grazing would be more economical.

Regional Economic Implications of Post-CRP Land Use

Land enrolled in the CRP generates a return to landowners in the form of a government payment, and landowners can receive additional revenues through hunting leases or fee hunting activities. In addition to the revenues received by the landowner, hunting activities will result in additional expenditures in the regional economy. Therefore, a combination of program payments and recreational expenditures represent the economic stimuli to the regional economy from the CRP.

Within the study region, post-CRP lands are generally returned to agricultural production (e.g., crop, hay, grazing) or remain in grass and left unharvested (e.g., dedicated wildlife habitat) when land is not re-enrolled or does not qualify for re-enrollment. Regional economic stimuli from post-CRP lands are likely to be based on agricultural revenues, from which production inputs and expenses are paid and a portion remains with the landowner or producer in the form of net returns. While recreational revenues may still be available to landowners when post-CRP land is returned to agricultural production, a larger potential impact to the regional economy may stem from the change in hunter expenditures associated with changes in wildlife populations and hunter participation rates in the region. These changes are expected to occur as wildlife habitat is either lost or greatly reduced when land is converted to agricultural production. Therefore, a tradeoff exists between economic stimuli associated with agricultural production and economic stimuli produced from hunting and/or recreational expenditures.

A number of scenarios was developed to track the potential economic implications of post-CRP land use by examining the amount of land leaving the program, the types of agricultural enterprises adopted on the lands, and the regional consequences to hunter participation rates and expenditures.

Direct impacts were estimated over a 10-year period. However, impacts in years 2 through 10 represented an estimation of the annual effects on post-CRP lands from previous years and impacts on land leaving the program in that year. For example, if 1,000 acres are leaving the program annually over a 10-year period, then the direct impacts in year 1 would

[3]Reference made only to the multiple-use grazing system evaluated in this study.

represent the activities (e.g., crop production, grazing) on the 1,000 acres leaving the program that year. In year 2, the regional impacts would be based on land use on the 1,000 acres leaving the program in year 2 and the activities occurring in year 2 on land that left the program in year 1. Similarly, in year 3, the regional impacts would be based on the activities occurring on the 1,000 acres leaving the program that year and the land use occurring in year 3 on land that left the program in year 1 and year 2.

Gradual CRP Reduction–Mixed Land Use

In this scenario the reduction of CRP land is expected to be less than scheduled expirations. Post-CRP land use is consistent with data obtained from a survey of CRP contract holders in North Dakota in 2002 (Hodur et al. 2002).

In this situation, annual direct effects[4] to the regional economy varied from $7.9 million to $18.2 million (Figure 6). Reductions in recreational activities were relatively minor compared to the gains with agricultural activities. The overall net effect of returning the majority of post-CRP lands to agricultural production was positive in the regional economy.

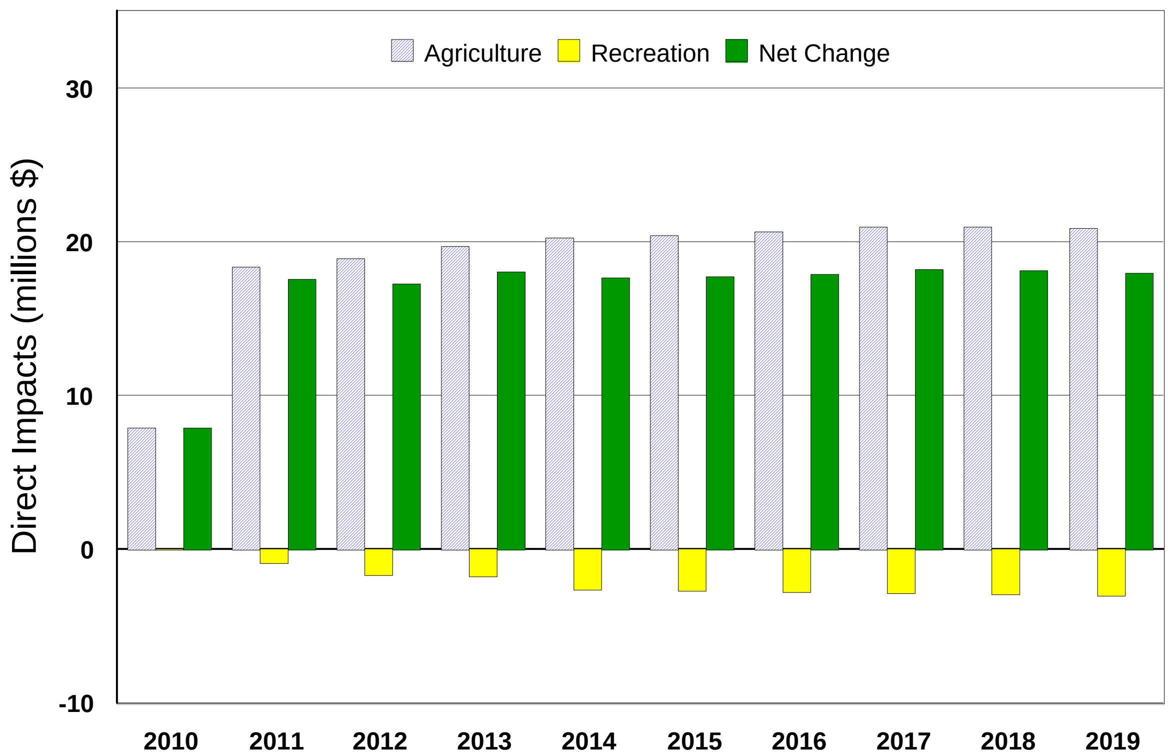

Figure 6. Direct Impacts from Post-CRP land Use in Study Counties Assuming Gradual CRP Reduction and Mixed Use of Post-CRP Lands, 2010 Through 2019

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[4]Impacts can be defined as direct and secondary economic effects. Only direct effects are measured in this study.

Gradual CRP Reduction–Multiple-Use Systems

In this scenario the reduction of CRP land is expected to be less than scheduled expirations. All post-CRP land is modeled to go into multiple-use grazing systems.

In this situation, the direct impacts were relatively minor compared to the other two scenarios. Annual direct effects to the regional economy varied from $2.3 million to $6.1 million (Figure 7). Losses in recreational expenditures were the smallest of the scenarios with a gradual loss of CRP; however, agricultural impacts were considerably smaller than found in the other two scenarios. Multiple-use grazing systems retain the greatest amount of recreational revenues since a greater proportion of CRP lands are retained in wildlife habitat, but multiple-use grazing also produces the lowest amount of agricultural revenues. The net result is that multiple-use results in less direct impact that the scenarios with greater amounts of crop production.

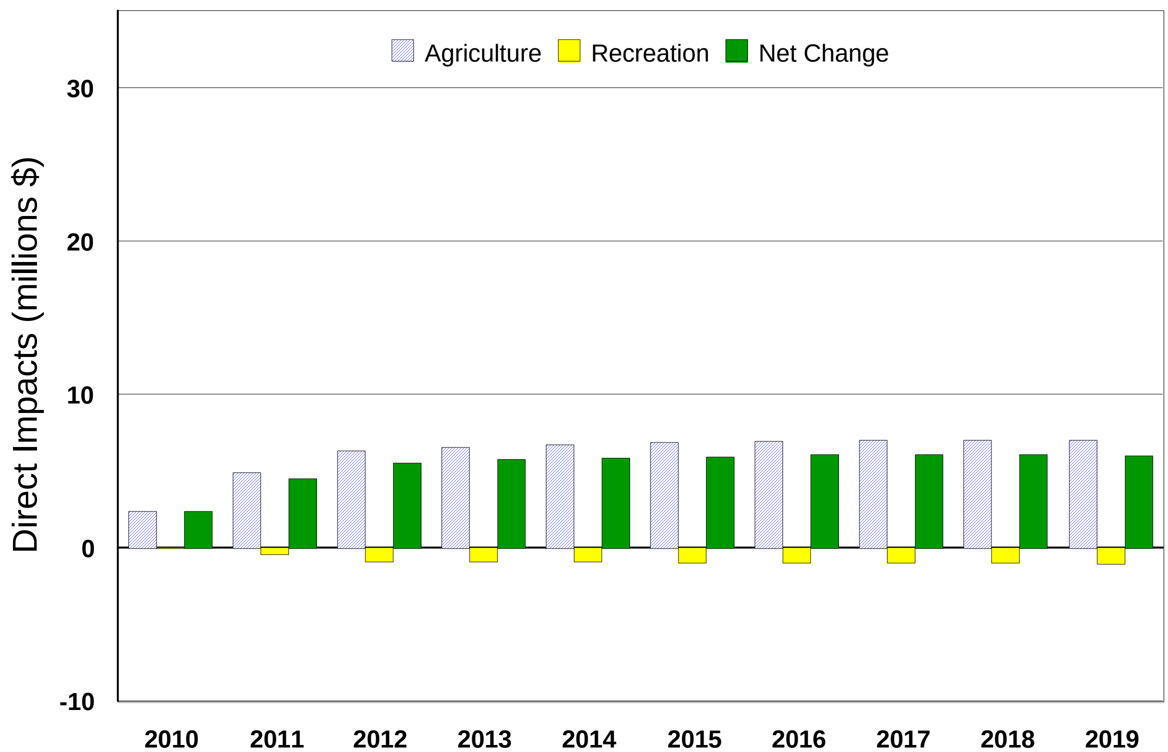

Figure 7. Direct Impacts from Post-CRP land Use in Study Counties Assuming Gradual CRP Reduction and 100 Percent Multiple-use of Post-CRP Lands, 2010 Through 2019

Gradual CRP Reduction–100 Percent Crop Production

In this scenario the reduction of CRP land is expected to be less than scheduled expirations. All post-CRP land is modeled to go to crop production.

In this situation, annual direct effects to the regional economy varied from $11 million to $25.9 million (Figure 8). Reductions in recreational activities were relatively minor compared to the gains with agricultural activities. Direct impacts from agricultural activities were higher in this scenario than the mixed land use or multiple-use grazing system. Reductions in recreational impacts remained low despite the conversion of post-CRP land into crop production largely because of the relative acreage of CRP lost. The difference in acreage lost in this scenario compared to the mixed land use scenario resulted in similar percentage decreases in permanent cover (see Figure 4) and therefore was expected to have similar effects on hunter participation and expenditures.

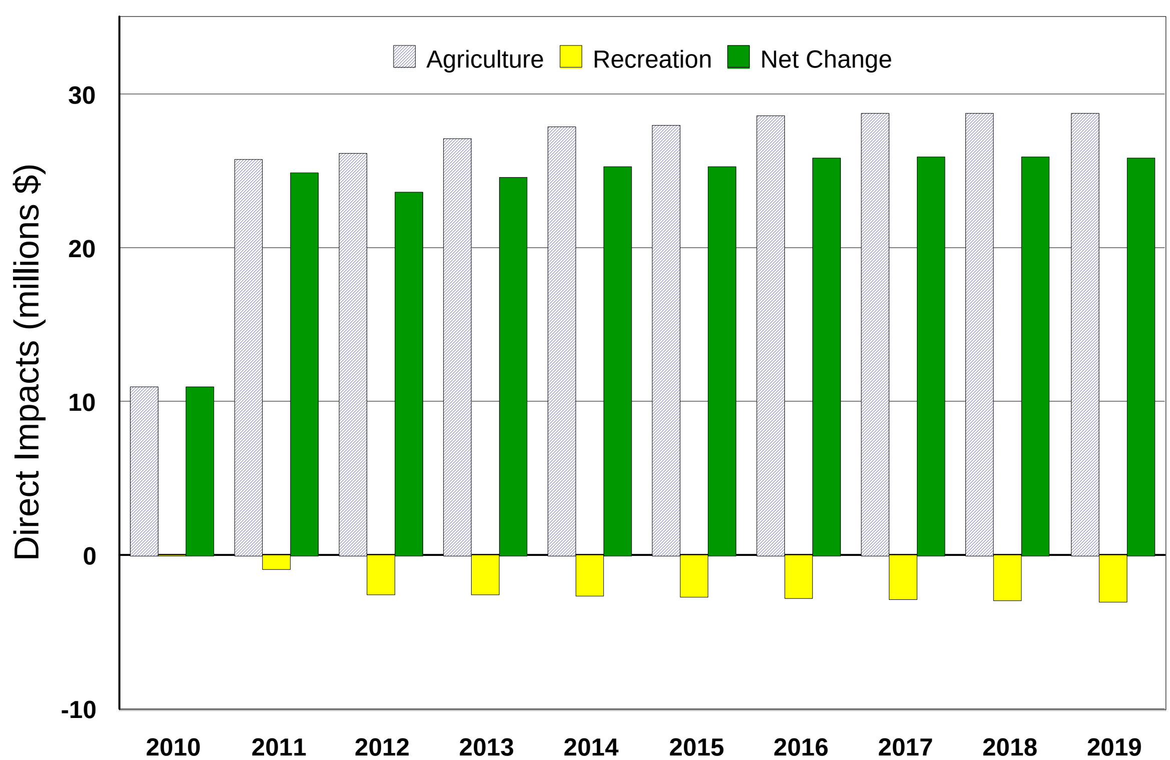

Figure 8. Direct Impacts from Post-CRP land Use in Study Counties Assuming Gradual CRP Reduction and 100 Percent Crop Production on Post-CRP Lands, 2010 Through 2019

Rapid Loss of CRP–Mixed Land Use

In this scenario the reduction of CRP land is expected to be equal to the scheduled expirations. The rate of loss in CRP is much higher in this scenario than in the situation where substantial re-enrollments and new enrollments limit the overall loss of CRP acreage (see Figure 5). Post-CRP land use is consistent with data obtained from a survey of CRP contract holders in North Dakota in 2002 (Hodur et al. 2002).

Annual direct effects to the regional economy varied from $7.9 million to $25.6 million (Figure 9). Reductions in recreational activities were considerably larger than the three scenarios with gradual reduction in CRP. Conversely, the agricultural impacts were larger than found in the three scenarios with gradual reduction in CRP. The net gains between agriculture and recreation resulted in direct impacts to the regional economy that were similar to those with gradual reduction in CRP acreage.

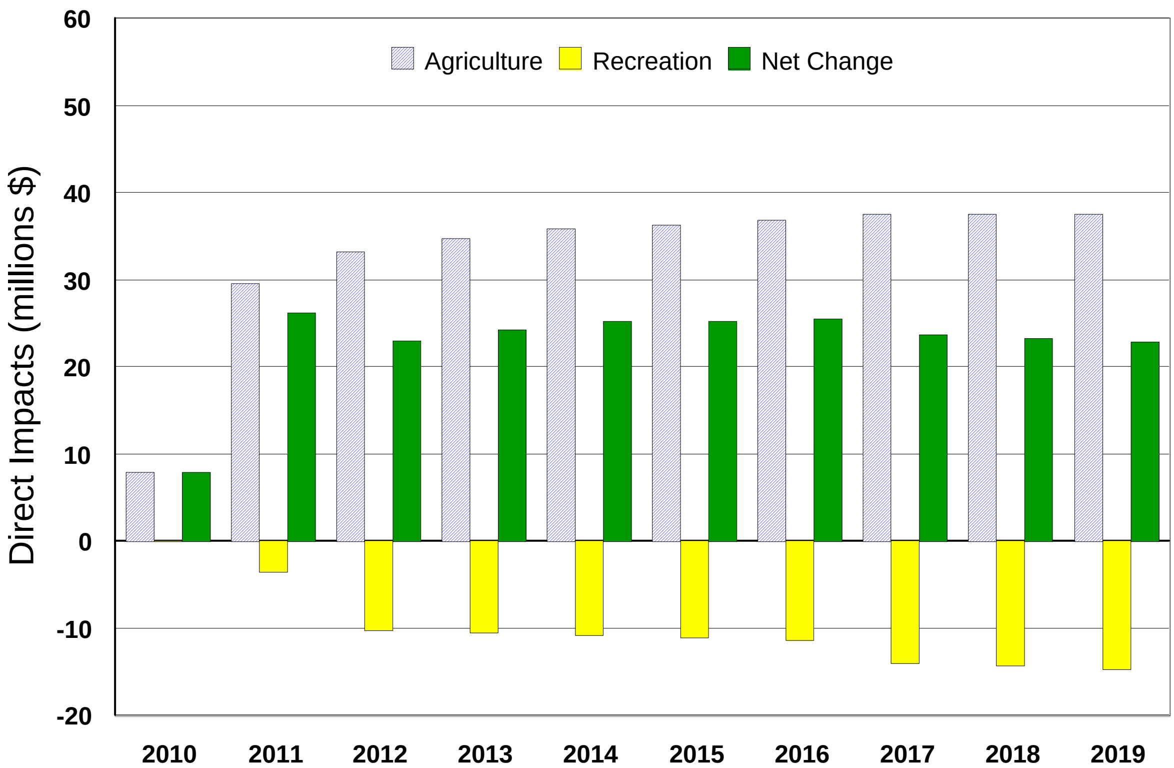

Figure 9. Direct Impacts from Post-CRP land Use in Study Counties Assuming Rapid Reduction in CRP and Mixed Use of Post-CRP Lands, 2010 Through 2019

Rapid Loss of CRP–Multiple-Use Systems

In this scenario the reduction of CRP land is expected to be equal to the scheduled expirations. All post-CRP land is modeled to go into multiple-use grazing systems.

In this situation, the direct impacts were relatively minor compared to the other two rapid-loss scenarios. Annual direct effects to the regional economy varied from $2.4 million to $6.8 million (Figure 10). Losses in recreational expenditures were relatively small, despite the increased acreage lost from the CRP. However, agricultural impacts were considerably smaller than found in the other two scenarios–a pattern also found with the three scenarios for gradual reduction of CRP. Consistent with results from the scenarios with gradual loss of CRP, the multiple-use grazing system retain the greatest amount of recreational revenues since a greater proportion of CRP lands are retained in wildlife habitat, but multiple-use grazing produced the lowest amount of agricultural revenues. The net result is that multiple-use results in less direct impact that the scenarios with greater amounts of crop production.

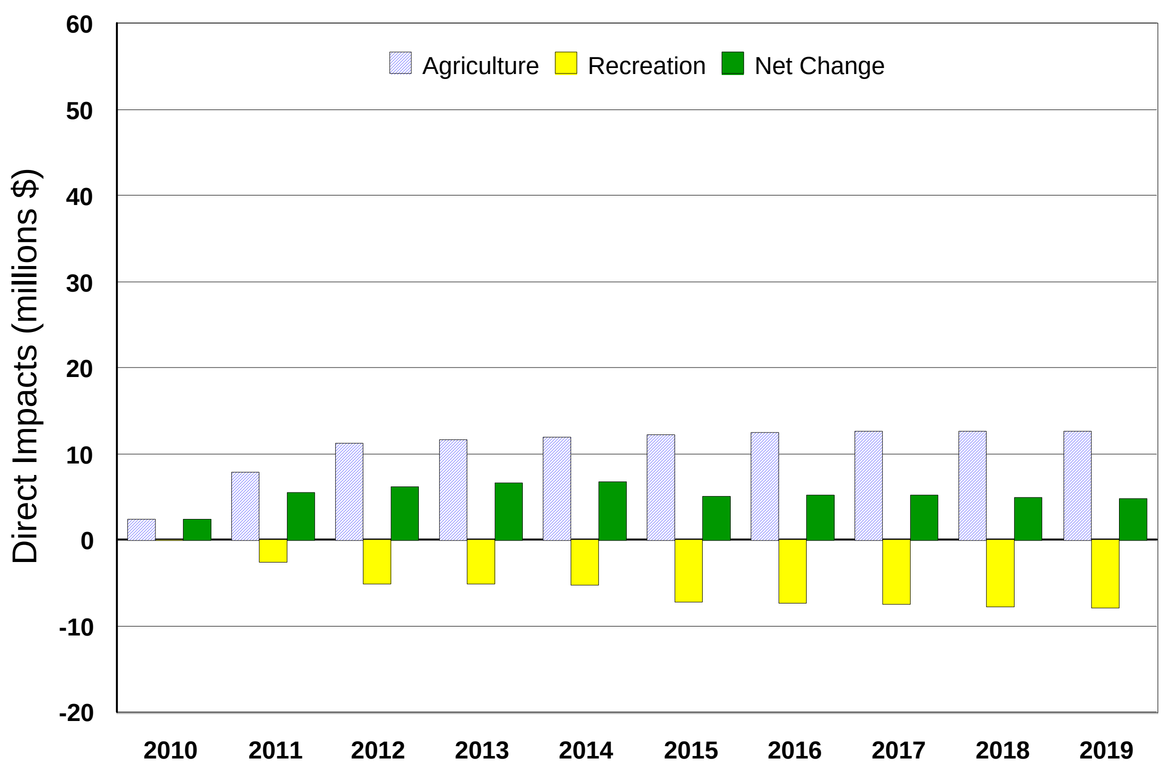

Figure 10. Direct Impacts from Post-CRP land Use in Study Counties Assuming Rapid Reduction in CRP and 100 Percent Multiple-use of Post-CRP Lands, 2010 Through 2019

Rapid Loss of CRP–100% crop production

In this scenario the reduction of CRP land is expected to be equal to the scheduled expirations. All post-CRP land is modeled to go to crop production

Annual direct effects to the regional economy varied from $11 million to $37.6 million (Figure 11). Reductions in recreational activities were considerably larger than the three scenarios with gradual reduction in CRP. The agricultural impacts were the largest of all the scenarios evaluated. The net gains between agriculture and recreation resulted in direct impacts to the regional economy that were the largest of all the scenarios evaluated.

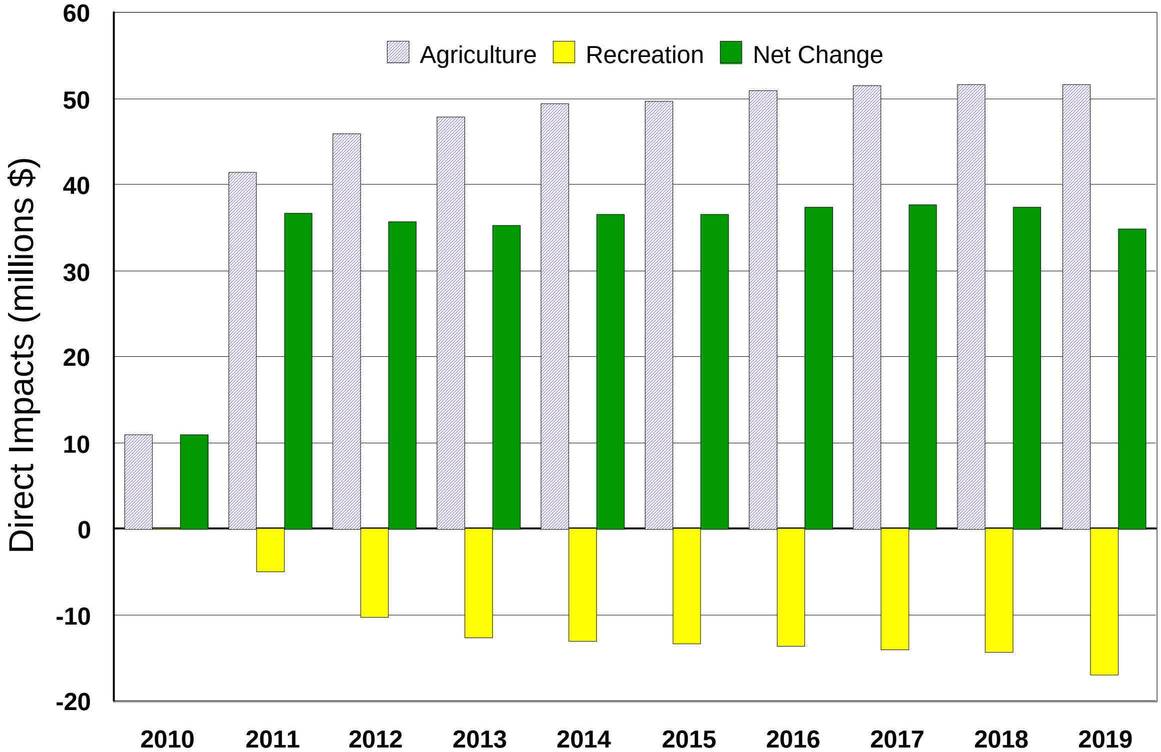

Figure 11. Direct Impacts from Post-CRP land Use in Study Counties Assuming Rapid Reduction in CRP and 100 Percent Crop Production on Post-CRP Lands, 2010 Through 2019

Discussion

Considering that much of the hunter response to a loss of CRP acreage is based on a set of postulated relationships, additional analysis was conducted using modifications to hunter spending and hunter numbers to evaluate alternative levels of recreational losses in the region. Also, the net economic effects in each scenario were averaged over the 10-year period and compared to the economic base for the region in 2009 to gauge the relative importance of those outcomes to the regional economy.

One way to modify the recreational component of the study was to use seasonal expenditures (i.e., per-hunter values) instead of per-hunter spending in rural areas. Seasonal expenditures represent the amount of money spent during an entire season and can include expenditures incurred in non-rural areas of the state (e.g., Bismarck). Applying seasonal expenditures for upland, deer, and waterfowl hunter participation for each of the scenarios reduced the net gain in the regional economy as the loss of recreational spending was larger than estimates using only rural spending. However, in each situation, agricultural gains remained larger than the loss of recreational spending.

Another modification on the recreational component of the study was to use a trend in hunter participation to estimating lost hunter participation. The trend in hunter participation in the region was increasing, and would require a key assumption that hunter numbers would continue to increase into the future if existing CRP acreage remained unchanged in the study region. This approach resulted in a greater number of lost hunters as a result of decreased CRP acreage and increased the level of lost recreational spending. However, as was the case with changing per-hunter spending levels, the recreational impacts were insufficient to offset the gains in agricultural impacts.

The combination of greater losses in hunter numbers and the use of seasonal expenditure levels for hunters produced recreational impacts that remained less than agricultural impacts. The difference between those estimated changes in the regional economy were less than found in the study's main scenarios, but insufficient to change the conclusions about the regional economic effects associated with post-CRP land use.

The analysis showed that the regional economy would likely increase with a reduction in CRP acreage; however, the relative importance of those gains were not presented in the study results. The average annual net change to the regional economy over the 10-year study period for each scenario was compared to the agricultural portion of the region's economic base[5] in 2009 (last year for which data were available). Agriculture comprised 16 percent of the region's economic base in 2009, compared to the region's largest industry, energy, at 56 percent. The six scenarios represented from 0.6 percent to 3.6 percent of the region's agricultural economic base–the percentages would be even smaller if compared to the overall economy. In terms of change to the regional economy, while the conversion of CRP acreage to agricultural production

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[5] Economic base is a measure of the revenue an industry brings into an economy.

would result in net positive changes to the economy, those changes would be relatively small compared to the overall size of the regional economy.

While not specifically addressed in this study, the loss of CRP acreage is likely to have a bigger effect on individual landowners, producers, sportsmen, and certain businesses than the economy as a whole. The loss of recreational opportunities is likely to affect those landowners and businesses that rely on recreational spending; however, businesses that provide inputs and services to the agriculture sector will likely benefit. Producers will be able to expand their operations as CRP acreage is converted to agricultural production. Conversely, sportsmen, who rely on wildlife produced by the habitat created by the CRP, will likely find less opportunity as land is converted to agricultural use and wildlife populations decrease.

Conclusions

This study attempted to answer the question of how multiple-use of post-CRP lands would compete with other land use systems and examine the regional economic consequences of a reduction in CRP acreage. The economics of multiple-use were based on producer net returns, whereas the analysis of regional economic effects focused on changes in gross receipts to the region.

Multiple Use of Post-CRP Lands

The multiple-use of combining grazing, crop production, and dedicated wildlife habitat on post-CRP lands has been proposed as a means to provide landowners with agricultural revenues while retaining wildlife producing capabilities. The multiple-use concept evaluated in this paper was weighted heavily towards livestock grazing. While the field trials showed this system of land management accomplished its wildlife production goals, the system of using post-CRP lands primarily for beef grazing while producing corn and barley for forage and retaining a portion of acreage in dedicated wildlife habitat would not compete economically with other conventional land uses.

Agricultural revenues from the multiple-use system evaluated in this paper were limited to about 35 cow-calf pairs on a section (640 acres) of post-CRP land. Forage production for the cow-calf pairs included the use of standing, unharvested corn and chopped barley for silage, as well as traditional hay production. The net returns to the beef cow enterprise were negative over the forecasted period despite omitting additional expenses for water development and necessary fencing on post-CRP lands. The multiple-use concept would have benefitted from the sale of grain from the corn and barley stands, or the use of other cash crops within the grazing system to provide some additional revenues to the producer/landowner. Perhaps a system that relied more on aftermath grazing would have been more economical. However, it is unlikely that a high percent of post-CRP land would return to grazing production given current commodity prices and given that most of the CRP land in Southwest North Dakota was used for crop production prior to enrollment in the CRP.

Given that the cow-calf grazing regime produced negative net returns, an analysis of the amount of recreational revenues necessary to breakeven with crop production revealed that it is improbable for hunting revenues to provide sufficient additional revenue for this multiple-use system to compete with crop production. Therefore, it is unlikely to expect multiple-use grazing systems, as structured in this study, to be adopted in any meaningful scale on post-CRP land by land owners or producers in the study region.

Regional Economic Implications of Post-CRP Land Use

The regional economic implications of post-CRP land use also were evaluated by examining agricultural and recreational impacts associated with reductions in CRP acreage. Agricultural impacts were estimated to include the direct effects of the net change in regional expenditures and retained earnings between land in the CRP and various post-CRP land management. Recreational impacts were based on several postulated responses of hunter participation and corresponding changes in recreational expenditures linked to the loss of wildlife habitat between land remaining in the CRP and various post-CRP land use options.

The economic impacts of a reduction in CRP acreage produced net positive changes in the regional economy when examined over a 10-year period from 2010 to 2019. The net change in gross receipts within the regional economy from agricultural uses of post-CRP lands (i.e., crops, grazing, hay) exceeded lost recreational expenditures in the regional economy in all scenarios evaluated.

Under the assumption that all post-CRP lands were managed for multiple use consistent with the system evaluated in this study, that scenario did produce lower (relative to other post-CRP land use options) rates of loss in recreational activity compared to the other scenarios. However, agricultural revenues from multiple-use options were the lowest of all scenarios evaluated, and the management of post-CRP lands using multiple-use as defined in this study would produce the least increase in regional activity of all the scenarios examined.

A key consideration in the regional economic implications of post-CRP land use is the rate of loss of CRP acreage. Long-term recreational values within the regional economy were much lower with a rapid loss of CRP compared to slower rates of loss of CRP acreage. However, among all the variations considered, conversion of post-CRP lands to crop production in the scenarios with rapid CRP loss produced the greatest net change in regional economic activity.

Much concern exists over the future of the CRP in southwestern North Dakota. In the scenarios examined in this study, the regional economy would benefit slightly as acreage is removed from the CRP. However, just as when the program was initiated, the loss of CRP acreage is likely to create another set of ‘winners’ and ‘losers’ in southwest North Dakota.

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Outreach, Presentations and Publications

Christopher Schauer, Hettinger REC Director and Animal Scientist

Presentations and Outreach

Feeding Distillers Grains in Lamb Rations
Lamb Feeding 101, Carrington, ND
January 8, 2011

Rambouillet Ram Test Results
Ram Test Field Day, Hettinger, ND
March 12, 2011

Effect of supplementing ewes during late gestation with metabolizable protein on wether lamb feedlot performance, carcass characteristics, and nitrogen balance
Western Extension, Research, and Academic Coordinating Committee, Spearfish, SD
June 6 – 8, 2011

NDSU Ultrasound School
Hettinger, ND
August 23 - 24, 2011

Sheep Management
ND Youth Sheep School, Hettinger, ND
October 1, 2011

Range Ewe Winter Supplementation Strategies
Northeast Wyoming Sheep Symposium, Gillette, WY
October 20, 2011

NDSU Shearing School
Hettinger, ND
November 19 – 21, 2011

NDSU and ASI Wool Classing School
Hettinger, ND
November 19 -21, 2011

Hettinger REC Research and Outreach Update
North Dakota Lamb and Wool Producers Association, Mandan, ND
December 2, 2011

Publications

Neville, B.W., G.P. Lardy, K.K. Karges, L.A. Kirschten, and **C.S. Schauer.** 2011. Sulfur intake, excretion, and ruminal hydrogen sulfide concentrations in lambs fed increasing concentrations of distillers dried grains plus solubles. Sheep & Goat Res. J. 26:13-19.

Saevre, C.B., J.S. Caton, J.S. Luther, A.M. Meyer, D.V. Dhuyvetter, R.E. Musser, J.D. Kirsch, M. Kapphahn, D.A. Redmer, and **C.S. Schauer**. 2011. Effects of rumen-protected arginine supplementation on ewe serum amino acid concentration, circulating progesterone, and ovarian blood flow. Sheep & Goat Res. J. 26:8-12.

Eckerman, S.E., G.P. Lardy, M.M. Thompson, B.W. Neville, M.L. VanEmon, P.T. Berg, and **C.S. Schauer**. 2011. Growth and carcass characteristics of conventionally raised lambs versus naturally raised lambs. Sheep & Goat Res. J. 26:1-7.

Walker, J.A., G.A. Perry, R. Salverson, P. Nester, **C.S. Schauer**, J.E. Held, and K.C. Olson. 2011. Evaluating glycerin supplementation on reproductive performance of sheep. J. Anim. Sci. Proc. 62:131-134

Eckerman, S.R., G.P. Lardy, M.M. Thompson, M.L. VanEMon, B.W. Neville, P.T. Berg, and **C.S. Schauer.** 2011. Effects of four levels of zeranol implants on lamb growth, carcass characteristics, nitrogen balance, and blood hormones. J. Anim. Sci. Proc. 62:183-188.

Thompson, M.M., C.R. Dahlet, M.L. VanEmon, R.F. Cooke, T.C. Gilbery, B.W. Neville, and **C.S. Schauer.** 2011. Effects of calf weaning method on calf stress, hormone concentration, growth performance, and carcass ultrasound characteristics. J. Anim. Sci. Proc. 62:139-144.

Schauer, C.S., C.B Saevre, A.M. Meyer, M.L. VanEmon, J.D. Kirsch, M. Kapphahn, J.S. Luther, J.S. Caton, and D.A. Redmer. 2011. Impacts of L-arginine on ovarian function and reproductive performance at the time of maternal recognition of pregnancy in ewes. J. Anim. Sci. 89(E-Suppl. 3):92 (Abstr.).

VanEmon, M.L. K.A. Vonnahme, S.E. Eckerman, L.A. Lekatz, K.R. Maddock Carlin, M.M. Thompson, and **C.S. Schauer**. 2011. Effect of maternal metabolizable protein supplementation during late gestation on wether lamb feedlot performance, carcass characteristics, and nitrogen balance. J. Anim. Sci. 89(E-Suppl. 3):694 (Abstr.).

Lekatz, L.A., M.L. VanEmon, **C.S. Schauer**, K.R. Maddock Carlin, and K.A. Vonnahme. 2011. Effects of maternal metabolizable protein level in late gestation on circulating amino acid concentrations in the ewe and the fetus. J. Anim. Sci. 89(E-Supp. 3):591(Abstr.).

Geaumont, B., K. Sedivec, and **C. Schauer**. 2011. The evaluation of ring-neck pheasant and duck production on a multiple land use management system on post-contract Conservation Reserve Program grasslands. Soc. Range Manage. 72:#0188.

Misar, C., L. Xu, R. Gates, A. Boe, P. Johnson, and **C. Schauer.** 2011. No-till interseeding Yellow-Flowered Alfalfa (*Medicago sativa* subsp. *falcata*) into crested wheatgrass (*Agropyron cristatum*) stands: Initial establishment. Soc. Range Manage. 72:#0336.

Gearhart, A.L., **C.S. Schauer**, D.T. Booth, and K.K. Sedivec. 2011. Variation among SamplePoint Users with respect to shadows and other variables. Soc. Range Manage. 72:#0292.

Houchen, D., B. Geaumont, **C. Schauer**, and K. Sedivec. 2011. Evaluation of habitat use by sharp-tailed grouse on the Grand River National Grasslands in Northwest South Dakota. Soc. Range Manage. 72:#0177.

Larson, K., B. Geaumont, **C. Schauer,** and K. Sedivec. 2011. Survival and habitat selection of ring-necked pheasant broods in Southwest North Dakota. Soc. Range Manage. 72:#0197.

Shukla, P. A. Modgil, C. Sun, K. Vonnahme, **C. Schauer**, J. Caton, L. Reynolds, and S. O'Rourke. 2011. Decreased maternal dietary protein intake during pregnancy alters large conductance, calcium-activated K channel (BKCa) function in fetal coronary artery smooth muscle cells. Experimental Biology.

Geaumont, B., K. Sedivec, and **C.S. Schauer**. 2011. The importance of maintaining structure to ring-necked pheasant and waterfowl production in the upper Great Plains. Range Beef Cow Symposium XXII. 197-202.

Bohnert, D.W., R.F. Cooke, S.J. Falck, B.I. Cappelozza, M. Van Emon, and **C.S. Schauer**. 2011. Protein supplementation of low-quality forage: Effects of amount and frequency on intake, nutrient digestibility, and performance. 2011 Oregon Beef Council Report BEEF075. p. 1-10.

Thompson, M.M., C.R. Dahlen, M.L. VanEmon, R.E. Cooke, T.C. Gilbery, B.W. Neville, and **C.S. Schauer**. 2011. Effects of calf weaning method on calf stress, hormone concentration, growth performance, and carcass ultrasound characteristics. 2011 NDSU Beef Cattle and Range Research Report. p. 21-25.

Eckerman, S.E., G.P. Lardy, M.M. Thompson, M.L. VanEmon, B.W. Neville, P.T. Berg, and **C.S. Schauer**. 2011. Effects of graded levels of zeranol implants on feedlot performance, carcass characteristics, and incidence of prolapse and mortality in lambs. 2011 NDSU Sheep Research Report. 52:7-12.

Saevre, C.B., A.M. Meyer, M.L. VanEmon, D.A. Redmer, J.S. Caton, J.D. Kirsch, J.S. Luther, and **C.S. Schauer**. 2011. Impacts of arginine on ovarian function and reproductive performance at the time of maternal recognition of pregnancy in ewes. 2011 NDSU Sheep Research Report. 52:13-16.

VanEmon, M.L., S.E. Eckerman, L.A. Lekatz, P.B. Berg, K.R. Maddock Carlin, K.A. Vonnahme, M.M. Thompson, and **C.S. Schauer**. 2011. Effects of maternal metabolizable protein supplementation during the last 50 days of gestation on ewe and offspring performance and carcass characteristics. 2011 NDSU Sheep Research Report. 52:17-22.

Neville, B.W., G.P. Lardy, K.K. Karges, L.A. Kirschten, and **C.S. Schauer**. 2011. Sulfur balance in lambs fed increasing concentrations of distillers dried grains with solubles. 2011 NDSU Sheep Research Report. 52:23-25.

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

Outreach Organized or Co-Organized

Grouse Viewing
Partnered with United States Forest Service
Grand River National Grasslands, Lemmon, SD
May 5, 2011

Wildlife Work Shop
Partnered with Natural Resource Conservation Service
Hettinger, ND
October 13, 2011

Expiring CRP: Alternative Management Systems to Sustain Wildlife Habitat Values
Society of Range Management Wildlife Habitat Committee Sponsored
2011 Society of Range Management Annual Meeting
Billings, MT

Presentations

B. Geaumont. 2011. Annual forages and cover crops in southwest North Dakota: What is being done? Southwest Ag. Forum. Bowman, ND.

B. Geaumont and C. Schauer. 2011. Annual forages and late season grazing. North Dakota Lamb and Wool Producers Association, Mandan, ND.

B.A. Geaumont, C.S. Schauer, and K.K. Sedivec. 2011. Managing post-conservation reserve program grasslands for wildlife and agricultural outputs. Habitat Workshop, Miles City, MT.

B.A. Geaumont, K.K. Sedivec, and C.S. Schauer. 2011. The evaluation of ring-necked pheasant and duck production on a multiple land use management system on post-conservation reserve program grasslands. Society of Range Management. Billings, MT.

B.A. Geaumont. 2011. Agriculture, wildlife, and post-conservation reserve program grasslands. Wildlife Workshop. Hettinger, ND.

B. Geaumont, C. Schauer, and K. Sedivec. 2011. Optimizing range management for gamebird habitat: The importance of maintaining structure. 22nd Range Beef Cow Symposium. Mitchell, NE.

D. Houchen, B. Geaumont, C. Schauer, and K. Sedivec. 2011. Evaluation of habitat use by sharp-tailed grouse on the Grand River National Grasslands in Northwest South Dakota. Society of Range Management. Billings, MT.

K. Larson, B. Geaumont, C. Schauer, and K. Sedivec. 2011. Survival and habitat use of ring-necked pheasant in southwest North Dakota. Society of Range Management. Billings, Mt.

Publications

Stackhouse, J.W. and B.A. Geaumont. 2011. Northern harrier hatches mallard nest. The Prairie Naturalist 43(3/4):73-75.

Geaumont, B.A., K.K. Sedivec, and C.S. Schauer. 2011. The importance of maintaining structure to ring-necked pheasant and waterfowl production in the Upper Great Plains. Proceedings of the Range Beef and Cow Symposium XXII:197-202.

Eric Eriksmoen, Hettinger REC Research Agronomist

Professional and Community Activities

ND Crop Variety Selection committee member
Western Weed Science Association member
Paramedic with West River Ambulance
Hettinger Chamber of Commerce member
Hettinger Ag. Marketing Club
Treasurer for the West River Breeders Association
Hettinger REC Safety Officer
Crops judge - Adams, Slope & Hettinger Co. Fairs
Certified First Detector with the National Plant Diagnostic Network

Meetings and Training attended

Dollars, Diversity and Direction meeting – Dickinson
Cover Crops Conference – Bismarck
ND Pulse Growers Assn. Annual Convention – Minot
Commercial Pesticide Training and Recertification - Dickinson
Best of the Best Wheat Research & Marketing Forum – Bismarck
ND Crop and Seed Assn. Annual Convention – Bismarck
Bowman Co. Extension Grower Meeting - Bowman
ND REC Agronomists meeting – Williston
ND Variety Release meeting - Fargo

Adams Co. Crop Improvement meeting – Reeder
Hettinger Co. Crop Improvement Assn. meeting – Regent
NDSU Branch Station Conferences – Fargo
High School Science Fair Judge – Scranton
Hettinger REC Advisory Board meetings – Hettinger
Commercial Pesticide Inspection by ND Dept of Ag. – Hettinger
SW Crop Improvement and Seed Assn. Meeting - Dickinson
Mandan ARS Board of Directors Meeting - Mandan
Mandan ARS Annual Growers Workshop – Mandan
Hettinger Ag. Marketing Club - Hettinger
Hettinger Chamber of Commerce Ag. Committee meetings – Hettinger
Plot Tours - Hettinger, Dickinson, Scranton, Regent, New Leipzig, Mandan, Ralph and Selfridge
Mandan USDA-ARS Grower Appreciation Tour – Mandan
28th Annual Western Dakota Crops Day show - Hettinger

Presentations

Research at the HREC (Poster & Presentation) - Mandan ARS Annual Convention – Mandan
Small Grain Varieties & Sawfly Strategies – Taylor Institute – Taylor
Small Grain Variety Update - West River Breeders – Reeder
Planned Research - HREC Advisory Board
Small Grain Varieties & Sawfly Strategies - Hettinger Co. Crop Improvement Assn. – Regent
Weed Control Update – SW ND Extension Agents meeting
HREC Employee Safety Training - Hettinger
Small Grain and Pulse Crops – Mandan
Crops Day and Field Tour Summaries – KNDC radio
Crop Growing Conditions in SW ND – KFGO radio
Enhancing Protein in Wheat – KMOT TV – Hettinger
Winter Wheat Production – KMOT TV - Hettinger
HREC Small Grain Variety Trial Field Tour - Hettinger
Small Grain Variety Trial Field Tour - Scranton
Small Grain Variety Trial Field Tour - Regent
Small Grain Variety Trial Field Tour - New Leipzig
Small Grain Variety Trial Field Tour - Selfridge
28th Annual Western Dakota Crops Day Show - Hettinger

Publications

USDA-ARS. Annual Report. W. Regional Dryland Spring Barley Nursery 2010. National Small Grains Germplasm Research Facility, Aberdeen, ID. Jan. 2011.

USDA-ARS. Annual Report. Report on Wheat Varieties Grown in Cooperative Plot and Nursery Experiments in Spring Wheat Region in 2010. USDA-ARS Midwest Area. St. Paul, MN. Jan. 2011.

NDSU Ext. Bul. A-652 rev. ND and SD Hybrid Sunflower Performance Testing 2010. Jan. 2011.

Knodel J.J., P.B Beauzay, **E.D. Eriksmoen**, and J.D. Pederson. 2009 (2010). Pest management

of wheat stem maggot (Diptera: Chloropidae) and wheat stem sawfly (Hymenoptera: Cephidae) using insecticides in spring wheat. J. Agric. Urban Entomol. 26(4):183-197.
NDSU Ext. Bul. A-1469. ND Dry Pea Performance Testing 2010. Jan. 2011.
NDSU Ext. Bul. A-793 (rev.). ND Single Location Corn Hybrid Performance Results 2010. Feb. 2011.
Qingwu Xue, Paul E. Nyren, Guojie Wang, **Eric Eriksmoen**, Gordon Bradbury, Mark Halvorson, Ezra Aberle, Kris Nichols and Mark Liebig. 2011. Biomass composition of perennial grasses for biofuel production in North Dakota, USA. Biofuels. 2(5):515-528.
NDSU Dept. Report. 2010 ND Weed Control Research. Feb. 2011.
NDSU Ext. Bul. A-1105 rev. 2010 ND Alternative Crop Variety Performance. Feb. 2011.
Eric Eriksmoen. NDSU Mandan Variety Trials. In Proc. 2011 Research Results and Technology Conference. pp 25-28. Feb. 21, 2011. Mandan, ND.
NDSU Ext. Bul A-1196 rev. ND Hard Winter Wheat Variety Trial Results for 2011 and Selection Guide. Oct. 2011.
NDSU Ext. Bul A-1067 rev. ND Durum Wheat Variety Trial Results for 2011 and Selection Guide. Nov. 2011.
NDSU Ext. Bul. A-1049 rev. ND Barley, Oat and Rye Variety Trial Results for 2011 and Selection Guide. Nov. 2011.
NDSU Ext. Bul. A-574 rev. ND Hard Red Spring Wheat Variety Trial Results for 2011 and Selection Guide. Nov. 2011.
NDSU Ext. Bul. A-1124 rev. 2011 Canola Variety Trials. Dec. 2011.
NDSU Ext. Bul. A-1469. ND Dry Pea Performance Testing 2011. Dec. 2011.
NDSU HREC Ag. Report 28. 28th Annual Western Dakota Crops Day Research Report. Dec. 2011.
NDSU Ext. Bul. A-843 (rev). ND Soybean Performance Testing 2011. Dec. 2011.
Eriksmoen, E.D., R. Olson, C. Pearson and K. Cella. 28th Annual Western Dakota Crops Day Research Report 2011. NDSU-HREC Ag. Report No. 28. Dec. 2011.
NDSU Ext. Bul. A-654 (rev). ND Dry Bean Performance Testing 2011. Dec. 2011.
NDSU Ext. Bul. A-652 rev. ND and SD Hybrid Sunflower Performance Testing 2011. Dec. 2011.

Advisory Board Meeting
Hettinger Research Extension Center
February 18, 2011

Board members present included Gloria Payne, Chuck Christman, Julie Kramlich, David Merwin, Dennis Sabin, Dean Wehri, Nathan Swindler, Joe Rohr, Justin Freitag, Terry West, Jeremy Fordahl, Chairman Ted Sailer, SBARE Representative Rodney Howe and Larry Leistritz joined the meeting via telephone. Staff present included Chris Schauer, Ben Geaumont, Michele Thompson, Dan Nudell, Eric Eriksmoen and Cassie Dick. Guest Tim Faller was also present.

After a noon lunch the meeting was called to order by Chairman Ted Sailer at 12:50 pm.

Chairman Ted Sailer called for a motion to approve the minutes from the previous meeting. Gloria Payne motioned to approve the minutes and David Merwin seconded, motion passed to approve the minutes from the previous meeting.

Chairman Ted Sailer called for a nomination to approve the agenda for the meeting. Dean Wehri motioned to approve the agenda and Rodney Howe seconded, motion passed to approve the agenda.

Directors Report- Chris Schauer (handout provided)

1. Chris asked that all board members feel free to question and comment anytime throughout the meeting, because the boards input is needed and wanted
2. Legislative update
    a. Rodney Howe gave input from SBARE standings with the legislature
    b. If budget cuts occur the Research Center will do what the legislature wants
    c. Agriculture is still ND’s major money maker even though oil is the hot topic; agriculture will still be here after the oil boom is gone
3. Infrastructure and Maintenance
4. Graduate Students update

Animal Science Report- Chris Schauer (handout provided)

1. 2010-2014 Strategic Plan
2. Progress toward goals in animal science discussed
3. Publications

Wildlife and Range- Ben Geaumont (handout provided)

1. Currently six research trials underway
2. Cooperator Agreements
3. Concerns over movement of prairie dogs for upcoming Tribal Beef Project
4. Questions about Ben’s involvement with community outreach and calls for help he receives
    a. Ben goes to many regional producer meetings and takes many calls from our area and neighboring states
    b. Ben gets information to Extension, Extension Agents are supposed to share his findings with public

Southwest Feeders Program- Michele Thompson (handout provided)

1. Beef programming (Beef Day)

2. Current Project
    a. Lamb Composting Pile, start with lambs and potentially work up to ewes
3. Publications including this years' Sheep Research Report and "Natural premiums studied" article published from Hettinger REC trial

Agronomy- Eric Eriksmoen (2010 crops day book given for handout)

1. Good year last year, weather good for crops
2. Need for breeders to keep developing new varieties
3. Studies show Sawfly continuing to move east
4. Need for weed and soil scientists (weed control, soil health and cover crops)

Ag Economics- Dan Nudell (handout provided)

1. Pattern of land sales in surrounding counties
    a. More non-family sale and absentee buyers
2. 31.3% of Adams County is absentee owned
    a. Concerns over if land is taken care of as well when land owner is not present (weeds)

2010-2014 Strategic Plan Progress Report (handout provided)

Chairman Ted Sailer called for any open discussion

1. Dust issues from oil production on crops
2. Cover crops drawing in wildlife
3. Population moving into area because of increased oil production
    a. Everyone needs to be prepared for an increase of people and stress on infrastructure
4. Need for weed control (snow and moving water are moving weeds to new places)

Chairman Ted Sailer called for nominations to replace and re-elect members of the advisory board. Members serve a three year terms and can serve two terms. Julie Kramlich, Denise Andress and Chuck Christman were eligible to serve another term. Gloria Payne nominated all members eligible to serve another term to remain on the board. All members voted in favor and no against. Julie, Denise and Chuck will serve another three year term.

Chairman Ted Sailer called for nominations to replace Matthew Benz and Gloria Payne, who have served two terms on the advisory board and are not eligible for re-election. Two names were brought to the board: Lyle Warner and Kat Weinert. Discussion was held on the candidates. Either Kat or her husband Sean would make great additions. Kat or Sean was nominated by Rodney Howe and Lyle Warner was nominated by David Merwin. Chris Schauer will contact all nominated members to see if they would like to sit on the Advisory Board.

The next meeting will be held in July on a date to be determined.

The meeting was adjourned at 2:30 and employees were asked to leave so the Advisory Board Executive Session could talk openly about any concerns.

Advisory Board Meeting

Hettinger Research Extension Center

July 28, 2011

Board members present included David Merwin, Dennis Sabin, Dean Wehri, Joe Rohr, Justin Freitag, Jeremy Fordahl, Kat Weinert, Lyle Warner and Julie Kramlich. Staff present included Chris Schauer, Ben Geaumont, Eric Eriksmoen and Cassie Dick.

After a noon lunch the meeting was called to order by Dean Wehri at 12:30.

Dean called for a nomination to approve the minutes from the previous meeting. Joe Rohr motioned to approve the minutes and Dennis Sabin seconded, the motion passed to approve the minutes from the previous meeting.

Dean called for any additions or changes to the agenda, only one change was made. There would be no Economics report from Dan Nudell, as he was not present. The agenda was approved.

Directors Report- Chris Schauer (handout provided)

1. Chris briefly explained to new members why the Hettinger REC needs an Advisory Board and encouraged them to ask question and give input throughout the meeting.
2. Legislative update
    a. Federal budget earmarks no longer exist, Hettinger REC lost one employee due to federal cut backs, Michele Thompson SW Feeders Coordinator
    b. There is a need for an animal scientist or technician, Chris is the only animal scientist at our facility; he uses grad students to help fill in. Dan Nudell is also going to help where needed.
    c. Two positions were funded in the Soil Health and Multiple Land Use Initiative: Ben Geaumont was hired as a permanent Ph. D. position and a technician will be hired this spring. These two positions took six years to become funded.
    d. Weeds scientist/ plant protection position was not funded. Neither was an agronomy/range lab.
    e. Deferred maintenance is always an issue.
    f. Chris explained that even though the last legislative session just ended, SBARE testimony will start this fall for the next session and ranking the needs of the research centers will probably be done this spring. Ranking the needs of the Hettinger REC should be done at this meeting to ensure timeliness.
3. Infrastructure review
4. Graduate students update

Animal Science Report- Chris Schauer (handout provided)

1. Strategic Plan 2010-2014
    a. Enhance the efficiency and profitability of crop production systems and promote science based environmental stewardship.
    b. Provide information and services to grow the economy of the region.
    c. Conduct applied research that evaluates the compatibility of agriculture wildlife.
    d. Explore alternative livestock production systems that increase profitability while maintaining environmental stability.
    e. Ensure stakeholders receive our information.
2. Progress towards goals in animal science discussed.
    a. Questions on why DDGS should not be fed to bulls/rams. There is no research why. A grad student is doing a trial studying semen quality.
    b. Need for an animal scientist
    c. Multiple birth study follows 5-6 years

Range Report- Ben Geaumont (handout provided)

1. Currently have seven research trials underway and two cooperator agreements
    a. Evaluation of the environmental consequences of agriculture production on post-contract Conservation Reserve Grasslands (CRP)
    b. Survival, home range and habitat use by ring-neck pheasant chicks in southwest ND
    c. Sharp-tailed grouse survival, home range and habitat use on the Grand River National Grasslands in northwest SD
    d. Establishment of Yellow-flowered Alfalfa Inter seeded into Crested Wheatgrass Stands
    e. Evaluate winter survival, home range and habitat use by ring-necked pheasant on a post-Conservation Reserve Program landscape in southwest ND
    f. Evaluation of annual forages associated with cover crops as forage for sheep, benefits to soil health, and as wildlife cover and food
    g. Small scale research project evaluating the use of cover crops on land devoted to oat and barley production in southwest ND
    h. Bowman-Slope Soil Conservation District, NDSU Bowman Extension Service and Hettinger REC
    i. Hettinger Research Extension Center, US Forest Service and Rocky Mountain Elk Foundation
2. The prairie dog study should begin next spring, to see if cattle and prairie dogs can co-exist. The paperwork took longer than planned; there were issues of who actually owned the land. Starting later means that a better strategic planning can be developed.
3. Ben asked the board to please give any direction for future projects and ideas.

Agronomy Report- Eric Eriksmoen

1. Has been a great year for crops

2. Our #1 priority is variety/crop development. There are 350 spring wheat varieties; 4-6 will probably become varieties grown here. New crops are being developed for our area; penny crest and camolina are a couple.
3. Saw fly: last year was a peak; there are less this year and less of the wasp's that kill the sawfly. The sawfly continues to move east, there is still a need to develop solid stem varieties and a need to understand what the bugs do. Sawfly has a 12 year cycle and research will lag when it is not a prevalent problem.
4. Canola: working on developing new varieties that are heat tolerant and stronger plants for our area. 50 new varieties are being developed. Winter Canola varieties are also being developed.
5. Protein: working on becoming more consistent with higher protein levels. Plants will use nitrogen as they get it, it does not last after being applied because the plant will take it all in for protein development.
6. Corn: continues to struggle in our area. Working with NDSU plant breeders to develop more drought and heat tolerant varieties.
7. Herbicide trials: $100,000 in grants from companies for weed control. This is why we need a weed scientist.
8. Short-term needs: weed scientist and a need for an agronomy lab. Long-term: expansion into foundation seed.

2010-2014 Strategic Plan, looking for new ideas

Open Discussion

1. Please let us know if there are any suggestions for field days, speakers that would work
2. NDSU research is at the top of the line and has great support from the agriculture industry
3. The Hettinger REC has ability to do research as needed, suggested and is able to pull summer technicians from all over the country
4. Orchard grass
    a. Can orchard grass be a substitute for alfalfa
    b. About 10 years ago there was a study of different grass varieties and there is some data on orchard grass
5. Land turnover
6. Record amounts of rain and commodity prices
7. No-till/minimum till
    a. No-till is being used right now because of government programs, when payments stop will farmers go back to old practices?
    b. Sustainability of ground being turned over that has come out of CRP program. About half the CRP land went back into production
    c. Should native sod be turned over, are we setting ourselves up for another dust bowl?
8. Discussion on ranking items for SBARE to take to legislation

a. Should items be combined? When we present our problems they come up with the answer (position title, education required)
    i. Plant protection
    ii. Agronomy/range lab
    iii. Animal scientist to work with Extension programs
    iv. Weed scientist
    v. Foundation seed

Dean called for a motion to pass the five items to take to SBARE and onto the legislature. Dennis Sabin motioned and Jeremy Fordahl seconded. There was no against and the motion passed for the five items listed to be presented to SBARE.

Next meeting will be held in February 2012, date to be determined.

The meeting was adjourned at 2:15 and employees were asked to leave so the Advisory Board Executive session could openly talk about any concerns.

Personnel

Hettinger Research Extension Center

Christopher Schauer	Director/ Animal and Range Science
Dan Nudell	Assistant R/E Center Specialist/ Ag Economics
Eric Eriksmoen	Associate R/E Center Specialist/ Agronomy
Michele Thompson	Assistant R/E Center Specialist/ Livestock
Ben Geaumont	Post-Doctorate Research Fellow/ Wildlife
Amanda Gearhart	Research Specialist/ Range
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

Range and Wildlife Graduate Students
Dean Houchen
Kristine Larson
Mark Mazza
Jeff Stackhouse
Derek Klostermenier

Animal Science Graduate Students
Megan VanEmon
Steve Eckerman

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, Caitlin Pearson, Matt Korang, Samantha Sayler, Derrick Stecher, Amanda Lipinski, Karla Ryan, Nicole Engraf, Krista Cella, Ben Hosel, Chelsey Faller, Sulley Merwin, Stephanie Schmidt, Brian Simmons, Shawna Monson and Devin Gaugler.

Advisory Board Members

Ted Sailer, Chair	Hettinger, ND	Dennis Sabin	Morristown, SD
Dean Wehri, Vice-chair	Mott, ND	Lyle Warner	Baldwin, ND
Denise Andress	Hettinger, ND	Nathan Swindler	Mott, ND
Chuck Christman	Lemmon, SD	Joe Rohr	Elgin, ND
Justin Freitag	Scranton, ND	Julie Kramlich	Hettinger,
NDTerry West	Hettinger, ND	Larry Leistritz	Fargo, ND
Jeremy Fordahl	Hettinger, ND	David Merwin	Hettinger, ND
Cole Ehlers	Hettinger, ND	Kat Weinert	Hettinger, ND
Rodney Howe	Hettinger, ND		

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