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LIGHT VS HEAVY WEIGHT STEERS GRAZING OLD WORLD BLUESTEM AT THREE STOCKING RATES. II. NUTRITIVE VALUE, FORAGE INTAKE, AND GRAZING TIME

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Story in Brief

Gains of light and heavy weight calves grazing Plains Old World bluestem at three stocking rates were evaluated during the summers of 1997 and 1998. Initial weights of mixed breed light weight steers (LHT) were 311 ± 37 lb in 1997 and 353 ± 51 lb in 1998. Initial weights of mixed breed heavy weight steers (HWT) were 584 ± 37 lb in 1997 and 547 ± 29 lb in 1998. Initial stocking rates for both sizes of steers were: light, 350 lb of live weight/acre; moderate, 450 lb of live weight/acre (increased to 550 lb live weight/acre in 1998); and heavy, 750 lb of live weight/acre. Average daily gains of both LHT and HWT steers were greater during 1997 and HWT steers had higher ADG than LHT steers during both years. The response of ADG to increasing stocking rate was mixed among steers' types and years. Forage nutritive value differed between years. Precipitation during the trial period was greater during 1997, while temperature was greater during 1998. Forage intake was greater for LHT than for HWT steers but was not different among stocking rates for either steer type. *In vivo* organic matter digestibility declined with increasing stocking rates, however, the magnitude of the decrease was small and other nutritive value variables were not different among stocking rates. Residual forage mass was less for LHT than for HWT steers, and the heavy stocking rate had the lowest residual forage mass. Grazing time of LHT steers tended to be greater than that of HWT steers. The lower rates of gain for LHT calves may have been due, in part, to differences in forage mass, nutritive value, and grazing time between cattle types.

Key Words: Growing Cattle, Old World Bluestem, Forage Nutritive Value

Introduction

Management of Old World bluestem to maintain as high a leaf to stem ratio as possible may be advantageous to maintenance of forage nutritive value and cattle gains (Forbes and Coleman, 1993). Therefore, intensive grazing pressure, which may maintain Old World bluestem in a vegetative, actively growing state, may optimize performance of growing livestock (Taliaferro et al., 1984). Heavy stocking rates may optimize utilization of Plains Old World bluestem because they help maintain the plant in a growing condition (Teague et al., 1996).

Plains Old World bluestem is more resistant to frequent defoliation than many forage species, and is more tolerant of high levels of continuous stocking because of its crown structure (Christiansen and Svejcar, 1988). However, plant vitality and survival may be challenged by this type of stocking rate management (Taliaferro et al., 1984). Individual plants may be weakened by frequent defoliation, and forage production/acre may decline, therefore, careful management and monitoring of forage production should be conducted to ensure maintenance of stand health and productivity (Taliaferro et al., 1984).

Average daily gain of cattle often declines as stocking rate is increased. However, gain per acre usually increases as stocking rate increases to a point of maximal stocking, after which further increases in stocking rate result in decreased gain per acre.

The objectives of this study were to determine the effects of stocking rate on forage nutritive value, intake, grazing time, and residual forage mass. Results of steer performance are reported in a companion paper in this research report.

Materials and Methods

Study Site. The study site was described in the companion paper in this research report.

Cattle and Stocking Rates. Cattle and stocking rates were described in the companion paper in this research report.

Forage. All forage nutritive value, organic matter (OM) intake, and forage mass collection techniques were conducted in the same manner during both 1997 and 1998. Forage OM intake was estimated once in August using intraruminal[1] controlled release chromium boluses. Four steers in each cattle type x stocking rate combination were given a Captec® bolus to provide an internal marker. Fecal samples were collected once daily for 4 d following a 6-d adaptation period. Chromium content of feces was used to estimate fecal output, and *in vivo* organic matter digestibility (IVOMD) and fecal output were used to estimate forage OM intake.

Forage nutritive value samples were collected monthly in June, July, and August. Eight ruminally cannulated steers (average body weight: 534 ± 25 lb) were placed on Old World bluestem pastures approximately 7 d prior to each collection period. Two ruminally cannulated animals were assigned to each pasture and four pastures were sampled each day for 3 d. Forage nutritive value samples were collected by removing ruminal contents, allowing animals to graze for 1.0 to 1.5 h, then removing the masticate from the rumen and replacing ruminal contents (Lesperance et al., 1960). Nutritive value samples were analyzed for DM, ash, Kjeldahl N, NDF, ADF, and IVOMD. Forage standing crop (DM) was estimated in August using clipped weights from all 12 pastures. Five .1 m^2 quadrats were clipped to approximately 1 in of height in each pasture. Grazing time was estimated during 1998 using vibracorders. Vibracorders were placed on two steers (both LHT and HWT) in each of the stocking rates and grazing time was recorded over 7 d.

Statistical Analysis. Data were analyzed using the GLM procedure of SAS (1992) as a replicated 2 x 3 factorial arrangement of treatments. Year was included in the model as a random variable. Forage nutritive value data was analyzed as repeated measures within steer x stocking rate. Least squares analysis and the P-DIFF procedure of SAS were used to separate treatment means when a significant ($P<.05$) F-Test was detected. Regression and indicator (dummy regression) analyses were conducted using PROC REG of SAS (1992) to determine the response of ADG and gain per acre of steers as stocking rate increased and difference in response between LHT and HWT steers.

Results and Discussion

Overall, ADG of HWT cattle was greater ($P<.05$) than that of LHT cattle during both 1997 and 1998. Crude protein and IVOMD were greater ($P<.05$) for HWT steers than for LHT steers (Table 1). However, the slight differences in nutritive value probably are of minimal biological significance.

Mean forage intake and forage mass data were pooled across both years because no significant ($P<.10$) two- or three-way interactions were detected. Forage intake (percentage of final live weight) of LHT steers was greater ($P=.01$) than HWT steers, while residual forage mass of pastures grazed by HWT steers tended to be greater ($P=.10$) than LHT steers (Table 2). It would appear that the greater forage intake by light weight calves resulted in lower residual forage mass and may have had a negative influence on forage CP and

IVOMD of masticate samples selected by cannulated steers, diet selectivity may have declined.

Grazing time was collected during 1998, therefore grazing time data refer to that year only. Forage mass and(or) allowance may often impact the amount of time an animal must spend grazing in order to maximize its intake. As mentioned previously, the difference in residual forage allowance between steer types was not great enough to result in a decrease forage intake for LHT steers. However, LHT steers spent more time grazing (P=.05; Table 2) than HWT steers. An increase in time spent grazing for LHT calves may be expected in light of the fact that they had lower residual forage mass than HWT steers. The combination of increased grazing time and lower (P<.05) absolute intakes of forage (Table 2) of similar quality may have contributed to lower gains for LHT vs HWT calves.

A year x cattle type x stocking rate interaction for ADG is described in the companion paper in this report. There was not (P<.05) a linear decline in ADG as stocking rate increased for LHT cattle during 1997 or HWT cattle during 1998. However, ADG of HWT cattle declined with increasing stocking rate during 1997 and LHT cattle during 1998. This interaction makes it difficult to evaluate the effects of stocking rate on ADG. Declining ADG as stocking rate increases is generally considered to be due to decreasing forage nutritive value. However, the only forage nutritive value factor which differed between stocking rates in the current study was IVOMD, which declined (P<.05) as stocking rate increased (Table 3). The differences were slight and effects on steer performance due to declining IVOMD of this magnitude should have been minimal. Forage intake of steers did not differ (P=.45) among stocking rates (Table 4). Therefore, a decline in ADG would not be expected to be due to differences in forage intake among stocking rates. Residual forage mass did not differ (P=.13) between light and moderate rates, however, residual forage mass (P<.02) for the heavy stocking rate was less than both light and moderate rates (Table 4). Additionally, grazing time increased (P<.05: Table 4) between the light and moderate stocking rates, and was not different between the moderate and heavy stocking rates. Lower residual forage mass may have resulted in increased grazing time for steers in the moderate and heavy stocking rates, increasing the energy expenditure to maintain forage intake, and possibly having a negative affect on animal performance.

Average daily gain of both LHT and HWT steers was greater (P<.05) in 1997 than 1998 (2.67 vs 2.22 lb/d for HWT steers and 1.72 vs 1.58 lb/d for LHT steers during 1997 and 1998, respectively). All nutritive value components were different (P<.05) between the two years (Table 5). Neutral detergent fiber and ADF were greater (P<.05), and IVOMD was less (P=.02) in forage masticate during 1998 compared with 1997. However, crude protein of masticate samples increased (P=.05) between 1997 and 1998. The variation in nutritive value variables between the two years may have been due, in part, to differences in temperature and precipitation between summers. During 1997, precipitation was above average in the months of June, July, and August. In 1998, precipitation was below average during these three months (Figure 1). Additionally, there were more days with temperatures equal to or greater than 95^{o}F during 1998 than during 1997 (Figure 2). Temperatures equal to or greater than 95^{o}F may cause significant declines in forage intake. The combination of reduced forage nutritive value and increased temperature during 1998 may have negatively impacted steer gains.

Average daily gain may often decline with increasing stocking rate. In the current study, there was a mixed response of steer types to stocking rate increases among years, which makes it difficult to provide conclusive statements regarding the effects of stocking rate on cattle performance. Large differences in forage nutritive value were not observed among stocking rates. However, decreasing forage mass and increasing grazing time may have had a negative effect on ADG as stocking rate increased. The lower rates of gain for LHT calves may have been due, in part, to differences in forage mass, nutritive value, and grazing time between cattle types. Furthermore, absolute intakes of forage (lb/d) were less for LHT than for HWT steers, which may have also resulted in lower gains for the LHT steers.

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Table 1. Crude protein and *in vivo* organic matter digestibility of Old World bluestem masticate samples for light vs heavy steers[a].

	Steer type[b]		
Item	Light	Heavy	SE[b]
CP	12.4[c]	13.2[d]	.25
IVOMD	65.5[c]	66.4[d]	.34

[a]Values expressed as a percentage of OM: pooled across stocking rate, month, and year.

[b]Standard error of the means.

[c,d]Means within a row without common superscripts differ (P<.05).

Table 2. Forage intake, grazing time, and residual forage mass of light vs heavy steers[a]

	Cattle type[b]		
	Light	Heavy	SE[b]
Forage OM intake, % final BW	3.2[d]	2.7[c]	.09
Forage OM intake, lb/steer	16.0[c]	20.9[d]	.90
Grazing time, min/d	665.5[d]	624.3[c]	11.94
Residual forage mass, lb DM/acre	5576[e]	6788[f]	487.9

[a]Data pooled across stocking rate and year.

[b]Standard error of the means.

[c,d]Means within a row without common superscripts differ (P<.01).

[e,f]Means within a row without common superscripts differ (P<.10).

Table 3. ***In vivo*** **organic matter digestibility of Old World bluestem masticate samples for light, moderate, and heavy stocking rates.**

	Stocking rate[a]			
Item	Light	Moderate	Heavy	SE[b]
IVOMD[c]	67.1[e]	65.9[d]	65.1[d]	.42

[a]Stocking rates: 350 and 750 lb initial live weight/acre for light

and heavy stocking rates, respectively; moderate stocking rate = 450 and 550 lb initial live weight/acre for 1997 and 1998, respectively.

[b]Standard error of the means.

[c]Values expressed as a percentage of OM: pooled across cattle type, month, and year.

[d,e]Means within a row without common superscripts differ (P<.05).

Table 4. Forage intake, grazing time, and residual forage mass of steers in the light, moderate, and heavy stocking rates.[a]

		Stocking rate[b]		
	Light	Moderate	Heavy	SE
Forage OM intake, % final BW	3.03	2.92	2.84	.11
Grazing time, min/d	598[c]	672[d]	665[d]	14.6
Residual forage mass, lb DM/acre	7878[d]	6505[d]	4163[c]	597.5

[a]Data pooled across steer type and year.

[b]Stocking rates: 350 and 750 lb initial live weight/acre for Light

and Heavy stocking rates, respectively; Moderate stocking rate = 450 and 550

lb initial live weight/acre for 1997 and 1998, respectively .

[c,d]Means within a row without common superscripts differ (P<.02).

Table 5. Chemical composition of Old World bluestem masticate samples during 1997 and 1998[a].

	Year		
Item	1997	1998	SE[b]
CP	12.2[c]	13.4[d]	.25
NDF	81.4[c]	82.9[d]	.36
ADF	42.0[c]	52.3[d]	.27
IVOMD	69.5[c]	62.5[d]	.34
Ash	10.6[d]	9.6[c]	.35

[a]Values expressed as a percentage of OM: pooled, all pastures within year.

[b]Standard error of the means.

[c,d]Means within a row without common superscripts differ (P<.06).

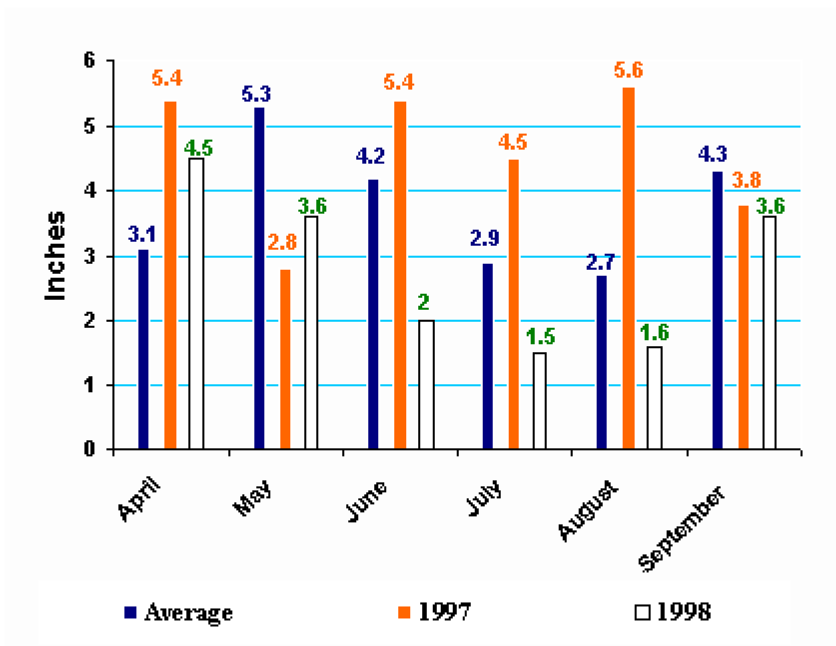

Figure 1. **Precipitation for April, May, June, July, August, and September of 1997 and 1998 for the Marena site of the Oklahoma Mesonet system near the bluestem research range and the historical average for Payne County, Oklahoma.**

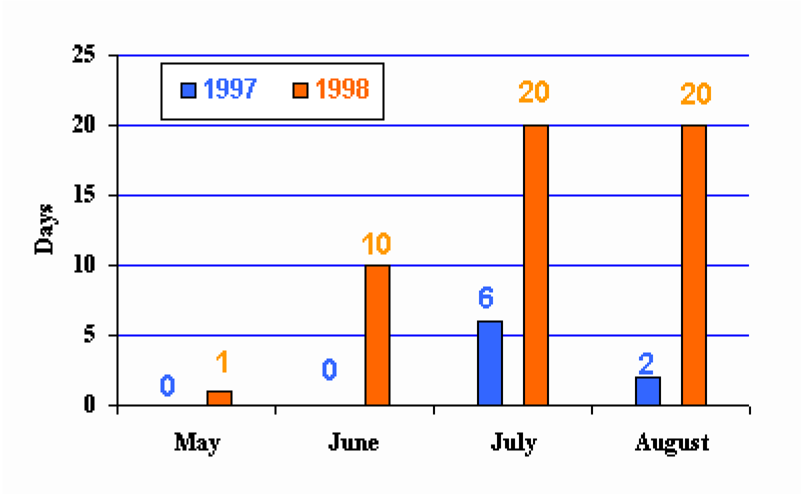

Figure 2. **Number of days with temperatures equal to or greater than 95°F during 1997 and 1998.**

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