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Swine Research

GRASSLAND RESEARCH

Modification of Vegetation by Grazing and Mowing Management to affect Grasshopper Populations

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Grasshopper egg laying and development of nymphs can be altered by modifications in vegetation structure and density (Onsager, pers. comm.). Grazing management can be used to modify vegetation structure and density. Grazing research in western North Dakota has shown that the twice over rotation grazing system with complementary domesticated grass pastures as described by Manske and Conlon (1986) can increase herbage production (Manske 1992), grass basal cover (Manske, Barker, and Biondini 1988), and livestock performance (Manske et al. 1988) compared to seasonlong grazing treatments and long term nongrazed (idle) areas. The purpose of this research project was to determine if the beneficial changes in vegetation structure and density that resulted when defoliation was regulated by twice over rotation grazing management would be sufficient to negatively effect grasshopper development and egg laying. This was a cooperative project between the Range Research Laboratory at the NDSU, Dickinson Research Center, Dickinson, ND. and the Rangeland Insect Laboratory, USDA-ARS, Bozeman, MT. The range laboratory team was responsible for the grazing management and vegetation data and the insect laboratory team was responsible for the grasshopper and micro-climatic data. This report will include a brief summary of the data collected during the 1993 field season.

Methods and Materials

The study sites were located in the McKenzie County Grazing District of the Little Missouri National Grasslands, 21 miles west of Watford City between 47°35´and 47°50´ N. lat. and 104°00´ and 103°45´ W. long., North Dakota. This study was conducted with the cooperation of the USDA Forest Service and the McKenzie County Grazing Association. The project was funded by USDA/APHIS.

The native rangeland treatments were organized with two replications. The rotation grazing treatments had four pastures with each grazed for two periods, one period between the third leaf stage and anthesis phenophase, 1 June – 15 July, followed by a second period between anthesis and winter dormancy, 15 July – 31 October. The dates for the four pastures during 1993 were: Grazed 1, 1-15 June and 16-31 July; Grazed 2, 16-24 June and 1-31 August; Grazed 3, 25 June – 4 July and 1-30 September; and Grazed 4, 5-15 July and 1-31 October. The first grazing period for the rotation system was designed to stimulate grass tiller development and activity of soil organisms in the rhizosphere. The second grazing period was designed to harvest some of the increased herbage biomass and secondary tillers.

The seasonlong grazing treatments consisted of two pasture study locations each with two replications. Each study location was grazed as a single pasture from 1 June to 31 October. The ungrazed treatments consisted of two pasture study locations each with two replications. The ungrazed treatments had no livestock grazing during the 1993 growing season but had some grazing in 1992. The long term nongrazed treatments have not been grazed, mowed, or burned for 35 years. A large barbed wire exclosure was constructed in the study area in 1958. Only nondestructive sample data was collected on the nongrazed treatments.

The crested wheatgrass treatments were organized with two replications. The mowed treatments have been mowed for hay production with one annual cutting in late June or early July and have not been grazed. The mowed treatments were cut in late June, 1993. The mowed and spring grazed treatments were used as spring pasture during 1-31 May. A large portion of the spring pasture was mowed for hay in late July – early August of 1992 but not mowed in 1993. The spring grazed treatments have been used as spring pasture during 1-31 May and have not been mowed or burned. The seasonlong grazed treatments were part of a large pasture with native range interspersed with large areas of seeded crested wheatgrass grazed from 1 June to 31 October.

Vegetation data was collected on similar range sites for each replication. Above ground plant biomass was collected on five dates from May to October by clipping five .25m^2 quadrats to ground level. The major components were separated into live material (by growth form), standing dead, and litter. Plant biomass samples were oven dried at 60°C. Values reported represent amount of herbage remaining on the site on each sample date after grazing. Plant species composition was determined by the ten pin point frame method (Cook and Stubbendieck 1986) between mid July and mid August. Line intercept method (Canfield 1941, Cook and Stubbendieck 1986) was modified to measure linear length of intercepted open areas not covered by vegetation canopy. Each replication was sampled four times between June and August with 10 transects of 2000 cm. in length. Total percent open area not covered by canopy and a frequency distribution of the length of open areas placed in categories of 5 cm. from 5 cm. to 60 cm. were determined from the line intercept data. Statistical methods used to analyze differences between means were a standard paired plot t-test (Mosteller and Rourke 1973). Each treatment has coordinated plots for micro climatic data and grasshopper population and phenology data collection.

Results and Discussion

The basic premise that we are working with is that most of the rangeland grasshopper species are favored by open or bare areas for access to solar radiation during development and for egg laying sites for some species. The assumption that we have made from this is, if a defoliation management treatment with grazing or mowing that decreases open areas can be developed, then there should be a decrease in the grasshopper population; or, if the open areas can not be decreased for the entire year, then the periods that open areas are available should be changed annually, which should, presumably, disrupt the natural patterns of the grasshopper's phenology enough to reduce the populations and no single pest grasshopper species should be strongly favored for successive years.

The changes in the vegetation that are presently expected to negatively effect grasshopper populations are: increases in live plant basal cover, decreases in vegetation canopy cover open areas, and increases in plant biomass. These parameters should yield lower temperatures, higher relative humidity, and reduced irradiation within the grasshopper microhabitat.

The changes in vegetation on the native range treatments show a trend for the expected beneficial effects to occur on the twice over rotation pastures. The mean basal cover on the rotation treatments was 42% greater than on the long term nongrazed treatments, which was significant (Table 1). The basal cover on the seasonlong treatments was also significantly greater than on the long term nongrazed treatments (Table 1). The percentage of open areas of ground not covered by vegetation canopy was significantly less on the rotation treatments than on the other treatments in June (Table 2). The amount of plant biomass remaining on the ground on 15 October at the end of the grazing season was only 14% less on the rotation treatments than on the ungrazed treatments (Table 3). There was 70% less plant biomass on the seasonlong treatments on 15 October than on the ungrazed treatments (Table 3).

The changes in vegetation on the crested wheatgrass treatments appear to favor the spring grazed treatments for basal cover and open areas. The spring grazed treatment had significantly greater basal cover than other treatments (Table 4). The mowed treatments had significantly less basal cover than the other treatments. The spring grazed treatments had significantly less open areas in June and August than the other treatments (Table 5). The mowed treatments had greater amounts of open areas than the other treatments. The mowed treatments and the grazed seasonlong treatments had the greatest amount of plant biomass remaining on 15 October (Table 6).

Prelimimary interpretation of the grasshopper population and phenology data for 1993 (Kemp and Onsager 1993, Onsager 1994) (Table 7) indicates a positive trend for the potential use of livestock grazing management as a tool to alter structure and density of vegetation and cause negative impacts on grasshopper populations. Generally, the nymph and adult grasshopper population on the native range pastures grazed with the rotation system had lower numbers of grasshoppers than the pastures grazed with seasonlong management. The length of time required for the nymph grasshoppers to develop through their 5 instar stages was longer on the rotation pastures than on the seasonlong pastures. This increase in time is desirable and indicates that the increase in vegetation reduces the quantity of solar radiation that reaches the nymph grasshoppers and retards their growth rate. This exposes the nymph grasshoppers to numerous causes of mortality for a longer period of time. The average daily mortality rate was greater on the rotation system. The longevity of the adult grasshoppers was slightly shorter on the rotation pastures than on the seasonlong pastures. It is not known at this time if this is significant or not but the trend is desirable and would mean that the adults would have a shorter period of time to develop, mate, and lay eggs. With a shorter longevity, some of the adult females may not successfully lay eggs. The predicted number of eggs layed on the seasonlong pastures was eighteen times greater than on the rotation pastures.

Spring grazing of crested wheatgrass does not seem to cause a reduction in the number of grasshoppers but it does seem to cause a shift in grasshopper species from *Melanoplus sanguinipes*, which is considered to be a very undesirable species, to *M. gladstoni*, which is considered to be a late hatching species. The importance of this shift in species is not known at this time but we are optimistic that it is a beneficial change, or at least, it is a shift to the "lesser of two evils".

This report includes data collected during the 1993 field season and definitive conclusions cannot be made from a data set of one year's sampling. These data, however, are very promising and exciting. The data show that defoliation management with grazing and mowing can cause significant changes in vegetation structure and density by timing the treatments differently in relation to the phenological development of the plants. Some defoliation treatments can increase the plant density, decrease open areas, and increase plant biomass. These changes in vegetation seem to retard development of nymph grasshoppers, shorten longevity of adult grasshoppers, and reduce the numbers of living grasshoppers. The future years of this study will be able to determine if these changes in vegetation structure and density, and grasshopper populations can provide long term negative effects on the rangeland grasshopper species that are economically important.

Table 1. Percent basal cover and percent greater than nongrazed control on native range treatments, 1993.

Treatments	% Basal Cover	% Greater Than Nongrazed
Nongrazed	29.4*a*	0.0
Ungrazed	34.6*ab*	17.9
Seasonlong	36.2*b*	23.3
Rotation	41.6*b*	41.9
Grazed 1	34.4	
Grazed 2	42.4	
Grazed 3	42.9	
Grazed 4	46.9	

Means of same column followed by the same letter are not significantly different (P<0.05).

Table 2. Percentage of ground not covered by vegetation canopy on the native range treatments, 1993.

Treatments	Early June	Late June	Mid July	Mid August
Nongrazed	--	21.1*a*	12.0*a*	11.5*a*
Ungrazed	--	14.8*a*	--	--
Seasonlong	10.5*a*	14.1*a*	7.8*b*	6.0*b*
Rotation	6.5*b*	3.9*b*	6.1*b*	5.9*b*
Grazed 1 (4)	8.0	6.4	7.3	6.3
Grazed 2 (7)	8.2	4.8	5.3	7.9
Grazed 3 (6)	6.9	2.0	8.1	3.8
Grazed 4 (5)	2.9	2.5	3.6	4.6

Means of same column followed by the same letter are not significantly different (P<0.05).

Table 3. Total above ground plant biomass in pounds/acre and percent utilization on native range treatments, 1993.

Treatments	1 Jun	24 Jun	19 Jul	12 Aug	Sep	15 Oct
Nongrazed	Destructive sampling data not collected on this treatment.					
Ungrazed						
lbs/acre	--	1382	1410	1152	--	1655
% utilization						
Seasonlong	I--I[a]					
lbs/acre	557	923	1094	609	--	504
% utilization		33.2	22.4	47.2		69.6
Rotation	I--I					
lbs/acre	897	998	1131	952	--	1424
% utilization		27.8	19.8	17.4		13.9
Grazed 1 (4)	I------I		I-------I			
lbs/acre	1024	919	818	644	--	1184
% utilization		33.5	42.0	44.1		28.4
Grazed 2 (7)	I----------I		I---------------I			
lbs/acre	819	809	829	799	--	1797
% utilization		41.4	41.2	30.6		-8.6
Grazed 3 (6)		I---------I		I-------------------I		
lbs/acre	876	1182	1579	1048	--	1521
% utilization		14.5	-12.0	9.0		8.1
Grazed 4 (5)		I---------I			I-------------I	
lbs/acre	869	1080	1298	1314	--	1193
% utilization		21.8	7.9	-14.1		27.9

Negative percent utilization values indicate greater herbage remaining after grazing compared to ungrazed control plots.

[a]Dashed lines indicate period of grazing.

Table 4. Percent basal cover and percent greater than mowed treatment on crested wheatgrass treatments, 1993.

Treatments	% Basal Cover	% Greater Than Mowed
Mowed	28.9*a*	0.0
Mowed/Grazed	35.5*b*	22.9
Grazed Spring	39.8*c*	37.6
Grazed Seasonlong	36.0*b*	24.7

Means of same column followed by the same letter are not significantly different (P<0.05).

Table 5. Percentage of ground not covered by vegetation canopy on the crested wheatgrass treatments, 1993.

Treatments	Early June	Late June	Mid July	Mid August
Mowed				
Pretreatment	26.4*a*	36.0*a*		
Post treatment		50.9*a*	20.1*a*	23.1*a*
Mowed/Grazed	9.6*b*	8.3*b*	7.7*b*	13.5*a*
Grazed Spring	3.3*c*	4.6*c*	10.7*c*	7.8*b*
Grazed Seasonlong		17.3*d*	10.9*c*	13.9*a*

Means of same column followed by the same letter are not significantly different (P<0.05).

Table 6. **Total above ground plant biomass in pounds/acre on crested wheatgrass treatments, 1993.**

Treatments	1 May	1 Jun	24 Jun	19 Jul	12 Aug	Sep	15 Oct
Mowed			I				
Pretreatment lbs/acre		1307	1441				
Post treatment lbs/acre			1005	1663	1392	--	1652
Mowed/Grazed	I-------------I[a]						
lbs/acre		828	727	1060	669	--	914
Grazed Spring	I-------------I						
lbs/acre		1097	735	837	1560	--	888
Grazed Seasonlong	I---I						
lbs/acre			1164	1364	1131	--	1331

[a]Dashed lines indicate period of grazing.

Table 7. Responses of grasshoppers to the changes in vegetation caused by grazing on two grazing management systems in the Little Missouri National Grasslands near Watford City, North Dakota, 1993.

	Grazing Management		
Grasshopper Population Parameter	**Seasonlong**	**Twice Over Rotation**	**% Difference**
Density of nymphs (per yd^{-2})	17.91	3.75	-79.06
Nymphal development time (# days)	26.20	36.60	+39.69
Average daily mortality rate (%)	6.15	7.05	+14.63
Density of adults (per yd^{-2})	3.40	0.26	-92.35
Egg production (per yd^{-2})	32.70	1.80	-94.50

From J.A. Onsager, 1994.

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Grazing Management for Western North Dakota Rangelands

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Abstract

Adaptive tolerance mechanisms have developed in grassland plants during their long period of evolution in two main general directions as compensation to defoliation from herbivores and fire. The mechanisms are; (1) changes in the physiological responses within the grassland plants and (2) changes in the activity levels of the symbiotic soil organisms in the rhizosphere. Grassland managers can beneficially manipulate the adaptive tolerance mechanisms by timing grazing for a short period (7-15 days) of partial defoliation of young leaf material between the third leaf stage and anthesis phenophase. Grass plant tiller numbers increase, above ground herbage biomass increases, nutrient content of herbage increases, exudated material increases in the rhizosphere, and the top trophic level of the rhizosphere (mites) increases in biomass as a result of defoliation at early phenological growth stages. This allows for subsequent increases in stocking rate and for improvement in individual livestock weight performance during a second grazing period after anthesis.

Introduction

Grassland ecosystems are extremely diverse and complex, which causes considerable difficulty in development of management recommendations. Increasing knowledge of ecological principles and the intricacies of the numerous mechanisms that function in the grassland ecosystem have allowed for improvements in management strategies. Recently (within the last ten to twelve years) several greenhouse and laboratory studies have opened the way to the initial understanding of the adaptive tolerance mechanisms that grassland plants have developed during their long period of coevolution as compensation to defoliation from herbivores and fire. These adaptive tolerance mechanisms can be separated into two main general categories that function interrelatively. The first mechanism is numerous changes in the physiological responses within the grassland plant and the second is numerous changes in the activity levels of the symbiotic soil organisms in the rhizosphere.

The physiological responses within the plant caused by defoliation have been reviewed and grouped into nine categories by McNaughton (1983). The physiological responses to defoliation do not occur at all times, and the intensity of the response is variable. The physiological responses can be related to different phenological stages of growth of the grass plants. The key to ecological management by effective defoliation is to match the timing of defoliation to the phenological stage of growth that triggers the desired outcome.

All of the relationships between the physiological responses and the application of the management treatment have not been worked out yet with scientific research. One of the main physiological effects of defoliation is the temporary reduction in the production of the blockage hormone, auxin, within the meristem and young developing leaves. This reduction of plant auxin in the lead tiller allows either for cytokinin synthesis in the roots or crown, or its utilization in axillary buds, which stimulate the development of vegetative tillers (Murphy and Briske 1992). Partial defoliation of young leaf material reduces the hormonal affects of apical dominance by the lead tiller and allows secondary tillers to develop from the previous years axillary buds. Secondary tillers can develop without defoliation manipulation after the lead tiller has reached anthesis phenophase, but usually only one secondary tiller develops from the potential of 5 to 8 buds because this secondary tiller suppresses additional axillary bud development hormonally by apical dominance. When the lead tiller is partially defoliated between the third leaf stage and anthesis phenophase, several axillary buds can develop subsequently into secondary tillers. Apparently no single secondary tiller is capable of developing complete hormonal apical dominance following defoliation of the lead tiller at this time. Some level of hormonal control from the older axillary buds still suppresses development of some of the younger axillary buds. With our present level of knowledge of this mechanism, we cannot get all of the axillary buds to develop into secondary tillers.

The second type of influence by defoliation on grassland plants is changes in the activity levels in the rhizosphere. The rhizosphere is that narrow zone of soil around living roots of perennial grassland plants where the exudation of sugars, amino acids, glycosides, and other compounds affects microorganism activity. Bacterial growth in the rhizosphere is stimulated by the presence of carbon from the exudates (Elliott 1978, Anderson et al. 1981). Protozoa and nematodes graze increasingly on the increased bacteria, and accelerate the overall nutrient cycling process through the "fast" pathway of substrate decomposition as postulated by Coleman et al. (1983). The activity of the microbes in the rhizosphere increases the amount of nitrogen available for plant growth (Ingham et al. 1985, Clarholm 1985). The presence of vasicular-arbuscular mycorrhizal (VAM) fungi enhances the absorption of ammonia, phosphorus, other mineral nutrients and water. Rhizosphere activity can be manipulated by defoliation at early phenological growth stages when a higher percentage of the total nitrogen of the plant is in the above ground parts and a higher percentage of the total carbon of the plant is in the below ground parts. At that time, partial defoliation disrupts the plants carbon to nitrogen ratio, leaving a relatively high level of carbon in the remaining plant. Some of this carbon is exuded through the roots into the rhizosphere in order to readjust the carbon-nitrogen ratio. Bacteria in the rhizosphere are limited by access to simple carbon chains under conditions with no defoliation. The rhizosphere bacteria increase in activity in response to the increase in exuded carbon under conditions with defoliation. The increases in activity by the bacteria triggers increases in activity in the other subsequent trophic levels of the rhizosphere organisms. This ultimately increases available nutrients for the defoliated grass plant.

Rhizosphere activity can be stimulated by disrupting the carbon-nitrogen ratio through defoliation at early phenological growth stages. During middle and late growth, the carbon and nitrogen are distributed more evenly throughout the plant, defoliation does not remove a disproportionate amount of nitrogen, and very little or no carbon is exuded into the rhizosphere. Soil water levels generally decrease during the middle and late portions of the grazing season and also limit rhizosphere organism activity levels. The relationship between grassland plants and organisms in the rhizosphere is truly symbiotic.

The adaptive tolerance mechanisms that work within grassland plants and symbiotic organisms in the rhizosphere following defoliation are the key to understanding beneficial manipulation of these mechanisms under field conditions and the development of ecologically sound recommendations for management of our grassland natural resources. These were the goals of a research project developed to study the ecological effects of defoliation at the Dickinson Research Center in western North Dakota (1983 – 1994).

The objectives of this study were to evaluate changes in plant exudation, soil organism activity and biomass, grass plant tiller development, above and below ground plant biomass, and livestock weight performance between a twice over rotation grazing treatment (Jun – Oct), a 4.5 month seasonlong (Jun – Oct), a 4.0 month deferred seasonlong (mid Jul – mid Nov), and a 6.0 month seasonlong (mid May – mid Nov) treatments, and a long term nongrazed treatment.

Methods and Materials

The long-term study site is located 20 miles north of Dickinson in southwestern North Dakota, U.S.A (47°14´N.lat., 102°50´W. long.) on the Dickinson Research Center operated by North Dakota State University.

Soils are primarily Typic Haploborolls. Average annual precipitation is 356 mm (14 in.) with 80% falling as rain between April and September. Temperatures average 19°C (66°F) in summer with average daily maximums of 27°C (80°F) and -11°C (13°F) in winter with average daily minimums of -17°C (2°F). The vegetation is the Wheatgrass-Needlegrass Type (Barker and Whitman 1988) of the mixed grass prairie. The dominant native range species are western wheatgrass (Agropyron smithii), needleandthread (Stipa comata), blue grama (Bouteloua gracilis), and threadleaved sedge (Carex filifolia).

The native rangeland treatments were organized as a paired plot design with two replications. The twice over rotation grazing treatments have three pastures with each grazed for two periods, one period of 15 days between 1 June and 15 July followed by a second period of 30 days prior to mid October for a total of 4.5 months (1 June – 17 October) at a stocking rate of 0.49 AUM's/acre. Three seasonlong treatments were used, a 4.5 month seasonlong grazed between 16 June to 30 October at a stocking rate of 0.35 AUM'S/acre, a 4.0 month deferred seasonlong grazed between 16 July to 15 November at a stocking rate of 0.45 AUM's/acre, and a 6.0 month seasonlong grazed between 15 May and 15 November at a stocking rate of 0.25 AUM'S/acre. The long term nongrazed treatments had not been grazed, mowed, or burned for more than 30 years prior to the start of data collection. Commercial crossbred cattle were used on all treatments in this trial.

Each of the treatments were stratified on the basis of three range sites (sandy, shallow, and silty sites). Samples from the grazed treatments were collected on both grazed and protected with cages (ungrazed) quadrats. Above ground plant biomass was collected on 7 sampling dates from May to October. Below ground plant biomass and soil microorganism data were collected on 4 sampling periods. Above ground and below ground net primary productivity (NPP) was determined by methods outlined by Sala et al. (1981), and Bohm (1979), respectively. The major components sampled were live material (by species), standing dead, and litter. Plant materials were analyzed for nutrient content using standard procedures (A.O.A.C. 1984). Plant species composition was determined by the ten pin point frame method (Cook and Stubbendieck 1986) between mid July and mid August. Root exudates were determined using procedures outlined by Haller and Stolp (1985). Statistical methods used to analyze differences between means was a standard paired plot t-test (Mosteller and Rourke 1973).

Individual animals were weighed on and off each treatment and on each rotation date. Cow and calf mean weights were adjusted to the 8th and 23rd day of each month of the grazing period. Biweekly live weight performance periods of average daily gain and accumulated weight gain for cows and calves were used to evaluate each treatment. Response surface analysis (Kerlinger and Pedhazur 1973) with a repeated observation design was used to compare animal response curves among treatments. These response surface analysis curves were reported by Manske et al. (1988).

Results and Discussion

Percent basal cover of grasses increased 25% (from 15% to 19% basal cover) on the rotation grazing treatments compared to 4.5 month seasonlong treatments (Table 1). Basal cover of sedges and forbs decreased by 4% and 36%, respectively, on the rotation treatments compared to seasonlong treatments. Relative percent composition (Table 2) increased by 14% for grasses and decreased by 14% and 40% for sedges, and for forbs plus shrubs, respectively, on the rotation treatments compared to seasonlong treatments.

The amount of herbage that remained standing on 1 September after the rotation treatments was greater than the amount of total current years growth on the long term nongrazed treatments (Table 3). This does not account for the amount of vegetation removed by livestock on the rotation treatments. During the entire grazing season an average of 15% more herbage biomass was standing after each grazing period on the rotation treatments compared to long term nongrazed treatments. The relatively greater amount of photosynthetic leaf area remaining on the rotation treatments at the end of the grazing season was beneficial for the continued development of the grassland ecosystem at a higher production level. This remaining herbage also provides a benefit as wildlife habitat. Seasonlong treatments averaged 8% and 29% less herbage biomass standing after grazing than on the nongrazed and rotation treatments, respectively.

Grass plant tiller development and resulting increase in above ground herbage biomass was greater on the rotation treatments than on the nongrazed and seasonlong treatments. This suggests that removal by defoliation of some young leaf material at early phenological stages has some effect on the reduction of auxin and the subsequent stimulation of cytokinin which causes axillary buds to develop into secondary tillers. Thus, defoliation of grass plants at an early phenological stage has beneficial effects on tiller development.

Preliminary interpretation of the rhizosphere data collected so far indicates that greater amounts of exudates were released into the rhizosphere on the rotation treatments than on nongrazed or seasonlong treatments. These data also indicate that soil mite biomass was greater on the rotation treatments compared to the nongrazed or seasonlong treatments. This suggests that removal by defoliation of some young leaf material at early phenological stages has some effect on increasing exudated material, which presumably stimulates activity of the bacteria, which causes increases in protozoa and nematodes, which causes increases in springtails and mites, which are the top trophic levels in the rhizosphere. This increase in activity levels of organisms in the rhizosphere increases the amount of nitrogen available for plant growth. Thus, defoliation of grass plants at an early phenological stage has beneficial effects on symbiotic rhizosphere activity.

The period of defoliation of grass plants that has shown beneficial effects on the increases of tillers and symbiotic rhizosphere activity during this study has occurred between the third leaf stage and anthesis phenological phenophase.

The increase in grass tiller development and symbiotic rhizosphere activity on the rotation treatments allowed a mean increase in stocking rate of 40% greater than on the 4.5 month seasonlong treatments, 96% greater than on six month seasonlong treatments, and 9% greater than the four month deferred seasonlong treatments. Initial turn out of the livestock on the deferred seasonlong treatments was delayed until near peak herbage production in mid to late July.

Cow and calf individual accumulated weight performance (Table 4) (Fig. 1 and 2), average daily gain (Table 5) (Fig. 3 and 4), and weight gain per acre (Table 6), were greater on the rotation treatments compared to the seasonlong and deferred seasonlong treatments. Cow and calf weight performance on the three grazing treatments was generally not significantly different during the first grazing period of June and July, but during the second grazing period after early August, the animal weight performance on the rotation treatments was significantly greater than on the seasonlong and deferred seasonlong treatments (Manske et al. 1988) (Fig. 1,2,3, and 4). The individual animal performance is improved on the twice over rotation grazing system with an increase in calf average daily gain of 6% greater than 4.5 month seasonlong and 23% greater than deferred seasonlong grazing treatments. Cow average daily gain is improved on the twice over rotation system by 82% greater than 4.5 month seasonlong and 94% greater than deferred seasonlong grazing treatments.

The combination of increases in stocking rate and individual animal performance gives the twice over rotation system a considerable increase in animal weight gain per acre over the other grazing treatments. Calf weight gain per acre on the twice over rotation system was 39% greater than 4.5 month seasonlong and 40% greater than deferred seasonlong treatments. Cow weight gain per acre on the twice over rotation system was 179% greater than 4.5 month seasonlong, and 212% greater than deferred seasonlong grazing treatments. The improved livestock weight performance during the later portion of the grazing season on the rotation treatments was primarily attributed to the increase in available nutrients from the addition of secondary tillers which had developed from axillary buds and were phenologically at an early growth stage. Generally, the available herbage on the rotation treatments was 1.5 and 2.5 percentage points greater in protein content than the herbage on the seasonlong and deferred seasonlong treatments during the later portion of the grazing season.

The grassland plant community can generally be beneficially changed when grazing is properly timed with the phenological development of the grass plants. The grass plant density is increased and total herbage production is increased. A greater amount of vegetation can remain at the end of the grazing season, which causes a noticeable change in the vegetation canopy cover. There is a decrease in the amount of bare ground present in the pastures.

Conclusion

Additional research needs to be done to quantify exudation material, soil organism activity and biomass, nitrogen, carbon and phosphorus cyclic flows, and axillary bud development into tillers, in order to completely understand the adaptive tolerance mechanisms developed by grassland plants to compensate for defoliation and thereby be able to manipulate the defoliation to be increasingly beneficial for the grassland ecosystem. Data collected to date has shown that defoliation of grass plants between the third leaf stage and anthesis phenological stage has beneficial effects on the physiological responses within the plant, which allows for greater tiller development and beneficial effects on the symbiotic rhizosphere activity, which presumably increases the amount of available nitrogen for plant growth. Deliberate and intelligent manipulation of these adaptive tolerance mechanisms can increase secondary tiller development and total herbage biomass. The secondary tillers increase the nutrient content of the herbage, which allows for improvement in individual animal weight performance during the later portion of the grazing season. The increase in herbage biomass allows for an increase in stocking rate and a greater amount of herbage left after grazing. Plant density, canopy cover, and litter cover increase as a result of increased tiller growth, which in turn, reduces the impact of raindrops, reduces and slows runoff, reduces erosion, and increases water infiltration. Grazing management recommendations that systematically rotate 7 to 15 day periods of defoliation between the third leaf stage and anthesis phenophase (which is 1 June – 15 July in western North Dakota) on each pasture should maximize beneficial effects on the adaptive tolerance mechanisms of grassland plants.

Table 1. Mean percent basal cover.

	Treatments		
	Seasonlong	**Rotation**	**% Difference**
Grass	14.7	18.6	+25.2
Sedge	7.7	7.6	-3.8
Forb	3.8	2.4	-35.9
Shrub	0.1	0.1	---

Table 2. Mean relative percent composition of plant communities.

	Treatments		
	Seasonlong	**Rotation**	**% Difference**
Grass	55.1	63.2	+14.1
Sedge	30.6	28.0	-13.6
Forb & Shrub	14.5	8.7	-39.6

Table 3. Mean monthly above ground herbage biomass remaining after grazing on three range sites.

	Sample periods				
1 **Treatments**	1 **Jun.**	1 **Jul.**	1 **Aug.**	1 **Sep.**	**Oct.**
Nongrazed lb/ac	822*a*	1010*a*	1144*a*	888*a*	
Seasonlong lb/ac	974*a*	1017*a*	785*b*	717*a*	
Rotation lb/ac	990*a*	1211*b*	1231*a*	993*b*	987

Means of same column followed by the same letter are not significantly different (P<0.05).

Table 4. Mean annual calf and cow accumulated weight gain.

	Treatments		
	Deferred Seasonlong	**Seasonlong**	**Rotation**
Calf lbs	204	284	309
Cow lbs	34	40	107

Table 5. Mean annual calf and cow average daily gain.

	Treatments		
	Deferred Seasonlong	**Seasonlong**	**Rotation**
Calf lbs	1.80*a*	2.09*b*	2.21*b*
Cow lbs	0.32*a*	0.34*a*	0.62*b*

Means of same row followed by the same letter are not significantly different (P<0.05).

Table 6. Mean annual calf and cow weight gain per acre.

	Treatments		
	Deferred Seasonlong	**Seasonlong**	**Rotation**
Calf lb/ac	20.4*a*	20.5*a*	28.5*b*
Cow lb/ac	2.6*a*	2.9*a*	8.1*b*

Means of same row followed by the same letter are not significantly different (P<0.05).

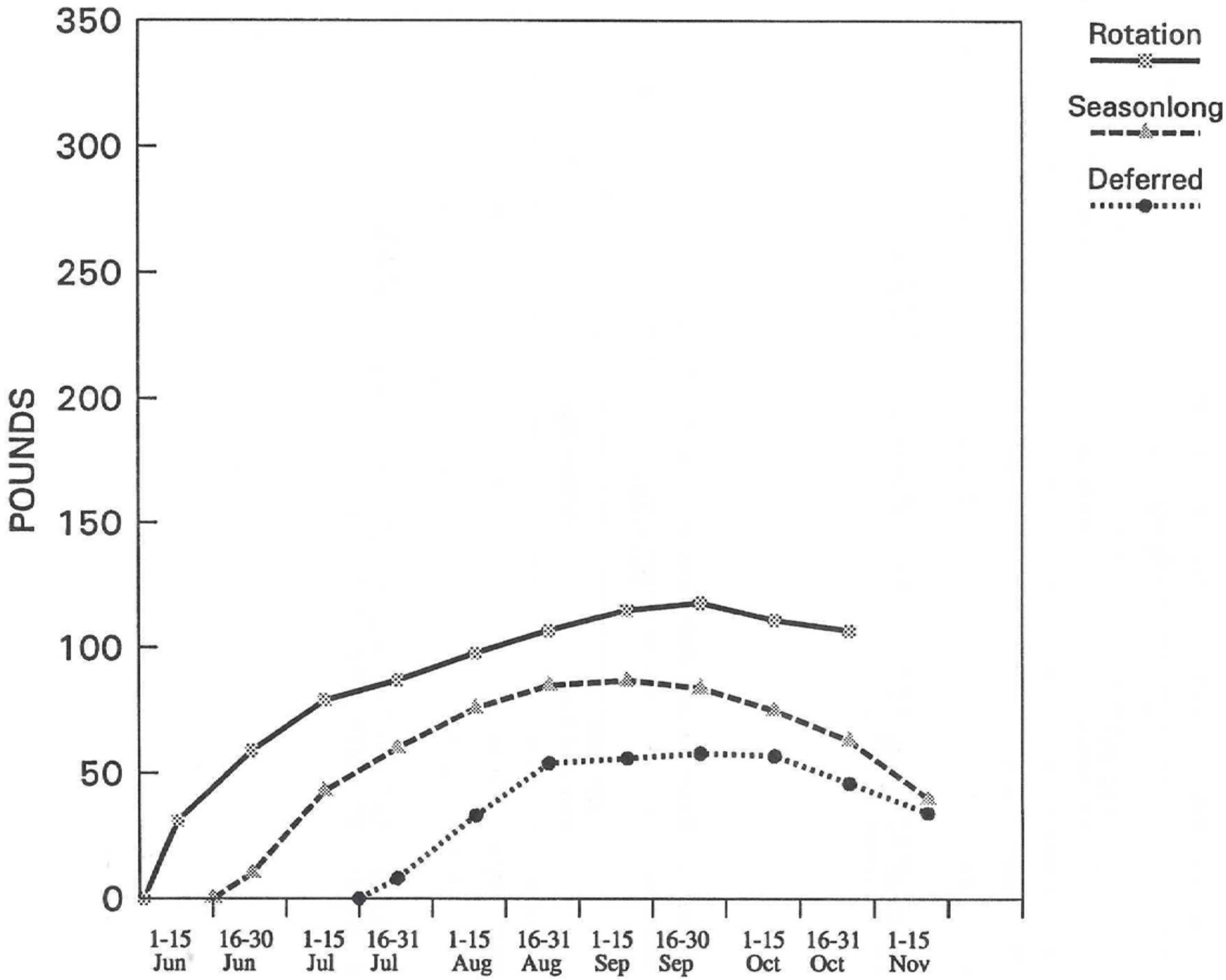

Fig. 1. COW ACCUMULATED WEIGHT GAIN

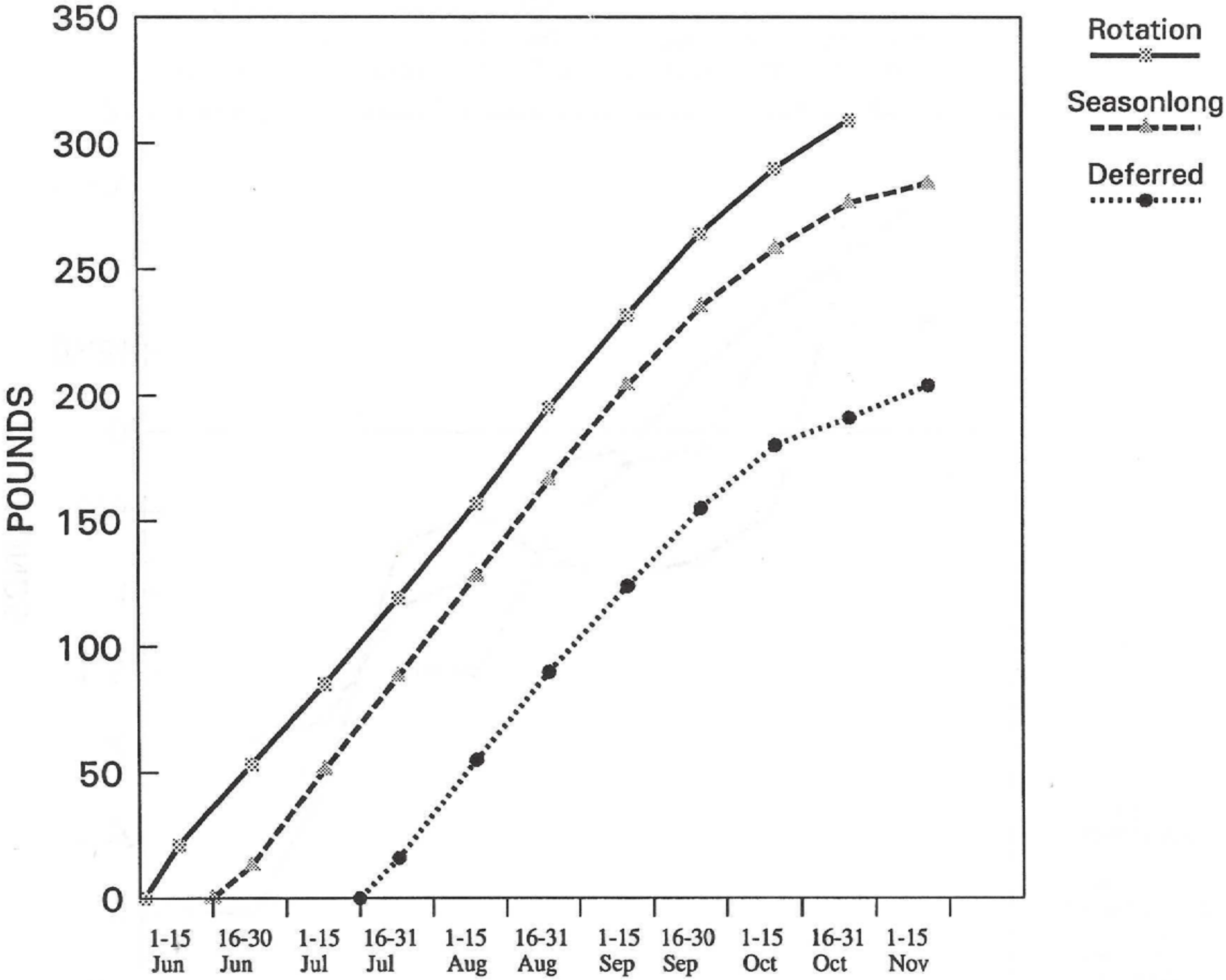

Fig. 2. CALF ACCUMULATED WEIGHT GAIN

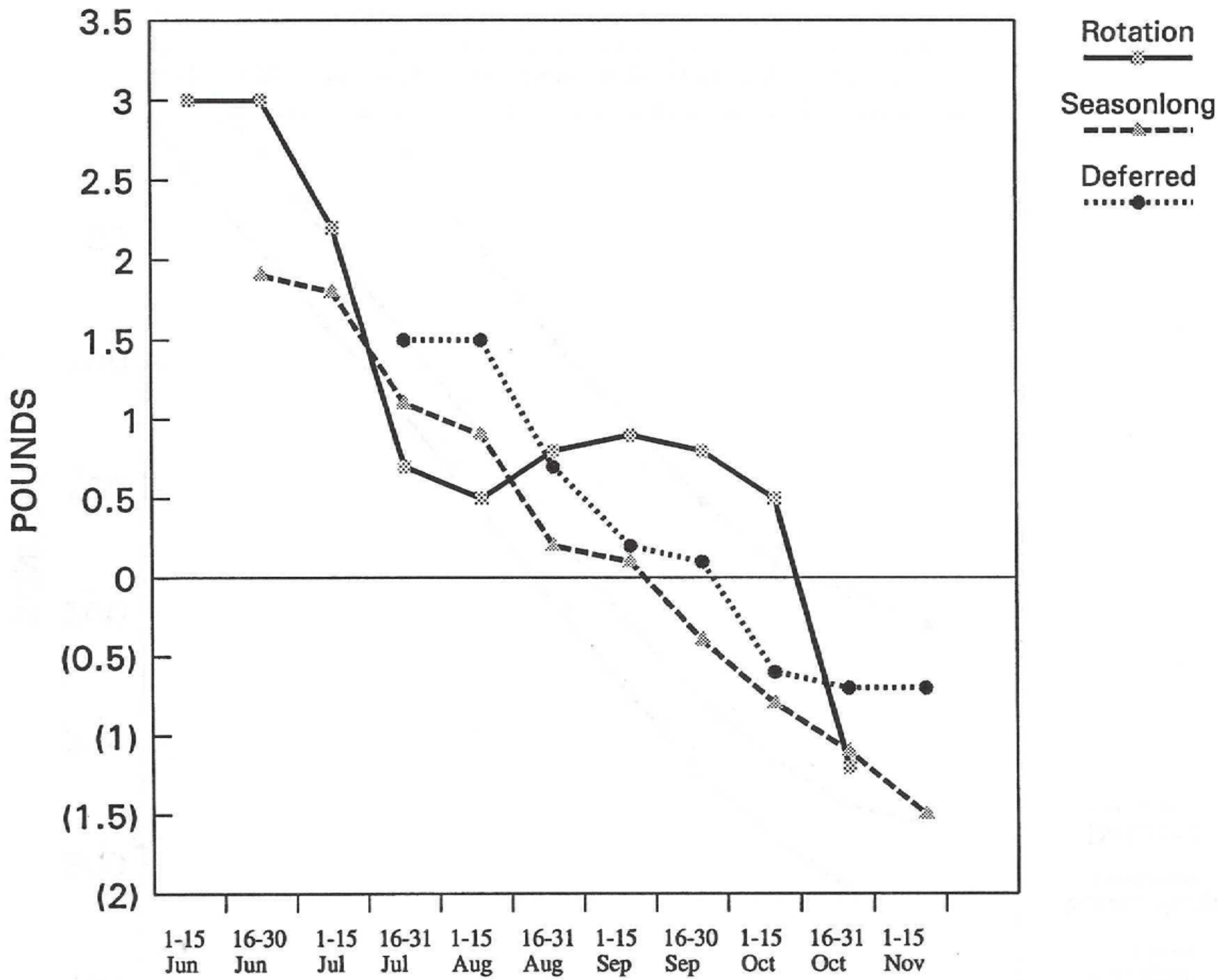

Fig. 3. COW AVERAGE DAILY GAIN

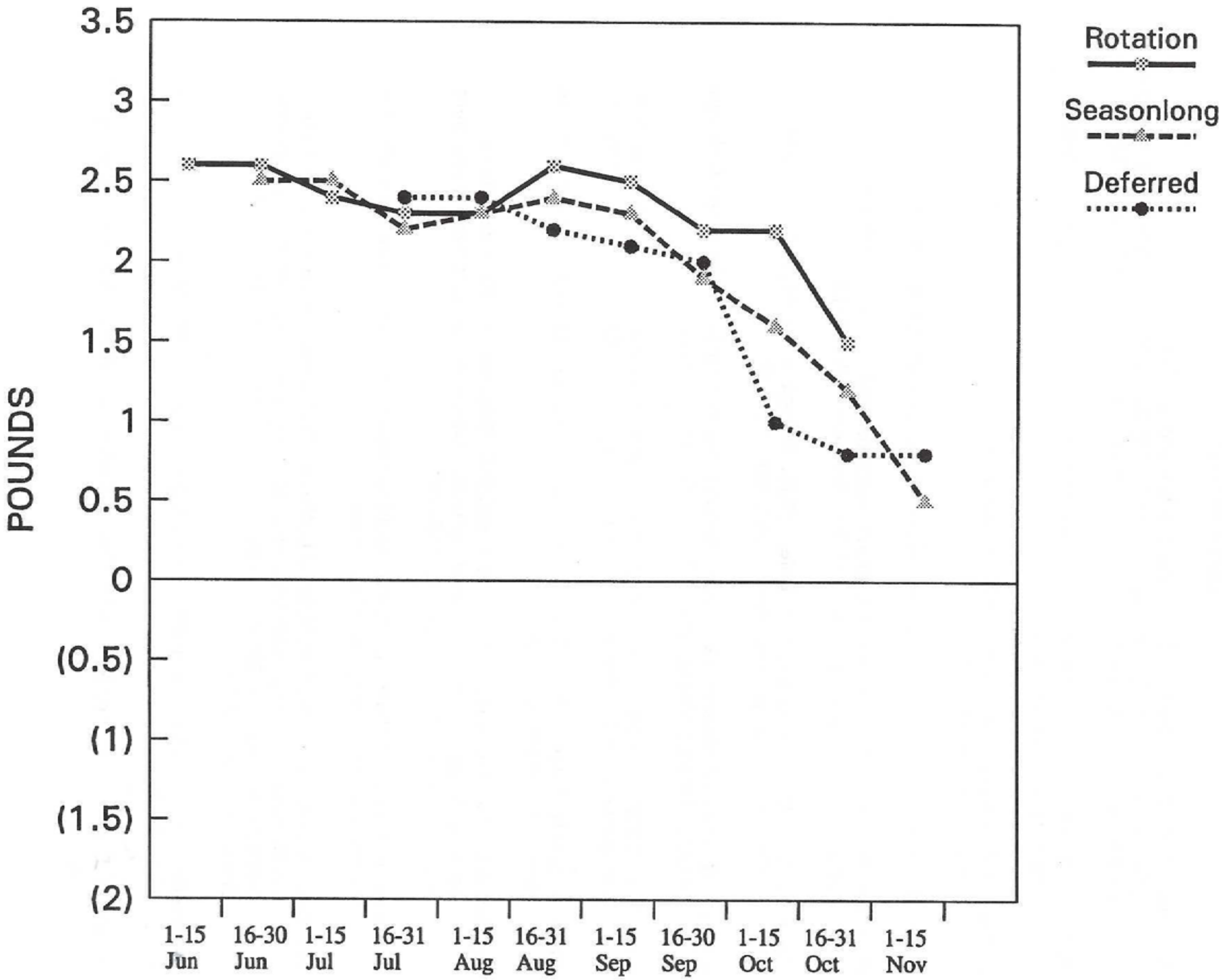

Fig. 4. CALF AVERAGE DAILY GAIN

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Problems to Consider when Implementing Grazing Management Practices in the Northern Great Plains

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Range management practices that have been developed and found to be successful in ecosystems outside the Northern Great Plains usually require modification and adjustments in order to successfully implement them into the Northern Great Plains grassland ecosystem. Each region of the country has a unique set of problems and circumstances that make "across the board" use of most range management principles and practices nearly impossible. Many practices need to be developed specifically for an ecosystem and may not be effective when tried in a different ecosystem. Identifying and understanding the set of problems for each region is essential for the development and implementation of optimum range management principles and practices for that region. This paper will attempt to point out three major problems that need to be considered when implementing grazing management practices in the Northern Great Plains. These three problems are: 1) plant growth is limited by several factors, 2) ungrazed grasses are low in nutritional quality during the later portion of the grazing season, and 3) some grazing starting dates cause negative effects.

The type of livestock grazing management that is successful in an ecosystem is generally regulated by the responses to grazing by the individual plant species and the productivity of those species. The plant species present are generally determined by the physical characteristics (climate, soil, and topography) of a region. Several grassland plant communities have been defined and described for the Northern Great Plains (Barker and Whitman 1988, Shiflet 1994). These grassland plant communities are basically quite similar in the species that are present. The main differences are in the relative amounts of each component graminoid species. The major graminoid plants with wide distribution throughout the Northern Great Plains are western wheatgrass, needleandthread, blue grama, upland sedges, prairie Junegrass, prairie sandreed, and plains reedgrass. Several species of forbs and shrubs also have wide distribution across the Northern Great Plains. The variations in relative abundance of the plant species present in grassland plant communities of the Northern Great Plains are primarily due to differences in soil moisture, soil type, geology, topography, and slope aspect. The precipitation and seasonal precipitation pattern are probably the most important factors in determining the type of vegetation and its productivity in a region.

The annual precipitation for the Northern Great Plains has a great deal of variability from year to year and the long term means range from less than 12 inches in the west to more than 20 inches in the east with a similar change from north to south. The average over most of the region is about 15 inches of precipitation. The seasonal precipitation pattern is characterized by a period of maximum precipitation in late spring and early summer, tapering off to a moderately light amount during fall and winter. Periods with low precipitation levels occur frequently. These periods may last in duration for several weeks, several months, and sometimes several years. The longer periods are identified as drought. The low precipitation periods place plants under water stress and limit growth.

Herbage production from grassland plant communities is also limited by temperature. The frost free period is usually short, from 120 days in the north to 160 days in the south. Plants require temperatures above the level that freezes water in plant tissue and the soil in order to continue active growth. Many perennial plants begin active growth in spring before the start of the frost free period and continue after the first frost in fall. Low air temperatures during the early and late portions of the growing season greatly limit plant growth. Plant growth is also limited after mid summer by high temperatures, high evaporation, drying winds, and low precipitation.

A technique to identify months with conditions that are unfavorable for plant growth was developed by Emberger et al. (1963). This method plots mean monthly temperature (C°) and monthly precipitation (mm) on the same axis but with the scale of the precipitation data at twice that of the temperature data. The temperature and precipitation data are plotted against an axis of time. The resulting ombrothermic diagram shows general monthly trends and identifies months with conditions that are unfavorable for plant growth. Plants are under water stress during months when the precipitation data curve drops below the temperature data curve and plants are under temperature stress when the temperature curve drops below the freezing mark (0°C). During the past 12 years (1983-1994) (Table 1) 43% of the growing season months from mid April through mid October had low precipitation conditions that have caused water stress in perennial plants. The ombrothermic diagram (Fig. 1) of long term data (100 years) for Dickinson, North Dakota shows that perennial plants are near water stress conditions during the months of August, September, and October. These long term near water stress conditions limit plant growth. Favorable conditions of precipitation and temperature for plant growth occur during the months of May, June, and July.

Dr. Harold Goetz collected plant leaf and flower stalk height data from ungrazed plants in western North Dakota for 6 years and reported his work as a thesis (Goetz 1963). These data are summarized in tables 2 and 3, and figure 2. The upland sedges complete 100% of their growth in leaf and flower stalk height by 30 June. The cool season grasses complete 100% of their growth in leaf and flower stalk height by 30 July. The warm season grasses complete 100% of their growth in leaf height and 91% of their growth in flower stalk height by 30 July. A small amount of flower stalk elongation occurs after 30 July for the warm season grasses. The short period of May, June, and July is when nearly all of the growth in graminoid leaf and flower stalk height occurs.

Peak above ground herbage biomass usually occurs during the last 10 days of July. This would coincide with the time when 100% of the growth in height has been completed. Herbage biomass of ungrazed plants increases in weight during May, June, and July, and after the end of July the weight of the herbage biomass decreases because the rate of senescence of the grass leaves exceeds growth and the cell material in the above ground parts is being translocated to the below ground parts.

The translocation of cell material from the above ground parts to the below ground parts causes a decrease in the nutritional quality of the above ground parts. Dr. Warren Whitman collected biweekly nutritional quality samples from ungrazed plants of the major grass species in western North Dakota for two years. The results of this work were reported by Whitman et al. (1951) and are summarized in table 4 and figure 3. Ungrazed plants of the major upland sedges, cool season grasses, and warm season grasses drop below 9.6% crude protein levels around mid July. This drop in crude protein levels occurs at about the same time that the maximum amount of plant growth in height and weight occurs.

The levels of crude protein in the above ground herbage after mid July become very important in livestock production because 1000 pound cows requires 9.6% crude protein from their diet in order to maintain body weight and average lactation (NRC 1984). Most ruminant animals require a daily dry matter intake of about 2% (1.5-2.5%) of their body weight (Holechek et al. 1989). Cows may be able to compensate for lower quality forage for a short period of time by increasing intake and/or selecting plant parts higher in nutritional quality than average plant parts.

Cows on seasonlong grazing systems lose weight from early or mid August to the end of the grazing season (Fig. 4). This loss of weight does not hurt the animal but it does decrease the level of lactation. Doug Landblom (1989) has sampled milk production by weigh-suckle-weigh method of commercial crossbred cows of mainly British breed ancestry over a 3 year period using a seasonlong grazing system on native range pastures. He has found that the milk production decreases from 14.1 pounds per day in mid June, to 11.4 pounds per day by the end of August, and to 7.0 pounds per day by the end of October. This reduction in milk production has a negative effect on calf growth.

Animal performance is also affected by the grazing starting date. The time of year that grazing is started is important because early grazing greatly effects the percentage of the potential peak above ground herbage biomass that is reached. Two good independent studies have been conducted in the Northern Great Plains that evaluated starting dates for seasonlong grazing management. One study was conducted at Swift Current, Canada and reported by Campbell (1952) and the other was conducted at Mandan, North Dakota and reported by Rogler et al. (1962). Summaries of these two studies are shown in table 5 and figure 5. Unpublished data collected at Dickinson, North Dakota has been added to table 5 and figure 5. The data from the 3 locations closely agree and show that if seasonlong grazing is started in mid May on native range, 45-60% of the potential peak herbage biomass will be lost and never be available for grazing livestock. If the starting date of seasonlong grazing is deferred until early or mid July, nearly all of the potential peak herbage biomass will grow and be available to grazing livestock but the nutritional quality will be at or below the crude protein levels required for a lactating cow. If the starting date is deferred until after mid July, less than peak herbage biomass will be available to grazing livestock because of senescence and the translocation of cell material to below ground parts.

A grazing starting date in May on native range has unacceptable reductions in herbage biomass. Starting dates after mid July have less than acceptable animal performance because of the low nutritional quality. Data from these studies indicate that a starting date between early June and early July would provide the lowest negative effects on herbage biomass production and nutritional quality of the available forage.

The phenological growth stage of the grass plants would be the best indicator to determine when to start grazing. Grazing grass plants before the third leaf stage causes negative effects in grass growth. Starting grazing after the third leaf stage seems to stimulate tiller production. Most native cool season grasses reach the third leaf stage around early June, and most native warm season grasses reach the third leaf stage around mid June. This indicates that seasonlong grazing management systems on native range should wait until mid June to start but rotation grazing systems could start in early June.

The Northern Great Plains has three major problems that need to be considered when implementing any grazing management practice. Plant growth is limited by several climatic factors. The most important of these are low annual precipitation, limited seasonal distribution of precipitation, frequent drought conditions, cool temperatures in spring and fall, and hot temperatures in summer. Favorable precipitation and temperature conditions occur during May, June, and July. Most of the plant growth occurs during the short period of May, June, and July. The nutritional quality of the native vegetation is a limiting factor in animal performance because all the major graminoid species drop below the 9.6% crude protein requirements for 1000 pound lactating cows after mid July if the plants are ungrazed. The low nutritional quality causes a loss of weight by the cows and a reduction in milk production which reduces the daily gain of the calves. The starting dates of seasonlong grazing in May causes great reductions in herbage biomass production which would cause reductions in stocking rates and animal production per acre. Deferring grazing starting dates until after mid July allows for near peak biomass production but causes a reduction in animal performance because of the low nutritional quality of the available forage. It is possible that no range management practice can solve all the inherent problems in an ecosystem completely, but the successfully implemented practices will have solutions or compensations for large portions of each of these problems. There may be more than one optimum or nearly optimum grazing management practice for an ecosystem.

One grazing management system that has attempted to address these three inherent problems on the Northern Great Plains is the twice over rotation system on native range with complementary domesticated grass spring and fall pastures. A spring pasture of crested wheatgrass is used during the month of May. A three or four pasture native range rotation system is used from early June until mid October with each pasture being grazed for two periods. The first period is grazed for 15 or 11 days in each pasture of a 3 or 4 pasture system, respectively, during the 45 day period when grasses can be stimulated to tiller which is from the third leaf stage to the flowering stage (1 June to 15 July) and a second period is grazed for 30 or 22 days in each pasture of a 3 or 4 pasture system, respectively, after mid July and before mid October. A fall pasture of Altai wildrye is grazed with cows and calves from mid October until weaning in early or mid November and grazed by dry cows from mid November until mid or late December.

The twice over rotation system with complementary domesticated grass pastures has a grazing season of over 7.5 months with the available forage above, at, or only slightly below the requirements for a lactating cow for nearly the entire grazing season. It requires less than 12 acres per cow-calf pair for the entire 7.5 month grazing season on grassland that traditionally requires 24 acres per cow-calf pair grazed for 6.0 months seasonlong. The cow and calf weight performance is an improvement over other systems tested in the Northern Great Plains.

The range management practices that can be implemented successfully on the Northern Great Plains, whether they are practices that have been developed in this ecosystem or modified practices that have been brought in from outside ecosystems, will have major components that address the inherent problems of this ecosystem and will solve large portions of each of the major problems. Only these management practices have the potential to maximize the vegetation and animal performance on the Northern Great Plains grassland ecosystem.

Table 1. Months when temperature and precipitation conditions caused water stress for perennial plants.

Year	**Months**							**Percentage of 6 Months 15 Apr – 15 Oct**
1983	Apr					Sep		25%
1984		May		Jul		Sep		50%
1985				Jul				17%
1986					Aug		Oct	25%
1987	Apr		Jun			Sep	Oct	50%
1988	Apr		Jun	Jul	Aug	Sep	Oct	83%
1989				Jul	Aug	Sep		50%
1990				Jul	Aug	Sep		50%
1991				Jul	Aug			33%
1992		May				Sep	Oct	42%
1993					Aug	Sep	Oct	42%
1994				Jul	Aug	Sep		50%

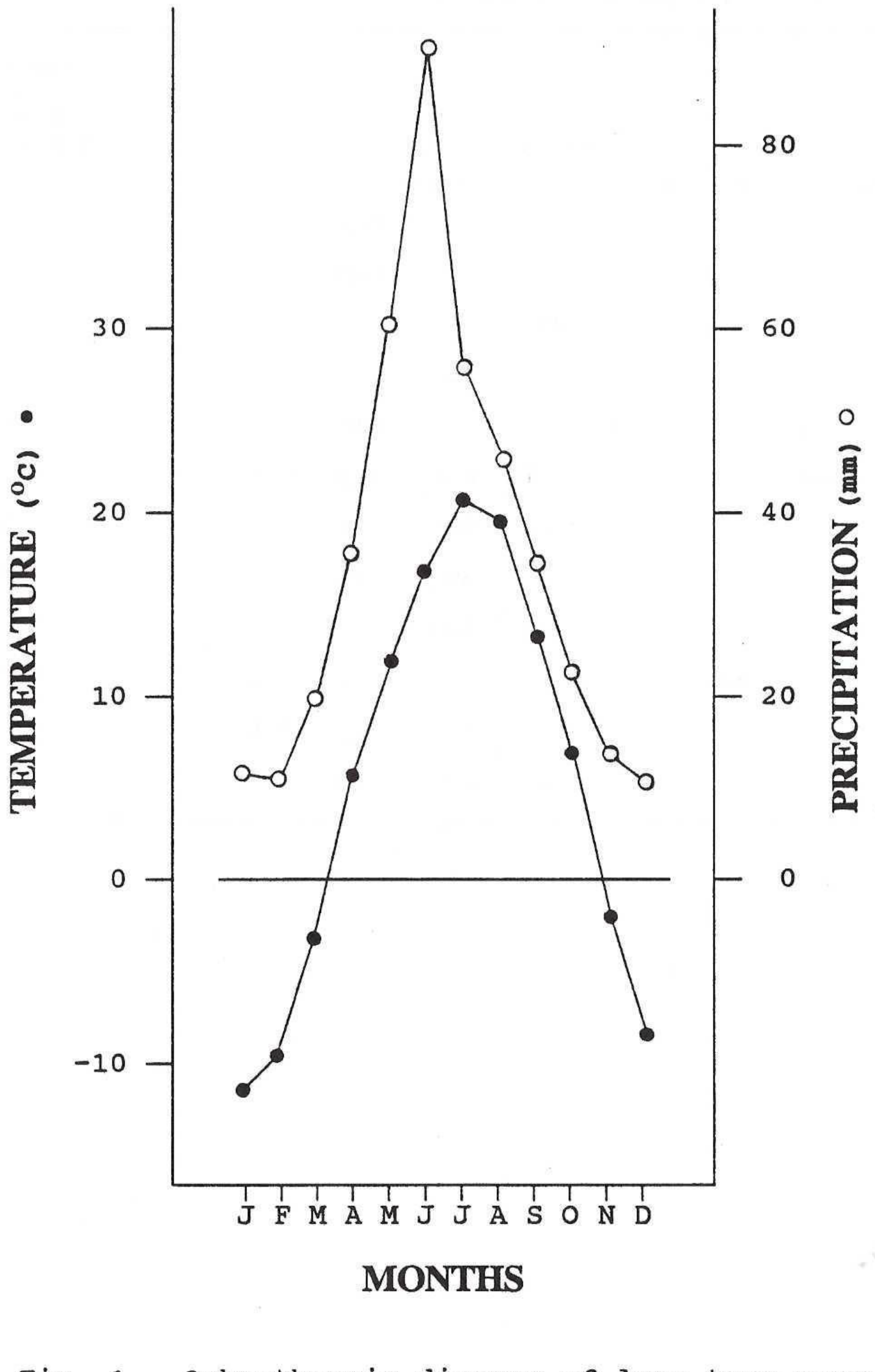

Fig. 1. Ombrothermic diagram of long term mean monthly temperature and monthly precipitation at Dickinson, North Dakota.

Table 2. Mean percent growth in leaf height completed by sample date from ungrazed plants of major graminoid species from western North Dakota mixed grass prairie.

	15 May	30 May	30 Jun	30 Jul	30 Aug	30 Sep
UPLAND SEDGES	**75**	**93**	**100**	**--**	**--**	**--**
Western Wheatgrass	54	69	92	100	--	--
Needleandthread	40	62	97	100	--	--
Prairie Junegrass	72	84	93	100	--	--
Plains Reedgrass	68	78	95	100	--	--
COOL SEASON GRASSES	**59**	**73**	**94**	**100**	**--**	**--**
Blue Grama	34	48	82	100	--	--
Prairie Sandreed	16	39	88	100	--	--
WARM SEASON GRASSES	**25**	**44**	**85**	**100**	**--**	**--**

Goetz. 1963. MS Thesis. NDSU

Table 3. Mean percent growth in flower stalk height completed by sample date from ungrazed plants of major graminoid species from western North Dakota mixed grass prairie.

	15 May	30 May	30 Jun	30 Jul	30 Aug	30 Sep
UPLAND SEDGES	**66**	**82**	**100**	**--**	**--**	**--**
Western Wheatgrass	0	0	91	100	--	--
Needleandthread	0	39	85	100	--	--
Prairie Junegrass	0	42	100	--	--	--
Plains Reedgrass	0	0	100	--	--	--
COOL SEASON GRASSES	**0**	**20**	**94**	**100**	**--**	**--**
Blue Grama	0	0	68	94	100	--
Prairie Sandreed	0	0	0	88	100	--
WARM SEASON GRASSES	**0**	**0**	**34**	**91**	**100**	**--**

Goetz. 1963. MS Thesis. NDSU

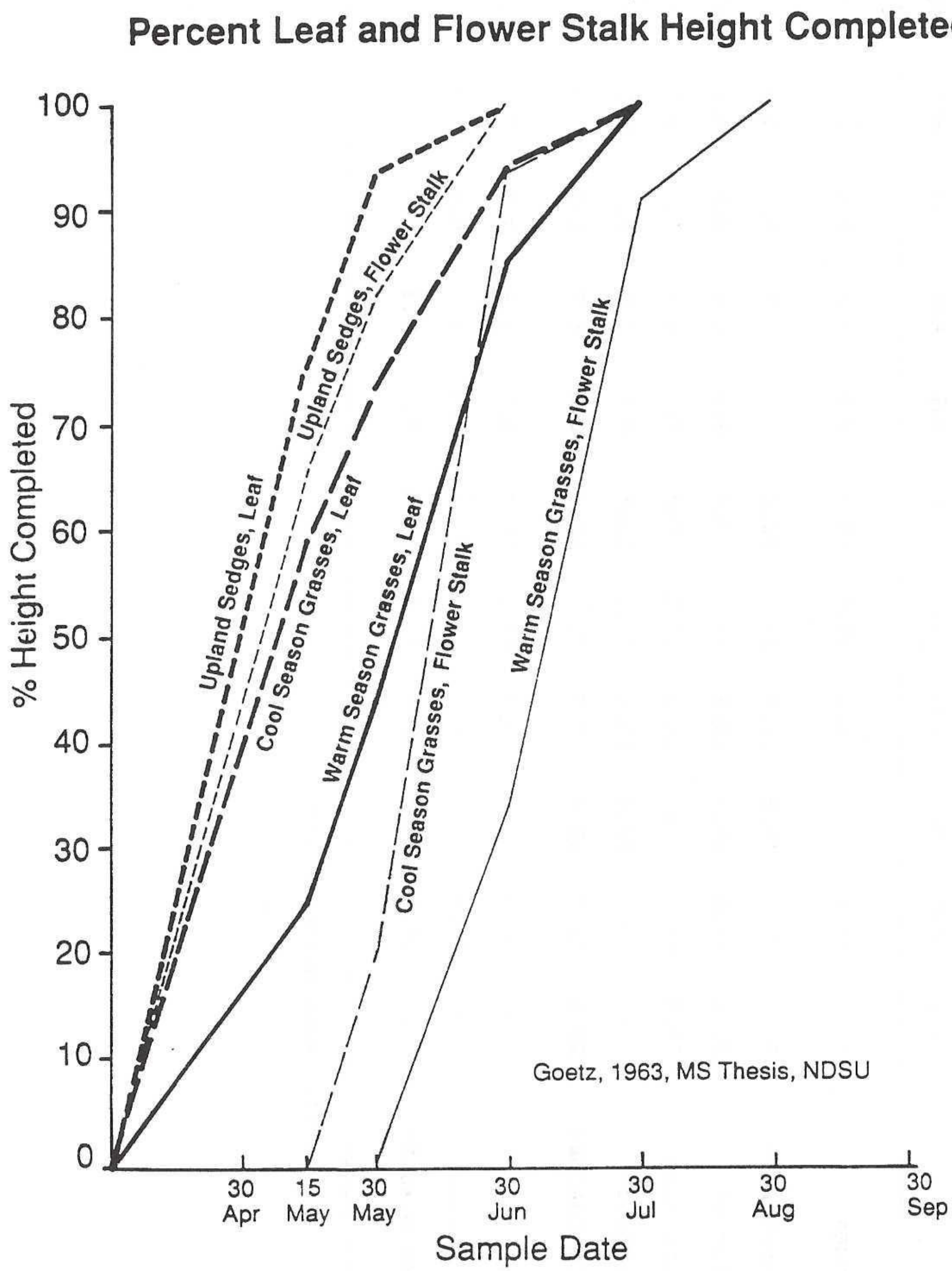

Fig. 2. Mean percent growth in leaf and flower stalk height completed by sample date from ungrazed plants of three categories of graminoids from western North Dakota mixed grass prairie.

Table 4. Mean percent crude protein from ungrazed plants of major graminoid species from western North Dakota mixed grass prairie.

	23 Apr	**8 May**	**23 May**	**8 Jun**	**23 Jun**	**8 Jul**	**23 Jul**	**8 Aug**	**23 Aug**	**8 Sep**	**23 Sep**	**5 Nov**
UPLAND SEDGES	**17.5**	**15.3**	**14.3**	**13.6**	**12.2**	**10.0**	**8.5**	**7.8**	**7.6**	**7.6**	**6.9**	**6.9**
Western Wheatgrass	24.3	23.2	18.5	15.3	14.3	12.8	9.1	7.7	6.9	6.0	6.6	--
Needleandthread	23.9	17.6	15.7	14.6	12.4	9.8	8.3	6.8	6.2	6.1	6.2	5.4
Prairie Junegrass	19.4	19.8	14.1	14.1	12.2	8.8	7.1	6.4	6.3	4.6	--	--
Plains Reedgrass	--	--	20.4	13.4	13.1	11.5	9.5	7.6	5.8	5.9	5.5	--
COOL SEASON GRASSES	**22.5**	**20.3**	**15.4**	**14.3**	**12.6**	**10.2**	**8.0**	**6.7**	**6.3**	**5.6**	**6.4**	**5.4**
Blue Grama	--	17.0	15.4	13.8	15.1	11.7	9.8	7.6	7.7	7.1	6.9	7.3
Prairie Sandreed	--	14.3	16.0	14.4	11.6	10.3	8.7	7.0	6.5	4.9	3.5	2.9
WARM SEASON GRASSES	**--**	**15.7**	**15.7**	**14.1**	**13.4**	**11.0**	**9.3**	**7.3**	**7.1**	**6.0**	**5.2**	**5.1**

Whitman et. al. 1951. NDAC Bulletin 370

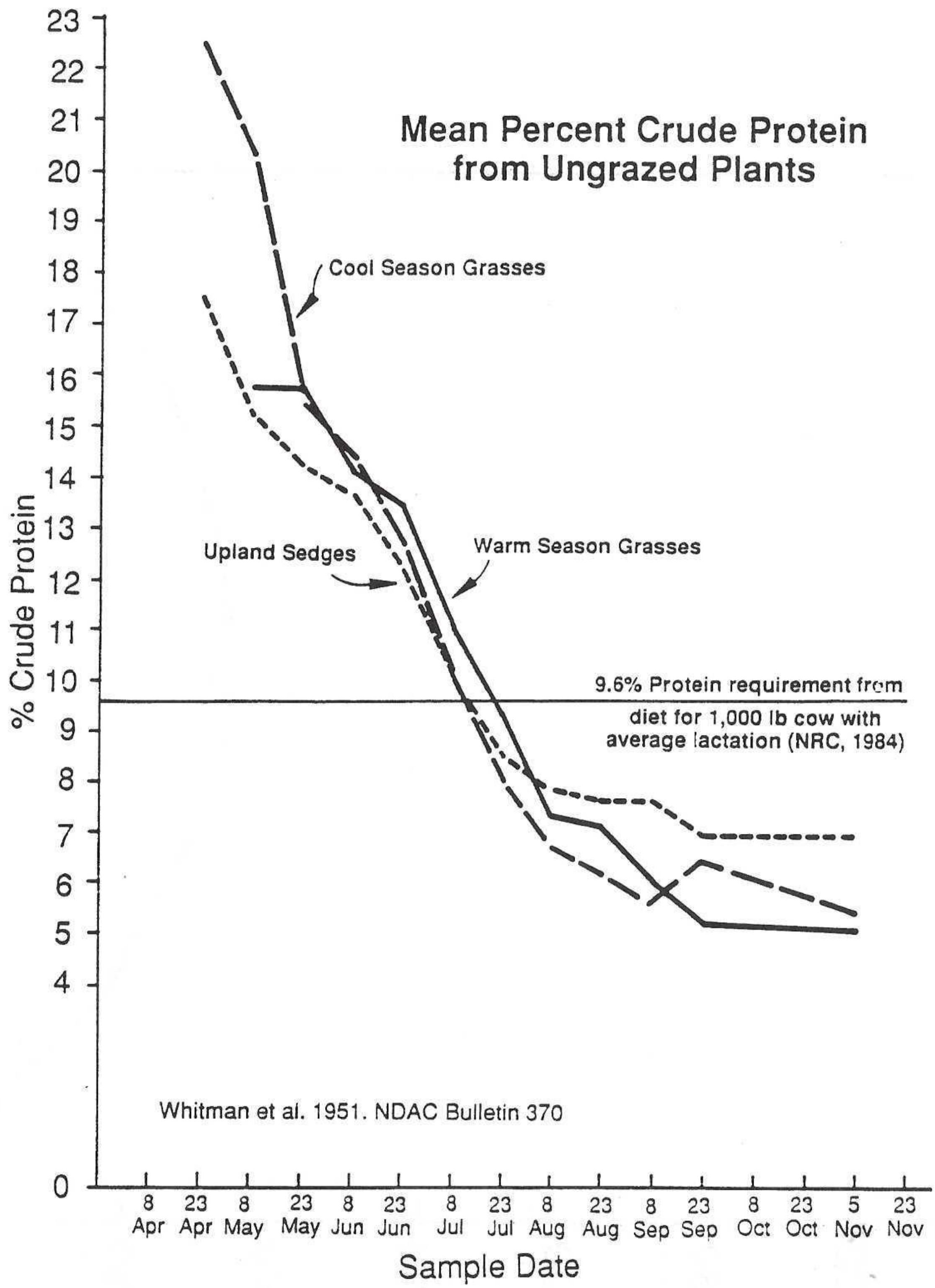

Fig. 3. Mean percent crude protein from ungrazed plants of three categories of graminoids from western North Dakota mixed grass prairie.

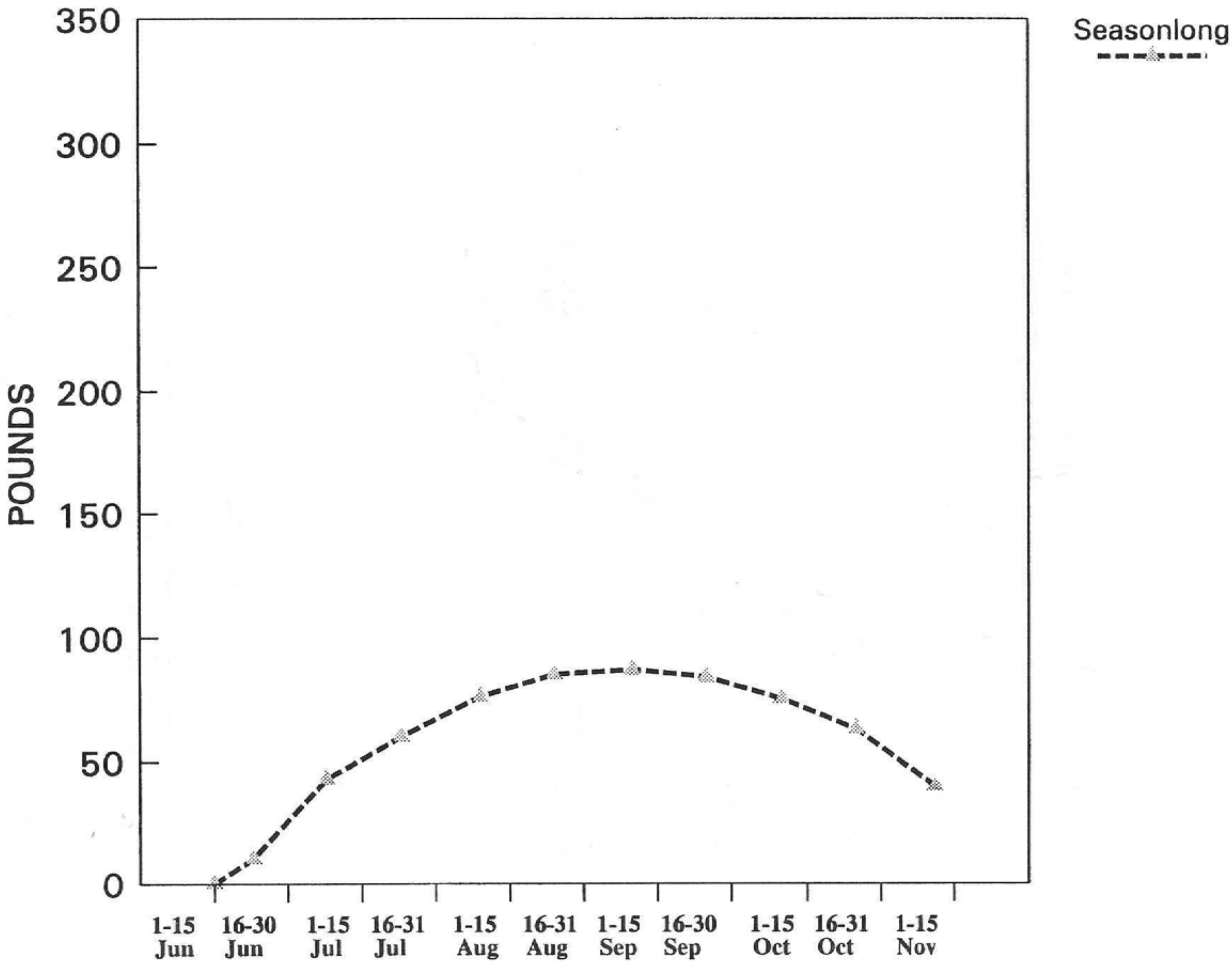

Fig. 4. COW ACCUMULATED WEIGHT GAIN

Table 5. Percentage of potential peak above ground herbage not produced as a result from different starting dates of seasonlong grazing management.

Starting dates for seasonlong grazing	Swift Current[a] grazing data	Mandan[b] clipping data	Dickinson grazing data
1 May	--	-76%	--
15 May	-46%	-57%	-45%
1-5 Jun	-13%	-43%	--
15-20 Jun	-7%	-33%	-21%
1-5 Jul	0%	-8%	--
15-20 Jul	-18%	0%	0%
1 Aug	--	-13%	--

[a]Campbell 1952.
[b]Rogler et al. 1962.

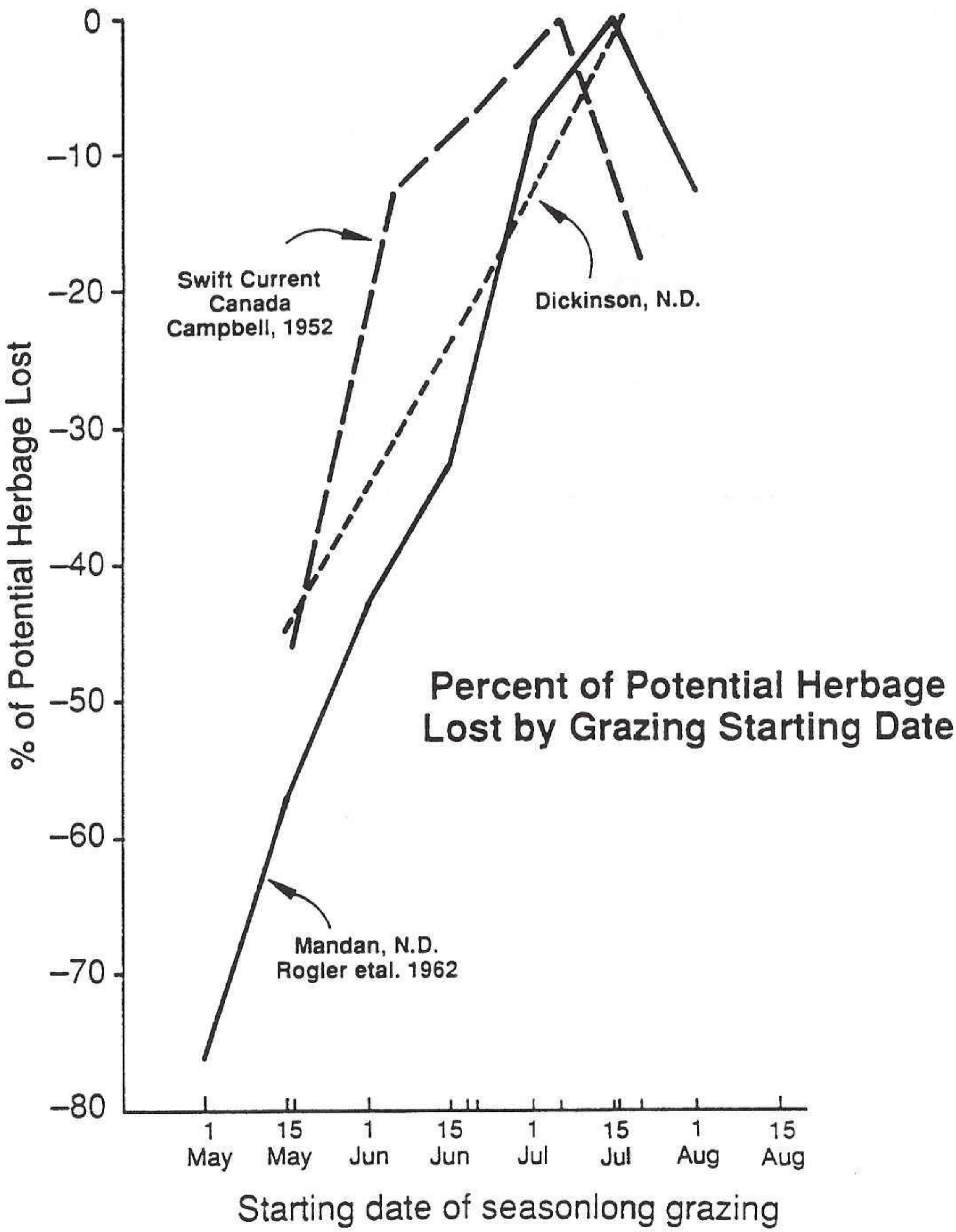

Fig. 5. Percentage of potential peak above ground herbage not produced as a result from different starting dates of seasonlong grazing management.

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GRAZING VALUE AND MANAGEMENT OF CRP LANDS

by

James L. Nelson and Lee Tisor

Summary:

Grazing bred yearling heifers on CRP acreage in South West North Dakota for a period of 126 days from May to September has yielded gains of 1.55 lbs./day for seasonlong grazing compared to 1.53 on a Twice Over Rotation system. However, gain per acre favored the TOR system at 46.2 lbs. compared to 39.5 lbs. on the SL system.

Cow-calf data from 1993 show the same advantage for the TOR system of grazing with cow gain averaging 17.3 lbs. and calves averaging 52.4 lbs./acre. This compares to SL gains with cows averaging 14.6 lbs. and calves gaining 41.9 lbs./acre.

Hay production has averaged 1.2 ton for the first cutting and 0.75 ton on the second cutting. A second cutting was not taken in 1994. Hay quality has improved after the first year's haying due to the removal of dead material found in the hay the first year.

This trial is due to continue for two more years and the results may change in the future.

Objectives

The objectives of this study are to determine:

1. The floristic composition and structure of CRP lands and to note changes in floristic composition and structure due to grazing and haying over 5 years.
2. The production and utilization of CRP land vegetation under seasonlong and twice-over grazing.
3. The production and quality of hay from CRP lands.
4. The success of game and non-game wildlife species on CRP lands.
5. The erosion from CRP lands that have been variously grazed and hayed and to compare this with similar cropland.
6. The economic returns from grazing and haying CRP lands.

This trial involves several other research centers and government agencies. This report will only cover that information gathered by the Dickinson Research Center. A complete report entitled Conservation Reserve Program (CPR) Grazing and Haying Study by William Parker, Paul Nyren et. al. will be published.

Materials and Methods

The third year of a proposed five year project to study the effects of haying and grazing on Conservation Reserve Program acres was conducted by the Dickinson Research Center in 1994.

Eighty six crossbred yearling heifers were allotted to either a 131 acre pasture grazed for the entire season (SL) or to a set of three 75 acre rotation pastures (TOR). There were 30 heifers on the seasonlong pasture and 56 heifers on the rotation pastures. The heifers grazed from May 25, 1994 to September 29, 1994, a period of 127 days.

The stocking rate was 1.77 acres/AUM on seasonlong and 0.95 acres/AUM on rotation pasture.

All heifers had been synchronized for estrus using a combination of MGA and Lutalyze. Artificial insemination followed synchronization using sires with known EPD's for birth weight and gain. Angus, Red Angus and Hereford clean up bulls, were turned with the heifers on June 10, 1994 and remained until July 14, 1994, a period of 34 days.

All heifers were individually weighed and body condition scored at the start, finish, and at intermediate dates based on rotation times. Heifers started grazing in pasture #3, rotated to #1 and then to pasture #2, back to 3, 1, and finished in pasture #2. (see diagram). Animal performance and body condition score (BCS) are shown in Table 1. Bull weights are not included in this report.

Pasture arrangement on Sec. 26 and 35-130-102

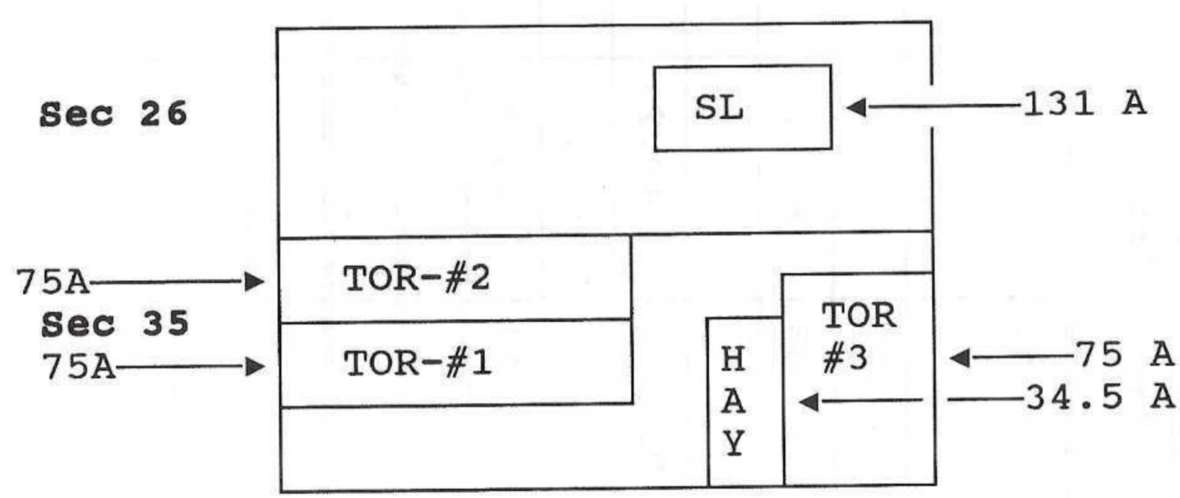

Table 1: Heifer Performance -1994			Season Long				Twice over Rotation			
Pasture Size			**131 Acres**				**3 x 75 Acres = 225 Acres Total**			
No. of Head			**30**				**56**			
Days Grazed			**127**				**133**			
Stocking Rate			**1.77 Acres/AUM**				**0.95 Acres/AUM**			
	Weigh Date	**No. of Days**	**Per Head**	**Gain/Hd**	**ADG**	**BCS**	**Per Head**	**Gain/Hd**	**ADG**	**BCS**
	May 25 initial .		874.53			7.15	862.53			7.06
	June 15	21	901.57	+27.04	1.29	7.02	887.23	+24.70	1.18	7.02
	July 7	22	951.63	+50.06	2.28	----	925.59	+38.36	1.74	----
	July 28	21	993.47	+41.84	1.99	7.17	978.61	+53.02	2.52	7.20
	Aug. 17	20	993.70	+0.23	0.01	7.07	978.16	-0.45	-0.02	7.27
	Sept. 9	23	1031.67	+37.97	1.65	7.10	1039.46	+61.30	2.66	7.13
	Sept. 29	20	1038.37	+6.70	0.34	7.21	1048.93	+9.47	0.47	7.21
Change in BCS						+0.06				+0.15
TOTAL GAIN			163.84	1.29			186.40	1.47		
Gain/Acre			37.52#/A				46.39#/A			
Gain/Acre/Day			0.295				0.37			
Value of Gain/Acre*			$22.51				$27.84			

Table 2 shows two year average performance of yearling heifers grazing CRP acreage. Table 2a. summarizes cow-calf performance for 1993.

Table 2. Heifer Performance	1992	1994	Ave.
Season Long Grazing			
Acres	131	131	131
Number of heifers	24	30	27
Days grazed	125	127	126
Gain per head	226	164	195
Average daily gain	1.81	1.29	1.55
Gain per acre	41.45	37.52	39.48
Twice Over Rotation			
Acres	225	225	225
Number of heifers	52	56	54
Days grazed	125	127	126
Gain per head	199	186	193
Average daily gain	1.59	1.47	1.53
Gain per acre	45.93	46.39	46.16

Table 2a. Cow-calf data -1993	Season long	Twice over rotation	
Acres	131	225	
Number head			
Cows	17	35	
Calves	17	35	
Days Grazed	128	128	
Gain per head			
Cows	112.6	111.4	
Calves	322.6	336.6	
Average daily gain			
Cows	0.88	0.87	
Calves	2.52	2.63	
Gain per Acre			
Cows	14.62	17.32	
Calves	41.86	52.37	

Table 3 shows the yield of hay harvested from the CRP in 1994.

Table 3. Hay production on CRP acres - 1994	
Total acres harvested	34.5
Harvest date	July 3
Number of large bales	62
Average weight per bale	890 lbs.
Total weight (Tons) harvested	27.6 T
Tons per acre	0.8 T
Gross return per Acre @ $45.00 per ton	$36.00
Hay quality	
Per cent Dry Matter	97.37
Per cent Ash	8.29
Per cent Crude Protein	11.66
Per cent Acid Detergent fiber	39.39
Per cent Neutral Detergent fiber	42.96

Table 3a shows the combined yield of hay for the years 1992, 1993

Table 3a. Combined hay yields.	**1992**	**1993**	**1994**	**Ave.**
Acres harvested	34.5	34.5	34.5	34.5
Yield per acre				
1st cutting	2.0	0.80	0.80	1.20
2nd cutting	0.87	0.63	---	0.75*
Dry matter				
1st cutting	96.40	96.70	97.4	96.80
2nd cutting	95.96	92.50	-----	94.23*
Ash				
1st cutting	5.75	8.6	8.29	7.55
2nd cutting	10.08	8.9	---	9.49*
Crude protein				
1st cutting	8.40	12.13	11.66	10.73
2nd cutting	18.70	18.55	-----	18.62*
Acid detergent fiber				
1st cutting	52.50	19.20	39.39	37.03
2nd cutting	36.08	32.80	-----	34.44*
Neutral detergent fiber				
1st cutting	74.90	45.00	42.96	54.29
2nd cutting	53.96	41.00	------	47.48*
* Two year average				

Discussion:

Results to date with both heifers and cow-calf pairs show satisfactory gains for both classes of cattle. The pastures grazed contain a significant amount of alfalfa in the grass mixture which has caused concern for the possibility of bloat. In all three years, proloxalene (Bloat-Guard) has been mixed with the mineral mixture in order to reduce or prevent bloat. However, in 1993, one cow died of suspected bloat, although too much time had elapsed after death for an autopsy to confirm cause of death.

Both grazing programs have provided more than adequate forage at the stocking rates used to date.

BEEF RESEARCH

Creep Feeding Effects on Calf Performance and Udder and Carcass Composition of Charolais Crossbred Replacement Heifers.

J. E. McLennan[1], D. V. Dhuyvetter[2], M. Marchello[3], K. Ringwall[1,4], G. Ottmar[4]

SUMMARY

When feed prices are low creep feeding can provide some advantages to beef cow calf producers such as; increased calf weaning weights, acclimation to concentrate diets and feed bunks; heifers would require less weight gain after weaning to reach puberty by the time of breeding; and during periods of drought, grazing pressure from calves could be reduced. Creep feeding has been very beneficial to the cow/calf enterprise when grass quality decreases towards the end of the growing season and calves become more dependent on other sources of nutrition to achieve their genetic potential for growth. This is oftentimes a common occurrence in North Dakota.

Generally, cattleman retain a portion of their heifers for replacements. However, past research indicates that creep feeding of beef replacement heifers inhibits future milk production and cow longevity. Therefore, many cattle producers may eliminate creep feeding as a practice and are unable to take advantage of the previously mentioned benefits.

PROJECT OBJECTIVES

To determine calf performance for a corn gluten feed based creep ration fed to suckling Charolais crossbred beef calves grazing native range.

To determine the effects of a corn gluten feed based creep ration offered free choice to suckling Charolais crossbred beef heifers grazing native range, on mammary tissue development.

To determine the effects of creep feeding on post weaning gain during backgrounding and finishing, and on carcass measurements.

Evaluate the use of bio-electrical impedance to measure fat-free mass of creep fed calves fed to finish.

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INTRODUCTION

Previous creep feeding research with replacement beef heifers has resulted in increased fat deposition in the mammary gland, a decrease in milk production during future lactations, reduced progeny weaning weights and decreased cow longevity. Holloway and Totusek et al. (1979) reported heifers that were creep fed produced 0.31 lbs. less milk/d during their first lactation than heifers that received no additional feed during the pre-weaning period. At the University of Florida, Prichard and Marshall et al. (1988) found that creep fed heifers had higher total lipid content (6.4 v.s. 5.2 lbs.) compared to heifers that did not receive creep. Further studies have revealed differences in milk content from heifers creep fed. Hixon et al. (1981) found higher milk butterfat content and an increase in non-fat solids from milk of creep fed replacement heifers compared to controls. These studies were conducted 15 to 20 years ago using cattle that were different in frame size, body composition and growth potential compared to the genetic base of cattle today.

Our goals in conducting this study are to investigate the effects of creep feeding on mammary tissue development, carcass composition and carcass quality in beef heifers. Furthermore, this research project will evaluate carcass composition and quality in beef steers when offered a corn gluten feed creep ration prior to weaning.

MATERIALS AND METHODS

Preweaning Phase:

Fifty crossbred cows of British origin with Charolais crossbred calves at side will be used in the experiment. Cow-calf pairs will be assigned to one of two pastures each consisting of two paddocks. Cow-calf pairs will be randomly assigned within each pasture to one of two dietary treatments. Treatments will be assigned randomly to paddocks within pastures A and B. Pasture A, consisting of two 160 acre paddocks will have 13 calves (6 heifers, 7 steers) offered a corn gluten feed based creep ration (CRE) free choice beginning day 0 of the experiment (August 15, 1994) in one paddock. The remaining 13 calves will receive no supplemental nutrition (CON) other than native range forage and milk from their dams in the other 160 acre paddock. Treatments will be assigned in the same manner for pasture B (two 160 acre paddocks) except 12 cow-calf pairs (6 heifers, 6 steers) will be used for each treatment. On d 0 (initiation of the experiment) and 70 (weaning date) cows will be measured for bodyweight (BW) and body condition score (BCS). Calf measurements for BW, BCS, hip height (HH) and fat-free mass measured by bio-electrical impedance will also be collected at the same times. Creep feed consumption will be monitored at 2 week intervals up to weaning for calculating feed efficiency for additional weight gain expected by the CRE treatment.

Postweaning Phase:

Upon weaning, heifers and steers will remain in assigned groups and be placed in one of four pens where they will be fed similar diets through backgrounding (60d) and finishing (180d). Upon slaughter, heifers will be measured for udder composition, fat-free mass, carcass quality grade and yield grade. Steers will be measured for fat-free mass, carcass quality grade and yield grade. Both steers and heifers will be subjected to bioelectrical impedance measurements at the beginning and end of both backgrounding and finishing periods. These values will then be incorporated into the development of prediction equations for carcass yield and retail cut measurements.

RESULTS

It is expected that calves subjected to the creep diet would have higher weaning weights opposed to non-creep fed calves. We also will be able to determine if there are differences in fat-free mass or udder fat deposition due to creep feed treatment effects. These measurements should help increase knowledge in creep feeding effects on future milk production potential of crossbred females that have a high growth potential compared to studies conducted earlier. Furthermore, carcass measurements which include yield and quality grades, may indicate if North Dakota producers can add value to their calves prior to weaning. Results may help those producers who are exploring retained ownership ventures, provided an increase in the quality of specific carcass measurements can be demonstrated. Finally, bio-electrical impedance may become a tool that can be used by cow-calf producers or feeders if equations can be perfected that will accurately predict carcass composition. This will especially become important if live measurements can confidently predict information that relates to the value of the carcass.

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Table 1: Nutrient analysis (percent of dry matter) of a corn gluten feed creep ration fed to Charolais crossbred heifers and steers.

	DM	ASH	CP	ADF	Ca	P
Corn gluten feed creep	90.12	9.87	15.38	18.01	1.04	.64

Table 2: Corn gluten feed creep formulation fed to Charolais crossbred heifers and steers.

Ingredient	Percent
Corn Gluten feed	54.5
Beet Pulp	42.5
Limestone	.95
TM Salt	.95
Vit. ADE	.075
Bovatec premix	.04
Bentonite	.85

The influence of different supplemental strategies after calving for cows managed to different body condition scores during gestation: A proposed study.

D. V. Dhuyvetter[1], K. Ringwall[1,2], J. S. Caton[3], J. McLennan[4] and G. Ottmar[2].

SUMMARY

Advances in reproductive efficiency from that which is now commonly obtained by beef cattle producers in North Dakota, may be difficult or economically infeasible. In contrast, feed costs associated with yearly maintenance of mature cows encompasses a large portion of cow-calf expenditures. Reducing these feed costs would have a greater impact on increasing the efficiency and add to greater profitability to beef production in North Dakota, as long as reproductive performance is maintained. The objective of this study is to evaluate the influence of nutrient supplementation after calving for beef cows managed differently during gestation on cow reproduction and calf performance. Sixty British crossbred cows, of similar age and breeding, will be assigned to two body condition score nutritional treatments in the fall after weaning. Cows will be fed to achieve a body condition score of either 4 or 6 at calving. After calving, cows will be assigned to one of three treatments for approximately 60 days: 1) control (CON) will receive a basal hay diet (8% CP), 2) energy (ENG) will receive the CON diet plus a barley supplement fed daily at 4.4 lbs./hd/d, 3) protein (PRO) will receive the CON diet plus a 40% natural protein supplement fed daily at 1.5 lbs./hd/d. Measurements that will be collected include: cow body condition score and body weight changes, calf birth and weaning weights, dystocia scores and calf morbidity, days to first estrus, percent of cows bred early and overall pregnancy rates. Economic analysis of production costs and cow longevity will also be measured over a four year period. Results of this study should indicate critical periods of cow nutritional requirements and what feeding management alternatives producers can use before and(or) after calving to maximize returns to North Dakota cow-calf enterprises.

PROJECT OBJECTIVES

Evaluate pre-calving body condition and post-calving supplementation effects on beef cow reproduction and calf performance.

INTRODUCTION

Two areas that can increase profitability for commercial cow-calf producers are: 1) a reduction in feed costs for cow maintenance and 2) an increase in reproductive efficiency. In fact, reproductive efficiency is five to ten times more important, economically, than growth. Because nutrition plays an important role in determining reproductive success, reducing feed costs by altering intake and nutrient densities in the diet, timing of nutrient supplementation, or type of feed resources offered must be carefully

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planned. Furthermore, management strategies that target a reduction in feed costs should be based on results from properly designed research where reproduction and calf health and performance have been fully evaluated.

Although nutritional effects on postpartum reproduction have been clearly established, direct biological mechanism(s) have not been elucidated. This has resulted in nutritional management guidelines based on correlations with body condition (reflective of previous nutrition). It has also prevented advances in research directed at reducing feed inputs and fostered the perception that body condition status of the female dictates reproductive outcomes.

Because maternal feed inputs are a large percentage of the expenses in cow-calf enterprises, we should consider the impact of altering cow nutrition during periods of high nutrient requirements (last stage of gestation and lactation) or when feed resources are most expensive to provide. Inadequate energy or protein nutrition before and(or) after calving lowers pregnancy rates and first-service conception, as well as increases the postpartum interval in suckled beef females (Randel, 1990). Conversely, as the plane of nutrition is increased, reproduction is improved. However, underlying mechanisms by which nutrition regulates reproduction are presently unclear.

Beef cow nutrient requirements increase from the mid-stage of gestation to the first three to four months of lactation (NRC, 1984). If producers have limited feed or economic resources, the importance in providing adequate nutrition during these physiological stages becomes apparent. Earlier research has shown that prepartum nutrition, primarily energy intake, is more critical to the length of postpartum anestrus than nutrition after calving (Dziuk and Bellows, 1983; Richards et al., 1986). The provision of nutrients at this physiological stage is intended to increase nutrient stores, and is subjectively measured in terms of body condition score. These researchers suggest that a minimum body condition score of 5 (1 = emaciated, 9 = obese) is optimal for satisfactory reproductive performance.

The classical work of Wiltbank et al. (1962) confirmed a decrease in days to first estrus for cows maintained on a high plane of nutrition prior to calving. However, the number of services per conception was not different for cows maintained on low nutrition (50% of NRC energy requirements) before calving and then fed on a high plane of nutrition (133% of NRC energy requirements) after calving. More recent research has confirmed this positive effect on reproduction when intake of postpartum energy (Houghton et al., 1990; Laflamme and Connor, 1992) or protein (Hunter and Magner, 1988; Wiley et al., 1991) is above requirements. These responses were especially notable when prepartum nutrition was inadequate to meet cow requirements based on NRC (1984). Although increased nutrition before calving may provide adequate nutrient stores for acceptable postpartum reproduction, this practice may conceal specific nutrient(s) that are metabolically active in the stimulation of reproductive processes.

During the winter feeding period in the Northern Great Plains region, beef cows may be in a negative energy balance during periods of extreme cold temperatures. In order to maintain adequate adipose tissue stores, the plane of nutrition must be increased. This adds to the expense of maintaining sound reproductive females. As suggested by prior research, it may be possible for beef cows to loose body condition or BW and still maintain reproductive efficiency, provided excess nutrients are fed after calving. It has not been determined if a specific nutrient (protein vs. energy) is more effective or directly involved in mechanisms stimulating these responses. This is especially true for cows consuming basal forage diets, typically found in North Dakota (cool season grass hays containing 8 to 12% CP). Furthermore, nutrient manipulation (prior to calving and after calving) may be successful within the confines of an experimental period, but data are lacking for treatment effects extended over continuous parities.

MATERIALS AND METHODS

British crossbred beef cows (n = 66) of similar age and breeding at the Dickinson Research and Extension Center will be required for the experiment. In the fall of 1994, cows will be assigned to two dietary winter treatments. Cows will be fed to achieve a body condition score of 5.5 to 6 (HBC), or a body condition score of 4 to 4.5 at calving (LBC). Wintering diets will be fed from December 1, 1994, to March 15, 1995, to achieve different body condition score status at calving. After calving (March 15 to April 30), cows will be assigned to one of three treatments postpartum for approximately 60 days. One group of cows will receive a basal hay diet (8% CP) fed ad libitum (CON). Another group will receive the CON diet plus a barley energy supplement fed daily at 4.4 lbs./hd/d (ENG). A final postpartum treatment group will receive the CON diet plus a 40% natural protein supplement fed daily at 1.5 lbs./hd/d (PRO). Supplements will be formulated to contain equal quantities of protein.

On May 31, 1995, cows will be turned out on pasture until the start of breeding (June 6) and managed as a group until weaning. Cows will remain on their respective treatments in subsequent years (total years = 4) unless culled from the herd.

Cow weights and condition scores will be measured at the beginning of the experiment, January 1, 1995, one week prior to calving, prior to breeding and at weaning each year. Milk production will be estimated with a portable milk machine (Dhuyvetter, et al. 1993) 30-40 d postpartum (approximate mean postpartum date). Cow forage intake will be estimated on a pen basis as the amount offered. This variable will not be statistically tested but used to describe basal diet conditions and approximate intake. Calf birth weights will be recorded and calf weights will be measured prior to breeding and at weaning. Calf health (morbidity and incidence of scours) and dystocia (calving difficulty scores, Wiley et al., 1991) will be measured after calving.

Days to first estrus will be determined analyzing blood progesterone concentrations beginning 20 d after calving and continuing to the start of breeding. Cow pregnancy rates will be determined by ultrasound on d 42 of the breeding season (determination of cows bred early) and at weaning (overall pregnancy rate).

This experiment is designed to be repeated over a four year period. Cows will remain on their respective treatments each year unless culled from the herd for typical management reasons (ie. nonpregnant, late bred, soundness, temperament, etc.). Culling rates for respective treatment groups will be analyzed as well as mean cow age for determination of treatment effects on cow longevity.

RESULTS

From this study, nutritional effects on reproduction before and after calving can be evaluated. Potential comparative measures are given in Table 1. Specific nutrient supplementation (energy vs. protein) may provide insight into their importance for reproductive success. By altering nutrient supply prior to calving, producers may be able to determine, when cow nutrient requirements are less critical. Or, if providing key supplementation after calving, can cows compensate for pre-calving shortages. This can be important for cows that go into the winter in marginal body condition, as well as cows that have ample fat reserves. Will cows that have excess condition at calving rebreed without supplementation expenses after calving? Can we manage cattle in this manner in successive years or will cows leave the herd earlier as a result of any one of these nutritional regimens? Calf growth and health could also be affected by nutritional manipulations of the cow herd.

How cows respond to treatments after calving may depend on how they were managed prior to calving. This would result in different nutritional recommendations for producers whose resources best match a successful treatment combination. Evaluation of these pre- and post-calving treatments may lead to a better understanding of nutritional effects on cow reproduction and optimization of cow reproduction, calf growth and enterprise profitability in North Dakota.

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Effects of feeding Naked Oats or Barley to lightweight feeder cattle in a total mixed ration or when concentrates and forages are fed separately.

Dan Dhuyvetter[5], Kris Ringwall[1,6], Jason McLennan[7], Gary Ottmar[2], Lee Tisor[2].

SUMMARY

The ND Crop Improvement Association recently released a variety of hull-less oats "Paul" in 1994. Livestock producers have expressed interest in Paul oats as a feed because of its high protein (16%) and fat (7 – 9%) content. In order to maximize daily gains and feed efficiency for feeder cattle, method of feed delivery may be important. This study will investigate the effects of naked oats compared to barley when fed in a total mixed ration or forage and concentrates fed separately to light weight feeder calves. Seventy-two Charolais crossbred calves (40 steers, 32 heifers) will be fed in 16 pens and assigned to 2 levels of treatments. Calves will receive a backgrounding diet formulated with equal quantities of either naked oats (NOAT) or barley (BRLY). Diets will then be delivered in a total mixed ration (TMR) or the concentrate and forage portions of the diet will be fed separately (FSR). The study will be conducted for 55 days beginning September 12, 1994. Calf gain, pen intake and feed efficiency will be tested for treatment effects and interactions between the two levels of treatments. Incidence of calf morbidity, mortality and bloat will also be measured. Economic costs associated with feed delivery methods and calf performance will be compared. Results from this study should provide information on the usefulness of naked oats when compared to barley in backgrounding diets. Furthermore, differences in feed delivery methods may assist producers when evaluating the purchase of a mixer wagon.

PROJECT OBJECTIVES

Compare the value and feeding properties of naked oats to barley when fed to lightweight feeder calves.

Evaluate lightweight feeder calf performance and feed efficiency as influenced by feed delivery in a total mixed ration or when concentrates and forages are fed separately.

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INTRODUCTION

A market for naked oats has not been established and interest for it's use as a livestock feed has been suggested. General feeding guidelines and recommendations are lacking. Furthermore, naked oats has unique qualities when compared to other cereal crops. Naked oats is high in CP (16-18%) and lipid (9%; resulting in an increased energy value, 90-94% TDN) compared to barley (84% TDN) or hulled oats (78% TDN). Nutrient composition for grains commonly fed in ND are given in Table 1. The increased nutrient density of this feed may prove useful when formulating diets of light weight feeder cattle by providing required nutrients for growth with less required concentrate intake compared to other grains.

Research conducted at South Dakota State University (Wagner et al., 1988) and the NDSU Carrington Research Center (Anderson, 1992) have demonstrated benefits for feeding backgrounding or finishing cattle diets respectively, in a total mixed ration (TMR) compared to concentrates and forages fed separately. These studies have suggested both an improvement in ADG and feed efficiency. North Dakota is primarily a cow-calf beef producing state where only 30 to 40% of the calf crop is backgrounded within its borders. There may be opportunities to expand this segment of the industry and add value to calves prior to their delivery to finishing yards in other states. Provision of a TMR requires additional equipment and therefore, increased animal performance and feed utilization must compensate for these added expenses for the number of cattle being fed. Wagner et al. (1988) stated that when feeder cattle are valued at $80/cwt and if corn, hay and corn silage were worth $90, $80 and $25 per ton, respectively, producers would need to feed a minimum of 114 head for 133 days each year to pay for costs associated with owning a mixer wagon. Evaluation of feeds more commonly found on a state –wide basis for ND is needed to localize these recommendations.

Severe environmental conditions often arise where weaning earlier than the normal date can increase cow body condition prior to the winter months. This can help reduce required stored winter feed supplies needed for optimal cow reproduction the following year. Earlier weaning may also increase the potential use of a mixer wagon by spreading ownership costs over more cattle being fed.

MATERIALS AND METHODS

Seventy-two Charolais crossbred calves were stratified by weight, blocked by sex and assigned to 16 pens (5 steers/pen and 4 heifers/pen). Treatments were randomly assigned to pens in a two x two factorial arrangement. The first level of treatments were based on the concentrate portion of the diet. Diets (Table 2) were formulated with either naked oats (NOAT), or barley (BRLY) with concentrate and protein levels in the diet the same for each treatment. The second level of treatments were based on the method of feed delivery. One diet was delivered in a total mixed ration (TMR). The concentrate and roughage portions of the other diet were fed separately (FSR). This factorial arrangement of treatments resulted in four treatment combinations with 2 pens/treatment combination for each sex.

Calves were vaccinated pre-weaning (August 15, 1994) for IBR, BVD, BRSV and $P1_3$. These vaccinations were repeated at weaning (Sept. 5) and calves (450 lb. BW) were treated for external and internal parasites with Ivomec. Starter diets were formulated with long-stemmed alfalfa and grass hay plus 2 lbs. of hulled oats fed per animal daily. This postweaning adjustment period ended on Sept. 11 and calves were weighed and assigned to their treatments on Sept. 12. The experiment will be conducted for approximately 55 days, ending November 7. Preliminary diet formulations are given in Table 2 and have been formulated for a 485 lb. steer calf.

Delivery of the TMR treatment was made daily, with the concentrates and hay (chopped and mixed) fed using a mixer wagon. For the FSR treatment, all concentrate portions of the diet were fed twice each day in a bunk with the forage portion of the diet (long-stemmed hay) offered pre-choice in round bale feeders (n = 8 pens).

Calf weights were recorded at the beginning of the experiment and two shrunk weights will be collected over two days at the end of the experiment. The average of these two final weights will be analyzed for treatment effects. Calculated ADG, feed offered and feed efficiency for gain will also be tested. Incidence of calf morbidity (calves treated for various health problems), mortality (death loss) and bloat or acidosis (acute and chronic incidence) will be monitored. Economic costs associated with TMR and FSR methods of feed delivery will be evaluated along with comparing the value of naked oats with barley.

RESULTS

The results of this study can lead to producer information in several areas of feeder calf management. The energy value and feeding properties of Naked Oats will be compared to Barley in backgrounding diets. The high protein and fat content of Naked Oats may have unique characteristics which could prove to be beneficial or detrimental to calves on growing diets. Furthermore, calf performance, feed efficiency and economic evaluations of feed delivery can be made. These measurements may help assist producers in evaluating the purchase of feeding equipment such as a mixer wagon. Results may also indicate what the minimum number of calves you will need to feed each year in order to justify equipment expense, if performance is enhanced with TMR feed delivery. A summary of measurements which should be tested for treatment comparisons are given in Table 3.

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Wagner, J.J., D. Peterson, R. Hanson and H.L. Miller. 1988. Economic analysis of using mixing equipment for growing heifers. South Dakota State University Annual Beef Report. Pg. 56-60.

Table 1. Nutrient composition of naked oats compared to other feed grains reported on a percent dry matter basis.

Feed	DM	CP	TDN	Fat	NEm[a]	NEg[a]	Ca	P
Naked Oats	92	16.5	94	9.0	1.07	.75	.07	.50
Oats	89	12.0	78	5.1	.86	.57	.07	.38
Barley	88	14.0	84	2.1	.94	.64	.05	.38
Corn	88	10.0	88	4.2	1.00	.68	.02	.34

[a]Mcal/lb

Table 2. Diet formulated for lightweight feeder calves containing either naked oats (NOAT) or barley (BRLY).

	BRLY	NOAT
Ingredient	Pounds Per Head Per Day	Pounds Per Head Per Day
Crested Hay	8.20	8.70
Barley	6.00	----
Naked Oats	----	6.00
Soybean oil meal	1.00	.3
Mixing Mineral[a]	.10	.10
BeefMix BVT[b]	.33	.33
	15.63	15.43

[a] Mineral supplement containing calcium (24%) and phosphorus (6%).
[b] Ionophore supplement containing Bovatec to provide 250mg/hd/day.

Effects of body weight gain and winter diets containing oats silage compared to oats-pea silage on reproductive performance in replacement beef heifers.

Dan Dhuyvetter[8], Kris Ringwall[9], Jason McLennan[10], Gary Ottmar[2], Jim Nelson[2].

SUMMARY

Beef cattle producers who raise their own replacement heifers have questioned the required level of heifer gain, in particular, when their late-winter or early-spring feed supplies are low. Furthermore, there has been an increase in the production of oats-pea forage crops in ND within recent years. Many producers are interested in the addition of field peas grown with oats because of the potential for increased forage protein concentrations. Therefore, forty-eight British crossbred beef heifers were used to investigate the effects of body weight gain and basal diets composed of either oats silage or oats-pea silage on reproductive performance. Heifers were fed in 8 pens (6 heifers/pen) to achieve an expected gain of .5 lbs./hd/day (LOW GAIN) or 1.75 lbs./hd/day (HIGH GAIN). Within these treatments (4 pens/treatment), basal diets were formulated with either oats silage (OAT-SIL) or oats-pea silage (OAT-PEA). Heifers were fed their respective treatments for 57 days (March 24 to May 19) until breeding. Silage treatment had no effect on body weight gain during the treatment period. However, by design, ADG was less for LOW GAIN compared to HIGH GAIN heifers (.72 vs. 1.63 ± .14 lbs./hd/day, respectively). Furthermore, LOW GAIN heifers continued to weigh less than HIGH GAIN heifers at the end of summer grazing (987.5 vs. 1031.6 ± 10.8 lbs., respectively). Body condition scores were also lower at the end of the treatment and summer grazing periods for LOW GAIN compared to HIGH GAIN heifers. Early pregnancy rates tended to be higher (P = .13) for OAT-SIL (75.0%) compared to OAT-PEA (54.2%) heifers, however, this numeric difference was reversed for final pregnancy rates (79.2% vs. 91.7%, respectively). Neither early (62.5% vs. 66.7% for LOW GAIN compared to HIGH GAIN, respectively) or final (87.5% vs. 83.3% for LOW GAIN compared to HIGH GAIN, respectively) pregnancy rates were affected by body weight gain treatments. Heifer performance was not affected by OAT-PEA silage, however, the amount of protein supplementation required for this treatment was less than for heifers fed OAT-SIL. These research results indicate that reproduction was not impaired by reducing gains to .72 lbs./hd/day, 57 days prior to breeding. Although feed costs can be reduced in this manner, producers must consider the final BW heifers will achieve at the beginning of breeding.

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PROJECT OBJECTIVES

Compare high versus low body weight gain 57 days prior to breeding on beef replacement heifer reproduction.

Evaluate beef replacement heifer growth and reproductive performance when fed basal diets comprised of either oat silage or oat-pea silage.

INTRODUCTION

Introducing females into the beef herd, is first achieved by proper development of replacement heifers, thereby ensuring a successful breeding season. Previous research has found that heifers should weigh approximately 65% of their mature cow weight at breeding, for optimal reproductive success (Bolze and Corah, 1993). Short and Bellows (1971), in research conducted at Miles City, Mt., found that winter heifer gains of 1.0 or 1.5 lbs./day, provided for satisfactory reproductive performance. Some beef producers have questioned the importance of heifer weight gain in late winter and early spring when winter feed supplies are low. The importance of maintaining weight gains above 1.0 lb./day may be questioned in particular, when heifers have reached puberty, and(or) are near their target body weight (65% of mature cow weight) well in advance of the breeding season. A reduction in weight gains may allow for reduced feed inputs, however, the impact on reproduction must be considered. Work done in Nebraska (Clanton et al., 1983) found that varying the rate of heifer body weight gain either early or late over the winter feeding period, did not affect reproductive responses, when compared to heifers managed for a constant rate of gain. As long as heifers achieved a minimum body weight at breeding, it appeared that the method by which the weight was obtained was not important.

Field peas have gained considerable interest by ND livestock producers in recent years, as a potential forage crop when grown with oats. Oats-pea combinations have been grown on crop land to produce hay or silage for beef producers. The major advantage for incorporating field peas into cereal grain forages is the potential to increase crude protein levels in the forage. This may decrease the amount of supplemental protein that is required in growing diets.

MATERIALS AND METHODS

Forty-eight British crossbred beef heifers were used to investigate the effects of body weight gain and basal diets composed of either oats silage or oats-pea silage on reproductive performance. Treatments were initiated on March 24, 1994 in a 2 X 2 factorial arrangement for a completely random design. In the first level of treatments, heifers were fed in 8 pens (6 heifers/pen) to achieve an expected gain of .5 lbs./hd/d (LOW GAIN) or 1.75 lbs./hd/d (HIGH GAIN). Within these treatments (4 pens/treatment), basal diets were formulated with either oats silage (OAT-SIL) or oats-pea silage (OAT-PEA). Diet formulations and nutrient analysis are given in Tables 1 and 2, respectively. Heifers were fed their respective treatments for 57 days until breeding (May 19). Following estrus synchronization with MGA (April 20 to May 3) heifers were artificially inseminated on May 23 and 24, and then moved to summer pasture. Clean up bulls were turned out on pasture with heifers from June 10 to July 14, resulting in a total breeding season of 53 days. The experiment ended on September 9.

Body condition scores (BCS) were measured on March 8, May 19 (end of the treatment period) and September 9. Body weights were recorded on March 24, May 19 and September 9. Average daily gain (ADG) was calculated for the 57 day treatment period. Change in BCS and BW were tested for the treatment period. Furthermore, BW change during the summer (May 19 to September 9) was tested for treatment effects. Heifer pregnancy rates were determined by ultrasonography on June 24 (early pregnancy) and August 21 (final pregnancy).

RESULTS

There were no interactions (P >.10) between silage type and rate of gain treatments. Therefore, treatment combinations will not be discussed. Silage treatments did not effect BSC (P = .25, Table 3) or BW change (P = .16, Table 4) during the treatment period. OAT-PEA heifers appeared to have greater ADG's during the treatment period (Table 4) compared to OAT-SIL heifers, but this difference was not significant (P = .16). However, OAT-SIL heifers gained 176.8 lbs. compared to 158.8 lbs. for OAT-PEA heifers (P < .04) during summer grazing. This increase in BW change over the summer for OAT-SIL heifers may have been a compensation for numerical differences that occurred during the treatment period. Daily ration costs are given in Table 1. Because the CP concentration of oat-pea silage was higher, the amount of commercial protein supplementation was reduced by 50 to 75% for the OAT-PEA treatments. This can have a significant effect on ration costs when the costs of commercial protein supplements are high.

By design, LOW and HIGH GAIN treatments produced different (P < .01) daily gains during the treatment period (Table 4). HIGH GAIN heifers gained 93.0 lbs. compared to 40.8 lbs. for LOW GAIN heifers over the 57-day treatment period. LOW GAIN heifers had achieved 65% of a 1245 lb. mature cow at breeding. This compared to HIGH GAIN heifers that reached 65% of a 1345 lb. mature cow. Hip height measurements were collected prior to the study but have not been analyzed for predicting mature cow weights. This may not be possible because these heifers were purchased and birth dates may not be available. During summer grazing, LOW GAIN heifers compensated (P < .01) somewhat, but not enough to recover BW losses that occurred during the treatment period (Table 4). This was evident by LOW GAIN heifers weighing 987.5 lbs. compared to 1031.6 lbs. for HIGH GAIN heifers in the fall (P < .05). BCS measurements (Table 3) corresponded well with gain treatment effects on BW. During the treatment period LOW GAIN heifers lost .3 condition score units while the HIGH GAIN heifers maintained body condition (Table 3). Differences in BCS (P < .07) were also observed in the fall (Table 3).

Early pregnancy rates tended to be higher (P = .13) for OAT-SIL (75.0%) compared to OAT-PEA (54.2%) heifers. However, numeric differences (P = .22) were reversed for final pregnancy rates (79.2% vs. 91.7%; OAT-SIL vs. OAT-PEA, respectively). An explanation for these findings is difficult from the data which was collected. Neither early (62.5% vs. 66.7% for LOW GAIN compared to HIGH GAIN, respectively) or final (87.5% vs. 83.3% for LOW GAIN compared to HIGH GAIN, respectively) pregnancy rates were affected (P > .68) by body weight gain treatments. These results agree with research from Nebraska (Clanton et al., 1983) where decreased heifer gains prior to breeding did not impair reproduction as long as heifers reached their target weight at breeding.

IMPLICATIONS

Although body weight gains were reduced by treatment design, and body weight differences were still apparent at the end of summer grazing, this research indicates that reproduction was not impaired by reducing heifer gains 57 days prior to breeding. Feed cost savings by including straw and limiting intake are given in Table 1. These experimental diets resulted in a savings of $11.40/heifer for the 57 day treatment period prior to breeding with the given feed costs. It may be suggested for replacement heifers that have been on a higher plane of nutrition early, a decrease in rate of gain prior to breeding does not affect subsequent reproduction, as long as heifers weigh approximately 65% of their mature weight at breeding. This information can assist producers who may have fed excess nutrients early and are running low on feed supplies in late-winter to early-spring. It is probably more cost effective to develop heifers with lower weight gains early, and then increase nutrition as breeding approaches to achieve target body weights. Caution is advised when restricting nutrients to growing heifers, particularly prior to breeding. Producers need to monitor heifer growth periodically to ensure that heifers are on track for achieving their target weight by breeding.

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Clanton, D. C., L. E. Jones and M. E. England. 1983. Effect of rate and time of gain after weaning on the development of replacement beef heifers. J. Anim. Sci. 56:280.

Table 1. Diet formulations (lbs./hd/day, as-fed basis) for oats silage (OAT-SIL) or oats-pea (OAT-PEA) silage based diets fed to replacement beef heifers managed for a high (HIGH GAIN) or low (LOW GAIN) gain, 57 days prior to breeding.

Ingredient	OAT-SIL HIGH GAIN	OAT-SIL LOW GAIN	OAT-PEA HIGH GAIN	OAT-PEA LOW GAIN
Silage	20.00	11.00	23.00	12.00
Barley	6.00	1.50	6.00	1.50
Wheat Straw	3.00	9.00	3.00	9.00
38% CP Supplement[a]	.39	.29	.10	.15
Mineral Supplement[b]	.10	.10	.10	.10
Ionophore Supplement[c]	.06	.06	.06	.06
Total	29.55	21.95	32.26	22.82
Ration Cost[d], ($)	.49	.29	.50	.29

[a] An all-natural commercial supplement containing 38% crude protein on an as-fed basis.
[b] Calcium and phosphorus (24:6) commercial supplement.
[c] Commercial ionophore supplement containing Bovatec.
[d] Based on the following prices; silages, \$20/ton; straw, \$15/ton; barley, \$1.60/bu.; protein supplement, \$200/ton; ionophore supplement, \$200/ton; mineral supplement, \$390/ton.

Table 2. Nutrient composition (DM-basis) of feeds used in experimental diets and fed to replacement beef heifers managed for a high (HIGH GAIN) or low (LOW GAIN) gain, 57 days prior to breeding.

Ingredient	DM (%)	CP (%)	NE_g (Mcal/lb.)
Oat silage	51.0	6.4	0.35
Oat-pea silage	48.0	8.6	0.43
Wheat straw	89.0	4.5	0.07
Barley	88.0	14.0	0.64
38% CP supplement	90.0	40.0	0.40

Table 3. Body condition score (BSC) and BCS change measurements for replacement beef heifers fed basal diets comprised of oats silage (OAT-SIL) or oats-pea silage (OAT-PEA) and managed for a high (HIGH GAIN) or low (LOW GAIN) gain, 57 days prior to breeding.

Item	OAT-SIL	OAT-PEA	LOW GAIN	HIGH GAIN	SE[a]
Heifers	24	24	24	24	
Initial BCS	7.1	7.1	7.1	7.1	.04
May 19, BCS	6.9	7.0	6.8[c]	7.1[d]	.05
Fall BCS	6.9	7.0	6.8[c]	7.1[d]	.05
BCS change[b]	-.20	-.10	-.30[c]	.0[d]	.03

[a] SE = Standard error of the means and represents the variability in the measurements collected.
[b] BCS change = May 19, BCS – initial BCS (change during the treatment period).
[c,d] Values within each row are different ($P < .06$) when they possess uncommon superscripts.

Table 4. Body weight (BW) and BW change measurements for replacement beef heifers fed basal diets comprised of oats silage(OAT-SIL) or oats-pea silage (OAT-PEA) and managed for a high (HIGH GAIN) or low (LOW GAIN) gain, 57 days prior to breeding.

Item	OAT-SIL	OAT-PEA	LOW GAIN	HIGH GAIN	SE[a]
Heifers	24	24	24	24	
Initial BW	784.3	765.4	768.5	781.2	9.2
May 19, BW	841.8	841.7	809.3[c]	874.3[d]	11.6
Fall BW	1018.6	1000.5	987.5[c]	1031.6[d]	10.8
ADG[b]	1.01	1.34	.72[c]	1.63[d]	.14
TRT[e] BW change	57.5	76.3	40.8[c]	93.0[d]	7.7
SUM[f] BW change	176.8[c]	158.8[d]	178.3[c]	157.3[d]	2.7

[a] SE = Standard error of the means and represents the variability in the measurements collected.
[b] ADG = Average daily gain to May 19 (ADG during the treatment period).
[c,d] Values within each row are different ($P < .04$) when they possess uncommon superscripts.
[e] TRT = May 19 BW – Initial BW (BW change during the treatment period).
[f] SUM = Fall BW – May 19 BW (BW change over summer grazing).

Table 5. Early pregnancy (June, 24) and final pregnancy (August 17) rates for replacement beef heifers fed basal diets comprised of oats silage (OAT-SIL) or oats-pea silage (OAT-PEA) and managed for a high (HIGH GAIN) or low (LOW GAIN) gain, 57 days prior to breeding.[a]

Item	**Heifers**	**June 24**	**August 17**
OAT-SIL	24	18 (75.0%)	19 (79.2%)
OAT-PEA	24	13 (54.2%)	22 (91.7%)
Total	48	31 (64.6%)	41 (85.4%)
OSL[b]		.13	.22
LOW GAIN	24	15 (62.5%)	21 (87.5%)
HIGH GAIN	24	16 (66.7%)	20 (83.3%)
Total	48	31 (64.6%)	41 (85.4%)
OSL[b]		.76	.68

[a] Values represent the number of heifers determined pregnant followed by the percentage of heifers pregnant within each treatment group.
[b] OSL = Observed significance level. Table values can be compared to the level of significance at which differences are determined to be due to treatment effects ($P < .10$).

Financial and Production Analysis of Heifer Development

John Dhuyvetter, Kris Ringwall, Jim Nelson,
Lee Tisor and Gary Ottmar

Summary

Management invested into the selection, health, feeding, and breeding of beef heifers being developed for herd replacements contributes to greater potential maternal productivity. A group of 130 spring born heifers representing a variety of breeds and crosses were developed from weaning through pregnancy confirmation with growth, reproduction, health, and costs monitored in a demonstration project at the Dickinson Research Extension Center.

Heifers, consigned to the project by members of the North Dakota Beef Cattle Improvement Association, were selected to have the potential to be above average replacements, with average CHAPS production records of 598 pound, 205 day weaning weight, and a 102 average nursing ratio.

At test start, November 15, the heifers were grouped by weight into light (L), medium (M), and heavy (H) feeding groups, averaging 535, 636, and 737 pounds respectively, and fed a high forage mixed ration containing the ionophore lasalocid. Through the 157 day wintering period in which heifers were housed in open wind protected lots, gains exceeded expectations. This was largely due to feed intakes greater than projected, averaging 1.87, 1.93, and 1.97 for L, M, and H groups respectively for an average daily feed cost of $.65, $.66, and $.72 for the groups.

At realized gains, body condition of heifers increased from a score of 6.0 (1-9 scale) to 7.1. As expected, average frame scores calculated from hip height measurements collected on heifers at project start, mid winter, and prebreeding remained similar at 5.6, 5.8, and 6.1; tending to increase slightly during the wintering period. All heifers averaged 940 pounds prebreeding on April 19 representing 75% of their average frame score projected mature weight of 1238 pounds and had an average pelvis area of 164 sq. cm.

A high cycling rate was observed in the heifers prior to breeding which contributed to good results from single service AI breeding following synchronization with MGA-prostaglandin in which 124 heifers were inseminated over a three day period. Following a two week lag, heifers were exposed to cleanup bulls for 30 days. Using ultrasound diagnosis, 60% of 111 heifers AI bred on detected heat were determined to have settled to AI service, where as only 1 of 13 heifers not showing heat and time bred on the third day settled to AI service. An additional 37 heifers (29%) were identified to have settled in the first cycle of cleanup service, and 18 (14%) in the second cycle of cleanup service for an overall pregnancy rate of 93% over a breeding season limited to 48 days.

All sires utilized were selected for calving ease using birth weight EPDs, as both sire and heifer development contribute to minimizing calving difficulties and economic consequences associated with calf death loss and rebreeding.

In addition to greater accuracy associated with AI sires for birth weight, selected sires also represented superior genetic merit for combining transmitted growth and milk along with calving ease as reflected by average within breed ranking for birthweight, yearling weight, and milk of AI versus cleanup sires of being within the top 12%, 41%, and 34% versus top 33%, 93% and 88% respectively.

Contributing to efficient gains and high reproduction was the high health status of the heifers in the project. Health treatments (9 heifers treated with antibiotics) and death loss (1 heifer died) were minimized by requiring all heifers to be prevaccinated prior to delivery, giving a booster on arrival, and again vaccinating prebreeding. In addition, heifers were treated with a pour-on for internal and external parasites.

At pregnancy testing on August 9, heifers averaged 1039 pounds (83% of projected mature weight) and a slight loss of prebreeding body condition (6.7) reflecting minimal gains of .9 pounds/day through breeding and while on pasture. Total gain per heifer over the entire 268 day project averaged 403 pounds (1.5 lb/day) and cost totaled $241.95 including: feed $148.64, yardage $48.65, veterinary $15.20, and breeding $29.46. Non breeding costs excluding death loss and interest contribute to a $.54 cost per pound of gain for heifers on the project. Breeding costs including estrus synchronization, semen, cleanup bulls, and technician fees averaged $29.46 per pregnancy.

Herd replacements and their development represents a significant cost to cow-calf producers. Costs can be minimized through an investment in management to feed balanced rations to achieve targeted growth, high reproduction, and minimize health and calving problems to increase the productivity of heifer entering the cow herd.

Objectives

North Dakota herd production records indicate about one third of the heifer calves raised each year are needed for herd replacements. Heifer selection, management, and development decisions can significantly affect lifetime productivity and bottom line profitability.

The Heifer Development Project was initiated with input from livestock production specialists, veterinarians, and producers to demonstrate recommended feeding and health management to get heifers to target weights for desired breeding and calving performance; use of frame scores, body condition scoring, and pelvic measurement to monitor development; use of synchronization to facilitate a concise breeding season and use of superior A.I. sires; the costs associated with raising heifers and the potential for commercial heifer development services, and the relationship between heifer selection and development to future productivity.

Materials and Methods

North Dakota Beef Cattle Improvement members utilizing the CHAPS performance recording system were invited to enter home raised heifers born between February 1, 1993 and May 1, 1993. A suggested heifer for the project was a moderate framed crossbred heifer with the potential to make an excellent replacement with a minimum in-herd weaning ratio of 95, out of a dam with an MPPA over 95.

Consigned heifers were delivered in early November to the Dickinson Research Extension Center Manning Ranch Unit accompanied with individual CHAPS information including: calf ID, dam ID, breed, weaning date, and weaning weight, and a certificate of health indicating types and dates of pre-delivery vaccinations and management.

Heifers were required to be pre-vaccinated at least two weeks prior to delivery with IBR, BVD, BRSV, PI_3, haemophilus somnus, and 7-way clostridial. On arrival, heifers received an intranasal vaccination, Ivomec for parasite control, and a booster IBR, BVD, PI_3, and BRSV vaccination. Heifers not bangs vaccinated prior to arrival were vaccinated on January 11, and all heifers received a prebreeding vaccination for 5-way Lepto, vibrio, IBR, PI_3, and BVD.

Heifers were given an adaption period in which they were fed a receiving ration and brought on feed. On November 15 the heifers were weighed on test and allocated to three feeding groups based on weight (light, medium, heavy) and placed in open wind board protected, straw bedded drylot pens.

Heifers were fed a mixed ration in fence bunks formulated initially by NRC guidelines using feed analysis for average daily gains of 1.75 pounds per day for large frame heifers and 1.5 pounds per day for small frame heifers. Based on heifer condition, weight, and performance the rations for L, M, H groups were periodically adjusted.

A high roughage ration was fed based on corn silage and chopped hay, along with limited amounts of oats and barley. The ration was supplemented with commercially prepared vitamin-mineral supplements and initially with soybean oil meal to insure it was balanced for mineral, vitamin, and protein requirements. The ionophore Bovatec was included in the ration at the rate of 360 mg/heifer per day. MGA was included in the prebreeding ration for a 14 day period for estrus synchronization.

Estrus activity was monitored by observation and the use of KMAR patches prior and after feeding MGA. Seventeen days following MGA feeding, all heifers were injected with prostaglandin for estrus synchronization and then inseminated on detected estrus over a four day period. Heifers not detected in estrus were time bred on the fourth day with the exception of several heifers determined not to have a follicle present by ultrasound scanning. A.I. detection and breeding was contracted to Select Sires and ABS. Consignors were given a choice of A.I. service sires available from participating breeding companies, with a list of recommended proven calving ease sires provided.

Following A.I. breeding May 24, heifers were moved to pasture where they remained through pregnancy diagnosis on August 9. Fifteen days following the end of A.I. service, Red Angus cleanup bulls selected for calving ease were placed with heifers for a 30 day natural service cleanup period.

At approximately 80 days following A.I. breeding, heifers were pregnancy examined using ultrasound scanning to determine pregnancy and breeding cycle confirming A.I. versus natural service sires.

Heifers were weighed, frame scored, body condition scored (1-9), and disposition scored (1-5) at test start, mid-winter, prebreeding, and at pregnancy diagnosis. In addition, prebreeding pelvic measurements were collected and additional periodic weights taken to monitor performance. Frame scores were used to project mature weight (projected mature weight = frame score x 75 + 800) which provided a means to express heifer weights as a percentage of mature weight. It was targeted for all heifers to achieve a minimum of 65% of their projected mature weight prior to breeding.

Heifers completing the project and confirmed pregnant, with an average disposition score of 3 or less, body condition score of 5 or greater, weighing at least 80% of projected mature weight, with a frame score of at least 4 and carrying the service of a recommended calving ease sire will be identified by the NDBCIA as "ND Choice" bred replacements.

Upon project completion and payment of all incurred development costs, consignors may take heifers home or in the case of heifers identified as "ND Choice" bred replacements, may choose to leave the heifers in the care of the Dickinson Research Extension Center for delivery and consignment to the Stockman's Livestock Thanksgiving Special Bred Heifer Sale.

Consignors are responsible for all costs in developing their heifers including: yardage, feed, veterinary products and services, and breeding fees including semen, technician, and cleanup bull costs. Yardage is assessed on a per head per day basis to cover charges for labor, facilities, equipment, utilities, fuel, repairs, and management at a rate of $.20/day in the drylot and $.10/day on pasture. Feed is charged at market price based on the average as fed per heifer per day within feeding group. Semen, veterinary supplies, and professional services will be at actual cost. Cost of cleanup bulls are shared by all heifers on test during the breeding period to cover estimated annual ownership cost. Death loss is borne by the consignor.

A $50 entry fee was collected at time of entry with consignors billed quarterly for incurred costs. Entry fees were credited to final period charges with all fees paid in full prior to release of heifers.

Table 1. Description of Consigned Heifers

Number of Consignors		9
Number of Heifers		130
Number Per Consignment		3-32
	Average	**Range**
Heifer Birthdate	March 17	Jan 25-May 4
Heifer Birthweight	83	50-116
Heifer Calving Ease Score	1	1-5
Heifer 205 Day Weight	610	477-773
Heifer Weaning Ratio	103	83-123
Dams MPPA	101.6	93.2-114.7
Heifer 365 Day Weight	911	706-1132
Heifer 365 Pelvic Area	158	116-210
Breeds and Breed Crosses Included: Angus, Gelbvieh, Simmental, Limousin, Hereford, Polled Hereford, Amerifax, Charolais, Salers		

Table 2. Heifer Weight, Body Condition, and Frame Score

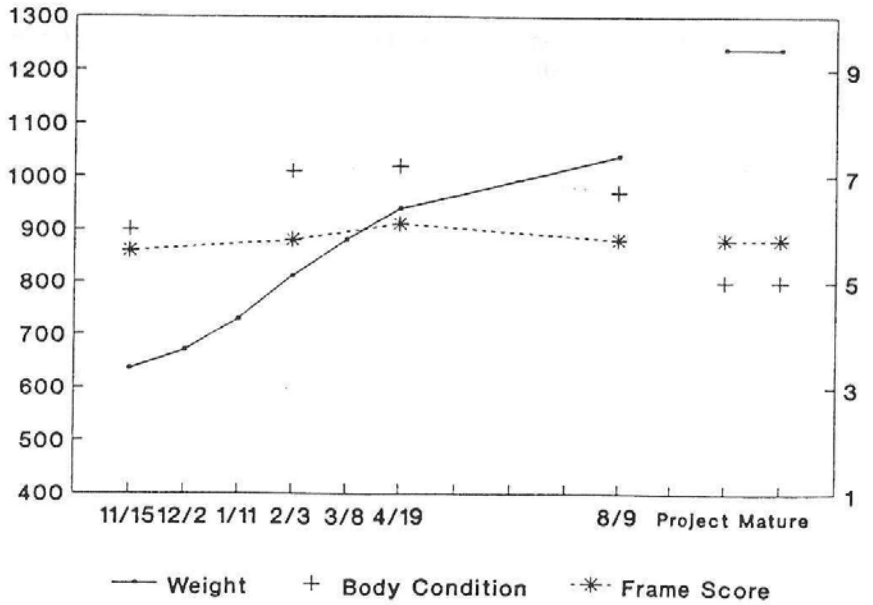

Table 3. Heifer Growth and Development by Feeding Period and Group

Measurement Date→	November 15				February 3				April 19				August 9
Description→	Test Start				Mid-Winter				Prebreeding				Preg. Diagnosis
Feeding Group→	L	M	H	All	L	M	H	All	L	M	H	All	All
Weight	535	636	737	636	705	814	915	812	829	940	1046	940	1039
Body Condition	5.6	6.1	6.3	6.0	6.6	6.6	6.7	7.1	7.1	7.2	7.3	7.2	6.7
Frame Score	4.7	5.6	6.6	5.6	5.0	5.8	6.7	5.8	5.3	6.1	6.9	6.1	5.8
Disposition Score	1.7	1.5	1.4	1.5	1.3	1.1	1.1	1.1	1.5	1.1	1.1	1.2	---
Pelvic Area	---	---	---	---	---	---	---	---	163	164	165	164	---
Preceding Period ADG	---	---	---	---	2.1	2.2	2.2	2.2	1.6	1.7	1.8	1.7	.9
Cumulative ADG	---	---	---	---	2.1	2.2	2.2	2.2	1.9	1.9	2.0	1.9	1.5
Projected Mature Weight	1150	1219	1292	1220	1178	1233	1301	1236	1197	1257	1317	1257	1238
% Mature Weight	47	52	57	52	59	66	70	66	69	75	79	75	83

Table 4. Drylot Feed Consumption (Lbs/head/day) and Daily Feed Cost ($/head/day) by Feeding Period

Feeding Period→	**Nov. 15-30**			**Dec. 1-31**			**Jan. 1-31**			**Feb.* 1-28**			**March * 1-31**			**April 1-20**			**Apr 21-30**	**May* 1-24**
Feeding Group→	**L**	**M**	**H**	**L**	**M**	**H**	**L**	**M**	**H**	**L**	**M**	**H**	**L**	**M**	**H**	**L**	**M**	**H**	**All**	**All**
Feed																				
Corn Silage	11.0	10.9	12.7	16.8	17.7	20.2	15.7	15.8	17.2	15.5	17.2	18.6	17.1	16.0	17.7	23.5	24.9	26.5	22.4	10.1
Oat Silage																				8.1
Tame Hay	3.6	4.1	5.9	5.9	6.2	7.1	5.8	5.9	6.5	8.0	8.4	9.3	10.1	9.3	10.4	11.0	11.6	12.1	12.3	10.6
Oat Hay													1.1	1.12	1.3	2.8	2.7	2.9		
Oats	2.8	2.0	2.0	3.3	3.5	4.0	3.1	3.1	3.4	3.2	3.4	3.8								
Barley				3.4	3.6	4.1	3.2	3.3	3.6	1.6	1.8	2.0	1.7	1.6	1.8	2.3	2.2	2.4	1.8	1.5
Soy Meal	.37	.39	.50	.94	.97	1.1	.81	.83	.82	.02	.06	.05							.06	
Min-Vit Mix	.11	.07	.06	.22	.23	.26	.21	.21	.23	.21	.22	.24	.22	.20	.23	.27	.29	.30	.16	.23
Vit. ADE	.04	.04	.04																	
Bovatec Supp.				.37	.38	.43	.49	.49	.55	.46	.47	.55	.55	.51	.57	.62	.64	.69	.34	.31
MGA Supp.																			1.47	.20
TOTAL	17.8	17.6	21.2	31.0	32.5	37.1	29.3	29.6	32.3	29.0	31.5	34.5	29.7	27.6	30.7	40.5	42.4	44.8	38.5	31.1
COST	.36	.34	.40	.73	.76	.87	.71	.72	.78	.62	.66	.73	.63	.60	.63	.67	.75	.76	.75	.55

* Not all feedstuffs and additives were in the ration all of the days. Values are averaged over the feeding period.

Table 5. Feed Prices and Usage

FEED	COST	Total Fed Nov. 15 – May 24
Corn Silage	18/T	1.6 T
Oat Silage	20/T	.1 T
Tame Hay	40/T	.8 T
Oat Hay	40/T	.03 T
Oats	1.25/bu	10.5 bu.
Barley	1.40/bu	8.7 bu.
Soybean Oil Meal	249/ton	.03 T
Min-Vit Mix	8.07/50 lbs	41.4 Lb.
ADE Supplement	15.15/50 lbs	.64 Lb.
Bovatec Supplement	8.41/50 lbs	86.1 Lb.
MGA Supplement	5.90/50 lbs	19.5 Lb.

Table 6. Service Sires Used in Heifer Development Project

BREED	REG.#	BIRTH WEIGHT			WEANING WT		YEARLING WT		MILK	
		EPD	ACC	PERCENTILE	EPD	ACC	EPD	ACC	EPD	ACC
AI SIRES *										
Red Angus	274272	-3.2	.72	10	23	.70	49	.68	9	.58
Red Angus	307777	-4.4	.81	5	19	.88	44	.83	10	.35
Red Angus	331945	-4.8	.48	5	15	.45	26	.42	8.7	.26
Angus	10988296	+.1	.94	10	31	.93	51	.86	32	.77
Angus	11592069	-2.0	.68	1	24	.64	50	.07	28	.15
Angus	11270134	+1.4	.75	20	29	.71	52	.51	19	.15
Polled Hereford	X23300822	+3.2	.91	35	16	.87	33	.75	4.2	.56
CLEANUP SIRES **										
Red Angus	408699	-1.6	B	20	14	B	22	P+	3	B
Red Angus	408659	+.4	B	45	14	B	18	B	2	B
Red Angus	408660	-.2	B	35	13	B	18	B	3	B
Red Angus	408713	-.9	B	30	16	B	17	P+	1	B

* Angus EPDs from spring 1994 analysis
Red Angus EPDs from 1994 analysis
Polled Hereford EPDs from spring 1994 analysis

** B calculated as non-parent backsolution
P+ calculated from pedigree and individual performance

Table 7: Breeding Schedule	
MGA feed for estrus synchronization	April 21 – May 3
Heifers injected with prostaglandin	May 20
AI Service Dates	May 22 - 24
Percent Heifers Detected in Estrus	
Day 1 after prostaglandin	0
Day 2 after prostaglandin	28
Day 3 after prostaglandin	53
Day 4 after prostaglandin	6
Cleanup Exposure Dates	June 9 – July 8
Pregnancy Diagnosis	August 9 and 17
Total Length of Breeding Season	48 days
Expected Calving Dates	March 1 – April 20

Table 8: Heifer Reproductive Summary							
	GROUP AVERAGES						
GROUP	**No.**	**%**	**Age**	**WT**	**FS**	**% MAT WT**	**BCS**
Overall							
Hfrs Available for Breeding	127*		432	940	6.1	75	7.2
Hfrs Settled to AI Service	67	53	429	945	6.3	75	7.2
Hfrs Settled to 1st Cycle Cleanup	33	26	435	913	5.8	75	7.1
Hfrs Settled to 2nd Cycle Cleanup	18	14	435	983	6.1	79	7.3
Hfrs Open	9	7	428	905	5.9	73	7.1
Artificial Insemination							
Hfrs AI Serviced	124		431	941	6.2	76	7.2
Hfrs AI Serviced on Detected Estrus	111	90	430	945	6.2	76	7.2
Detected Hfrs Settling to AI	66	60	429	946	6.3	75	7.2
Hfrs AI Serviced on 4th Day w/D.E.	13	10	431	981	6.0	79	7.3
Non-Detected Hfrs Settling to AI	1	8	479	886	5.2	74	7.0

* 1 heifer died prior to breeding, 1 heifer was bred and calved, 1 heifer not checked.

Table 9. Summary of Sickness and Death Loss		
	Number	Percent
Total Heifers	130	
Number Treated	9	6.9
Number Died	1	.8

Table 10. Veterinary Procedures and Treatments		
Scheduled Procedures		**Date**
Preweaning Vaccination: IBR, BVD, BRSV, $P1_3$ Haemophilus Somnus, Clostridium		minimum of 2 wks prior to delivery
Arrival Processing: IBR, BVD, BRSV, $P1_3$ Haemophilus Somnus, Clostridium booster IBR Intranasal, ectoparasite control		1st week in Nov. on arrival
Bangs Vaccination		January 11
Lice Control		June - July
Prebreeding Vaccination: IBR, BVD, $P1_3$ Vibriosis, Leptospirosis		April 16
Prostaglandin Injection for Estrus Synchronization		May 20
Ultrasound Pregnancy Diagnosis		August 9
Problems Treated	**Number**	**Treatment**
Elevated Temperature	7	injectable antibiotic
Foot Rot	1	injectable and oral antibiotic
Pneumonia	1	injectable and intravenous antibiotics, pasteurella vaccine
Abscess	1	lanced, injectable antibiotic

Table 11. Summary of Heifer Development Project Costs			
Feed			
Feeding Period	**Days**	**Cost/Day**	**Cost**
November 15-30	16	36¢	5.76
December 1-31	31	78¢	24.18
January 1 – Feb 3	31	73¢	22.63
February 3-28	28	67¢	18.76
March	31	61¢	18.91
April 1-20	20	73¢	14.60
April 21-30	10	75¢	7.50
May 1-24	24	55¢	13.20
May 25-August 9	77	30¢	23.10
			148.64*
YARDAGE			
Phase/Item	**Days**	**Cost/Day**	**Cost**
Drylot	191	20¢	38.20
Pasture	77	10¢	7.70
Trucking			2.75
			48.65
VETERINARY/TESTING			
Procedure			**Cost**
Bovishield			.85
Somna Shield			.23
Ivomec			3.35
Intranasal IBR			.31
Preg Guard 9			.78
Bangs			1.80
Lysoff			.30
Treatments			2.21**
Lutalyze			2.67
Pregnancy Diagnosis			2.00
Ear Tags			.70
			15.20
BREEDING			
Item			
Semen			11.46***
Technician			6.00
Clean-up Bull			12.00
			29.46
TOTAL – Test start through pregnancy diagnosis August 9			**241.95**
* Feed cost by feeding groups: Light $144.49, Medium $147.20, Heavy $156.52			
** Includes health treatments averaged over all heifers			
*** Average semen cost. Individual semen costs ranged from $6.00 to $16.00			

Breeding by Appointment and Transportation Effects on Pregnancy Among MGA/Prostaglandin Synchronized Heifers

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SUMMARY:

A synchronization program using a combination of MGA and Lutalyse was used to synchronize estrus in yearling crossbred heifers. Conception rate following insemination at 72 hours post Lutalyse injection was not different than insemination at 12-14 hours following detection of standing heat. Transportation of heifers at 5 or 9 days following insemination did not adversely affect conception rates.

INTRODUCTION:

The Dickinson Research Center conducted a breeding management investigation with yearling crossbred beef heifers to evaluate the following objectives:

1. To compare insemination by appointment with estrus detection and insemination among heifers synchronized with a combination of MGA and Lutalyse.

2. To evaluate the effect of transportation, following breeding, on embryo survival among heifers carrying free floating 5 to 9 day old embryos.

Breeding synchronized groups of beef females by appointment is a goal of many progressive cattlemen. Three approaches to estrous synchronization are currently available. The first approach uses prostaglandin products such as Lutalyse, Estrumate, or Bovilene. The second approach is to use Syncro-Mate B (SMB). A third approach uses a sequential combination of a feed grade progesterone compound melengesterol acetate (MGA) along with a prostaglandin.

Methodologies developed over the last several years that generate a synchrony compact enough for appointment breeding have focused on the use of progesterone as the principle ingredient. Syncro-Mate B combines a progesterone like Norgestomet ear implant with an intramuscular injection containing 3 mg. of Norgestomet and 5 mg. of estradiol valerate. To obtain maximum synchrony with the product, administration must effectively control corpus luteum (CL) formation and function at all stages of the estrous cycle. Syncro-Mate B has been shown to yield variable response depending upon the stage of the estrous cycle females are in at the time of administration. Syncro-Mate B efficacy is decreased when administered any time during the first 5 days of the estrous cycle (Lauderdale, 1972; Peters, 1984; McVey Williams 1989; Pratt et al., 1991), but administration on day 9 of the estrous cycle yields satisfactory CL control and subsequent reproductive response (Peters, 1984; McVey and Williams, 1989; Pratt et al., 1991). Using SMB requires more labor and handling than other available techniques.

Combining a sequential feeding of feed grade MGA for 14 days with administration of a prostaglandin 17 days later has been shown to be an effective method for estrous synchronization in cows and heifers (Brown et al., 1988; Patterson et al., 1986). Moreover, the method also appears to yield a synchrony compact enough for timed appointment breeding, while also being less labor intensive (Brown et al., 1988; Patterson et al., 1986; Beal et al., 1988). The purpose of the first objective is to compare breeding by appointment with insemination according to estrus among heifers synchronized in a MGA/prostaglandin program.

Our second objective focused on the potential detrimental effect that transportation may have on embryo survival in heifers carrying free floating 5 to 9 day old embryos. Some local cattlemen have reported lowered conception rates following insemination and subsequent transportation when compared to non-transported females.

MATERIALS AND METHODS:

Objective 1:

To evaluate breeding by appointment, seventy-six yearling Angus X Hereford heifers averaging 862 lbs. were synchronized using the MGA/Prostaglandin program shown in Figure 1. The heifers were fed a supplement containing MGA (.5 mg/hd/da) for 14 days and then 17 days after the last MGA feeding the heifers were injected with 20 mg (Landblom and Nelson, 1986) of prostaglandin (PGF). Half of the heifers (n=37) were

Figure 1

MGA PROSTAGLANDIN PROGRAM

inseminated 72 hours after administration of the PGF without regard to standing heat. The remaining heifers (n=39) were detected for standing heat and inseminated 12 – 14 hours after detection. Epididectomized detector bulls wearing chin ball markers were used to aid heat detection. Pregnancy status was determined using real-time ultrasound (33 days post insemination) and by actual calving date.

Objective 2:

To evaluate the effect of transportation on 5 to 9 day embryos, the same seventy-six virgin Angus X Hereford heifers used in objective one were divided by insemination method and transported a distance of 112 miles to summer pastures south of Bowman, North Dakota. Pickup drawn livestock trailers measuring 7’ x 24’, 7’ x 18’, and 5’ x 16’ were used to transport the heifers. Each group of heifers, carrying embryos of either 5 (n=38) or 9 (n = 38) days of age, were delivered to the pastures south of Bowman at approximately 11:30 am. each morning of the two delivery days.

RESULTS & DISCUSSION:

Objective 1:

Seventy-two hour insemination by appointment among virgin Angus x Hereford heifers was as reproductively effective as inseminating according estrus. Estrous response did not differ between treatments (78.4% vs 84.6%), and a compact distribution was observed (Table 1). In the 48 hour period between 29 and 77 hours after PGF_2 was administered, 78.2% of the heifers in the appointment breeding treatment, and 74.3% of the heifers in the estrous detected treatment were in standing heat.

Also, as shown in Table 2, no difference was measured for synchronized conception rate (69.0% vs 72.7%), synchronized pregnancy rate (54.1% vs 61.5%) or 25 day pregnancy rate (78.4% vs 79.5%).

Based on these data, breeding synchronized heifers by appointment in an MGA/prostaglandin synchronization program would save considerable heat detection labor while being reproductively efficient.

Objective 2:

The effect of transportation on freshly inseminated females was evaluated. No measurable impact on embryo survival was observed for either of the two treatments (Table 3). Hauling either 5 or 9 days after breeding did not effect synchronized conception rate, or 25 day pregnancy rate. Based on these data, no detrimental effects on embryo survival would be expected when freshly bred females are hauled distances similar to the ones used in this study.

Table 1

Hours and Percentage of Estrous Response Following Prostaglandin Administration

Bred By Appointment (72 Hr. Post Inj.)		**Bred After Estrous Detection (12-14 Hr.)**	
39 Hrs.	7.8%	29 Hrs.	2.5%
43 Hrs.	21.0%	43 Hrs.	25.6%
48 Hrs.	18.3%	48 Hrs.	15.4%
53 Hrs.	18.3%	52 Hrs.	10.3%
65 Hrs.	7.8%	53 Hrs.	5.1%
77 Hrs.	5.2%	65 Hrs.	7.7%
No Response	21.6%	74 Hrs.	7.7%
		87 Hrs.	7.7%
		98 Hrs.	2.6%
		No Response	15.4%

Table 2

Seventy-Two Hour Breeding by Appointment vs Estrous Detection and Insemination

	Bred by Appointment	**Detection/ Insemination**
No. Heifers	37	39
Estrous Response[1]	29/37 (78.4%)[a]	33/39 (84.6%)[a]
No. Open	4/37 (10.8%)[a]	6/39 (15.4%)[a]
Synchron. Conception Rate[2]	20/29 (69.0%)[a]	24/33 (72.7%)[a]
Synchron. Pregnancy Rate[3]	20/37 (54.1%)[a]	24/39 (61.5%)[a]
25 Day Pregnancy Rate[4]	29/37 (78.4%)[a]	31/39 (79.5%)[a]

1. Estrous Response = proportion of heifers observed in estrus during the synchronized period of the treatment total.

2. Conception Rate = proportion of heifers that conceived during the synchronized period of the total responding.

3. Pregnancy Rate = proportion of heifers that conceived during the synchronized period of the treatment total.

4. 25 Day Pregnancy Rate = proportion of heifers that conceived during the synchronized estrus plus those conceiving during the additional cycle initiated by the synchronization treatment.

Table 3

Transportation Effect on Embryo Survival

	Embryo Age 5 Day	**Embryo Age 9 Day**
No. Heifers	38	38
Estrous Response	32/38 (84.2%)[a]	31/38 (81.6%)[a]
No. Open	5/38 (13.2%)[a]	5/38 (13.2%)[a]
Synchron. Conception Rate	22/32 (68.8%)[a]	22/31 (71.0%)[a]
Synchron. Pregnancy Rate	22/38 (57.9%)[a]	22/38 (57.9%)[a]
25 Day Pregnancy Rate	32/38 (84.2%)[a]	28/38 (73.7%)[a]

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Evaluation of a Late Summer Thirty Day Breeding/Late Spring Calving Program for North Dakota Beef Producers 1994 Preliminary Report

K.A. Ringwall

SUMMARY

North Dakota cow calf producers need to be cost conscious and production wise. Most beef cow management focuses around production. Understandably so, since total output or the level of beef production is under total control of the producer. Producers generally accept the limitations imposed by the various biological types of cattle. Then they are free to concentrate on improving or maintaining production levels within their respective herds. Astute producers also conclude that cost containment is under their control. Although some inputs seem out of control, generally total costs are manageable.

Producers today can reach production goals that were once considered unattainable. North Dakota herd managers have attained 99 percent pregnancy rates and 96 percent weaning percentages. These same herds subsequently weaned 678 pound calves as documented by the Cow Herd Appraisal of Performance Software (CHAPS). This all translates into 623 pounds of marketable product for each cow maintained in the breeding herd. Not all producers have attained these production levels, but there is no question that these levels of production are attainable. These producers are production wise.

Cost conscious producers also need to set goals. For those herds involved within the North Dakota State University Extension Service's Integrated Resource Management program (IRM), total cow costs involved in producing 568 pound weaning weights were $356. These producers pulled off $73 per cow in family living costs and netted $76 cash income per cow after family living in 1993. To reach levels of cost containment not currently considered achievable, producers need to thoroughly break apart the $356 in cow costs. The challenge to producers is to maintain 678 pounds of product per cow at weaning, and keep costs at $356 per cow.

PROJECT OBJECTIVE

This project is being designed to evaluate production costs and herd performance for late spring (early May) calving in contrast to the traditional spring (late March, early April) calving in southwestern North Dakota.

INTRODUCTION

North Dakota cow calf producers need to be cost conscious and production wise. Much of beef cow management focuses around production. Understandably so, since total output or the level of beef production is relatively under total control of the producer. Producers generally accept the limitations imposed by the various biological types of cattle and concentrate on improving or maintaining production levels within their respective herds. Astute producers also conclude that cost containment is under their control. Although some inputs seem out of control, generally total costs can be managed.

Producers today can reach production goals that were once considered unattainable. Reviewing North Dakota herds that process through the Cow Herd Appraisal of Performance program (CHAPS), herd managers have attained 99 percent pregnancy rates, 96 percent weaning percentages and 678 pound weaning weights. This all translates into 623 pounds of marketable product for each cow maintained in the breeding herd. Not all producers have attained these production levels, but there is no question that these levels of production are attainable. These producers are production wise.

Cost conscious producers also need to set goals. For those herds involved within the North Dakota State University Extension Service's Integrated Resource Management program (IRM), total cow costs involved in producing 568 pound weaning weights were $356. These producers pulled off $73 per cow in family living costs and netted $76 cash income per cow after family living in 1993. To reach levels of cost containment not currently considered achievable, producers need to thoroughly break apart the $356 in cow costs.

Some real questions are involved in controlling costs. Feed costs are and will continue to be major components of cost. Those producers involved with IRM had $93 summer feed costs and $144 winter feed costs per cow. Feed costs accounted for two thirds of the total production costs. These same producers had $297,495 invested to maintain a 165 cow herd, but only carried $41,085 debt on the herd. Net income per cow in 1993 was $104, which is a 5 percent return on the dollars invested in the cow herd.

Most cattle operations have fairly static management calendars due to the difficulty of keeping a cow on a 365 day calving interval and managing the labor demands of calving around other farm/ranch enterprises. However, quantity and quality of feed required and total dollars invested in facilities and equipment are heavily influenced by the selected calving season. Therefore, this study is to evaluate production costs and herd performance for late spring (early May) calving in contrast to the traditional spring (late March, early April) calving in southwestern North Dakota.

MATERIALS AND METHODS

Two herds of cattle will be developed at the Dickinson Research Extension Center. One herd will be maintained under late March calving/early April calving. The other herd will be managed for early May calving. Both herds will be fed NRC requirements when confined. The early calving herd will be drylot calved and turned to Crested Wheat pasture with calves and the late calving herd will be flushed on Crested Wheat grass precalving and calved on pasture. Both herds will be managed in summer grazing systems. Data will be analyzed through SAS and combined with current CHAPS and FARMS data to simulate cost effective cattle production systems.

RESULTS

Preliminary data has been presented in the introduction. The production and cost data was obtained from the NDSU CHAPS and FARMS program. Special thanks goes to Dr. Harlan Hughes for the cost data. Future data will combine the CHAPS and FARMS data, as well as utilizing the data obtained from the early and late calving herds.

NCA-IRM-SPA COW-CALF ENTERPRISE SUMMARY OF REPRODUCTION AND PRODUCTION PERFORMANCE MEASURES FOR NORTH DAKOTA COW-CALF PRODUCERS.

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ABSTRACT:

Being competitive in current beef production requires that producers understand all details of their working operation. The North Dakota State University Extension Service in cooperation with the North Dakota Beef Cattle Improvement Association provide managerial reports generated through the Cow Herd Appraisal of Performance Software (CHAPS III). These reports assist producers with total herd evaluations which are utilized in North Dakota's Integrated Resource Management (IRM) program. For more effective utilization of individual herd data, production benchmark values utilizing the NCA-IRM-SPA calculations are as follows: Pregnancy Percentage 93.7%; Pregnancy Loss Percentage 0.3%; Calving Percentage 93.4%; Calf Death Loss 3.1%; Calf Crop or Weaning Percentage 90.5%; Female Replacement Rate Percentage 16.1%; Calf Death Loss Based on Number of Calves Born 3.3%; Calves Born During the First 21, 42, 63 and after 63 Days 59.3%, 87.1%, 96.0% and 4.0% (respectively); Average Age at Weaning 199 days; Actual Weaning Weights for Steers, Heifers and Bulls 581 lbs, 551 lbs, and 626 lbs (respectively); Average Weaning Weight 570 lbs; and Pounds Weaned per Exposed Female 514 lbs. Summary of cow culling information per cow exposed: dead 0.6%; age 2.5%; physical defect 1.6%; poor fertility or open 4.7%; inferior calves 2.6%; replacement stock 3.0% and unknown 0.7%.

INTRODUCTION:

Performance and production data need to be collected and utilized for a sound beef operation to function in the 90's. The collection of data, such as birth date, weaning weight, etc., is a common event, however the utilization of the data may vary considerably from one beef producer to the next. The purpose of this paper is to enhance the beef producer's ability to evaluate production records and increase the understanding and utilization of production data within the operation.

Beef performance data actually only comes in one form, but with two purposes. The purpose that most producers first think of and relate to, is performance data. Performance data is used within genetic evaluation programs to estimate the direction of genetic change and allows for accurate cow culling, heifer selection and bull buying. The second purpose is the appraisal of overall cow herd productivity which allows a beef producer to evaluate management decisions for the past year through changes in overall cow herd output. In other words, do the management regimes and selected individuals actually perform at the expected level.

The beef producer needs to first incorporate into the cow herd the CHAPS (Cow Herd Appraisal of Performance System) evaluation program and focus on both individual performance as well as overall herd productivity. The following evaluations are provided by CHAPS on individual performance data. The calf output is divided by sex and provides birth date, birth weight, calving ease, actual weaning weight, age in days, adjusted 205 day weight, adjusted 205 day weight ratio, frame score, average daily gain, weight per day of age, calf grade and parentage information on each calf. Averages presented are within sex and include an overall sex group average, individual sire averages and cow breed averages for all traits recorded.

A separate sire summary is included to provide trait averages by sire for birth weight, calving ease, actual weaning weight, adjusted 205 day weight, average daily gain, weight per day of age, calf age and frame score. Most probable producing ability (MPPA) values are calculated for all cows within the herd. The cow summaries include the cow identification, age of cow, cow breed, MPPA, number of calves born, number of calves weaned, calving interval, and sire of cow. All previous years individual calf records are available for review if needed.

The appraisal of overall cow herd productivity is accomplished within CHAPS through summarizing the calf data. The herd summary includes a reproductive analysis of the herd, a calving distribution report, an overall growth report, herd uniformity score and a cow culling report. The herd comparison report identifies those factors which are critical to the operation of the beef business. The last report includes the NCA-IRM-SPA cow-calf summary of reproduction and production performance measures values. The NCA-IRM-SPA performance values are standardized calculations based on guidelines established by National Cattlemen's Association National Integrated Resource Management Coordinating Committee Cow-Calf Financial Analysis Subcommittee.

MATERIALS AND METHODS:

The North Dakota Beef Cattle Improvement Association has processed beef cattle records since 1963. Individual calf records for 121 North Dakota beef cow herd during 1989 to 1993 are inputted into the CHAPS III computer program. Sixty eight thousand seven hundred and ninety individual calf records are combined into one large data set to generate typical North Dakota beef cow herd performance.

RESULTS AND DISCUSSION:

Although a producer's natural instinct is to review the individual performance data first, the initial step should be to review the overall herd productivity data. Once the total operation has been evaluated, the beef producer can initiate changes to the operation. Generally, the operation will need to modify some combination of management and cattle genetics. Table 1 summarizes the typical North Dakota NCA-IRM-SPA production measures. The mean standard deviation, top and bottom 10 percent of the herds performance values are presented to encourage producers to critically evaluate their own operations. As each value is reviewed, a producer should ask if that information is available for his/her operation. If the data is available, than the producer should compare his/her operation to the data presented. If the data is not available, than the producer should consider how the data might be obtained. Annual trends in NCA-IRM-SPA production measures during 1989 to 1993 are listed in Table 2.

Individual cow as well as herd performance records are a valuable and necessary tool for making accurate selection and culling decisions. However, beef producers must realize that these records need to be utilized in a comprehensive evaluation of herd productivity in order for the beef cattle operation to discover the greatest efficiency and profitability.

Table 1. North Dakota NCA-IRM-SPA cow-calf enterprise summary of reproduction and production performance measures.

Reproduction Performance Measures Bases on Exposed Females:				
	Mean	**SD**	**Top**	**Bottom**
Pregnancy Percentage	93.7	4.4	99.1	87.0
Pregnancy Loss Percentage	0.3	0.8	0.0	2.2
Calving Percentage	93.4	4.5	99.1	86.8
Calf Death Loss	3.1	2.9	0.3	10.3
Calf Crop or Weaning Percentage	90.5	5.1	96.7	82.4
Female Replacement Rate Percentage	16.1	8.1	1.8	31.4
Calf Death Loss Based on Number of Calves Born	3.3	3.1	0.3	10.8
Calves Born During First 21 Days	59.3	16.2	82.5	28.9
Calves Born During First 42 Days	87.1	10.2	96.4	66.1
Calves Born During First 63 Days	96.0	5.8	100.0	84.0
Calves Born After First 63 Days	4.0	5.8	0.0	16.0
Production Performance Measures:				
Average Age at Weaning(days)	199	20	167	237
Actual Weaning Weight for Steers	581	64	705	446
Actual Weaning Weight for Heifers	551	54	651	458
Actual Weaning Weight for Bulls	626	87	812	469
Average Weaning Weight	570	57	678	468
Weight Weaned per Exposed Female	514	61	623	400

Table 2. ANNUAL NCA-IRM-SPA COW-CALF ENTERPRISE SUMMARY OF REPRODUCTION AND PRODUCTION PERFORMANCE MEASURES VALUES

Year	Pregnancy Percentage	Pregnancy Loss Percentage	Calving Percentage	Calf Death Loss	Calf Crop	Female Replacement Rate	Percentage Death Loss	Calving Distribution 21	42	63	late	Average Calf Age	Average Wean Weight	Pounds Weaned per Exposed Cow
1989	91.2	0.3	90.9	2.7	88.4	16.3	2.9	60	85	95	5	196	566	498
1990	93.5	0.2	93.3	2.3	91.2	16.2	2.5	59	88	96	4	195	565	507
1991	94.4	0.4	94.0	2.5	91.7	15.2	2.6	59	88	96	4	200	555	509
1992	94.7	0.3	94.4	3.4	91.1	15.9	3.6	59	86	96	4	200	568	519
1993	93.8	0.5	93.4	4.0	89.9	16.9	4.2	61	88	96	4	200	592	526

Integrated Annual-Perennial Forage Systems for Livestock

Production in Southwestern North Dakota

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Summary:

Based on results of this trial to date (two years), it appears producers can expect to get about 67 days of grazing using annual pastures with calf gains averaging from 23.5, 57.5 and 93.1 pounds per acre on Winter Rye, Siberian Millet or Oats and Peas. Oats and Pease appear to offer the most grazing to date.

Pearl Millet has yet to prove its merit due to its difficulty in stand establishment

Objectives:

This trial was designed to study and document the use of annual forage pastures as a supplement and/or an replacement for native range. The goal of this trial was to graze a mixture of oats and peas in June; Pearl Millet in July; Siberian Millet in August; Pearl Millet in September and Winter Rye in October.

Methods:

In 1993, the oat and pea pastures were grazed for 14 days in July. The Siberian Millet pastures were grazed from September 1 to the 15th, and again from October 8 to the 14th. The Pearl Millet did not develop adequately to graze and this fall seeded Winter Rye was severely injured by grasshoppers.

In 1994, the Winter Rye seeded in 1993 had overwintered and was ready to graze by June 16. There were two sets of replicated pastures so the cows grazed on Winter Rye – Rep. 1 from June 16 to June 30. On June 30, they were transferred to Rep. 2 and grazed there until July 13.

The cows and calves were weighed off the rye pastures and moved to the oat and pea pastures on July 13. They grazed on oats and peas from July 13 until August 8, a period of 26 days. Gains were good for both cows and calves.

Since the Pearl Millet failed to make adequate growth, it was decided to put the cows and calves on native range pastures until the Siberian Millet pastures were ready to graze.

On August 23, the herd was moved to fields of Siberian Millet, where they grazed until September 6, a period of 14 days.

There was no rye pasture available to graze on September 6, so the herd was moved to native pasture.

Due to the dry weather conditions, much of the Siberian Millet was pulled out of the ground and either stepped on or grazed, roots and all. The rye that was grazed in June and July was too mature and coarse to support adequate cow or calf gains. In fact, the cows lost considerable weight while grazing the rye pasture.

Results and Discussion:

Tables 1-4 summarize the cattle performance on annual pastures in 1994. Table 5 shows the estimated increase in calf value based upon actual calf gains and a sliding market value based on calf weight. Estimated increase in calf value varied from $95.84 to $124.00 per calf based on the figures used.

Table 6 summarizes the returns per acre based on calf value and gain for the three annual pastures grazed in 1994. The best gain and return per acre were obtained by grazing a mixture of oats and peas. The lowest return was gained on Winter Rye pastures grazed in June. The Siberian Millet pastures were intermediate.

Table 7 shows the two year results from 1993 and 1994 for oats and peas and for Siberian Millet pastures.

Cow gain shows an advantage for grazing oats and peas while average calf are almost identical for the two pasture types.

Conclusion:

So far, we have had difficulty in getting a good stand of Pearl Millet. It appears that for the best use of Winter Rye pastures they need to be grazed earlier than they were in 1994. Weather conditions in 1993 and 1994 have not been conducive for the annual pastures selected for this trial, being either to cold or to dry.

Table 1. Cattle performance grazing Winter Rye Pastures						
Period Grazed	**Rep**	**Initial Weight**	**Final Weight**	**Total Gain/hd**	**Days Grazed**	**Avg. Daily Gain**
June 16-30						
COWS	1	1193	1105.7	-87.3	14	-6.24
	2	1205.1	1052	-153	14	-10.90
June 16-30						
CALVES	1	231.5	248.92	17.42	14	1.20
	2	260.9	271.67	10.76	14	0.77
June 30-July 13						
Cows	1	1105.7	1105.2	-0.53	13	-0.04
	2	1052	1045.2	-6.83	13	-0.57
Calves	1	248.92	281.75	32.83	13	2.53
	2	271.67	275	4.16	13	0.32
June 16-July 13						
Cows	1	1193	1105.2	-87.8	27	-3.25
	2	1205	1045.2	-156.2	27	-5.78
	Avg	1197.2	1075.2	-122.0	27	-4.52
Calves	1	231.5	281.75	50.25	27	1.86
	2	260.9	275.83	14.92	27	0.55
	Avg	246.2	278.79	32.58	27	1.22

Table 2. Cattle performance grazing Oats and Peas						
Period Grazed	**Rep**	**Initial Weight**	**Final Weight**	**Total Gain/hd**	**Days Grazed**	**Avg. Daily Gain**
July 13- Aug 8						
COWS	1	1105.2	1161.9	56.75	26	2.18
	2	1045.2	1123.5	78.33	26	3.01
	Ave	1075.2	1142.71	67.54	26	2.60
CALVES	1	281.5	345.75	64.25	26	2.47
	2	275.8	340.42	64.58	26	2.48
	Ave	278.7	343.08	64.41	26	2.48

Table 3. Cattle performance grazing Native Pasture						
Period Grazed	**Rep**	**Initial Weight**	**Final Weight**	**Total Gain/hd**	**Days Grazed**	**Avg. Daily Gain**
Aug 8-Aug 23						
COWS	1	1161.92	1211.42	49.5	15	3.30
	2	1123.50	1168.3	44.8	15	2.99
	Avg	1142.71	1189.90	47.20	15	3.15
CALVES	1	345.75	379.0	33.2	15	2.22
	2	340.42	380.0	39.6	15	2.64
	Avg	343.08	379.5	36.4	15	2.43

Table 4. Cattle performance grazing Siberian Millet						
Period Grazed	**Rep**	**Initial Weight**	**Final Weight**	**Total Gain/hd**	**Days Grazed**	**Avg. Daily Gain**
Aug 23-Sep 6						
COWS	1	1211.4	1224.17	12.7	14	0.91
	2	1168.3	1187.0	18.7	14	1.34
	Ave	1189.9	1205.6	15.7	14	1.12
CALVES	1	379.0	418.9	39.9	14	2.85
	2	380.0	419.7	39.7	14	2.83
	Ave	379.5	419.3	39.8	14	2.84

Table 5. Economics of Grazing Annual Pastures based on calf gains and calf value.							
Pasture type	**Rep**	**Initial wt**	**Price per pound ***	**Calf Value**	**Final Weight**	**Price per pound ***	**Calf value**
Winter Rye Pasture							
June16-30	1	231.5	1.00	231.50	248.9	1.00	248.90
	2	260.9	1.00	260.9	271.7	1.00	271.70
June 30-July 13	1	248.9	1.00	248.90	281.9	1.00	281.90
	2	271.7	1.00	271.70	275.8	1.00	275.80
Oats and Peas Pasture							
July 13- Aug 8	1	281.9	1.00	281.90	345.8	0.95	328.51
	2	275.8	1.00	275.80	340.42	0.95	323.40
Native Pasture							
Aug 8 – Aug 23	1	345.8	0.95	328.51	379.0	0.88	333.52
	2	340.42	0.95	323.40	380.0	0.88	334.40
Siberian Millet							
Aug 23- Sept 6	1	379.0	0.88	333.52	418.7	0.85	355.90
	2	380.0	0.88	334.40	419.7	0.85	356.74
Total increase in Calf value	1						**124.40**
	2						**95.84**
* Price per pound estimated for comparison only.							

Table 6 - Gain per acre and expected dollar returns per acre based on calf performance.			
	Winter Rye Pastures	**Oats and Peas Pasture**	**Siberian Millet Pastures**
Number of calves	24	24	24
Acres grazed	33.2	16.6	16.6
Weight gain per calf	32.58	64.4	39.8
Total gain per pasture	781.9	1545.8	955.2
Average gain per acre	23.55	93.1	57.5
Increase in calf value per pasture	$783.60	$1130.52	$536.64
Average return per acre based on increased calf value	$23.60	$68.10	$32.33

Table 7. Two year Cattle Performance Grazing Annual Seeded Pastures.				
Pasture Type	**YYear**	**Gain Per Head**	**Avg. Daily Gain**	**Gain Per Acre**
Oats and Peas Mixture				
Cows	1993	28.0	2.07	59.3
	1994	67.5	2.60	97.6
	Avg.	47.8	2.33	78.4
Calves	1993	43.0	3.07	88.1
	1994	64.4	2.48	93.1
	Avg.	53.7	2.78	90.6
Siberian Millet Pasture				
Cow Data	1993	46.0	2.31	94.8
	1994	15.7	1.12	22.7
	Avg.	30.8	1.72	58.8
Calves	1993	61.0	3.07	125.6
	1994	39.8	2.84	57.5
	Avg.	50.4	2.96	91.6

SWINE RESEARCH

Nutritional Relationships for Sow Productivity and Lean Growth

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SUMMARY:

A swine nutritional relationships study has been initiated to evaluate three nutritional areas of swine production. This new research initative is directed toward swine production units that utilize semi-confinement rearing systems, which are common among 60-120 sow units in southwestern North Dakota. Industry response to consumer demand for leaner pork products have resulted in genetically leaner sow herds. Research emphasis in this project focuses on the response of leaner sows to varying gestation energy levels and the subsequent effect on farrowing, lactation and rebreeding performance. A second project objective further evaluates sow response to protein(lysine) and energy ratio modifications during lactation, and the third objective is designed to develop dietary protein(lysine) and energy ratios for barrows and gilts developed to slaughter weights in sheltered outdoor facilities. Gilts in the first breeding cycle began farrowing in mid October. The first preliminary data will be available in the fall of 1995.

INTRODUCTION:

The swine industry is undergoing a significant amount of change nationally to maintain a strong market share. In a highly competitive environment, swine producers have adopted numerous technological advances. Relaxed corporate farming laws in some states are developing a mature swine environment paving the way for corporate swine farms that utilize vertical integration from conception to consumer.

By comparison to a national swine industry where corporate swine farms are becoming more prevalent, North Dakota's swine industry is immature with many farms utilizing hogs as a supplemental source of diversified income from herds of 60-120 sows. Systems for rearing range from very modest low input arrangements to total confinement. In the western and southwestern portions of the state, a greater number of facilities are of the semi-confinement type in which farrowing, nursery, and in some cases the grower phase is completed in confinement, with breeding, gestation and growing/finishing completed in sheltered outdoor facilities. Since semi-confinement is a commonly used rearing method, this new swine research initative has been developed around the needs of producers utilizing semi-confinement and genetically lean sows.

Review of nutritional scientific literature indicates that voids exist with respect to the genetically lean sow reared in the semi-confinement environment of North Dakota. The following three project objectives have been identified for initial investigation:

1. To determine the effect of dietary energy intake during gestation on sow body condition, lactation weight change, and litter and rebreeding performance.

The carryover effect of winter gestation energy level on sow weight change and body condition, farrowing litter size, post weaning estrus interval, and nonproductive sow days will be evaluated.

2. To determine the effect of modifying lysine to energy ratios during lactation on sow body condition, lactation weight change, and litter and rebreeding performance.

Sows receiving inadequate amounts of total protein and limiting amino acids experience substantial tissue depletion from muscles and organs. Negative protein and energy balance during lactation accelerates sow body weight loss and reduces total milk production. Maternal-line sows bred for higher milk production and larger litters require larger intakes of total protein and energy, but recommendations for the sow gestated outdoors needs to be evaluated and updated recommendations prepared. Data will be obtained by evaluating the impact of varying lactation protein(lysine)/energy rations and their subsequent effect on sow weaning body condition, litter nursing performance, sow rebreeding performance, and nonproductive sow days.

3. To determine the effect of protein and lysine/energy ration modification on performance and carcass merit of growing/finishing pigs.

Pork producers responding to the packing industry's request for leaner pork are receiving lean premiums and yield margin payments for their hog carcasses when the genetic capability for lean gain and proper nutrient balance occur simultaneously. Nutritional guidelines for pigs developed to slaughter weights in total confinement are well documented. Feeding recommendations for pigs reared in the outdoor environment of North Dakota are currently extrapolated from research with totally confined pigs, but approximately 50 – 60% of the pigs marketed from southwestern North Dakota are developed outdoors. Therefore, intake response of barrows and gilts fed varying ratios of protein(lysine) and energy during summer, winter and transition environments (spring and fall) are to be evaluated and recommendations prepared.

MATERIALS AND METHODS:

Parameters of this nutritional relationships study were initated by depopulating the existing swine breeding herd and repopulating with Pig Improvement Company (PIC), Camborough-15 gilts, and PIC line 326-II boars. Using All In/All Out management, and three week weaning, four farrowing groups of 16 sows each will be used to conduct the three investigational objectives.

Objective one will be conducted during the winter months between November and March when weather conditions are most severe. Gestation energy levels to be fed are expressed in megacalories of metabolizable energy per head daily and are shown below. Diets will be fed once daily in individual feeding stalls. During non-winter months the medium gestation energy level will be fed.

TREATMENT	WINTER MONTHS November – March MCal ME	NON-WINTER MONTHS April – October MCal ME
Low	09	11
Medium	11	11
High	13	11

Sow weights, body condition score, and ultrasound measurements for backfat and loineye muscle area will be taken at weaning, and days 40, 75 and 110 of gestation. Feed intake during lactation will be recorded for each sow. Once a sow has completed farrowing, she and her litters weights will be obtained within 12 hours. At weaning, each sow and litter will be weighed again and sow ultrasound measurements for loineye area and fat depth taken. The post weaning first estrous interval, interval between weaning and pregnancy, and non productive sow days will be recorded for each sow. During lactation the sows will be fed a corn/barley lactation diet formulated to contain 17.0% protein, .80% lysine, and 1.33 MCal of ME/lb of lactation diet.

Objective two will be conducted concurrently with objective one, and will utilize sows not assigned to objective one. Sows assigned will be gestated with the medium level of energy used in objective one and will be assigned to one of the following protein and energy levels:

TREATMENT	PROTEIN	LYSINE	ENERGY
Low	15.5%	.70%	16 MCal ME
Medium	17.0%	.80%	16 MCal ME
High	18.5%	.95%	16 MCal ME

Daily feed intake during lactation as well as the same series of measurements outlined for objective one will be conducted for the sows assigned to objective two.

In objective three, several barley based growing/finishing diet response trials will be conducted using feeder pigs weighing 45-60 pounds that are produced in objectives one and two. Outdoor dirt lots equipped with frost-free waterers, self feeders, and portable wooden shelters will be used to evaluate animal response in a single grower (50-110 lbs.) and two finisher (110-170 lbs and 170-240 lbs.) phases. Initial diets to be used will contain the lysine levels shown below:

GROWTH PHASE	LYSINE LEVEL	SEX
Grower	.75%	Barrow
		Gilt
	.95%	Barrow
		Gilt
Finisher I	.70%	Barrow
		Gilt
	.85%	Barrow
		Gilt

Finisher II	.65%	Barrow
		Gilt
	.80%	Barrow
		Gilt

Diet response criteria to be measured will include: feed intake by period (28 day), feed intake by season, digestible energy (DE) intake, DE:amino acid intake by season, weight gain by period (28 day), weight gain:amino acid intake ratio, ultrasound fat depth and loineye area, and calculated percent lean. Commercial marketing response for percent lean and carcass yield will be obtained through grade and yield marketings at the John Morrell and Company plant in Sioux Falls, South Dakota.

RESULTS AND DISCUSSION:

The first group of summer gestated gilts in cycle one will begin farrowing October 15th, which will mark the beginning of farrowing in this study. Preliminary data will be summarized for this report in the fall of 1995.

A Comparison of Semi-Confinement and Outdoor Isolet Rearing Systems for Swine

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SUMMARY:

Two swine production systems – Semi-Confinement and Outdoor Isolets – were evaluated to document production and economic inputs and outputs, to evaluate the feasibility of an isolet system in North Dakota, and to prepare a microcomputer generated economic analysis for each system to aid lenders and entry level producers in their decision making process. Overall systems comparison favored all in/all out semi-confinement rearing during all phases of production, but the Isolet system performed quite well and would be a very effective entry level system. Daily gestation intake was similar, but the isolet system sows, which farrowed spring, mid-summer and fall, consumed more total feed because their non-productive period was longer. Daily lactation feed intake was significantly lower for the semi-confinement sows, eating 5.15 pounds less feed head/day. Farrowing performance of sows farrowed in crates was similar for pigs born alive (Semi- 10.4 vs Isolet- 10.6), but death loss after farrowing was 0.6 pig less/sow (Semi- 1.98 vs Isolet- 2.83). While several criteria contributed to the losses, being laid on was the most frequent cause. Confinement pigs were more efficient, but the higher nutrient dense diets resulted in a higher nursery period cost of $1.02 per head. Growing/finishing pigs developed in the confinement nursery were more efficient through to slaughter, consuming an average 28 pounds less feed/head. Feed costs/head were $1.34 less for the pigs started in confinement (Semi- $34.70 vs Isolet- $36.04). Economic analysis was prepared using NDSU's Swine Production Analyzer software. Analysis of both systems, using two year averages for production data and total costs for facilities and equipment, was favorable for both profitability (opportunity costs) and feasibility (cash flow) analysis. Net returns to operator to cover unpaid family labor, management and equity capial costs for the profitability and feasibility analysis were $159/sow and $102/sow for semi-confinement, and $138/sow and $89/sow for the isolet system.

INTRODUCTION:

North Dakota is the nation's leading producer of several field crops (wheat, barley, oats, sunflowers and flax). As a major crop producing state, two-thirds of all farm income is derived from a combination of crop production and government payments. The remainder is derived from livestock marketings (ND Ag. Statistics, 1994). Historical review of income source figures compiled by the ND Agricultural Statistics Service, indicate that demand for income from livestock has declined steadily since 1950, and averaged about 24% during the 1980's. Livestock production has shifted from a general distribution statewide to its present distribution in which livestock income exceeds crop income in one-third of the states' counties located primarily in the central, westcentral and southwestern counties. Farmer decisions to replace livestock with more specialized farming has been stimulated largely by export growth, government farm subsidies and periods when crop prices were substantially higher than livestock prices. Hog numbers in the state declined 32% from 1950 to 1985, then began increasing to their present level of approximately 320,000 head.

North Dakota represents a disproportionate environment with respect to hog production, since the state is the nation's largest producer of feed barley, but is also one of the smallest pork producing states, raising only 1% of the nation's hogs. As a region, North Dakota is ideally suited for hog production because of its large feed grain base, generally favorable environment, low farm density, minimal swine disease, and work ethic. A logical inference from this is that farmers within the state could utilize these resources to increase net farm income by increasing hog production.

Without careful swine enterprise analysis, entry into the hog business can easily become capital intensive creating unmanageable debt resulting in business failure. The purpose of the present investigation was to evaluate two swine rearing systems, Semi-Confinement and Outdoor Isolets, as alternatives to total confinement, by documenting production and economic inputs and outputs, followed by preparation of microcomputer generated economic analysis for each system to aid lenders and entry level producers in their decision making process.

MATERIALS AND METHODS:

Two rearing systems *1) Semi-confinement, and 2) Outdoor Isolet* were established at the Dickinson Research and Extension Center. As a supplemental source of income to an existing farm enterprise, several assumptions were made. It was assumed that grain storage and handling equipment, farm tractor, water well, pickup and trailer, and electricity were available. Constructed at the Research Center's Ranch Headquarters, the two systems were populated with backcrossed Largewhite X Landrace sows that were bred to Hampshire boars. The herds were maintained at 30-40 sows each during the two year period of the study, and all breeding was done naturally. The two systems are described as follows:

SEMI-CONFINEMENT SYSTEM

The semi-confinement system combined totally confined farrowing and nursery facilities with outdoor breeding, gestation, growing and finishing. Females were farrowed in groups year round. Four week weaning and five week intervals between farrowing groups allowed one week for cleanup. Sows were bred on their weaning heat using multiple sire breeding. Elevated farrowing crates and nursery pens were used in a remodeled 26' x 60' insulated building with concrete floor that sloped to a center gutter running the full length of the building. Manure solids were scraped weekly into the center gutter and then the floor and solids in the gutter were flushed with a high pressure hose into an outside underground holding tank. Underground manure storage was provided by a discarded 16,000 gal. oil field tank that was pumped periodically with a tractor driven hydraulic pump and the manure spread on cropland. Thermostatically controlled variable speed fans and air inlets provided summer ventilation and a heat exchanger provided winter ventilation and tempered incoming winter air. Weanling pigs were developed using a commercial starter ration the first week after weaning followed by a three phase meal type starter diet. Pigs weighing 50-60 pounds were sold as feeders or retained and fed to finish. Approximately one-third of the pigs produced were retained and finished.

OUTDOOR ISOLET SYSTEM

The outdoor isolet system evaluated was a two litter system the first year and a three litter system the second year of the study. In year one gilts and then sows were farrowed spring and fall, and in year two sows were bred for spring and fall farrowing, and a group of gilts selected from the market hogs were bred to farrow mid summer before being sold. Sows were farrowed in sixteen Smidley Farrowing House units (isolets) purchased from Marting Manufacturing, Inc., Britt, la. Half of the isolets were attached to 8' x 8' porches equipped with tip out feed pans and 55 gal. drum water barrels with drinkers. The other half were attached to 6' x 16' dirt runways that had a feed and entrance gate at one end. The gate was equipped with a divided cast iron folding pan for feed and water. Pigs were weaned at five weeks of age, and when they reached 50-65 pounds were either sold as feeder pigs or were fed to finish. Sows were bred the first week of December for April farrowing, and the third week of May for mid September farrowing. Gilts farrowed mid summer were bred in early march and sold after their pigs were weaned.

Diets fed in this system were the same as those fed in the semi-confinement system, and are also shown in table 2. Creep feed was not offered to the pigs in this system, but they had access to sow feed with their mothers.

Production data accumulated from the two production systems were subjected to profitability and feasibility analysis using NDSU's Swine Production Analyzer, an NDSU Extension microcomputer software package.

RESULTS AND DISCUSSION:

PRODUCTION ANALYSIS

Two swine production systems, Semi-Confinement and an Outdoor Isolet System, were evaluated to document production and economic inputs and outputs, to evaluate the feasibility of an isolet system, and to prepare a microcomputer generated economic analysis for each system to aid lenders and entry level producers in their decision making process.

Overall production favored the semi-confinement system. Two year combined averages for the two systems are shown in table 1. Gestation costs were similar for the systems because the sows were limit fed the same level of intake, but during lactation sows housed in the isolets ate a significant 5.15 lbs. more feed/head than the sows confined to crates (17.70 lbs. vs 12.55 lbs.). Additional exercise and piglet feed sharing experienced by isolet sows increased daily lactation cost $.23/sow/day.

Overall farrowing performance favored sows confined to crates in the semi-confinement system. Sows in both groups farrowed nearly the same number of pigs born alive (Semi -10.4 vs Isolet -10.6), but death loss within two days after birth was significantly greater among the isolet sows that roamed freely (Death loss: Semi -1.98 pigs/sow vs Isolet -2.83 pigs/sow). While several factors contributed to the losses recorded, the most prevalent cause was due to more pigs being laid on. Sows confined to crates weaned 0.6 more pigs/sow than those in the isolets.

Nursery performance reflected differences in the two rearing environments as well. Pigs in confinement were weaned directly from crates to nursery pens at 4 weeks of age. Totally confined nursery pigs were more efficient converting 1.90 pounds of feed/pound of gain. Isolet pigs consumed 2.13 pounds of feed/pound of body gain. Pigs in the less intense isolet system nursed their mothers for five weeks and therefore were heavier and more developed at weaning. The isolet pigs received no creep feed, but ate lactation feed with their mothers. Since the isolet pigs were heavier at weaning, post weaning starter diets were less nutrient dense and the pigs were switched to grower diets sooner. Also, since the isolet pigs were heavier at weaning, they ate more feed during the post weaning period, but the feed cost per pound was less expensive making the gains more economical. Nursery feed cost/head ranged from $5.30 for the isolet pigs to $6.32 for the pigs reared in confinement.

Growing/finishing pig performance between the two systems was similar. This is understandable because, like with the gestation phase, the growing/finishing phases for each system were as conducted as identically as possible. Six separate groups of pigs from each system were fed side by side during the two year study. The averages in table 2 represent the combined averages for the separate groups fed. Pigs reared in confinement were more efficient during the finishing phase consuming 28 lbs. less feed. Feed cost per head ranged from $34.70 for the pigs born in confinement to $36.04 for the pigs born in the isolets.

ECONOMIC ANALYSIS

Production data is essential to establishing realistic budget analysis reports for enterprise profitability and feasibility. A swine producers decision to invest in a production technology needs to be based on his projected answers to two fundamental economic questions. First, is my proposed production system projected to be profitable over the long-run? Economic profitability question is based on the assumption that the swine enterprise has to pay the "opportunity cost" of the resources consumed. That is, if the long-run average corn price is $2.40/bushel, the swine enterprise has to pay the $2.40 opportunity cost for the corn consumed. This opportunity cost concept should be used for all resources consumed by the swine enterprise.

If the answer to the profitability question is no, then that investment probably should not be excecuted. If the long-run projected answer to the profitability question is positive, a second feasibility question needs to be asked before initiating the investment. The second question, is my proposed swine enterprise projected to be feasible i.e., will it cash flow? Cash flow requirements change substantially if the investment is financed with equity capital or with debt capital. Feasibility determines if the swine enterprise is projected to supply sufficient cash to pay its own cash obligations or will the swine enterprise need to be subsidized by other farming enterprises?

Profitability is determined by the returns to unpaid labor, management, equity capital and risk. Cash flow is determined by the amount of cash left over each year after that year's bills are paid. It is recommended that a producer invest in a production technology only if the answer to these two critical questions is "yes". Yes, my proposed technology investment proposes to be profitable and yes, my proposed investment projects to cash flow.

The two production systems – Semi-Confinement and Outdoor Isolets – were each subjected to a profitability and feasibility analysis. NDSU's Swine Production Analyzer, an NDSU Extension microcomputer software package, was used to analyze the profitability and feasibility of the two systems. Results of these analysis are presented in tables 3 and 4.

PROFITABLITY ANALYSIS of SEMI-CONFINEMENT

The economic analysis for the Semi-Confinement System is summarized in table 3. The investment in buildings ($265/sow), equipment ($256/sow), brood sows ($136/sow) and boars ($300/boar) totaled $688/sow. The analysis was based on 100 percent debt capital – A WORST CASE SCENARIO. This worst case scenario was used even though most farmers would normally have to put up some equity capital before a banker would participate in this type of investment.

The actual gross income generated from this 39 sow enterprise was 2,591 pounds of pork from the sale of slaughter hogs, feeder pigs, cull sows, cull boars, adjusted for purchased replacement gilts and sow death loss, totaled $861 per sow. The feed consumed per sow was made up of 107 bushels of barley, 0.17 tons of alfalfa, 0.12 tons of premix, and 401 pounds of soybean protein supplement. The feeds fed to this herd were all purchased so that the opportunity cost and the cash flow cost both totaled to $339 per sow.

Livestock costs are made up of vet and medicine ($29), marketing (49), repairs for building and equipment ($26), bedding ($5), power fuel utilities ($76), herd performance fees ($0), and miscellaneous expenses ($13) totaled $198 per sow. It was assumed tht all operating capital was borrowed at 9 percent interest for 6 months. This resulted in an additional operating interest charge of $24 per sow. When combined with feed costs, operating capital required for this enterprise was $561/sow.

Fixed costs for capital assets were based on some common farm management rules of thumb. The 8.67% fixed asset cost for buildings was based on a 15 year depreciation schedule (6.66%), a one percent (1%), annual repair cost, and a one percent (1%) annual insurance cost. The 17.29% equipment cost was based on a 7-year depreciation (14.29%), annual repair cost (2%), and insurance cost (1%). Annual depreciation and insurance on boars were figured at 36% per year. No insurance cost was assumed on the sow breeding herd. Fixed expenses totaled to $78/sow in the profitability analysis.

Interest paid on borrowed investment capital is an opportunity cost that needs to be taken into account. Principal payment, however, only reflects who owns the asset on the balance sheet and is not a legitimate opportunity cost. The interest cost for the Semi-confinement System totaled $63/sow. Total opportunity costs for the semi-confinement system totaled $702 per sow. Return to operator was $159/sow ($861-$702).

FEASIBILITY ANALYSIS of SEMI-CONFINEMENT

Since all feed was assumed purchased, the cash flow feed costs and cash flow livestock costs paralleled the economic analysis. A practicing farmer may well raise the feeds fed to the sows so he would include his cash cost of producing the farm raised feeds. Depending on his unique cash costs of producing his farm raised feeds, these cash costs of his farm raised feeds may exceed or be less than the market price used on the opportunity cost side.

Depreciation is not a cash cost so the cash flow fixed costs covered only repairs and insurance. The farm management rules of thumb used for annual cash costs were 2% for buildings, 3% for equipment, and 36% annual cost for boar replacements. This gave a total cash cost of $24 for the buildings and equipment. Interest on debt capital totaled to $63/sow and principal payments on debt capital totaled to $110/sow. Total cash costs (feasibility) of production was $758/sow. Cash return to operator was $102/sow ($861-$758).

Final economic analysis for the semi-confinement system is based on the calculated returns to unpaid labor, management, equity capital and risk. This bottom line is used because any farm family's total contribution to the swine enterprise is the family's unpaid labor, management and equity capital. Risk is also included in the bottom line definition because pure profits are the rewards to risk. This 39 sow semi-confinement generated a $159/sow return to unpaid family labor, management, equity capital, and risk. Yes, this investment was profitable in the two years covered by this research project. The break even price for this semi-confinement system was calculated at $38.11 per hundred weight of slaughter hogs produced.

PROFITABILITY ANALYSIS of OUTDOOR ISOLETS

Economic analysis for the outdoor isolet system is summarized in table 4. Investment in isolets with porches ($297), equipment ($221), brood sows ($115) and boars ($300/boar) totaled $663/sow. Gross income per sow from this 30 sow outdoor isolet enterprise was $798/sow (2,731 lbs. marketed/sow), and was generated from slaughter hogs, feeder pigs, cull sows and boars, and adjusted for purchase of replacement gilts and sow death loss.

Across herd feed consumption per sow was made up of 126 bushels of barley, .13 ton of alfalfa, .12 ton of premix, and 400 pounds of soybean protein supplement. Opportunity cost and cash flow costs were equal because all feeds were purchased.

Livestock costs were vet and medicine ($14), marketing ($52), repairs for buildings and equipment ($17), bedding ($7), power fuel and utilities ($24), miscellaneous ($13), and totaled $125/sow. Combined feed and operating costs per sow were $525/sow.

Fixed costs for capital assets were depreciated using the same rates and time intervals applied to the semi-confinement system. Isolet fixed expenses totaled $75/sow in the profitability analysis.

Interest paid on borrowed investment capital is an opportunity cost and totaled $61 per sow. Total opportunity cost for feed, livestock expense, interest on feed and livestock expense, and fixed expenses in the isolet system was $660/sow.

FEASIBILITY ANALYSIS of OUTDOOR ISOLETS

Feed consumed in the isolet system was also all assumed to have been purchased. Therefore, profitabiltiy costs and feasibility costs (cash flow) were similar are shown as like values in table 4.

Since depreciation is not a cash cost, cash flow fixed cost covered only repairs and insurance. Total cash cost for buildings and equipment amounted to $23/sow. Interest on debt capital totaled $61, and principal payments on debt capital totaled $100 per sow. Total cash costs (feasibility) of production was $709/sow. Cash returns to the operator were calculated to be $89/sow.

Overall final economic analysis for the isolet system is also based on the calculated returns to unpaid labor, management, equity capital, and risk. Unpaid labor, management, and equity capital are the farm family's contribution to the swine enterprise, and as such profits are the reward for risk taken. The 30 sow outdoor isolet system generated $138/sow return to unpaid family labor, management, equity capital and risk. Using the isolets in a farrow to finish rearing system was profitable over the two year period of the investigation. Break even price for this system was calculated to be $36.97 per hundred weight of market hogs produced.

Comparison of the two systems shows profitable scenarios for both rearing systems, although the semi-confinement system yielded a greater return to unpaid labor, management, equity capital, and risk ($159 vs $138).

Results from the isolet system evalutated certainly indicate that they can be effectively used in a lower investment farrow to finish swine enterprise by entry level producers that want to step into hog production without putting up permanent buildings. As with any enterprise that is to be successful, efficiencies within the system must be maximized. Farmers considering the use of isolets should focus on maximizing the number of farrowings/isolet just as a producer would that uses farrowing crates in a permanent structure. Keeping isolets full is a key success factor that is attainable only by careful advance planning to insure that an adequate supply of replacement gilts are available when each sow group is bred, and through adherence to a rigid breeding, end breeding, return heat check (pregnancy testing), farrowing and weaning schedule. Failure to adhere to rigid scheduling results in a rapid deteriation of pig flow resulting in a reduced number of farrowings/isolet/year, a reduction in the number of farrowings/sow/year, and an increase in the number of non-productive sow days.

Farmers considering the use of isolets should also consider the following:

1. Porches attached to the isolets keep pigs cleaner, eliminate rooting, and catching pigs is easier.

2. The effective time frame for use in North Dakota is from mid March through November. Supplemental heat must be provided otherwise pigs cuddle to their mothers closely and are easily laid on. Schedule breeding so no farrowings occur during December, January, February, and early March.

3. Summer heat is stressful. Sows are subject to heat stroke if shade isn't provided, especially during farrowing labor. Portable shade can be provided in a variety of ways, and should not be overlooked.

LITERATURE CITED

North Dakota Agricultural Statistics. 1994. Compiled by the North Dakota Agricultural Statistics Service, P.O. Box 3166, Fargo, ND 58108-3166.

Table 1. Semi-Confinement and Outdoor Isolet Production Summary

	SEMI-CONFINEMENT	ISOLET
GESTATION		
Feed/Head, lbs.	8.41	8.18
Feed Cost/Head, $	$.35	$.33
LACTATION		
Litters/Year	67	41
Feed/Head/Day, lbs.	12.55	17.70
Feed Cost/Head/Day, $	$.66	$.89
FARROWING		
Litters/Sow	1.73	1.34
Pigs Born Alive	10.4	10.6
Pigs Born Dead	1.98	2.83
Pigs Weaned/Sow	8.4	7.8
NURSERY		
Number of Head	1,087	609
Days Fed	38.7	31.5
ADG, lbs.	.82 1/	1.07
Feed/Head, lbs.	60.3	70.8
Feed/Head/Day, lbs.	1.56	2.28
Feed/Gain, lbs.	1.90	2.13
Feed Cost/Head, $	$6.32	$5.30
GROWING/FINISHING		
Number Finished	279	314
ADG	1.61	1.63
Feed/Head, lbs.	677	705
Feed/Head/Day, lbs.	4.98	5.71
Feed/Gain, lbs.	3.10	3.50
Feed Cost/Head, $	$34.70	$36.04
Months: Birth to Market	5.95	6.0
(Range)	(5.8 to 6.1)	(5.7 to 6.3)

1/ Reduced performance due to Strep. suis outbreak in the second year of the study.

Table 2. Nutrient Composition of Diets (Expressed In Percent)

INGREDIENTS	GESTATION	LACTATION	START 1	START 2	START 3	GROWER	FINISHER
Wheat	--	--	23.3	20.0	--	--	--
Barley	97.4	71.7	20.0	36.8	73.8	84.7	92.6
SBOM	--	19.0	19.9	17.3	19.4	11.2	5.0
Dried Whey	--	--	24.5	15.0	--	--	--
Fish Meal	--		6.0	3.0	--	--	--
Dical Phos.	.75	1.2	.35	.90	1.66	.85	.95
Limestone	.75	1.9	.80	.95	.71	1.0	.75
TM Salt	.60	.5	.45	.45	.45	.45	.35
XP-4 Phos.	.38	1.0	--	--	--	--	--
Vit. A, D&E	.062	.05	.05	.05	.05	.05	.05
Vit. B Complex	.075	.17	.17	.17	.17	.17	.17
Zinc Sulfate	.012	.03	.012	.012	.012	.012	.012
Lysine	--	--	.35	.30	.20	.125	.16
Medication	--	--	1.1	1.1	1.07	--	--
Sunflower Oil	--	4.5	4.0	4.0	2.5	1.5	--
CALCULATED ANALYSIS:							
Protein	13.2	18.1	20.3	18.6	18.5	16.3	14.7
Lysine	.35	.81	1.50	1.25	1.00	.75	.65
Calcium	.52	1.1	.82	.67	.77	.67	.58
Phosphorus	.57	.85	.82	.67	.67	.51	.52
Met. Energy/lb. (kcal)	1,346	1,415	1,446	1,439	1.386	1,384	1,353

TABLE 3. SEMI-CONFINEMENT FARROW TO FINISH PROFITABILITY & FEASIBILITY SUMMARY (39 SOWS & 100% DEBT CAPITAL)				
INVESTMENT/SOW $688 **DEBT PER SOW** $688 **EQUITY CAP/SOW** $ 0 **GROSS INCOME PER SOW:**	**PROFITABILITY (OPPORTUNITY)** **-----------------------**	**-------------** $861	**FEASIBILITY (CASH FLOW)** **--------------------**	**----------** $861
FEED COSTS:				
CORN	$0		$0	
BARLEY	$200		$200	
WHEAT	$0		$0	
PREMIX	$89		$89	
PROTEIN	$41		$41	
PAST & HAY	$8	$339	$8	$339
LIVESTOCK EXPENSE				
VET & MED	$29.05			
MARKETING	$49.22			
REPAIRS	$25.64			
BEDDING	$5.12			
POWER & FUEL	$76.02			
PIGS FEE	$0.00			
MISC	$12.82	$198	$12.82	$198
INTEREST ON FEED & LIVESTOCK EXP		$24		$24
FIXED EXPENSE:				
HIRED LABOR		$0		$0
BLD, FAC & SOWS		$78		$24
INV INTEREST/SOW		$63		$63
PRINCIPAL PAYMENT		XXXX		$110
		--------------		----------
TOTAL COSTS/SOW		$702		$758
FAMILY LIVING DRAW		XXXX		$0
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RETURNS TO OPERATOR & UNPAID		$159		$102
FAMILY LAB, MGT & EQUITY CAPITAL $ ($/SOW)				

TABLE 4. OUTDOOR ISOLET FARROW TO FINISH PROFITABILITY & FEASIBILITY SUMMARY (30 SOWS & 100% DEBT)				
INVESTMENT/SOW $663 **DEBT PER SOW** $663 **EQUITY CAP/SOW** $ 0 **GROSS INCOME PER SOW:**	**PROFITABILITY (OPPORTUNITY)** ------------------------	------------- $798	**FEASIBILITY (CASH FLOW)** --------------------	---------- $798
FEED COSTS:				
CORN	$0		$0	
BARLEY	$235		$235	
WHEAT	$0		$0	
PREMIX	$94		$94	
PROTEIN	$41		$41	
PAST & HAY	$7	$377	$7	$377
LIVESTOCK EXPENSE				
VET & MED	$13.83		$13.83	
MARKETING	$51.90		$51.90	
REPAIRS	$16.66		$16.66	
BEDDING	$6.66		$6.66	
POWER & FUEL	$23.50		$23.50	
PIGS FEE	$5.00		$5.00	
MISC	$12.82	$125	$12.82	$125
INTEREST ON FEED & LIVESTOCK EXP		$23		$23
FIXED EXPENSE:				
HIRED LABOR		$0		$0
BLD, FAC & SOWS		$75		$23
INV INTEREST/SOW		$61		$61
PRINCIPAL PAYMENT		XXXX		$100
		--------------		----------
TOTAL COSTS/SOW		$660		$709
FAMILY LIVING DRAW		XXXX		$0
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RETURNS TO OPERATOR & UNPAID		$138/SOW		$89/SOW
FAMILY LAB, MGT & EQUITY CAPITAL $ ($/SOW)				

ECONOMIC DEVELOPMENT THROUGH THE ENHANCEMENT OF SWINE PRODUCTION IN WESTERN NORTH DAKOTA

D.G. Landblom and K.A. Ringwall

NDSU – Dickinson Research and Extension Center

SUMMARY:

The NDSU Dickinson Research and Extension Center has requested and received funding from the North Dakota Agricultural Product Utilization Commission to enhance economic development opportunities through swine production education for western North Dakota's rural citizens. The purpose of this project is to assure the continued development of a swine industry within commercial agriculture in western North Dakota. The swine development program supports an educational network to service the needs of 20 to 100 sow farrow-to-finish enterprises. The development project supports a curriculum based educational program for entry level producers that is supported by on farm consultant services. Prospective students attended informational meetings in Dickinson and Hettinger, and 14 students registered for classes that began meeting regularly in April of this year. Class members took a break over the summer to plant and harvest crops and resumed meeting in mid September. Classroom instruction was completed in mid October. Students that attended represented a cross section of the targeted audience, which were individuals that were interested in raising hogs, but had little or no experience as well as farmers that were raising hogs on a limited basis, but wanted to expand their knowledge base. On farm visitations revealed students that were ambitious and willing to learn. Success ratios with programs like this one are difficult to evaluate, since financial histories may plague a student that is very capable of being a successful hog producer, but is unable to secure adequate financing to establish even the most modest of facilities. Of the students enrolled, approximately 35% will establish a hog business on their existing farm by either feeding feeder pigs to finish, or establishing a farrow to finish business. Another 14% will expand their present enterprise to feed out the feeder pigs they have been raising. Yet, another 14% will resume growing out feeder pigs to finish that had been out of business. Seven percent will not operate operate their own swine business, but will be employed as a swine herdsman by a larger business that hires people with swine management skills. The remaining 30% will probably never raise hogs or work for someone that does, but value the training they received.

INTRODUCTION:

The major challenge facing rural leaders is to foster stability and develop growth in rural communities. Rural areas have been decimated by the farm crisis of the 1980s. Moreover, current federal farm policy has implemented a massive land retirement program, the Conservation Reserve Program (CRP), to reduce soil erosion and reduce surpluses of the mid-1980s. The impact of this idling of productive capacity for ten years has devastated many rural areas. The problem, in the short term, is to ease the financial stress on individual members of rural communities. The challenge, in the long term, is to enhance rural economic development to provide financial stability to producers and indirectly to rural areas as a whole, and to all of North Dakota.

For many rural people, especially beginning producers, grain farmers that want to add value to home grown feed grains, youth, farm wives and small town citizens, additional income opportunities exist when livestock are added to the present daily work load. Swine would not only increase the value of present crop production systems, but would also provide rural economic development opportunities for the area. Unfortunately, specialization of the farm has often led to the sale of the livestock enterprise including the swine enterprise. Hog numbers in the state declined 32% from 1950 to 1985, then began to increase to their present level of approximately 340,000 head. Compared to other states, North Dakota's current hog production amounts to less than 1% of the nations total production (ND Ag. Statistics). Annually, tons of feed grain are exported out of the state due to the lack of hogs to consume the feed resources available.

Nationally, the pork industry is undergoing tremendous change in every aspect of the business. While the current focus is on large intense production units, pork producers in the southwest realize that expansion of the industry in North Dakota must focus on smaller moderate sized sustainable units which will play an integral role in establishing new swine enterprises in the state; ultimately increasing farm unit income. This proposal focuses on small and moderate sized "all in: all out" farrowing units that utilize existing farm buildings, grain handling equipment, utilities and water facilities. These units are an excellent outlet for excess farm labor and offers increased opportunity for supplemental farm income. Providing an "all in: all out" farrowing system is utilized, historic ten year net income estimates for a moderate investment semi-confined 60 sow farrow-to-finish system in western North Dakota range from $9,000 to $14,000/year. These operations also add value to the present cropping system, through enhancing the overall cash flow by approximately $100,000 per year.

Overall intent of this project is enhancement of the swine industry in western North Dakota to provide an opportunity to ease the financial stress on individual members of rural communities. As the industry grows, a stronger industry will be in place to provide value added dollars to local crop production systems.

PROCEDURE:

The development project supports a curriculum based program for the entry level producers as well as an expansion program for hog producers that desire to manage 20 to 100 sow production units.

A.) Swine curriculum based training program:

The introduction of hogs to producers will be coordinated through schools, workshops and individual contact. A multi-faceted program has been developed to accommodate individuals with different needs. However the core of the program will be the North Dakota Swine School. The school consists of an initial series of 7 to 9 six hour classes of intensive training involving both classroom and "hands-on" experience. The classroom instruction has provided a basis upon which private on farm consultation visits will be developed. Classroom instruction will include discussion of economics, genetics, reproduction, nutrition, disease and parasite control, housing principles and existing facility renovation for hogs, marketing, computerized ration balancing, computerized swine herd record keeping and performance analysis and computerized whole farm record keeping. Hog production labs have included sow feeding, baby pig processing, castration, vaccination, farrowing practices, artificial insemination, boar management and other mamagement aspects germaine to swine production. All participants receive routine consultant visits by project coordinator Doug Landblom.

A farrowing workshop will be held to supplement the regular school during farrowing at the Dickinson Research Extension Center. Baby pig survival is often the most limiting factor to a successful enterprise. These workshops will be designed to help producers understand what changes are occurring within the sow during late gestation and delivery as well as the needs of the newborn. The majority of the time will be spent assisting sows in labor and solving problem situations as they develop both with the mother and newborn. Additional annual activities include:

1.) Conduct swine management workshops/clinics that address specific specialized areas.
2.) Conduct North Dakota swine development seminars.
3.) Introduce swine herd appraisal software.

4.) Conduct swine enterprise analysis package.
5.) Update county extension staff on improved swine technology.

B.) North Dakota Swine Development Program:

As a supplement to the swine training program, a swine development unit will be established in southwestern North Dakota consisting of those producers who have attended the swine school classroom series (7-9 six hour classes). The individual and group educational program will be supervised by the unit coordinator. Individuals within the unit will be encouraged to establish their own production goals and priorities through utilization of educational opportunities provided by the project. By the end of the developmental phase, producers will be encouraged to obtain help directly from extension's ongoing swine educational programs. The swine coordinator will:

1.) Design and implement a recruitment program that will successfully encourage agricultural producers to consider improving or implementing a swine enterprise within their farm or ranch operation.
2.) Work individually and in small groups with potential and current swine producers to provide the necessary technical knowledge and skills needed for successful hog production.
3.) Instruct producers in the process and procedure for establishing and evaluating progress toward whole farm and ranch goals, family goals and personal goals relating to the family and local community.
4.) Conduct financial enterprise analysis for swine producers.
5.) Obtain and screen a detailed list of resources, finances and available labor from each producer and develop individual feasibility plans.
7.) Encourage each producer to enroll in a swine herd appraisal software program such As HOGCHAMP or PIGTALES and to purchase money management software such as MONEYCOUNTS.
8.) Determine initial and expansion swine numbers for each producer based on feasibility plan and production records.
9.) Advise the state extension services in designing a year-round program of large group, small group and individualized instruction based upon the needs of swine producers in western North Dakota.

PROGRAM EVALUATION:

The impact of this project will be evaluated through producer survey responses. Evaluation of efforts will be conducted in a manner consistent with the project's objectives. When the program focus is localized, observations and informal feedback on educational program efforts will be assessed. For funding organizations, specific information on project impacts will be evaluated. These include but are not limited to 1) number of individuals with increased knowledge, 2) the timeliness and adequacy of management data provided, 3) the number of information requests answered and swine producers served, 4) secondary trend data collected including change in livestock inventories, production statistics and enterprise profiles. Trend data would include the measurement of change in profitability to the whole farm and ranch and the swine enterprise.