SECTION III

RANGE AND PASTURE

MANAGEMENT RESEARCH

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SECTION 3

SHORT DURATION GRAZING TRIAL

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Summary

Short duration (SD) and repeated seasonlong (SL) grazing trials were initiated at the Dickinson Experiment Station Ranch Headquarters in 1981. Forage production has generally been greater on the SL treatment, yet forage disappearance has been similar despite a greater stocking rate on the SD treatment. Average daily gain of calves has been similar between treatments; therefore, the increased average calf gain/acre on the SD treatment is a reflection of the prior greater stocking rate on this treatment.

Introduction

The mixed grass prairie comprising approximately 30% of the land area of the state is dominated by cool and warm-season midgrasses, shortgrasses and sedges. The principle effects of previous unrestricted, heavy grazing in the mixed grass prairie is a marked decrease of tall and midgrasses and an increased coverage of short grasses and sedges, with a subsequent decrease in total forage yield. Considered to be below their potential for forage hence livestock production, North Dakota's rangelands warrant research into more efficient management systems such as short duration grazing.

Short duration grazing is a rotation system using multiple pastures and generally one herd. Stocking rate increases appear necessary and combined with a large number of smaller sized pastures results in a high stocking density (animals/area). The grazing period of a pasture is short, usually 7 days or less, to eliminate grazing of new plant regrowth. The rest period, generally 30 to 90 days, allows plants to recover from grazing and is short enough to allow animals to graze plant regrowth before it matures. Graze and rest period lengths should vary according to the growth rate of the vegetation.

Study Area and Methods

A trial comparing short duration (SD) to repeated seasonlong (SL) grazing was initiated June 25, 1981 on typical mixed grass prairie. Section 16 of the Ranch Headquarters was divided into one 320 acre pasture grazed seasonlong and eight 40 acre paddocks grazed rapidly in rotation. Twenty and 35 cow/calf pairs were allocated to SL and SD treatments, respectively, in June 1981, 1982, and 1983. From 1984 through 1986 an additional 5 cow/calf pairs were added to the SL treatment. In 1987 ten additional cow/calf pairs were allocated to the SL treatment for a total of 35 pairs on the SL treatment also. Due to dry conditions 30 cow/calf pairs were stocked on each treatment in 1989. Cattle were rotated every 5 days on the SD trial and paddocks rested 35 days throughout the grazing season. Grazing seasons totalled 70, 112, 131, 131, 126, 140, 140, 80, and 86 days between 1981 and 1989. Average annual precipitation for the study area is 16 inches. Precipitation recorded for 1981 through 1989 was 8.5, 25, 15.5, 14, 24, 14, 7.5 and 13 inches, respectively. Forage production and disappearance was determined utilizing portable cages and the paired-plot technique. Fifty paired, caged and uncaged quadrats were clipped at the beginning of trials and approximately every 40 days thereafter until termination of trials. Caged plots were used to estimate growth and total annual production while comparison of paired, caged and uncaged quadrats allowed estimation of forage disappearance (use). Plant basal cover was estimated using the point contact method on permanent transects. Livestock were weighed on and off grazing trials and every 28 days throughout the trials.

Results and Discussion

Annual herbaceous production on grazing treatments has ranged from 507 and 1766 lbs./ac (Table 1). In 1988 and 1989 approximately 50 and 80% of the long-term average annual precipitation was received, respectively. This resulted in similar percentage decreases in total annual forage production on both grazing treatments. To maintain proper range use, the grazing season was terminated after 80 and 86 days in 1988 and 1989, respectively. Forage disappearance was estimated to be 40 and 43%, respectively, on the SL and SD grazing treatments in 1989.

Livestock performance is summarized in Table 1. Cow and calf performance were better in 1988 and 1989 than any of the preceding years due to the well cured forage and shortened grazing season. Calf average daily gains have exceeded 2 lbs./day on both treatments each year with the exception of 1984. Differences in calf daily gains between annual grazing treatments were insignificant. Calf production per acre was higher on the SD treatment between 1981 and 1986 which is a reflection of the greater stocking rate on this treatment. Calf production per acre has been similar between treatments since 1987.

Percentage basal cover by plants on five range sites has been monitored since 1981 on the grazing treatments. Between 1981 and 1987 basal cover increased on all sites in both grazing treatments. Tables 2 and 3 summarize basal cover changes that occurred during the past three droughty years on the two grazing treatments. Despite a shorter grazing season and fewer cattle stocked, graminoid basal cover decreased on each site and treatment between 1987 and 1989. However, total basal cover did not always follow this trend. Forbs, fringed sage, and shrubs generally increased in basal cover on each site and treatment between 1987 and 1989; therefore maintaining plant basal cover. This trend is not desirable from a cattle production standpoint.

Table 1. Forage Production and Disappearance and Livestock Performance on Short Duration (SD) and Seasonlong (SL) Grazing Treatments, Dickinson Experiment Station

		Forage		Livestock			
				Cows		Calves	
Year	System	Production (lbs./ac)	Disappearance %	ADG (lbs.	AG/ac (lbs.)	ADG (lbs.)	AG/ac (lbs.)
1981	SD	678	55	0.4	3	2.2	16
	SL	679	51	0.7	3	2.3	10
1982	SD	1645	41	0.3	4	2.1	25
	SL	1766	36	0.5	4	2.1	15
1983	SD	1057	46	0.3	5	2.1	30
	SL	1720	43	0.5	5	2.2	18
1984	SD	919	60	0.0	0	1.9	26
	SL	1371	60	0.0	0	1.9	19
1985	SD	702	61	0.1	2	2.1	28
	SL	865	61	0.1	1	2.2	21
1986	SD	1667	56	0.1	2	2.2	23
	SL	1558	60	0.2	2	2.2	24
1987	SD	1286	65	0.7	11	2.4	37
	SL	1310	63	0.7	11	2.5	38
1988	SD	507	47	0.8	7	2.6	23
	SL	521	45	0.6	5	2.6	23
1989	SD	668	43	0.6	5	2.9	23
	SL	721	40	0.7	6	2.8	22
1981-1989 Average							
Average	SD	1014	53	0.4	4.3	2.3	26
Range		507-1667	41-65	0-0.8	0-11	1.9-2.9	16-37
Average	SL	1168	51	0.4	4.1	2.3	21
Range		521-1766	36-63	0-0.7	0-11	1.9-2.8	10-38

Table 2. Basal Cover (%) on Five Short Duration Grazed Range Sites Between 1987 and 1989 at the Dickinson Experiment Station, Ranch Headquarters

	Sa			Si			Sh			Cl			Tcp		
	87	**88**	**89**	**87**	**88**	**89**	**87**	**88**	**89**	**87**	**88**	**89**	**87**	**88**	**89**
Wheatgrasses	0	0	0.1	0.2	0.3	1.1	0	0	0	0.4	0.4	1.5	0.2	1.4	0.9
Needlegrasses	2.0	2.3	3.1	1.4	1.3	1.2	4.7	8.6	9.6	0.4	1.2	0.6	0.3	0.2	0
Other cool-season grasses	5.0	0.3	0.1	7.0	1.9	1.5	1.7	1.7	0.1	1.3	0.4	0.1	1.9	0.5	0.5
Sedges	7.3	6.1	6.6	1.3	3.3	0.9	3.2	6.9	7.7	1.9	0.8	0.7	0.3	1.4	0.9
Blue grama	7.0	6.1	2.4	18.1	16.7	6.0	10.0	5.6	4.3	21.9	20.0	7.0	15.5	17.4	9.2
Other warm-season grasses	0.6	0.3	0.9	1.5	0.4	0	1.2	0.2	0	3.9	0.1	0	1.1	0.8	0
Total graminoids	21.9	15.1	14.0	29.5	23.9	10.4	20.8	23.0	21.7	29.8	22.9	9.9	19.3	21.7	11.5
Forbs	0.5	0.9	7.1	0.9	0.3	11.8	2.1	0.9	5.0	0.6	0.3	17.6	1.5	0.3	5.6
Fringed sage	2.9	1.9	4.5	0.5	0.5	2.5	0.4	0.2	2.2	0.8	1.3	1.0	1.8	1.0	0.9
Cactus	0	0	0	0.1	0	0	0.1	0.2	0	0.1	0.1	0	2.4	2.4	4.1
Shrubs	0	0.6	1.2	0	0.1	0.2	0	0.3	1.6	0	0.1	0.3	0.6	0.6	1.8
Total herbaceous	25.3	17.9	25.6	30.9	24.7	24.7	23.3	24.1	28.9	31.2	24.5	28.5	21.6	23.0	18.0

Table 3. Basal Cover (%) on Five Seasonlong Grazed Range Sites Between 1987 and 1989 at the Dickinson Experiment Station, Ranch Headquarters

	Sa			Si			Sh			Cl			Tcp		
	87	**88**	**89**	**87**	**88**	**89**	**87**	**88**	**89**	**87**	**88**	**89**	**87**	**88**	**89**
Wheatgrasses	0.2	0.1	0.6	0.1	0.6	0.9	0.1	0.1	0.4	0.6	0.6	1.2	0	0.8	2.2
Needlegrasses	2.6	2.6	1.8	1.6	1.1	1.9	2.6	7.0	1.6	0.5	2.0	0.5	0.2	0.4	1.0
Other cool-season grasses	6.0	0.6	0.2	6.9	1.4	1.1	5.9	0.3	0.2	2.4	0.4	0.2	3.3	2.2	0.3
Sedges	3.4	2.8	3.1	1.9	2.4	2.2	3.6	5.6	4.4	2.3	2.1	0.6	0.3	0.2	0.4
Blue grama	14.4	11.5	5.3	14.1	14.7	6.0	7.2	6.5	2.9	19.0	12.5	12.5	7.2	7.3	5.7
Other warm-season grasses	0.4	0	0	2.2	0.1	0	1.3	0.1	0.7	2.0	8.5	0	2.2	0.3	0.6
Total graminoids	27.0	17.6	11.0	26.8	20.3	11.0	20.7	19.6	10.2	26.8	26.1	15.0	13.2	11.2	10.2
Forbs	0.5	0.8	4.1	1.0	0.7	6.2	0.7	0.2	0.3	1.1	0.1	2.8	3.9	2.5	6.1
Fringed sage	2.1	1.9	1.9	1.4	0.9	4.4	0.9	0.7	1.1	0.8	0.8	3.3	0.5	0.6	0.4
Cactus	0	0	0.1	0	0	0	0.1	0	0.1	0.2	0.2	0	1.0	0.3	1.0
Shrubs	0	0.3	0.4	0	0	0.6	0	0.3	1.0	0	0	0.2	0.1	0.2	0.5
Total herbaceous	29.6	20.3	17.0	29.2	21.9	21.6	22.3	20.5	11.6	28.7	27.0	21.1	17.6	14.3	16.7

COW AND CALF PERFORMANCE ON SEASONLONG AND TWICE OVER ROTATION GRAZING TREATMENTS IN WESTERN NORTH DAKOTA

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Livestock are the primary harvestable product of economic value from rangelands. Wildlife, water and aesthetics are also important "products" from rangeland that require sincere consideration for management decisions but it is very difficult for land owners to receive economic return from these. Maximum economic return from rangeland requires livestock to maintain production at or very near their potential for the entire grazing season. Anything short of this is lost potential capital. It is difficult to sustain maximum livestock production without crossing over a very fine line and causing detrimental effects to the range natural resource and its intrinsic values. Grazing livestock on native rangeland has a multitude of complex interactions and relationships between the plants and animals. Rangeland has a wide diversity of plant species. Each species has different needs for growth and development and respond differently to any given set of environmental factors. Animal performance is variable with the changes in the growth of plants. Scientists and managers need to understand the variations in weight performance through the grazing season in order to understand the ecology of grazing and evaluate the effects of any grazing management technique. Frequently animal performance on rangeland is evaluated by comparing single annual mean values of rate of gain and total weight gained for the entire season. Animal weight gain performance is not at the same rate during the entire grazing season and it is not the same for animals grazing on single pasture treatments and animals grazing on multiple pasture systems. This study was designed to describe and compare cow and calf rate of gain and change in accumulated weight gain for the grazing season during biweekly performance periods on three grazing treatments.

Study Area

This study was conducted for five years between 1983 and 1987 at the Dickinson Experiment Station located in western North Dakota. The vegetation was the Wheatgrass-Needlegrass Type (Barker and Whitman, in press) of the mixed grass prairie. The dominant native range species were western wheatgrass (Agropyron smithii), needleandthread (Stipa comata), blue grama (Bouteloua gracilis) and sedge (Carex filifolia). Long term mean annual precipitation was 15.89 inches.

Treatments

Three grazing treatments were included in this study, deferred seasonlong, seasonlong, and twice over rotation system. The deferred seasonlong grazing treatment had a delay of the starting date until mid July. This treatment was based on tentative interpretation of herbage production data collected from clipping studies in Canada (Campbell, 1952) with supporting herbage data collected in central North Dakota (Rogler et al., 1962) and western North Dakota (Whitman, 1954). This treatment was located at the Dickinson Experiment Station Pyramid Park area and consisted of one pasture of 600 acres grazed by one herd of 68 cow-calf pairs for 3.7 months from 16 July to 5 November in 1983 to 1985. These livestock were on several smaller breeding pastures prior to mixing and the start of this treatment.

The seasonlong grazing treatment was the control treatment of this study and consisted of a single 320 acre pasture grazed by one herd of 35 cow-calf pairs for 4.4 months from 18 June to 30 October, 1983 to 1987. It was located at Dickinson Experiment Station Ranch Headquarters. The pasture was not replicated.

The three pasture twice over rotation grazing system consisted of two 80 acre pastures and one 75 acre pasture for a total of 235 acres. Twenty-six cow-calf pairs grazed for 4.5 months from 1 June to 17 October,1983 to 1987. These pastures were replicated twice but the data was combined and used as one replication. This grazing technique was based on an unproven hypothesis suggested by Sampson (1914 and 1954) and expressed by Heady (1975) that there were three critical periods for grass plants when grazing has greater detrimental effects than at other periods (Manske and Conlon, 1986). Each pasture was grazed for two periods with one period of 15 days and a second period of 30 days for a total of 45 days of grazing in each pasture per year.

Commercial crossbred cattle were used on all treatments in this trial. Dates grazed, number of total days grazed, number of cow-calf pairs, acres and stocking rates data for the three grazing treatments are shown in Table 1.

Methods

Individual animals were weighed on and off each treatment and at 28 or 30 day intervals while on the treatments. Cow and calf mean weights for each treatment were adjusted to the 8^{th} and 23^{rd} day of each month of the grazing period. Biweekly performance periods of average daily gain and accumulated weight gain for cows and calves were used to evaluate each treatment from the start of the grazing period. Response surface analysis (Kerlinger and Pedhazur, 1973) with a repeated observation design (years as the repeated observation) was used to compare animal response curves among treatments. Simple mean annual average daily gain and gain per acre were calculated for each treatment and evaluated by unbalanced AOV (Mosteller and Rourke, 1973).

Results

Cows grazing seasonlong and deferred seasonlong treatments steadily decreased in average daily gain from the start of the grazing period (Fig. 1). There was no significant difference ($P > 0.05$) in the response curves of the cow average daily gain between seasonlong and deferred seasonlong treatments. The average daily gain was negative for the cows in most years during the last six weeks of the grazing period for the two seasonlong treatments. There was no significant difference ($P > 0.05$) for the cow mean annual average daily gain between the seasonlong and deferred seasonlong treatments (Table 2). Cow performance on the seasonlong and deferred seasonlong was less than desirable. Cows on the seasonlong and deferred seasonlong gained an average of 77.1 and 50.0 pounds, respectively, during the early portion of the grazing season. Cows lost 24.1 and 24.9 pounds on the seasonlong and deferred seasonlong treatments, respectively, during the latter portion of the grazing period.

The cow average daily gain response curves were significantly different ($P < 0.05$) between the twice over rotation treatment and the seasonlong and deferred seasonlong treatments (Fig. 1.). Cows on the twice over rotation treatment initially had a reduction in average daily gain but a period with no reduction occurred during the middle portion of the grazing period before cows lost weight at the end of the grazing period. Weight loss for cows occurred in most years only for the last two weeks of the grazing period on the twice over rotation grazing treatment. A significant difference ($P < 0.05$) between twice over rotation treatment and seasonlong and deferred seasonlong existed for mean annual average daily gain (Table 2). Cow average daily gain was more desirable on the twice over rotation treatment than the seasonlong and deferred seasonlong treatments. The period of weight loss that usually occurred on the two seasonlong treatments was delayed about four weeks on the twice over rotation system.

Accumulated weight gain for cows from the start of each grazing period was significantly different ($P < 0.06$) between seasonlong and deferred seasonlong treatments (Fig. 2). Accumulated weight gain was not different on the two seasonlong treatments but the rate of loss of accumulated weight during the latter part of the season was greater on the deferred seasonlong treatment. The upward slopes of the accumulated weight gain response curves were similar but the downward slope was greater on the deferred seasonlong treatment compared to the seasonlong treatment (Fig. 2).

The cow accumulated weight gain response curve of the twice over rotation treatment was significantly different ($P < 0.05$) from the response curves on the seasonlong and deferred seasonlong treatments. The upward slopes of these three curves (Fig. 2) were not different. The downward slope for the cows on the twice over rotation treatment was significantly less steep than the two seasonlong treatments. Cows on the twice over rotation treatment gained an average of 87.4 pounds and lost 11.7 pounds. These cows gained more weight and lost less weight than the cows on the two seasonlong treatments. Cow weight performance on the twice over rotation treatment was more desirable than the performance of cows on the two seasonlong treatments. Cow gain per acre (Table 2) was not different ($P > 0.05$) between the deferred seasonlong and seasonlong treatments. Cow gain per acre was significantly greater ($P < 0.05$) on the twice over rotation treatment compared to deferred seasonlong and seasonlong treatments.

Calf average daily gain (Fig.3) decreased with the progression of the grazing period. The rate of decrease was different for all three grazing treatments. The shape of the calf average daily gain response curves were not different but the downward slope of the deferred seasonlong treatment was significantly greater ($P < 0.002$) than the seasonlong treatment. The downward slope of the twice over rotation treatment was significantly less ($P < 0.01$) than the seasonlong and deferred seasonlong treatments. Average daily gain for calves on the twice over rotation treatment was more desirable than for calves on the seasonlong treatment which was more desirable than for the calves on the deferred seasonlong treatment. Average daily gain for calves on the twice over rotation treatment was steadier throughout the grazing period compared to the two seasonlong treatments.

The mean annual average daily gain (Table 2) for calves was significantly different ($P < 0.05$) between the deferred seasonlong treatment and the seasonlong and twice over rotation treatments. There was no difference ($P > 0.05$) for calf mean annual average daily gain between the seasonlong treatment and the twice over rotation treatment. Simple annual average daily gains have been used for a long time to evaluate animal performance but should not be the only method to evaluate animal performance when comparing grazing treatments. This technique did not detect the differences in calf average daily gain between the seasonlong and twice over rotation treatments.

Accumulated weight gain for calves was significantly greater ($P < 0.004$) on the seasonlong treatment when compared to the deferred seasonlong treatment (Fig. 4). Calf accumulated weight gain for the twice over rotation treatment was significantly greater ($P < 0.0001$) than on the seasonlong and deferred seasonlong grazing treatments. The greatest differences between these three performance response curves occurred toward the latter portion of the grazing period. The dip towards the latter portion of the grazing period for the calf accumulated weight gain curves (Fig.4) tended to follow the same trend as the downward slopes of the cow accumulated weight gain curves (Fig.2) for each treatment. The greatest downward slope occurred for the cows and calves of the deferred seasonlong treatment. The least downward slope occurred for the cows and calves of the twice over rotation treatment. The seasonlong treatment was between the other two treatments.

Calf gain per acre (Table 2) was not different ($P > 0.05$) for the three grazing treatments. Gain per acre values would be important to livestock producers but these values did not detect the differences between the three treatments in this study.

The performance response curves for cows (Fig. 1) and calves (Fig. 3) on the three grazing treatments show that cows and calves do not gain weight at the same rate for the entire grazing period and different grazing treatments cause differences in cow and calf weight performance. Simple annual average daily gain values (Table 2) do not show variation in rate of gain during the grazing period and they may or may not show differences between grazing treatments.

Discussion

Livestock production in western North Dakota has three major problems that need to be overcome by management in order to have maximum potential performance from cows and calves on rangeland. A) Western North Dakota has only a three month period, May, June and July, in which range grasses complete most of their growth (Goetz, 1960). Water is usually a limiting factor after July and very little new growth occurs in the latter portion of the grazing season. B) Lactating cows that are around 1000 pounds require 9.9% protein from their diet in order to maintain body weight and average milk production (NRC, 1984). The major grasses in western North Dakota drop below this level after mid July (Whitman et al., 1951). C) Grazing native range too early in the spring (May) reduces total herbage production by 40 to 60% of the potential growth (Campbell, 1952; Whitman, 1954; and Rogler et al., 1962).

These three problems limit maximum cow and calf production on rangeland in western North Dakota when management of grazing treatments ignores the negative effects of these factors. The standard seasonlong grazing treatment with a six month grazing season from mid May to mid November was the traditional grazing management in western North Dakota. This treatment was not included in this study because a set of data with six months grazing in one pasture did not exist. We can by apriori reasoning explain the effects of this treatment. The stocking rates would need to be low because of the loss of potential herbage production by grazing early. The average daily gain of cows and calves would be low because 3.5 months (58%) of the grazing period would be on mature vegetation that would be below nutritional requirements. On seasonlong grazing treatments with early starting dates the animals tend to select for green growing vegetation from choice species and most grass leaves are grazed before they are fully expanded. These immature leaves are very nutritious but below their potential weight. Under seasonlong grazing, it requires a larger number of plants with immature leaves to provide daily forage requirements for each animal. There is only a limited number of desirable plants available and this increases the number of times each plant is regrazed which keeps the leaves below potential weight. This repeat grazing reaches a point that is detrimental to the plants and inhibits growth which considerably reduces quantity and quality of adequate forage. The grazing animal then must turn to the plant species that initially escaped the selection and regrazing process. By this time, these plants would be in various stages of late senescence and below the nutritional requirements for the livestock. The animals lose weight during the latter portion of the grazing season.

The deferred seasonlong grazing treatment used in this study delayed grazing until nearly all the vegetative growth had been completed and after the nutritional quality of the major grass species had dropped below the minimum requirements of the animals. Most of the grass leaves available were fully expanded and at later stages of senescence. The cows were able to select forage early in the grazing period that provided adequate nutrition and were able to gain weight. Shortly after midway into the grazing period the animals were unable to select adequate forage to maintain body weight and presumably milk production. The cows lost weight and calf production was greatly reduced. The calf average daily gain and rate of accumulated weight gain decreased after the cows started to lose weight.

The seasonlong grazing treatment used in this study delayed the start of grazing until mid June. Vegetation was still growing but initial leaves on several grass species were fully expanded at or near full weight and all major grass species were above minimum nutritional requirements. The initial mean average daily gain for cows on the seasonlong treatment was greater than for the cows on the deferred seasonlong treatment. The cows on the seasonlong treatment had a steady decline in average daily gain and lost weight during the latter portion of the grazing season the same as the cows on the deferred seasonlong treatment. The loss in weight occurred after July when most of the vegetative growth had been completed and the available vegetation had dropped below nutritional requirements. Calf average daily gain and accumulated weight gain decreased during the latter portion of the grazing period after the cows started losing weight.

Loss of weight by cows in late summer was not harmful to the health of the animals but it did indicate that they were unable to maintain body weight and lactation on the forage available. Milk production for cows from the same experiment station herd but on another study grazing seasonlong showed that daily production of milk increased from May to June and then steadily decreased until weaning (Landblom et al., 1988). Cow body weight and milk production on seasonlong grazing treatments followed the same downward trends as the season progressed.

Grazing on the twice over rotation treatment was delayed until early June. No grazing occurred in May when the effects of grazing on young immature leaves reduce total potential herbage. In early June grass plants were still actively growing with several leaves fully expanded at full weight and still above minimum nutritional requirements. The livestock were moved to all three pastures one time during the early portions of the grazing period prior to mid July so that each pasture was grazed while the vegetation was growing and the nutritional quality was above the minimum requirements. Average daily gain for the cows decreased during the first rotation in the early portion of the grazing period presumably because the fully expanded leaves were decreasing in nutritional quality. The nutritional quality was still above requirements and the cow weight gain remained positive and weight was accumulated. During the second rotation the cows were still able to select forage that met their nutritional requirements in the first two pastures and the cows were able to maintain positive weight gain. The cows did not lose weight until the second rotation of the third pasture.

Cows on the twice over rotation system prolonged weight gain late into the grazing period and delayed weight loss. The reason for this was thought to be that a higher amount of leaves consumed by the cows during the first rotation were near full weight and that fewer plants were required to fulfill the daily needs of the animals. This would allow a high number of immature leaves to escape grazing during the first rotation and be available as fully expanded leaves during the second rotation. This would explain the increase in total available herbage and the ability to increase stocking rates on rotation grazing systems over seasonlong treatments.

Light grazing during the early portion of the grazing season seems to stimulate grass plant tillering which would increase plant density and the number of leaves available for the grazing animal during the second rotation and possibly the following year. The leaves from the new tillers would be phenologically less developed than the leaves from the older plants of the same species and relatively higher in nutritional quality. Calf performance on the twice over rotation treatment was also benefited. The average daily gain did not drop off during the latter portion of the grazing period as much as the calves on the deferred seasonlong and seasonlong treatments.

Conclusions

Cow and calf production from rangeland can not be maximized to the potential of the natural resource if the cows lose weight for long periods and calf average daily gain decreases well below their potential.

During this five year study cows and calves grazing on the twice over rotation grazing treatment had greater average daily gain and accumulated weight gain than cows and calves on the seasonlong and deferred seasonlong treatments. Cows on the two seasonlong treatments had a steady decrease in average daily gain and lost weight during the latter portion of the grazing period. The calves on the two seasonlong treatments had decreases in average daily gain during the latter portion of the grazing period. Cows on the twice over rotation grazing treatment gained weight for a longer period and delayed and shortened the period of weight loss at the end of the grazing period. Calves on the twice over rotation treatment had only a slight decrease in average daily gain during the latter portion of the grazing period.

In order for livestock producers in western North Dakota to maximize production and economic return from rangeland they need to move away from seasonlong grazing treatments and implement rotation grazing systems.

Table 1. Dates and Total Days Grazed, Number of Cow-Calf Pairs, Acres and Stocking Rates for Three Grazing Treatments

Treatment	Dates Grazed	Total Days	Number Cow-Calf Pairs	Acres	AUM Per Acre
Deferred Seasonlong	16 Jul – 5 Nov	112±6.3	68	600	0.45±0.03
Seasonlong	18 Jun – 30 Oct	134±2.4	35	320	0.36±0.03
Twice Over Rotation	1 Jun – 17 Oct	138±1.7	52	470	0.43±0.04

Table 2. Mean Annual Average Daily Gain and Gain per Acre for Cows and Calves on Three Grazing Treatments

	Average Daily Gain		Gain Per Acre	
Treatment	**Cow**	**Calf**	**Cow**	**Calf**
Deferred Seasonlong	0.25±0.11a	1.72±0.07a	4.4±1.6a	24.6±2.0a
Seasonlong	0.46±0.15a	2.14±0.11b	4.4±1.8a	24.2±3.4a
Twice Over Rotation	0.87±0.22b	2.21±0.07b	8.0±1.4b	28.4±3.0a

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

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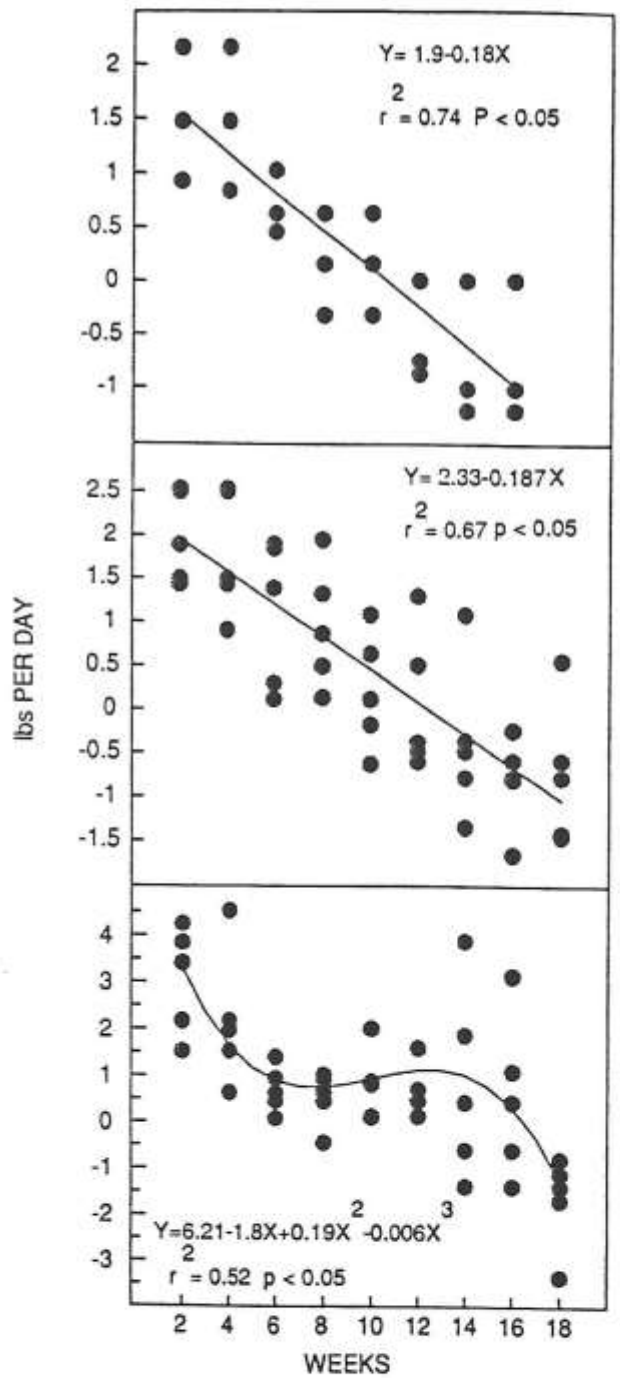

Fig. 1. Cow average daily gain response curves for deferred seasonlong (top), seasonlong (middle), and twice over rotation (bottom) treatments.

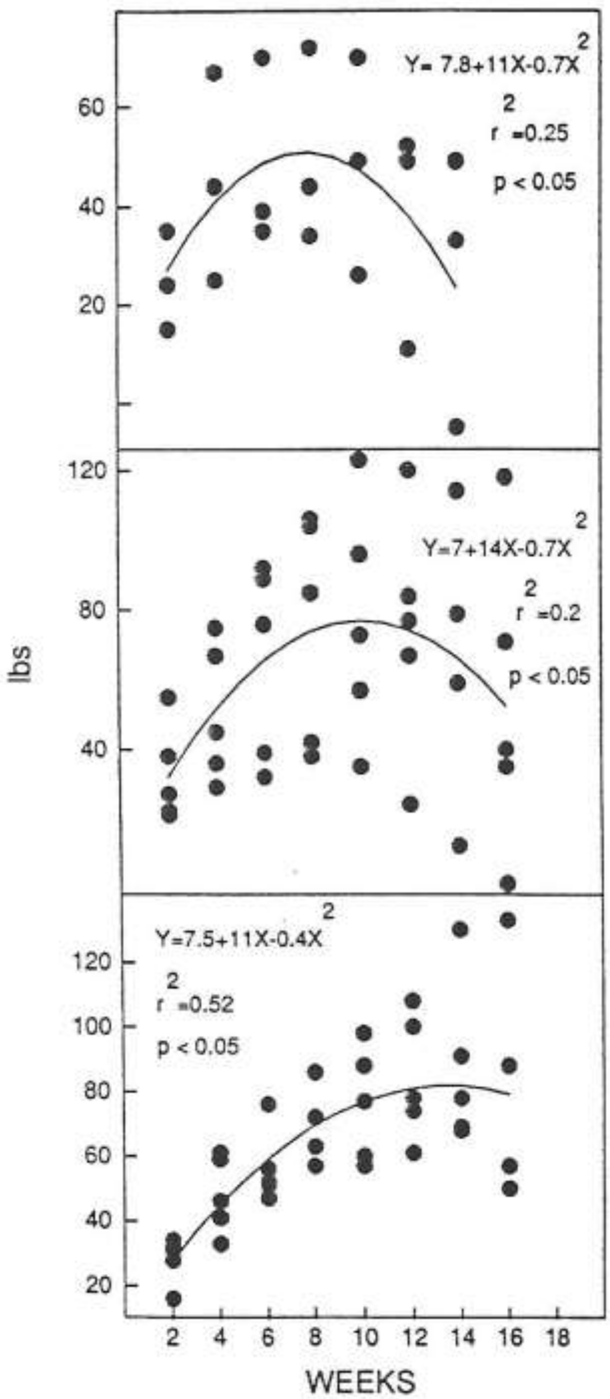

Fig. 2. Cow accumulated weight gain response curves for deferred seasonlong (top), seasonlong (middle), and twice over rotation (bottom) treatments.

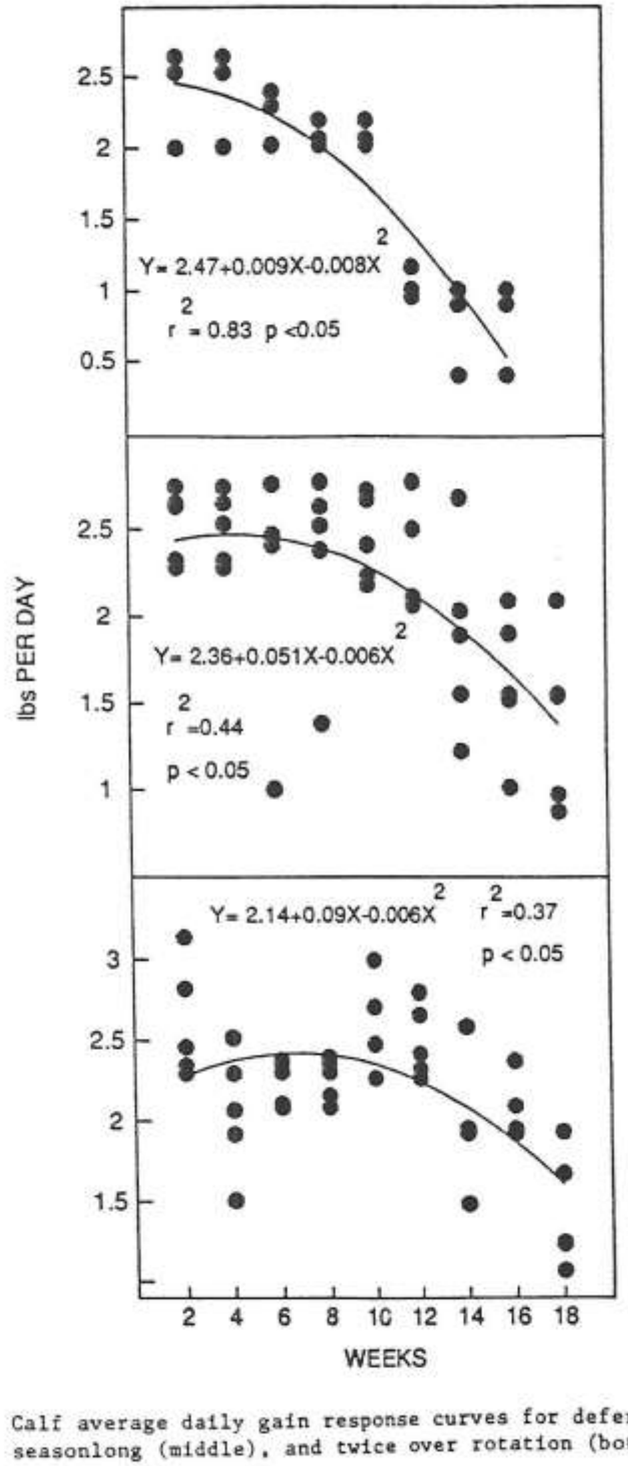

Fig. 3. Calf average daily gain response curves for deferred seasonlong (top), seasonlong (middle), and twice over rotation (bottom) treatments.

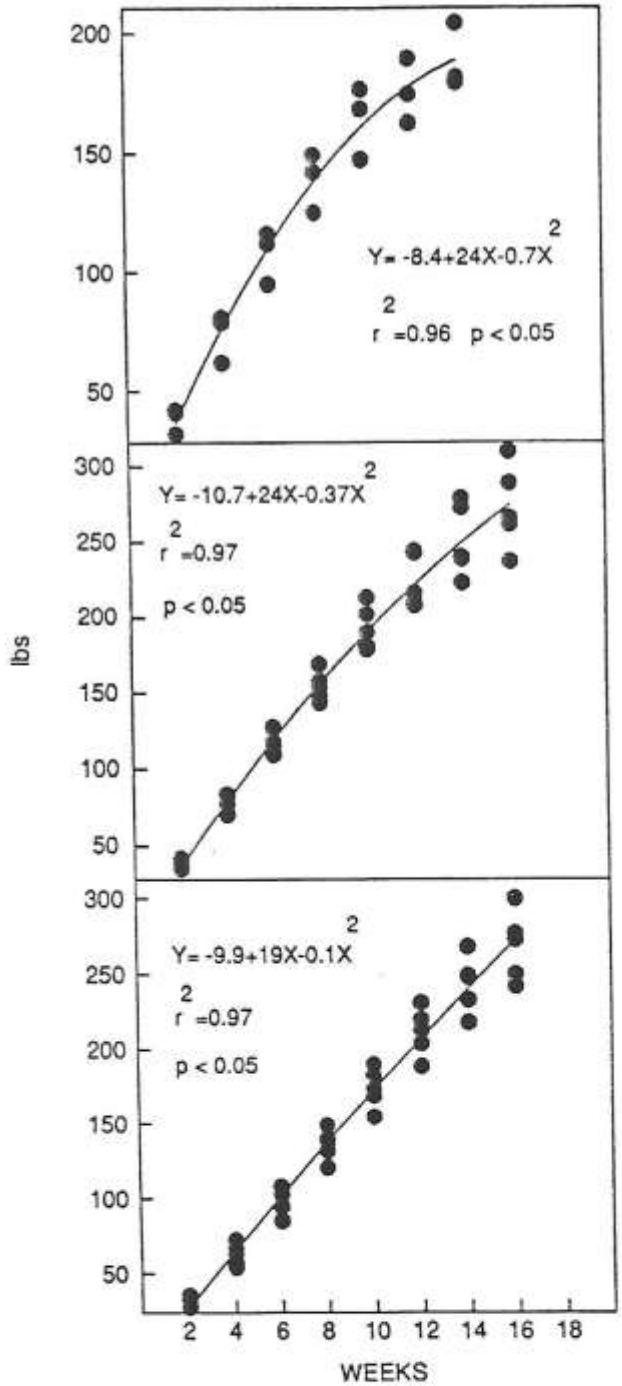

Fig. 4. Calf accumulated weight gain response curves for deferred seasonlong (top), seasonlong (middle), and twice over rotation (bottom) treatments.

GRAZING EFFECTS ON THE STRUCTURE AND DYNAMICS OF GRASSLAND ECOSYSTEMS

Project No. 1786

Complementary Rotation Grazing System in Western North Dakota

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Introduction

Complementary grazing uses domesticated grass, legume, or annual crop pastures to add to or complement native range pastures. Rotation grazing moves livestock through a successive series of pastures in a preplanned sequence. Management of native range and domesticated grass pastures must be based on sound ecological principles that consider the growth and development of the dominant species and the physiological needs, weaknesses and strengths of the plants to maintain productive stands. The nutritional needs of the livestock must be included in management considerations. Sound management recommendations can only be based on reliable scientific research.

Procedures

This project compares nongrazed, seasonlong grazing and rotation grazing on three native range sites to evaluate species composition, herbage production, and animal performance and the use of domesticated grass pastures in a complementary rotation grazing system. The present complementary rotation grazing system has been in place at the ranch headquarters of the Dickinson Research Center since 1983. It consists of two crested wheatgrass (Agropyron desertorum) pastures of 13 acres for spring grazing from early May to 1 June and two altai wildrye (Elymus angustus) pastures of 30 acres for fall and early winter grazing from 15 October to 15 December. Native range has been grazed as two sets of three pastures during the summer from 1 June to 15 October and managed as a twice over rotation system. Two pastures were 80 acres and one pasture was 75 acres. Twenty-six cow-calf pairs were used on each replication of the rotation grazing treatment. The seasonlong pasture treatments were established in 1986 and grazed from mid June to late October and consisted of 3 replicates of 80 acres of native range. Ten cow-calf pairs were used on each replication of the seasonlong grazing treatment. The two native range nongrazed treatments were established in 1987 and have not been grazed for more than 30 years.

The intended purpose of the trial is to maximize herbage and livestock production for a cow-calf operation, lengthen the grazing season in the spring and fall, improve range condition of native range, and reduce total acreage required to carry a cow and calf. The intention is to accomplish these goals with a low number of pastures with few rotation times and be flexible enough to be adapted by a wide range of livestock operations. This type of grazing system should improve operation efficiency, reduce costs and decrease labor per unit of production, and increase saleable production per acre.

Plant data collected on the treatments in this study were above ground herbage production, plant species composition, and leaf height measurements and phenological phases of eight major graminoid species. Animal weight performance for the commercial crossbred cattle used in this trial was collected only while livestock were on pasture at 15 or 30 day intervals.

Results and Discussion

The 1989 grazing season experienced drought conditions. A total of only 13.12 inches of precipitation fell for the entire year. The long term mean was 15.89 inches. Only 10.60 inches of precipitation occurred during the growing season, April to October.

The length of the grazing periods on the complementary rotation grazing system and seasonlong grazing treatments were reduced because of the drought conditions. The crested wheatgrass pastures were grazed from 26 May to 5 June for 10 days. Generally these pastures were grazed 21 days. The native range was grazed from 5 June to 11 September for 98 days. The native range was previously grazed from 1 June to 15 October for 136 days. The altai wildrye pastures were grazed from 11 September to 6 October for 25 days. Generally these pastures were grazed from 15 October to 15 December or later for 60 plus days. The native range seasonlong pastures were grazed from 20 June to 12 September for 89 days. Generally these pastures were grazed from mid June to late October for 129 days.

The total plant basal cover (Table 1) decreased on the sandy and shallow range sites but increased on the silty sites. The nongrazed, seasonlong, and rotation treatments decreased in basal cover by 24%, 23%, and 13%, on the sandy sites, respectively, and by 26%, 15%, and 5% on the shallow sites, respectively. The nongrazed, seasonlong, and rotation treatments increased by 84%, 6%, and 3% on the silty sites, respectively. The large increase on the nongrazed treatments was primarily due to an increase in upland sedges.

The total above ground herbage production (Table 2) decreased on the sandy and shallow range sites compared to 1988 data but increased on the silty sites. The nongrazed, seasonlong, and rotation treatments decreased in herbage production by 39%, 18%, and 27% on the sandy sites, respectively, and by 1%, 24%, and 9%, on the shallow sites, respectively. The nongrazed treatments decreased by 18% and the seasonlong, and rotation treatments increased in herbage production by 40%, and 17% on the silty sites, respectively.

The cow and calf average daily gain (Table 4) was decreased in 1989 compared to 1988 on the seasonlong treatments. The calf average daily gain (Table 4) was decreased on the crested wheatgrass, native range, and increased on the altai wildrye pastures of the complementary rotation treatments in 1989 compared to 1988. The cow average daily gain (Table 4) for the rotation treatments was decreased on the crested wheatgrass pastures, stayed the same on the native range and increased on the altai wildrye pastures in 1989 compared to 1988. The cow and calf performance in 1989 was generally reduced compared to 1988 because of the continuation of drought conditions from August 1986.

Summary

The management of this complementary rotation grazing system has been based on ecological principles that consider the physiological needs, weaknesses, and strengths of the dominant plant species. Consideration of the nutritional needs of the livestock have been incorporated. Season of use of each pasture type was limited to periods of grazing when the detrimental effects of grazing were minimized and the potential for improvement in animal weight performance was maximized to near potential. Effort has been made to limit the number of pastures and rotation times to the minimum. One pasture of crested wheatgrass was used for spring grazing. A second pasture may be necessary to move the starting date earlier. The native range was managed with three pastures, each grazed two times during the grazing season. One pasture of altai wildrye was used in this system for fall and early winter grazing. The grazing season has been lengthened from the traditional 6 months to 7.1 months. This system has the potential to lengthen the grazing season to 8.0 months with additional research. The acreage required to carry a cow and calf was reduced from 24.4 acres for 6 months to 11.6 acres for 7.1 months.

By using a complementary rotation grazing system similar to the one at the Dickinson Research Center, livestock producers have the potential to: lengthen the grazing season, reduce the acreage required to feed a cow and calf, and increase the amount of saleable beef produced from each livestock unit.

Table 1. Mean Percent Basal Cover for Native Range Treatments, Dickinson Research Center, July, 1989

RANGE SITE Treatment	Grass	Sedge	Forb	Shrub	Other Plant	Total Plant	Litter	Soil
SANDY								
Ungrazed								
Non grazed	11.4	10.5	3.6	0.1	0.0	25.6	74.6	0.0
Seasonlong	-	-	-	-	-	-	-	-
Rotation	9.4	9.5	5.4	0.5	0.1	24.9	70.8	4.2
Grazed								
Seasonlong	9.0	7.9	6.7	0.1	0.1	23.8	64.4	11.8
Rotation	8.3	8.7	4.6	0.2	0.0	21.8	67.0	11.0
SHALLOW								
Ungrazed								
Nongrazed	4.4	10.2	5.8	0.2	0.1	20.7	72.1	7.4
Seasonlong	-	-	-	-	-	-	-	-
Rotation	9.8	6.8	4.3	0.1	0.3	21.3	67.2	10.0
Grazed								
Seasonlong	4.5	11.4	5.0	0.1	1.4	22.4	59.5	16.5
Rotation	11.5	7.3	4.2	0.3	0.5	23.8	65.1	9.5
SILTY								
Ungrazed								
Nongrazed	10.5	18.7	12.0	0.1	0.0	41.3	54.7	4.1
Seasonlong	8.9	4.4	8.0	0.0	0.0	21.3	74.4	4.2
Rotation	15.9	4.7	6.4	0.0	0.0	27.0	66.2	4.5
Grazed								
Seasonlong	14.0	3.4	10.1	0.0	0.2	27.7	67.6	4.6
Rotation	12.6	5.5	6.5	0.0	0.0	24.6	61.6	12.1

Table 2. **Mean Herbage Production in Pounds per Acre, Dickinson Research Center, July, 1989**

Range site Treatment	Cool Season	Warm Season	Sedge	Forb	Shrub	Total Live	Standing Dead	Total Above Ground Herbage	Litter
SANDY									
Ungrazed									
Nongrazed	115	620	365	24	0	1124	483	1607	1845
Seasonlong	131	636	286	282	0	1335	323	1658	2307
Rotation	164	343	418	298	0	1223	187	1410	2226
Grazed									
Seasonlong	114	170	351	218	0	852	189	1042	1709
Rotation	107	139	356	153	0	756	151	907	1655
SHALLOW									
Ungrazed									
Nongrazed	87	17	497	102	0	704	164	868	1262
Seasonlong	133	76	331	132	0	672	131	803	1014
Rotation	191	74	236	334	0	835	109	944	1094
Grazed									
Seasonlong	113	81	277	138	0	609	81	690	1203
Rotation	140	93	208	212	0	653	73	726	1236
SILTY									
Ungrazed									
Nongrazed	171	66	468	341	0	1045	257	1302	1460
Seasonlong	422	106	139	517	0	1184	248	1432	1493
Rotation	354	142	144	369	0	1009	262	1271	1013
Grazed									
Seasonlong	237	138	123	291	0	789	179	968	1173
Rotation	193	129	151	195	0	668	123	791	973

Table 3. Mean Cow and Calf Periodic Weight in Pounds, Dickinson Research Center, 1989

Treatment	1 May	15 May	1 Jun	15 Jun	1 Jul	15 Jul	1 Aug	15 Aug	1 Sep	15 Sep	1 Oct	15 Oct	30 Oct	15 Dec
Seasonlong					|		**Native**			|				
Rotation	| **Altai** |	**Crested** |		|	|	| **Native**	|		|	|	**Altai** |			
COW														
Seasonlong				1380			1444		1420	1410				
Rotation	1215	1196	1221	1245	1287	1285	1278		1287	1268		1265		
CALF														
Seasonlong				312			395		489	551				
Rotation	187	222	245	273	307	337	402		450	490		547		

Table 4. Mean Cow and Calf Average Daily Gain and Gain per Acre in Pounds, Dickinson Research Center, 1989

	Crested Wheatgrass	Native Range	Altai Wildrye	Total System
Average Daily Gain (ADG)				
COW				
Seasonlong	----	0.36	----	0.36
Rotation	2.42	0.49	-0.13	0.34
CALF				
Seasonlong	----	2.84	----	2.84
Rotation	2.29	2.51	2.29	2.42
Gain/Acre (G/A)				
COW				
Seasonlong	----	3.62	----	3.62
Rotation	48.35	5.25	-2.82	4.63
CALF				
Seasonlong	----	29.70	----	29.70
Rotation	45.73	27.16	49.60	33.72