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Intensive-early stocking for yearling cattle in the Northern Great Plains

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Abstract

A 3-year study was conducted to evaluate grazing strategies for production of growing cattle during summer on Northern Great Plains rangeland. Crossbred yearling steers (N = 123 per year, avg initial weight = 275 kg) were allotted to 1 of 2 treatments replicated in 3 pastures. Treatments were season-long grazing of pastures at recommended stocking rates assuming a 4-month grazing period or intensive-early grazing of pastures stocked at the same rate assuming only a 2-month grazing season. Precipitation in 1993 was 169% of normal resulting in greater forage quality than in other years and no differences were observed in weight gains between treatments during 1993. In 1994 and 1995, steers in the intensive-early stocked pastures gained less weight during the 2 months of grazing than did those in the season-long stocked pastures; however, gain per hectare was greater in the intensive-early stocked pastures. Intensive-early stocking with growing steers may be a viable means to overcome limited forage quality during late summer in the Northern Great Plains and to maximize forage utilization in years of abundant forage.

Key Words: grazing management, beef cattle, protein supplementation

Resumen

Se condujo un estudio de tres años para evaluar las estrategias de apacentamiento para la producción de ganado en crecimiento durante el verano, el estudio se realizó en el pastizal de las Grandes Planicies del Norte. Novillos un año de cruzas de razas (N = 123 por año, peso inicial promedio = 275 kg) se asignaron a 1 de 2 tratamientos repetidos en tres potreros. Los tratamientos fueron: 1) apacentamiento del pastizal durante estaciones largas con la carga animal recomendada, asumiendo un periodo de apacentamiento de 4 meses y 2) apacentamiento intensivo temprano de los pastizales con la misma carga animal asumiendo un periodo de apacentamiento de solo 2 meses. La precipitación en 1993 fue 169% de la precipitación normal resultando una mayor calidad de forraje que en otros años, por lo que no se observaron diferencias en las ganancias de peso entre los tratamientos. En 1994 y 1995 los novillos en el tratamiento de apacentamiento intensivo y temprano ganaron menos peso durante los dos meses de apacentamiento que los novillos en el tratamiento de apacentamiento de estación larga, sin embargo, la ganancia por hectárea fue mayor en el tratamiento de apacentamiento intensivo y temprano. El apacentamiento intensivo con novillos en crecimiento puede ser un medio viable para sobreponer la calidad limitada del forraje a fines del verano en las Grandes Planicies del Norte y para maximizar la utilización del forraje en años en que este es abundante.

Growing season precipitation in the Northern Great Plains occurs mainly during May and June. Drier, hotter conditions in late summer result in lowered forage quality and quantity with an associated decreased rate of gain of steers grazing these forages (Heitschmidt et al. 1993). By monitoring daily weight of grazing steers, Currie et al. (1989) found gains to decline in late July to early August, and some steers lost weight during late summer, indicating that keeping steers on rangeland after this time could be counterproductive.

Decreased gains during late summer may be avoided by removing steers from rangeland before the decrease in forage quality. Intensive-early stocking strategies that employ high stocking rates but remove cattle from range in mid-summer have been used in the central and southern Great Plains to effectively utilize early season forage for the production of growing cattle (McCollum et al. 1990, Olson et al. 1993, Smith and Owensby 1978). Economic analyses of intensive-early stocking strategies in Oklahoma (Bernardo and McCollum 1987) indicate that these systems require high rates of gain early in the growing season. Heitschmidt et al. (1993) found that gains over 1 kg/day can be expected for steers on Northern Great Plains rangelands in early summer, indicating good potential for intensive-early stocking strategies. The objective of this study was to evaluate intensive-early stocking compared with season-long stocking for the production of growing cattle grazing Northern Great Plains rangelands.

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Methods

The study was conducted at the Fort Keogh Livestock and Range Research Laboratory near Miles City, Mont. (46°22'N 105°5'W). Climate is continental and semi-arid with vegetation dominated by western wheatgrass [*Pascopyrum smithii* (Rydb.) Love], threadleaf sedge [*Carex filifolia* Nutt.], needle and thread [*Stipa comata* Trin. and Rupr.], blue grama [*Bouteloua gracilis* (H.B.K.)], and downy [*Bromus tectorum* L.] and Japanese bromes [*B. japonicus* Thunb.]. Average annual rainfall in the area is 338 mm with 60% received during the 150-day, mid-April to mid-September growing season.

During each of 3 years, 123 crossbred yearling steers of British-type breeding (avg initial weight = 275 kg) were allotted to 1 of 2 treatments replicated in 3 pastures (6 pastures total) in a completely random design. Treatments were season-long stocking with pastures stocked at the recommended rate assuming a 4-month grazing period and intensive-early stocking with pastures stocked with about twice the number of steers for a shorter period of time. The timing of grazing varied among years due to forage conditions (Table 1). Pasture size varied from 36 to 90 hectares. Stocking rate was based on SCS (1983) guidelines for range sites in good condition. Hectares available per steer averaged 4.9 for season-long and 1.9 for intensive-early stocked pastures. Animal numbers per pasture were assigned based on range site composition, therefore, number of hectares per steer for the season-long-stocked treatment did not equal twice that of intensive-early stocked pastures. Pastures were assigned the same treatment each year, allowing evaluation of any short-term carryover effects of grazing management on pasture quality and animal performance.

Before the study, steers were implanted with a 200-day estradiol implant. Steers were weighed initially and then about every 14 days on a non-shrunk basis. Decisions concerning removal of cattle from intensive-early stocked pastures were based on biweekly weight changes and visual estimates of forage quality and utilization. Steers were removed from intensive-early stocked pastures when weight gains began to diverge from those of steers in season-long stocked pastures and when cool-season forages became dormant. During 1993, forage quality and quantity were visibly above average and cattle remained on intensive-early stocked pastures until 17 September.

Standing crop was estimated each year before grazing, after removal of intensive-early stocked steers and after remaining steers were removed from pastures. Two sites per pasture were chosen, representing an average of 48.5% of the pasture area with a range from 26.2 to 73.1%. Three total range sites were sampled as not all pastures were comprised of the same range sites. Botanical composition of each site was visually estimated by the dry weight rank method (t'Mannetje and Haydock 1963) and is presented in Table 2. For standing crop, 4 non-random reference plots (0.25 m^2) per range site were chosen based on a range of biomass densities from least to most abundant. Additionally, 10 random plots per site per pasture were estimated. The 4 reference plots and every fifth random plot were clipped for calibration of the estimates. Herbage was clipped to the ground, sorted by grass and forbs, dried at 55°C for 48 hours, and weighed. The non-random reference plots were not included in standing crop estimates for the pasture. Samples were composited by site within grazing treatment and saved for chemical analysis. Chemical analyses on herbage included dry matter, ash (AOAC 1990), crude protein (Hach 1987), neutral detergent fiber (Robertson and Van Soest 1977), and in vitro organic matter digestibility (IVOMD; Tilley and Terry 1963).

Analysis of variance of weight gain data was conducted with a model that included treatment, year, and pasture within treatment (SAS 1989). Treatment means were tested with the pasture within treatment mean square as the error term. Year effects were tested with the residual error term. Standing crop was evaluated with a model including year, treatment, and the interaction which were tested with pasture within treatment as the error term. The model also included sampling time, year x sampling time, treatment x sampling time, and year x treatment x sampling time which were tested using the residual mean square as the error term. The model for forage quality included year and time of sampling (pre-grazing, mid-grazing, and end of grazing). Due to compositing of samples for chemical analysis, the residual error was used to test effects on chemical analysis of forage.

Table 1. Dates of the beginning and ending of the grazing periods for season-long (SS) and intensive-early stocked (IES) pastures.

Year	Start of grazing	IES cattle removed	SS cattle removed
1993	19 May	17 Sep.	4 Oct.
1994	17 May	15 Jul.	8 Sep.
1995	15 May	4 Aug.	26 Sep.

Table 2. Botanical composition of 3 range sites found within pastures used for intensive-early or season-long stocking of pastures.

	Range site		
Species group	Silty clay	Claypan	Silty-Shallow
	(%)		
Pascopyrum smithii	35.9	63.0	18.3
Stipa comata	25.2	1.3	26.5
Other cool-season grasses	1.3	2.7	5.2
Warm-season grasses	12.7	17.0	18.3
Annual bromes	9.2	8.8	3.7
Carex filifolia	3.3	0.0	23.5
Forbs	12.4	7.2	4.5

Table 3. Forage standing crop for 2 range sites within pastures used for intensive-early stocking (IES) and season-long stocking (SS), SEM = 32.6.

	Treatment		Year		
Item	IES	SS	1993	1994	1995
	(kg/ha)				
Initial pre-grazing[1]	1,406	1,576			
Pre-grazing	1,425	1,803	1,491	1,807	1,544
Mid-grazing	1,483	1,814	1,804	1,711	1,431
Post-grazing	1,418	1,904	1,636	1,722	1,625
Average	1,442	1,840	1,644[a2]	1,747[a]	1,533[b]

[1]May 1993.
[2]Means by year with differing superscripts differ, $P < 0.05$.

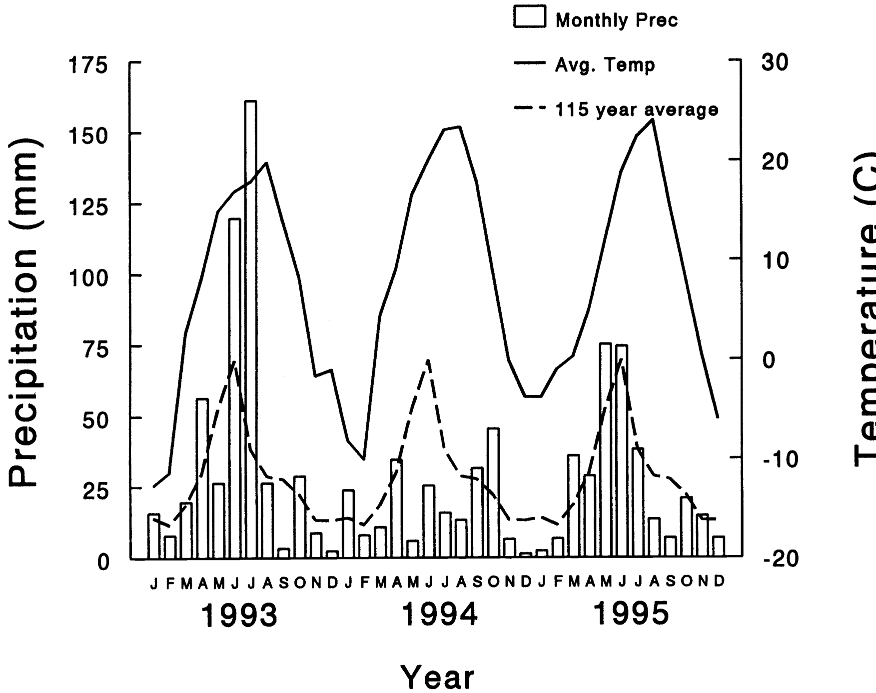

Fig. 1 . Temperature and precipitation throughout 1993 to 1995 compared to a 115 year average.

Results and Discussion

Environmental Conditions

Precipitation during May through August 1993 was about 169% of normal, with rain falling throughout the grazing period (Fig. 1). July 1993 precipitation was 400% above normal. Precipitation in 1994 was 44% of normal, with all months being below normal. Precipitation in 1995 was close (104%) to the average for the area, with a fairly typical monthly pattern.

Seasonal Changes in Herbage Quantity and Herbage

At the initial pre-grazing sample in 1993, available forage did not differ between treatments (Table 3). The increase in forage availability between 1993 and 1994 may be related to carry-over of biomass from 1993 into 1994. Quantity of forage was less in 1995 than it had been the previous 2 years. No interactions ($P > 0.10$) of grazing treatment with year or sampling time on forage availability were observed.

As forage quantity did not differ between treatments at any time, we hypothesize that pastures could have been stocked at a heavier rate with little detriment to cattle performance. However, care should be taken to not overstock pastures with an intensive-early stocking system. Olson et al. (1993) compared season-long to intensive-early stocking in the Central Great Plains at either 2- or 3-times the number of animals in the intensive-early stocked pastures for 9-years and found vegetation shifted to more warm-season grasses with the heavier intensive-early stocking. Willms and Jefferson (1993) also suggested shifts to warm-season grasses will occur with heavy early grazing in the Northern Great Plains.

Forage quality declined throughout the summer as evidenced by a consistent decline in crude protein between pre-grazing samples and those collected later in the season (Table 4). Crude protein did not differ between mid- and post-grazing samples. Greater forage crude protein was observed in 1993 than in other years and is related to the greater amounts of precipitation and cooler temperatures observed in 1993. Forage IVOMD did not differ among years for the pre-grazing sample, but was greater for mid- and post-grazing samples in 1993 than in other years. Mid- and post-grazing IVOMD were lowest in 1995.

The only forage quality measure to be affected by grazing treatment was neutral detergent fiber. These values were higher ($P < 0.05$) for samples collected from intensive-early stocked (81.1%) than season-long (79.2%) treatments. This could be the result of increased grazing intensity in the intensive-early stocked pastures.

Grazing Management

At the end of the early grazing period, cattle grazing intensive-early stocked pastures weighed about 10 kg less than the cattle grazing season-long stocked pastures (Table 5). In 1993, steers were lighter at the beginning of grazing than in other years, but were heavier by the end of both grazing periods. This was related primarily to the increased length of grazing in 1993.

There was a year x treatment interaction ($P < 0.05$) for average daily gain during the early grazing period as no differences were observed in gains between the treatments during 1993 (Table 6). This occurred even though the intensive-early stocked pastures were grazed for 4 months rather than the proposed 2 months (Table 1). The increased length of grazing greatly

Table 4. Forage quality of pastures used during the summer with intensive-early stocking (IES) or season-long stocking (SS) and sampled before grazing, at the time steers were removed from IES pastures, and at the end of SS grazing.

	Time of sampling			
Item	Before grazing[1]	IES steers removed	Post-SS grazing	SEM
Crude protein[1]		(% OM)		
1993[A2]	9.7	7.8	7.3	0.19
1994[B]	8.1	5.4	4.9	0.17
1995[B]	7.8	5.2	5.2	0.17
Neutral detergent fiber				
1993	77.0[aA]	81.6[bA]	82.1[bA]	0.79
1994	78.6[aA]	82.9[bA]	82.4[bA]	0.72
1995	73.7[aB]	78.9[bB]	84.5[cB]	0.73
IVOMD				
1993	61.4[a]	58.9[bA]	54.8[cA]	0.67
1994	60.4[a]	51.7[bB]	50.6[bB]	0.61
1995	59.6[a]	48.2[bC]	45.9[cC]	0.62

[1]There was a main effect of sampling time with pre-grazing differing from mid- and post-grazing samples, $P < 0.05$.
[2]Means within year with differing lowercase superscripts differ by sampling time. Means within sampling time with differing uppercase superscripts differ by year, $P < 0.05$.

Table 5. Weight changes of yearling steers grazing Northern Great Plains rangeland in summer and intensive-early-stocked (IES), season-long stocked (SS).

	Treatment		Year			
	IES	SS	1993	1994	1995	SEM
	(kg)					
Initial weight	276	275	268^{A1}	278^{B}	280^{B}	0.87
Weight, after IES	391	401	432^{A}	370^{B}	386^{C}	1.16
Weight, at end of SS grazing	–	429	451^{A}	408^{B}	426^{C}	2.11

[1]Year means with differing superscripts differ, $P < 0.01$.

increased the gain per hectare (Table 6) for this treatment in 1993 (treatment x year interaction) and indicates a potential advantage to the intensive-early stocking system. It was possible to take advantage of a season of high forage production for additional weight gains in steers. In 1994 and 1995, steers in the intensive-early stocked pastures gained less weight per day during the 2 months of grazing than did those grazing season-long; however, gain per hectare was greater in the intensive-early stocked pastures. The decreased gain per steer but increased gain per hectare is typical of intensive-early stocked grazing systems (Smith and Owensby 1978, McCollum et al. 1990). Olson et al. (1993) did not observe this response on shortgrass range in Kansas and suggested that this may be related to a slower decline in forage quality on those ranges. In the current study, forage quality had substantially declined in 1994 and 1995 by the time intensive-early stocking cattle were removed from pastures and associated gains of season-long stocking steers were reduced in the second half of the grazing season.

High rates of gain early in the grazing season (1.3 kg/day) are reflective of the high forage quality available at this time of the year. Average daily gain over the entire grazing season for the season-long stocked steers was 1.19, 1.07, and 1.11 kg/day in 1993, 1994, and 1995, respectively. Average daily gain throughout the season-long grazing period was greater ($P < 0.05$) for 1993 (1.2 kg/day) than for 1994 and 1995 (1.1 kg/day). This was related to the increased available forage crude protein and IVOMD observed in 1993 compared with other years.

Implications

Gain per hectare was improved with the use of intensive-early stocking for yearling steers; therefore, the use of this strategy for growing cattle may be a viable means to overcome limited forage quality during late summer in the Northern Great Plains and to maximize utilization of the rangeland resource in years of abundant forage. Additional long-term research is required to define optimal stocking rates for this environment.

Table 6. Average daily gain and gain per hectare for steers grazing intensive-early stocked (IES) or season-long stocked (SS) pastures.

	IES	SS	SEM
ADG, during IES period	(kg/day)		0.01
1993	1.22^{A1}	1.24^{A}	
1994	1.29^{aB}	1.48^{bB}	
1995	1.25^{aA}	1.38^{bC}	
ADG after IES period			0.02
1993	-	1.11^{A}	
1994	-	0.59^{B}	
1995	-	0.66^{B}	
Gain per hectare	(kg gain/ha)		0.69
1993	82.8^{aA}	39.8^{bA}	
1994	43.2^{aB}	26.8^{bB}	
1995	52.8^{aC}	30.0^{bB}	

[1]Means with differing lowercase superscripts differ by treatment within year, $P < 0.05$. Means with differing uppercase superscripts differ by year within treatment, $P < 0.05$.

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