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Roundup 2001

Abstract

Roundup is the major beef cattle education and outreach event sponsored by the Agricultural Research Center-Hays. The purpose is to communicate timely, applicable research information to producers and extension personnel. The research program of the Agricultural Research Southeast Agricultural Research Center Center-Hays is dedicated to serving the people of Kansas by developing new knowledge and technology to stabilize and sustain long-term production of food and fiber in a manner consistent with conservation of natural resources, protection of the environment, and assurance of food safety. Primary emphasis is on production efficiency through optimization of inputs in order to increase profit margins for producers in the long term. Roundup 2001 was held at the Agricultural Research Southeast Agricultural Research Center Center--Hays, KS, February 8, 2001

Keywords

Kansas; Beef cattle production

ROUNDUP 2001

February 8, 2001


Round-Up on the Fort Hays Reservation

THE Kansas Experiment Stations at Hays and Manhattan invite you and your neighboring stockmen to be present at the Fort Hays Branch Experiment Station, Hays, Kansas,

Friday, May 1, 1914,

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Kansas State University
Agricultural Research Center–Hays
1232 240th Avenue
Hays, KS

Timed Insemination in Beef Heifers after Synchronization of Estrus and Ovulation with Melengestrol Acetate and Prostaglandin $F_2 \alpha$

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Summary

The combination treatment of Melengestrol Acetate (MGA) and Prostaglandin $F_2\alpha$ (PGF) for estrous synchronization of heifers has been widely adopted by producers. Attempts to incorporate timed insemination with the original system produced less than optimal results. Increasing the interval between MGA withdrawal and PGF injection from 17 to 19 days increased estrus response and improved synchrony in heifers. At this interval, most heifers were observed in estrus 60 hours after PGF. The objective of this study was to determine if a single fixed-time insemination would result in pregnancy rates comparable to that for heifers bred after heat detection. Yearling heifers from two herds were fed MGA (.5 mg/hd) daily for 14 days. On day 19 after withdrawal of MGA, heifers received 25 mg PGF (hour 0). Heifers receiving no further treatment served as Controls (n=401) and were inseminated based on the following schedule. Heifers observed in estrus from dark to 0800, 0800 until 1200, and 1200 until dark were inseminated beginning at 1330, 1800 and 0800 the following morning, respectively. In the Timed Bred group (n=158), heifers were inseminated and received an injection of GnRH (100 µg) 60 hours after PGF. Pregnancy rate during the synchrony period (0 to 120 hours) was greater ($P<.05$) for Control (255/401, 63.6%) than for Timed Bred (74/158, 46.8%) heifers. The cumulative proportions of Control heifers in estrus from 48 to 72 hours, 48 to 84 hours and 48 to 96 hours were 72.1%, 77.8% and 83.3%, respectively. While the synchronized pregnancy rate was not as high in Time Bred heifers as in Control heifers, the pregnancy rate achieved in this study might be acceptable in some production situations.

Introduction

The MGA/PGF system, developed by Colorado State University, is the most widely used system to synchronize estrus in heifers. More producers may incorporate artificial insemination (AI) into their heifer development programs if they had a reliable fixed time insemination protocol. The original MGA/PGF system consisted of feeding MGA for 14 days and then waiting an additional 17 days to give PGF. Increasing the interval between MGA withdrawal and PGF injection from 17 to 19 days increased estrus response and improved synchrony in heifers. With this interval between MGA and PGF, a majority of heifers were observed in estrus 60 hours after PGF. The objective of this study was to determine if synchrony was tight enough with this system that a single fixed-time insemination would result in pregnancy rates comparable to that for heifers bred after heat detection.

Materials and Methods

Yearling heifers from two herds were used in the study. Herd 1 consisted of 118 head of Angus cross, South Devon cross and Limousin cross heifers from the Agriculture Research Center-Hays. Herd 2 included 441 head of black and black baldy heifers from Losey Brothers, Agra, KS.

Heifers were fed MGA (.5 mg/hd) daily for 14 days in a total mixed ration. On day 19 after withdrawal of MGA, heifers received 25 mg PGF (Lutalyse®, hour 0). The injection of PGF was given between 1600 and 1900 so that the timed insemination would begin in the morning. Heifers receiving no further treatment served as Controls (C; n=401) and were inseminated based on the following schedule. Heifers observed in estrus from dark to 0800, 0800 until 1200, and 1200 until dark were inseminated beginning at 1330, 1800 and 0800 the following morning, respectively. In the Timed Bred group (n=158), heifers were inseminated and received an injection of GnRH (100 µg; Factrel®) 60 hours after PGF. Actual time of insemination for the Timed Bred heifers was 63.5 – 68.5 hours in both herds. Timed Bred heifers observed in estrus before 38 hours were inseminated on the same time schedule as Control heifers and were not inseminated at 60 hours (n=7). For determination of pregnancy rate during the synchrony period, these heifers were all classified as open.

The length of the total AI period varied with location. Heifers were exposed to bulls after AI for a total breeding season of 53 days in Herd 1 and 60 days in Herd 2. Conception rates to AI were determined via ultrasound between 30 and 55 days after the initial insemination.

Results and Discussion

The single time period when the most Control heifers were observed in estrus occurred at 60 hours after PGF (38.9%, figure 1). The cumulative proportions of Control heifers in estrus from 48 to 72 hours, 48 to 84 hours and 48 to 96 hours were 72.1%, 77.8% and 83.3%, respectively. Pregnancy rate during the synchrony period (0 to 120 hours after PGF), determined at 30 – 55 days after the timed insemination, was greater (P<.05) for Control (255/401, 63.6%) than for Time Bred (74/158, 46.6%) heifers. Using the same 14/19 day MGA/PGF system but no GnRH at insemination, Patterson et al. (1999), found pregnancy rates to a single timed insemination at 72 hrs after PGF (53%) or a double insemination at 65 and 85 hours after PGF (49%) did not differ.

Conception rates to a single sire in Control heifers in Herd 2 were examined for heifers detected in estrus by 0800 (43/54, 79.6%), from 0800 to 1200 (14/19, 73.7%) and 1200 to dark (101/138, 73.2%) and did not differ. Studies in which estrus was detected with an electronic detection system have indicated the optimum time for insemination is between 4 and 12 hours after first observation of heat. Typically the Heat Watch System® will detect animals up to 6 hours before they are observed by normal visual detection. Inseminating heifers 3 times per day rather than two, resulted in excellent conception rates and helped spread daily labor needs.

Synchronized pregnancy rates differed (P<.05) between sires within herds and between herds. Conception rates for bulls used in Herd 1 were 32.7% (17/52) and 61.0% (36/59) and for Herd 2 were 67.4% (211/313) and 66.3% (67/101). The low conception rates to AI in Herd 1 were also reflected in the overall breeding season pregnancy rates. In Herd 1, the same bulls that were used for AI were used for natural service. Season long pregnancy rates are in Table 1 and were not different between treatments for Herd 2 but were lower (P<.05) in the Time Bred heifers than in the Control heifers in Herd 1.

Because of the low fertility of one sire in Herd 1, results from Herd 2 are more likely what might be expected in herds with top management. Producers that place a high value on the genetics available from AI sires and for which time is at a premium, may find the pregnancy rates to timed insemination achieved in this study to be acceptable.

Acknowledgements

We thank Losey Bros., Agra, KS and Stephanie Eckroat, Hays, KS for cooperation and assistance in the completion of this experiment.

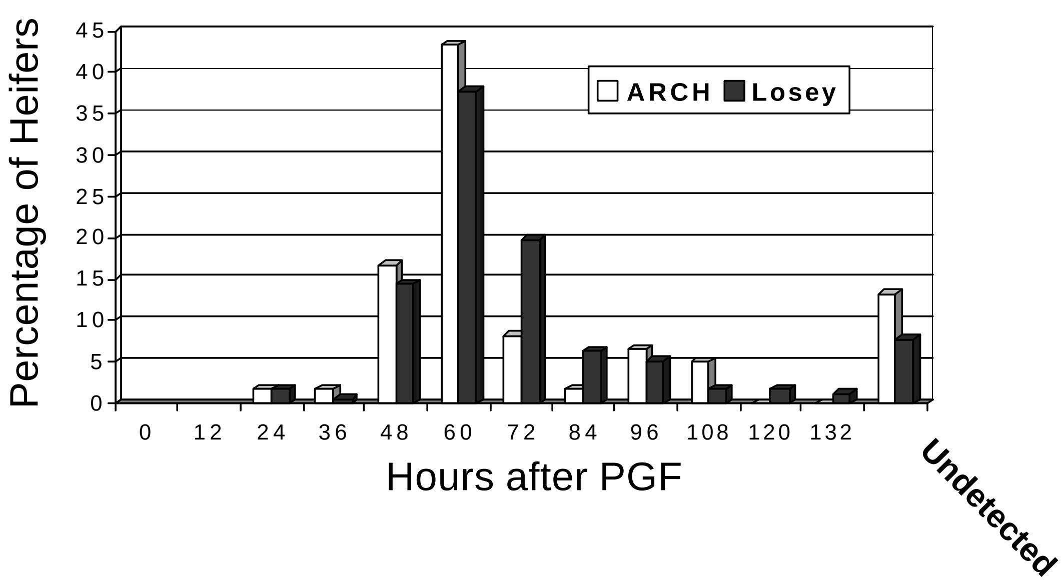
The authors appreciate the donations of Lutalyse® from Pharmacia and Upjohn and Factrel® from Fort Dodge Animal Health.

Table 1. Pregnancy Rates in Control or Time Bred Heifers after Synchronization with MGA/PGA

	Synchrony Period *		Season Long **	
	Control (%)	Timed Bred (%)	Control	Timed Bred (%)
Losey	227/342 (66.4) [a]	51/99 (51.5) [b]	324/342 (94.7)	93/99 (93.9)
ARC-H	28/59 (47.5) [a]	23/59 (39) [b]	49/59 (83.1)[a]	41/59 (69.5)[b]
Combined	255/401 (63.6)[a]	74/158 (46.6)[b]	375/401 (93)[a]	134/158 (84.8)[b]

* Synchrony period = 0 to 120 hours after PGF
** Entire Breeding Season 53 - 60 days
[a,b] Means differ $P<0.05$

Figure 1. Timing of Estrus in Control Heifers



Effect of Feeding Sunflower Seeds to Mature Beef Cows on Reproduction and Calf Performance

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Introduction

Increasing evidence indicates that supplementing the cow diet with fat can improve both postpartum reproduction and calf survivability. The addition of fat to postpartum cow diets has been shown to increase follicular growth (Talavera et al., 1985), increase concentrations of progesterone (Hightshoe et al., 1991), and increase the number of early postpartum cows with luteal activity (Wehrman et al., 1991), all changes that are associated with the resumption of estrous cycles in postpartum cows. Pregnancy rates have been improved by feeding supplemental fat to first calf heifers (Lammoglia et al., 1997) and mature cows (Espinoza et al., 1997). In addition, Lammoglia et al., (1999) reported that feeding oilseeds such as sunflowers or safflowers to first calf heifers prior to calving improved cold tolerance, measured by a rectal temperature response to cold exposure. The improved cold tolerance has been related to more glucose available for metabolism and heat production and possibly more brown adipose tissue.

Most data available to date has been on feeding supplemental fat to first calf heifers. The precise length of supplementation required to achieve enhancement in reproductive performance is unknown. Because fat supplementation pre-calving has slightly increased birth weight, although not calving difficulty, this area requires further study. Calf weaning weights have been reported to be heavier from cows receiving fat supplementation.

The objectives of the current study were to determine the effects of feeding a locally available source of fat, sunflowers, fed either pre-calving, post-calving, or both, to mature cows on cow reproductive performance, body condition and calf performance.

Materials and Methods

Two hundred and seventy-seven mature (3 – 12 yrs of age) Angus, South Devon, and Simmental cross cows were fed a low fat (2.6%) or high fat (32.1%) supplement, either pre-calving or post-calving in a 2x2 factorial arrangement of treatments. Cows were assigned to treatments by expected calving date, age, winter feeding group and weight. The primary ingredient in the high fat supplement was sunflower seeds that had been processed through a roller mill to crack the hulls. The low fat supplement was composed primarily of ground milo and soybean meal and was developed so that the two supplements would be isocaloric and isonitrogenous. Cows also received 25 lbs of sorghum-sudan hay each day.

Supplements were group fed and began an average of 64 days prior to calving. Cows were managed in four groups based on supplement type and calving group. Cows that had conceived to a timed insemination were in the early calving group and those that conceived to natural service were in the late calving group. The post-calving supplementation started approximately one week after calving. Each week, pairs were moved from their pre-calving supplementation group to the post-calving supplementation group. Post-calving supplementation was continued through a 5-day AI period, at which point all cows were taken to summer pastures. The average length of the post-calving supplementation period was 76 days.

Cow body condition and backfat were measured in January at the start of pre-calving supplementation, in February just prior to calving (late-calving cows were worked two weeks after the early calving group), at the start of the breeding season in May, and at weaning time in September. Scale problems prevented cow weight information in January and February, but weights were obtained at subsequent time points.

To determine the proportion of cows cycling prior to the start of the breeding season, two serum samples were collected 14 days apart in conjunction with the administration of Prostaglandin $F_2\alpha$ (Lutalyse®, PGF) used to synchronize estrus. Cows with concentrations of progesterone > 1 ng/ml at one or both samples were considered to have resumed normal estrous cycles prior to the beginning of the breeding season. The breeding season began on the day of the second PGF injection and cows were inseminated 6-12 hours after estrus was observed. Cows were exposed to bulls (1:38) for an additional 53 days beginning 9 days after the last cow was inseminated. Artificial insemination (AI) conception rate was determined by ultrasonography 44-50 days after AI. Pregnancy rate for the entire breeding season was determined via palpation 45 days after bulls were removed.

Results and Discussion

There was no effect of type of supplement fed Pre Calving on reproductive measures. However, the proportion of cows cycling at the beginning of the breeding season and the pregnancy rate to AI was greater (P<.05) for cows receiving Milo as compared to Sunflowers Post Calving, 74% vs 65% and 44% vs 32%, respectively. Pregnancy rate for the entire breeding season (95.4%) was not different due to treatment. Stevenson, 1999 reported an average of 53% of mature cows cycling at the onset of the breeding season in 1,718 mature cows sampled from herds in Kansas. Given the relatively high percentage of cows cycling at the beginning of the breeding season in this study, it is not surprising that the addition of fat to the diet had no beneficial effect.

Cows fed Sunflowers Pre Calving had less backfat just prior to calving (1.5 mm vs 1.9 mm) and a greater loss in body condition score (-.2 vs -.1) and backfat (-.4 mm vs -.1 mm) from January to February as compared to controls. Cows receiving the Milo supplement Pre Calving experienced a greater decrease in backfat from February to May than Sunflower supplemented cows (-.9 mm vs -.7 mm).

Post Calving supplementation with Milo resulted in a higher body condition score and less backfat loss from February to May than the Sunflower cows (5.2 vs 4.7 and -.3 mm vs -.6 mm, respectively). The only difference noted in cow weights was in May when cows receiving Milo Post Calving were heavier than cows receiving Sunflowers (1094 lbs vs 1060 lbs). These differences in cow weight and condition may explain the increased proportion of cows cycling and becoming pregnant to AI in the cows that received Milo Post Calving. The change in body condition from May to September was positive for cows fed Sunflowers Post Calving (.3) and negative for cows fed Milo (-.1).

Calf birth weights averaged 90 lbs and did not differ with treatment. The time from birth to when the calf was standing was similar between treatments (mean=32 minutes). The weather during the calving season was relatively mild and thus no natural test of calf vigor occurred. There was a significant Pre x Post supplementation type interaction for the May calf weight. This was due to calves whose dams had received Sunflowers Post Calving being heavier than calves whose dams had received Milo Post Calving if they received Milo Pre Calving, but weights decreased if they had received Sunflowers Pre Calving. Calf weight gain from May to September was greater in the group that was fed Milo Post Calving.

The beneficial effects observed in other studies from feeding supplemental fat were not detected in this study. The cows used in this study were in an acceptable body condition when they started the study, lost some body condition during lactation, but still averaged a body condition score of 5 at weaning. It is not clear if supplemental fat may be beneficial for cows in poorer body condition and/or experiencing more challenging winters. This study supports many others that show the importance of body condition late in gestation and weight change prior to breeding on reproductive performance.

Acknowledgements

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The authors appreciate the donation of Lutalyse® from Pharmacia and Upjohn.

Table 1. Cow data.

	No.	Jan. BCS	Jan. BF (mm)	Feb. BCS	Feb. BF (mm)	Change BCS (J-F)	Change BF (J-F; mm)
Pre-calving							
Milo	133	5.5	2.0	5.4	1.9[a]	-.1[a]	-.1[a]
Sunflowers	136	5.5	1.9	5.3	1.5[b]	-.2[b]	-.4[b]

	No.	May BCS	May BF (mm)	May Wt.	Change BCS (F-M)	Change BF (F-M; mm)	% Cycling	AI Preg. Rate	Preg. Rate
Pre-calving									
Milo	133	5.0	1.0	1074	-.4	-.9[a]	66%	37%	94%
Sunflowers	136	4.9	.9	1080	-.5	-.7[b]	73%	39%	96%
Post calving									
Milo	135	5.2[a]	1.0	1094[a]	-.3[a]	-.8	75%[a]	44%[a]	96%
Sunflowers	134	4.7[b]	.9	1060[b]	-.6[b]	-.8	64%[b]	32%[b]	94%

		Sept. BCS	Sept. BF (mm)	Sept. Wt.	Change BCS (M-S)	Change BF (M-S; mm)
Pre-calving						
Milo	133	5.0	.9	1207	0.0	-0.1
Sunflowers	136	5.0	.9	1218	0.1	0.0
Post calving						
Milo	135	5.0	.9	1216	-.1[a]	-0.1
Sunflowers	134	5.0	.9	1209	.3[b]	0.0

* Time from birth to calf standing, minutes.
[a, b] Means differ ($P<.05$)

Table 2. Calf data.

		Birth Wt.	Up*	May Wt.	Sept. Wt	Gain (M-S)
Pre-calving						
Milo	136	88	32	228	523	2.2
Sunflowers	136	91	32	229	524	2.2
Post Calving						
Milo	134			228	528	2.3 [a]
Sunflowers	132			229	519	2.2 [b]

* Time from birth to calf standing, minutes.
[a, b] Means differ (P<.05)

Variations of the CoSynch Protocol for Timed Breeding in Postpartum Beef Cows

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Summary

The objective of this study was to determine if the responsiveness of postpartum beef cows to a GnRH-PGF (CoSynch) synchronization system could be improved by addition of a progestin or by increasing the responsiveness of follicles to GnRH. Postpartum beef cows (n=1035) from two herds (10 locations) were assigned by calving date and age to one of four treatments. All cows received an injection of $PGF_2\alpha$ (25 mg, i.m.) on day 0 and GnRH (100 μg, i.m.) on day 2 at timed insemination. Treatments were as follows: 1) 100 μg GnRH, on day -7 (GnRH-PGF); 2) 100 μg GnRH on day -14 and day -7 (+GnRH); 3) 100 μg GnRH, on day -7 and an intravaginal insert (CIDR-B) containing 1.38 g of progesterone from day -7 to 0 (GnRH/CIDR); 4) CIDR-B from day -7 to 0 (CIDR). Pregnancy rate to timed insemination was lower (P<.05) in CIDR (39%) vs GnRH-PGF (47%). Pregnancy rates in +GnRH (50%) and GnRH/CIDR (45%) were similar to GnRH-PGF. For cows < 60 days postpartum (n=297), pregnancy rate was higher (P<.05) for cows in +GnRH compared to GnRH-PGF (53% vs 36%, respectively). An additional injection of GnRH one week prior to the CoSynch treatment was beneficial for cows less than 60 days postpartum at breeding. The addition of a CIDR to the CoSynch system did not improve pregnancy rates and reduced pregnancy rates if GnRH was not given at the time of CIDR insertion.

Introduction

The use of estrous synchronization systems for timed insemination that include an injection of GnRH, an injection of PGF 7 days later and a second injection of GnRH 48 hours after PGF are increasingly being applied in beef cattle (Stevenson et al., 1997, Geary et al., 1998). Two limitations of this approach are its effectiveness in anestrous cows and the failure to synchronize ovulation in a portion of cyclic cows. Short-term exposure to progestins will induce the onset of estrous cycles in a proportion of anestrous cows (Day et al., 1998). An injection of GnRH will induce ovulation and provide a source of progestin exposure in anestrous cows but the response is variable (Thompson et al., 1999, Stevenson et al., 2000). In cows on days 13-17 of the estrous cycle at the time of GnRH treatment, the dominant follicle does not ovulate or becomes atretic, resulting in estrus 5-7 days later, or 2-4 days before timed insemination (Geary et al., 2000). Providing an exogenous source of progestin during the period between the first GnRH injection and PGF is one possible solution to this problem. Alternatively, the probability that ovulation will occur in response to the initial GnRH injection may be enhanced by a pretreatment with GnRH.

The objective of this study was to determine if the responsiveness of postpartum beef cows to a GnRH-PGF synchronization system for timed insemination could be improved by the addition of a progestin or an additional injection of GnRH.

Materials and Methods

Spring calving, postpartum beef cows from 2 herds (Kansas and Ohio) were assigned by days postpartum and age to one of four treatments (Table 1). Cows used in Kansas were from the Agricultural Research Center-Hays and those in Ohio were owned by Shugert Farms, Lore City, OH. Cows included in the study were at least 30 days postpartum at the time of insemination in Kansas and at least 24 days in Ohio. All cows received a 25 mg, injection of PGF (Lutalyse®) on day 0 and a 100 µg i.m. injection of GnRH (Cystorelin®) on day 2 immediately after timed insemination. Treatments shown in Figure 1 were as follows: 1) 100 µg GnRH, on day -7 (GnRH-PGF); 2) 100 µg GnRH on day -14 and day -7 (+GnRH); 3) 100 µg GnRH, on day -7 and an intravaginal insert containing 1.38 g of progesterone (CIDR-B®) from day -7 to 0 (GnRH/CIDR); 4) CIDR-B® from day -7 to 0 (CIDR).

Serum progesterone were determined in 50 primiparous and 98 multiparous cows in Kansas to determine the proportion of animals cycling prior to the onset of treatments. The multiparous cows represented the last 40% of the herd to calve. Samples were taken on days -14 and -7 for GnRH-PGF, GnRH/CIDR and CIDR and on days -21 and -14 for +GnRH cows. Cows were classified as anestrous if concentrations of progesterone were < 1 ng/ml in both samples or classified as cycling if concentrations of progesterone in one or both samples were > 1 ng/ml.

Cows were inseminated to one of four sires in Kansas and one of 6 sires in Ohio. Natural service sires were placed with the cows 10 - 26 days after the timed insemination for the remainder of the breeding season. Pregnancy was diagnosed by transrectal ultrasound between 75 and 50 days following timed insemination.

Results and Discussion

Pregnancy rate to timed insemination was lower (P<.05) in CIDR (39%) vs GnRH-PGF (47%). The reduction in pregnancy rate in the CIDR group may be a reflection of the importance of GnRH in setting up the timing of follicular growth in a timed insemination program. Pregnancy rates in +GnRH (50%) and GnRH/CIDR (45%) were similar to GnRH-PGF. Other studies have reported a 0-10% improvement in pregnancy rate from the addition of a CIDR to the CoSynch protocol. Discrepancies in results may be related to the proportion of cows cycling in each study.

Cows less than 60 days postpartum on day 0 had a lower (P<.05) pregnancy rate (39%) compared to cows 60-80 days postpartum (50%) or > 80 days postpartum (47%). For cows < 60 days postpartum (n=297), pregnancy rate was higher (P<.05) for cows on +GnRH compared to GnRH/PGF (53% vs 36%, respectively).

An additional injection of GnRH one week prior to the CoSynch treatment may be beneficial for cows less than 60 days postpartum at breeding. The addition of a CIDR to the CoSynch system did not improve pregnancy rates and reduced pregnancy rates if GnRH was not given at the time of CIDR insertion.

Acknowledgements

We thank Shugert Farms, Lore City, Ohio and Stephanie Eckroat, Hays, KS for cooperation and assistance in the completion of this experiment.

The authors appreciate the donations of Lutalyse® from Pharmacia and Upjohn, Cystorelin® from Merial and CIDR-B® from Dec-Interag.

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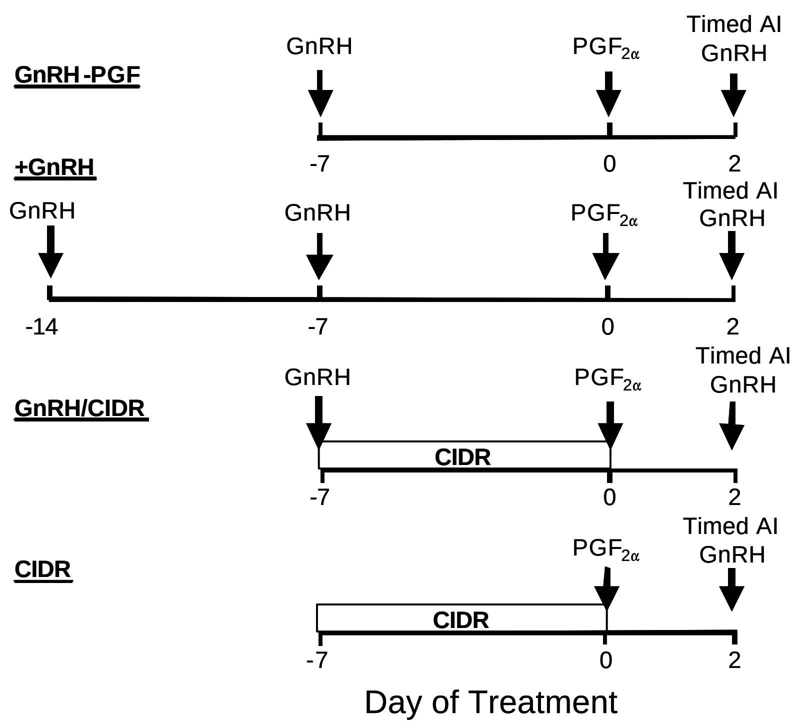
Table 1. Description of cows used in study

		Days Postpartum at AI	
Cow Age	Number	Range	Mean ± SD
Kansas			
primiparous	50	52 – 120	95 ± 18
multiparous	231	30 – 104	59 ± 14
Ohio			
primiparous	139	37-104	83 ± 15
multiparous	618	24-126	70 ± 18
Total	1038		71 ± 19

Figure 1. Schedule of Treatments



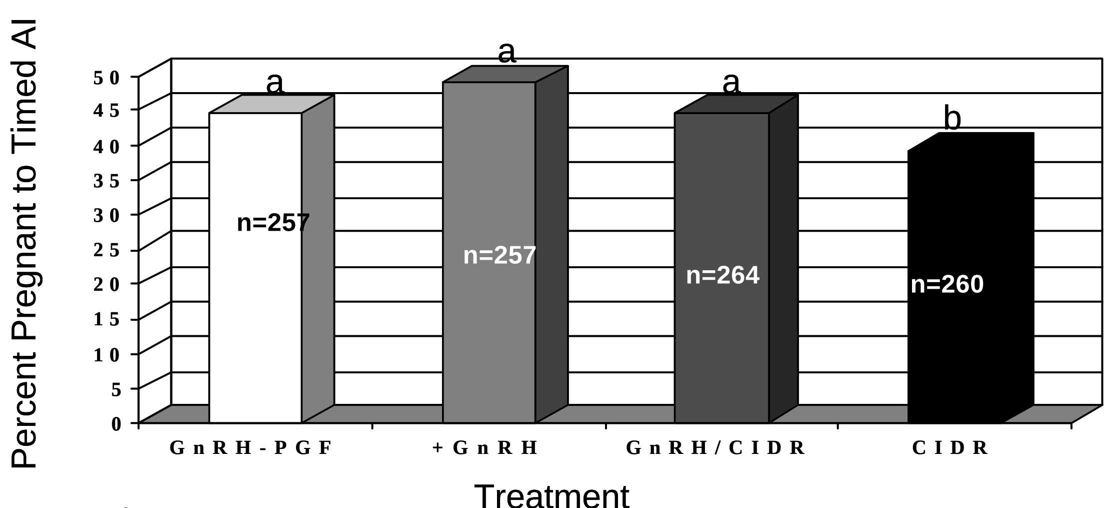
$PGF_2\alpha$ – Lutalyse® (Pharmacia and Upjohn) 25 mg, i.m.
GnRH – Cystorelin® (Merial) 100 µg, i.m.
CIDR – CIDR-B® (DEC-InterAg) contained 1.38 g progesterone

Table 2. Pregnancy rate in cyclic and anestrous cows in response to timed insemination.

	Total	GnRH-PGF	+ GnRH	GnRH-CIDR	CIDR
Primiparous					
Total	**50**	**13**	**13**	**12**	**12**
Cycling (%)		**5/9 (56)**	**3 /4 (75)**	**5/10 (50)**	**6/9 (67)**
Anestrous (%)		**1/4 (25)**	**4/9 (44)**	**1 /2 (50)**	**2/3 (67)**
Multiparous					
Total	**98**	**24**	**25**	**25**	**24**
Cycling (%)		**3/8 (35)**	**2/4 (50)**	**5/10 (50)**	**3/13 (23)**
Anestrous (%)		**8/16 (50)**	**9/21 (43)**	**3/15 (20)**	**4/11 (36)**

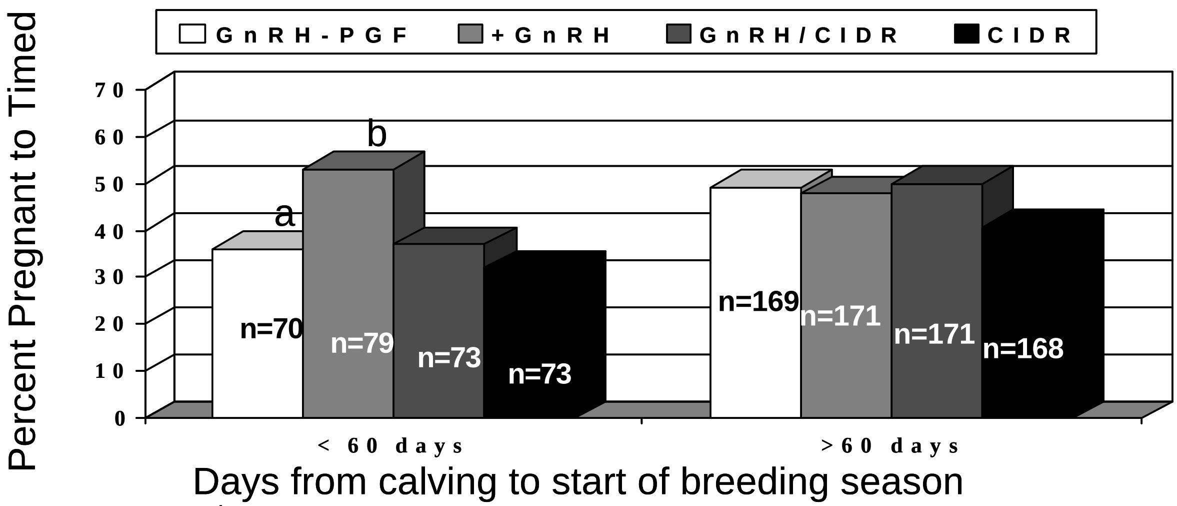
Primiparous cows, 36% anestrus, 52 to 120 days postpartum (x = 95 d)
Multiparous cows, 64% anestrus, 30 to 61 days postpartum (x = 47 d)

Figure 2: Pregnancy Rate to Timed AI



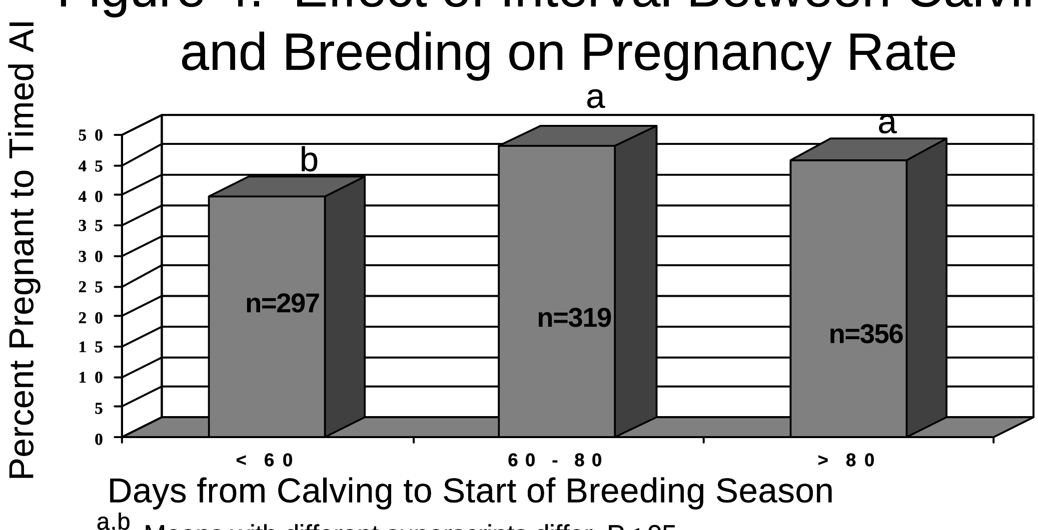
[a,b] Means with different superscripts differ, P<.05

Figure 3: Effect of Interval Between Calving and Breeding on Pregnancy Rate



a,b Within days, means with different superscripts differ, P<.05

Figure 4: Effect of Interval Between Calving and Breeding on Pregnancy Rate



a,b Means with different superscripts differ, P<.05

Growth Characteristics and Development of Perennial Complementary Cool-Season Grasses for Grazing

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Summary

Ten cool-season grass varieties were evaluated for first-year growth in the variable climate of west-central Kansas. Introduced grasses had greater initial seedling density, tiller density, and dry matter production than did native western wheatgrass. 'Slate' intermediate wheatgrass and 'Lincoln' smooth bromegrass had the two best overall ratings for summer production. All introduced grasses also had greater growth than native western wheatgrass during the fall period.

Introduction

The major cost of cow/calf operations for west-central Kansas, beside the cost of original animal purchase, is stored feed cost for winter diets. Of the 1.55 million mature cows and heifers that calved during 1997 in Kansas, 151,000 were in a nine county area surrounding Hays, KS (USDA, 1997). Winter feeding in this geographic region typically lasts 4-5 months, from November or December until April. In just one month, producers could incur more than $3 million in opportunity costs for winter feeding fair quality hay to 151,000 cows and heifers at fall 2000 hay prices. The ability of a producer to manage systems that utilize grazed forages during the late fall, winter, and early spring months could drastically reduce the cost of buying or attaining stored feed, as well as reduce labor inputs during those time periods. Winter grazing of cool-season forage is utilized extensively in parts of Texas, Oklahoma, and southern Kansas, but has not been used to its potential as a common source of winter feed in west-central Kansas. Cool-season grasses need to be evaluated for their potential as complementary forage.

The objectives of this study are as follows:

1) Quantify early spring initial growth, spring regrowth, and fall growth distribution characteristics of perennial cool-season grasses for grazing system compatibility with native range.

2) Quantify plant and tiller densities to evaluate summer and winter survival of cool-season grasses following defoliation from grazing.

3) Develop an understanding of relationships between morphological advancement, leaf growth rates, canopy biomass, forage quality, and growing degree days for initial growth and regrowth of these perennial cool season grasses.

Methods

Ten perennial cool-season grass cultivars were selected for testing. These were smooth bromegrass (SB) cv. 'Lincoln', intermediate wheatgrass (IW) cvs. 'Slate' and 'Oahe', tall wheatgrass (TW) cvs. 'Jose' and 'Alkar', pubescent wheatgrass (PW) cvs. 'Manska' and 'Luna', Russian wildrye (RW) cv. 'Bozoisky', western wheatgrass (WW) cvs. 'Barton' and 'Flintlock'. Cultivars were spring seeded at two sites (10 Apr 00 and 28 Apr 00) into four replications for evaluation as complementary forages to be grazed during the spring, fall, and possibly winter. Species and cultivars were selected because of suggested tendencies for adaptation to west-central Kansas.

After seeding, seedling densities were counted within two 0.2 m^2 frames from each plot. Stands were counted again for tiller density after plants had established in mid-summer. Forage was clipped from a 0.1 m^2 area from two locations in each plot during the summer to determine yield.

Individual tillers from each variety were randomly selected and identified within each plot. At 3.5 day intervals, length of the most recently developed leaf was measured. When a measured leaf formed a collar and stopped elongation, leaf width was also measured. Stage of maturity of each tiller was also noted. Density, yield, maturity, and leaf elongation were measured during both the summer and fall. Results included in this report are for the establishment year only. Grazing will be initiated the second year of the stand for evaluating effects of animal interaction on growth.

Results and Discussion

Emergence of all grass varieties occurred within three days of each other. During the establishment phase of these grasses, all intermediate, pubescent, and tall wheatgrass varieties had similar seedling densities and were similar to smooth bromegrass (>350 seedlings m^{-2}). Both western wheatgrass varieties and the Russian wildrye variety tended to have lower seedling densities and seedling growth than most other cultivars. Seedling densities for all grasses were above the level acceptable to develop adequate stands for grazing.

After ten weeks of growth, plant densities were hard to discern, and tiller densities were used for comparison between cultivars. ‘Jose’ TW had the greatest tiller density, followed by ‘Slate’ and ‘Oahe’ IW, and ‘Alkar’ TW (Table 1). ‘Slate’ IW had the greatest dry matter production by this time with 1388 kg ha^{-1} of dry matter forage, followed by ‘Manska’ PW and ‘Oahe’ IW (Table 1). Once again, the western wheatgrasses and Russian wildrye had significantly lower tiller densities and dry matter production than the top cultivars. Tiller density had a strong relationship with dry matter production, with more than 50% of the variation in dry matter production attributed to tiller density.

The Haun index is used to compare morphological development of the different cultivars. Since all grasses were spring seeded and were not induced to flower, all growth during the summer was vegetative in form rather than reproductive. The Haun index value in this instance indicates the relative number of photosynthetically active leaves present on each tiller during a given period of time. The greater the index value, the greater the number of retained green leaves. Smooth bromegrass had the greatest number of retained leaves, with a Haun value of 6.1. The two western wheatgrass cultivars were close behind with 5.3 and 5.2 retained leaves respectively. ‘Bozoisky’, ‘Oahe’, and ‘Slate’ followed with more than 4 retained active leaves.

Leaf growth rate has also been correlated with grass dry matter yield in other studies. ‘Lincoln’ SB had the greatest leaf growth rates of 7.4 cm per 3.5 d interval, while ‘Bozoisky’ RW had 6.3 cm of growth per 3.5 d interval (Table 1). ‘Oahe’, ‘Slate’, ‘Flintlock’, ‘Manska’, and ‘Luna’ were statistically equal with 5.0-6.0 cm of growth per 3.5 d interval. Leaf growth and dry matter yield were not highly correlated during the first 10 weeks of growth. Grasses with the greatest leaf growth rates per 3.5 d interval tended to have lower tiller densities, while grasses with the greatest tiller densities tended to have much lower leaf growth rates.

All cultivars were given a ranking for initial summer growth. Rankings were from 1-10, with 1 being the highest rank for the greatest value, for each of four traits: tiller density, dry matter production, Haun index, and leaf growth per interval. ‘Slate’ IW had the greatest combined rank of all grasses (Table 2). ‘Slate’ ranked highly in tiller density and dry matter production, while it’s middle ranking in Haun index and leaf growth rate kept it from being the overwhelming top producer up to this point. 'Lincoln' also had a high combined rank score, but lower dry matter production and tiller density limited its combined ranking. 'Oahe' and 'Manska' were the only other cultivars close to 'Slate' or 'Lincoln' in combined score ranking.

Fall growth was less than summer growth for all grasses. More than 150 mm of precipitation fell during late June and July, allowing cool-season grasses to remain productive even with increasing temperatures. August and September were extremely dry and hot, and cool-season grasses did not show any significant growth for measurement. Although early October temperatures were better suited for cool-season grass growth, dry conditions still limited leaf elongation. 'Alkar' TW had one of the lowest summer leaf elongation rates, 4.3cm per 3.5 d growing period (Table 1), but also had the highest leaf elongation rate during early fall (2.3cm per 3.5 d growing period) (Table 3). 'Alkar' growth rate was significantly greater than 'Jose' TW growth, even though both varieties are of the same species. All non-native cool-season grasses showed greater fall leaf elongation than the native western wheatgrass varieties (Table 4).

This work gives an early indication of possible cool-season grass species and varieties best adapted to west-central Kansas. Since leaf production tends to be greater in forage quality and is selected for consumption by grazing animals, greater leaf production in a complementary cool-season grass is desirable. Leaf extension has also been shown to be highly correlated with forage yield. Early measurements show that several introduced species and cultivars showed greater or equal leaf growth to native western wheatgrass. These introduced grasses show great potential for growth and production for grazing animals. Late summer climate in west-central Kansas was extremely hot and dry in 2000, yet all grass species and cultivars showed acceptable tiller densities during fall measurement. Ability to survive hot, dry summer conditions is requisite of grasses to be implemented in grazing systems.

Future Work

Tiller densities following winter stress also need to be determined. Great extremes between hot, dry summers and cold winters may limit the number of cool-season grasses that will maintain acceptable tiller densities for grazing. Furthermore, exposure to stress from grazing animals and regrowth following grazing needs to be examined. Grazing stress combined with the extreme weather conditions may alter growth habits seen during the first establishment season. Repeated summer heat stress, drought stress, winter cold stress, and grazing stress will further indicate which of these grasses has characteristics that will enable them to persist and maintain stands for grazing. Continued tiller density, leaf growth, morphology, and forage quality measurements will take place to investigate which species and cultivars will be most persistent and productive in the central Kansas environment.

Table 1. Ten week growth summary of 10 cool-season perennial grasses.

Grass	Density (tillers m^{-2})†	Grass	Dry Matter (kg ha^{-1})†
'Jose' tw	1589a	'Slate' iw	1388a
'Slate' iw	1290ab	'Manska' pw	1311ab
'Oahe' iw	1224ab	'Oahe' iw	1185abc
'Alkar' tw	1218ab	'Jose' tw	966bcd
'Manska' pw	1172b	'Luna' pw	939bcd
'Luna' pw	919bc	'Alkar' tw	922bcd
'Bozoisky' rw	738cd	'Lincoln' sb	878cde
'Lincoln' sb	584cde	'Barton' ww	746de
'Barton' ww	522de	'Bozoisky' rw	565de
'Flintlock' ww	359e	'Flintlock' ww	465e

Grass	Haun Index†	Grass	3.5 Day Leaf Growth (cm)†
'Lincoln' sb	6.1a	'Lincoln' sb	7.4a
'Barton' ww	5.3b	'Bozoisky' rw	6.3ab
'Flintlock' ww	5.2b	'Luna' pw	5.6bc
'Bozoisky' rw	4.6c	'Manska' pw	5.5bcd
'Oahe' iw	4.4cd	'Flintlock' ww	5.2bcd
'Slate' iw	4.1de	'Slate' iw	5.1bcd
'Manska' pw	3.9e	'Oahe' iw	5.0cd
'Luna' pw	3.8ef	'Barton' ww	4.8cde
'Jose' tw	3.5f	'Alkar' tw	4.3de
'Alkar' tw	3.5f	'Jose' tw	3.7e

†Values with the same letter are statistically equal.

Table 2. Initial growth combined rank score of 10 perennial cool season grasses.

Grass	Score
‘Slate’ iw	15
‘Lincoln’ sb	17
‘Oahe’ iw	18
‘Manska’ pw	18
‘Luna’ pw	22
‘Bozoisky’ rw	22
‘Jose’ tw	24
‘Barton’ ww	27
‘Flintlock’ ww	28
‘Alkar’ tw	29

Table 3. Fall growth summary of 10 cool-season perennial grasses.

Grass	Haun Index†	Grass	3.5 Day Leaf Growth (cm)†
‘Barton’ ww	4.1a	‘Alkar’ tw	2.3a
‘Flintlock’ ww	4.1a	‘Luna’ pw	2.2ab
‘Lincoln’ sb	3.9ab	‘Manska’ pw	2.1ab
‘Jose’ tw	3.3bc	‘Lincoln’ sb	1.9ab
‘Alkar’ tw	3.2c	‘Slate’ iw	1.9ab
‘Manska’ pw	3.2c	‘Bozoisky’ rw	1.8ab
‘Slate’ iw	3.2c	‘Jose’ tw	1.7b
‘Oahe’ iw	3.1c	‘Oahe’ iw	1.7b
‘Luna’ pw	3.0c	‘Flintlock’ ww	0.8c
‘Bozoisky’ rw	2.9c	‘Barton’ ww	0.6c

†Values with the same letter are statistically equal.

Control and Utilization of Japanese Brome

Keith Harmoney
Range Scientist

Summary

Pastures containing dense stands of Japanese brome were subjected to prescribed burning or early grazing to control or utilize the cool-season invader. Burning, grazing, and a combination of burning and grazing all reduced the density of Japanese brome in pastures. Burning, grazing, and burning and grazing all produced similar quantities of residual dry matter as that of the idle control pasture by the end of the growing season.

Introduction

Annual bromes, namely Japanese brome and downy brome, are regarded as highly invasive, noxious weeds. They are non-native, winter annual grasses that begin growth in the late fall or early winter and mature quickly the following spring. They have invaded cropland under cultivation as well as under fallow and are commonly found in great concentrations in several native rangeland areas. Annual bromes are high quality forages at immature growth stages, but become lower in quality and unpalatable to grazing animals when mature and seed heads are produced. Stems become lignified and less digestible, and awns and calluses in the seedhead become rigid, stiff, and sharp. Utilization and control of annual brome in short-grass rangeland has not recently been investigated in west-central Kansas. Because it is a cool-season grass, herbicides used to control Japanese brome would also tend to reduce composition of desired cool-season grasses, such as western wheatgrass, on native rangeland. Control measures are then limited to animal management and other cultural practices. Burning and grazing management are two low input practices most likely to affect Japanese brome concentrations.

Methods

A study was initiated to investigate management practices for the control and utilization of Japanese brome. A pasture with high density of annual brome was divided into paddocks of three replications of four treatments, for a total of 12 paddocks. Treatments under investigation are a control (idle rangeland with no grazing or burning), prescribed spring burning, early spring grazing, and a combination of early spring burning and grazing. Annual brome density was measured in four permanent plots within each paddock by counting annual brome plants before treatment application. Two permanent transects also were placed in each paddock to follow range plant vegetative trends. Annual brome densities were again counted following treatment application. Biomass was determined at the start and end of the growing season by clipping standing vegetation from two frames in each paddock. Population of annual bromes, differences in litter composition, and other vegetative composition changes are being followed.

Results and Discussion

The annual brome population between treatment paddocks did not differ in mid-March before treatments were applied. Population ranged from 83 plants/ft^2 to 119 plants/ft^2 (Figure 1). Annual brome density in all paddocks under investigation averaged 101 plants/ft^2 at the inception of the study. Prescribed burning treatments were applied on 12 Apr 00, with wind conditions less than 10 mph from the southeast, 82% relative humidity, and a temperature of 37^{o}F. Grazing only treatments were applied 26-28 Apr 00. Grazing was applied again to the early spring grazing and the first time to burned and grazed combination treatment between 30 May 00 and 8 June 00.

Annual brome densities following treatment applications in the grazed, burned, and burned and grazed paddocks was significantly lower than the idle treatment (Figure 1). Idle paddocks contained an average of 108 plants/ft^2. Grazed only paddocks averaged 51 plants/ft^2, while the burned and the burned and grazed combination averaged 29 and 35 plants/ft^2, respectively. Both the burned and burned and grazed combination reduced annual brome densities significantly from their first observations. Grazed only paddocks averaged 32 plants/ft^2 less than the first observation but was not statistically different.

The presence of annual brome and the use of prescribed burning may alter moisture characteristics of the soil profile. Annual brome utilizes moisture early in the spring that would be available to desirable grasses later in their growth period. Burning blackens the soil surface, and may increase soil surface temperatures, reduce litter and shading, thus exposing the soil profile to more rapid drying. The grazed only treatment had greater moisture content than either of the treatments that included burning. In a 12-inch soil profile 0.75 inches in diameter, the grazed only paddocks averaged 3.72 inches of moisture, while the burned and burned and grazed pastures averaged 3.40 and 3.41 inches/ft of moisture respectively.

Since bulk densities may have an effect on holding capacity of soils, moisture was also determined based on a percentage of the soil dry weight. Grazed only paddocks had 19.8% moisture, and were significantly different than the burned only and the grazed and burned combination, which had 18.4% and 18.2% moisture, respectively. The idle paddocks were not different than any of the other three treatments, averaging 19.2% soil moisture, or 3.67 inches/ft of soil. The greater presence of annual bromes in the control treatment may have slightly reduced the moisture content compared to the grazed only, but did not reduce the soil moisture as much as either of the burned treatments.

End of season dry matter residue was not different among management treatments. Idle, grazed, burned, and burned and grazed areas had 2307, 2305, 1999, and 1819 lb/ac, respectively.

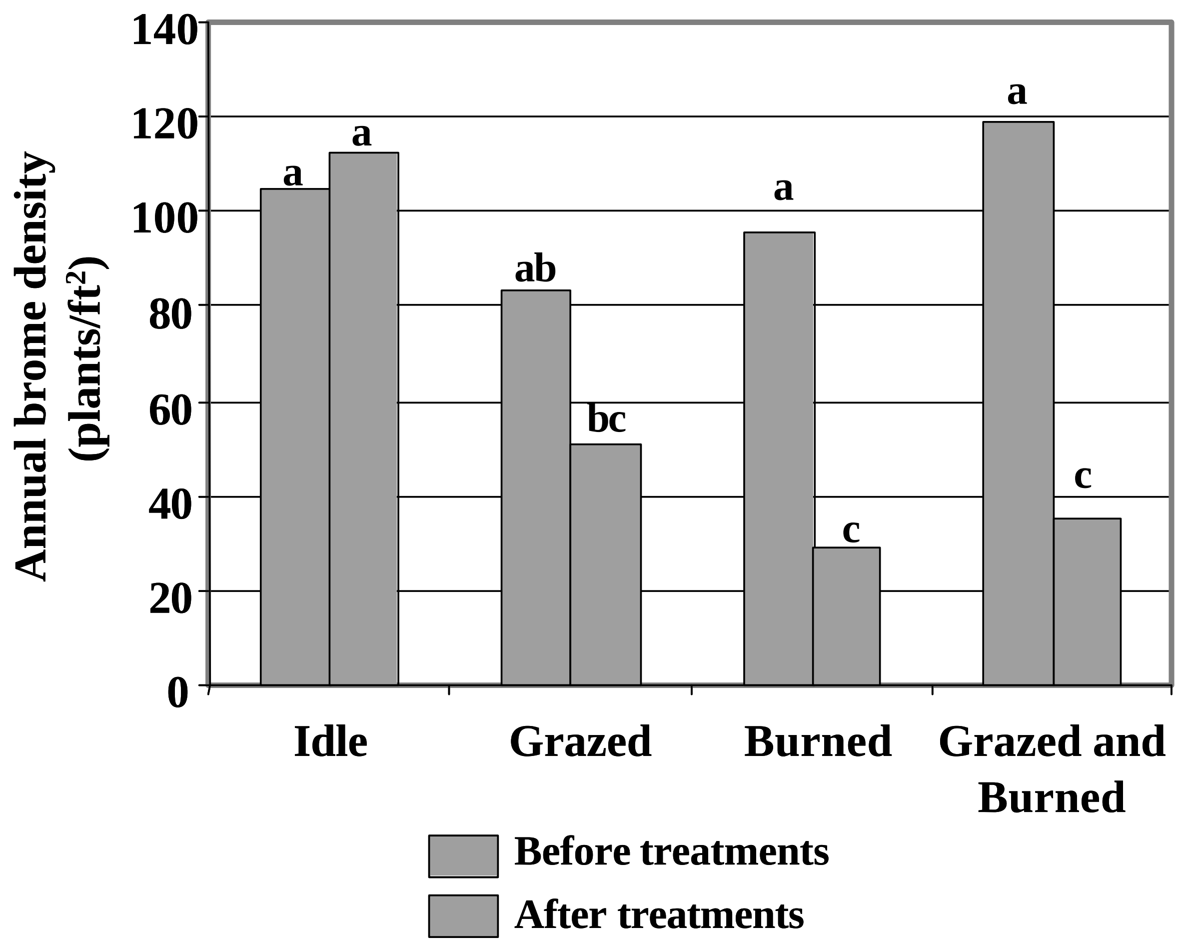
Range condition of the treatments was quite similar among paddocks. The idle, burned, and burned and grazed combination paddocks were in fair to good range condition with 49.8, 50.1, and 54.3% of climax vegetation, respectively. The grazed only paddocks contained 66.4% of climax vegetation, which was mostly attributed to a greater concentration of big bluestem.

Management systems to either utilize or control annual bromes showed that both methods have potential to reduce populations of the noxious weeds. Utilization of the early season forage through early grazing would allow producers to get some benefit from the presence of annual brome species. Grazing early also conserved moisture, which would have the potential benefit of more moisture available for more desired native species later in the season. Although burning reduces litter and standing residue, end of season biomass was not different between treatments with burning and treatments without burning. Burning currently shows no detrimental effects compared to the idle or grazed only treatments. Invasive weed species populations were less than or equal to idle and grazed treatments, and dry matter production was equal.

Future Work

Annual measurements over the course of several years need to take place. Repeated prescribed burning may eventually result in lower production and dry matter accumulation, especially during years of low precipitation. Trends in both the annual brome populations and the native rangeland vegetation in response to early grazing and prescribed burning combinations will be closely monitored. Effects of treatments on soil moisture status will also continue. Several years of data need to be collected in order to fully realize whether treatments are effective or if patterns of precipitation are more effective in manipulating annual brome populations.

Figure 1. Annual bromegrass densities from permanent plots within each treatment, before and after treatment application.†



†Bars with the same letter are statistically equal.

Modified Intensive-Early Stocking on Shortgrass Rangeland

Keith Harmoney and John Brethour
Range Scientist and Beef Scientist

Summary

Modified intensive-early stocking places more animals on pasture early in the season compared to season-long continuous stocking, but then also leaves a portion of the animals on pasture during the last half of the season. Modified intensive-early stocking at a 1.6X rate early in the season was evaluated to determine animal production and carcass quality. Average daily gain and mean total individual animal gain were similar for animals of both systems during the first half of the grazing season. No difference was found for average daily gain or total animal gain for steers remaining on pasture season-long. The modified intensive-early system produced more beef on a land area basis because of the greater early stocking density. Steers from the season-long continuous grazing system had greater carcass weight and carcass quality than steers from the modified intensive-early grazing system. Modified intensive-early stocking at a 1.6X rate can improve beef production on a land area basis when compared to season-long continuous stocking.

Introduction

Intensive-early stocking is a common management practice on tallgrass rangeland in eastern Kansas. On shortgrass rangeland in western Kansas, intensive-early stocking using double density stocking the first half of season was found to have no production advantage over continuous season-long stocking. Over several years, continued intensive-early stocking was found to reduce the composition of desired western wheatgrass, important for early season animal gains. It was hypothesized that gains per animal could be maximized and gains per acre could be increased by reducing the density of animals early in the season to less than double the season-long density, then allowing some animals to remain on pasture season-long..

Methods

A comparison was made between continuous season-long stocking of steers on shortgrass native rangeland and intensive-early stocking (IES) steers at 1.6 times (1.6X) the density early in the season, then removing the heaviest animals half-way through the season. Four replications of 10 animals for the continuous system and four replications of 16 animals in the 1.6X intensive-early treatment were used. Mean May beginning steer weight was 589 lb and 587 lb for the modified 1.6X IES and continuous systems in 1999, and 639 lb for both the IES and continuous systems, respectively, in 2000.

Animals were shrink weighed after overnight exclusion from food and water before treatment allotment and again just before the onset of pasture grazing. Animals were stocked the first week of May 1999 and the last week of April 2000. Intensive-early stocking concluded in mid-July of 1999 and the end of June 2000. Animals again were excluded from food and water overnight and then weighed. The six heaviest animals were removed from the intensive-early system at the conclusion of the early stocking period half-way through the grazing season and placed directly in the feedlot. Animals from the continuous season-long stocking and animals that remained season-long following intensive- early stocking were removed from rangelands the first week of October 1999 and mid-September 2000. Steers again were excluded from food and water overnight and weighed.

Animals from both treatments were placed in the feedlot following grazing in order to follow effects of the grazing treatments through to slaughter. Feedlot and slaughter data are available for animals from the 1999 grazing season only. Feedlot and slaughter data will be available for animals from the 2000 grazing season in the summer of 2001.

Results and Discussion

For the animals that were on pasture during the first half of the season, average daily gains and total gains per animal were not statistically different between stocking systems. Continuously stocked animals gained 128 lb during the first period, while intensive-early stocked animals gained 114 lb during the first period (Figure 1). However, the intensive-early stocked system produced 54 lb ac^{-1} beef during the first half of the grazing season, which was greater than the continuously stocked system at 38 lb ac^{-1}. For animals that remained on pasture season-long from both systems, no difference was found between average daily gains and total gains per animal during the last half of the season. This resulted in no difference in total season gain or season average daily gain of animals that stayed on pasture during the entire grazing season from either of the two systems. Animals from the continuously stocked pastures gained 207 lb through the season, while animals that grazed season long from the intensive-early system gained 196 lb through the season. Late season gain ac^{-1} was also similar between the two stocking systems. Animals from the intensive early system gained 25 lb ac^{-1}, while continuously stocked animals gained 23 lb ac^{-1} during the last half of the season. Total gain on a land area basis was greater for the entire season both years from the intensive-early stocking system (79 lb ac^{-1}) with greater animal densities during the early period than from the continuously stocked system (61 lb ac^{-1}). Animals from the more densely stocked intensive-early system had similar early and late gains, but produced more beef on a land area basis. Before entering the feedlot, the steers from the modified IES system produced a greater return on investment of $38.42 and $18.28 per acre in 1999 and 2000. Continuous season-long stocking produced $32.61 and $11.10 per acre, respectively.

Carcass data from 1999, however, revealed that animals from the continuous season-long stocking system had greater total carcass weight and quality than the animals that remained the entire season from the intensive-early system. Steers from the continuous system had greater total gain (516 lb) during the feedlot phase than did steers from the intensive-early system that stayed season-long (472 lb). Steers from the continuous system also had greater carcass weight (829 lb) than steers from the intensive-early system (801 lb). Carcass quality was also greater for the steers from the continuous system with a higher grade of choice than the intensive-early steers (5.47 versus 5.18, respectively).

Two years of data show that intensive-early stocking at a 1.6X rate and then allowing animals to graze season-long at a 1X rate allows animals to attain maximum individual performance, similar to continuously stocked animals at a lower initial stocking density. However, because initial stocking densities are greater from the 1.6X intensive-early stocking system, greater beef production on a land area basis results. The intensive-early system allows a greater number of animals to attain maximum individual performance, thus increasing beef production efficiency on a land area basis. This system improves gain on a land area basis compared to a previous intensive-early double stocking system in which a 2X number of animals were placed on pastures during the first half of the grazing season.

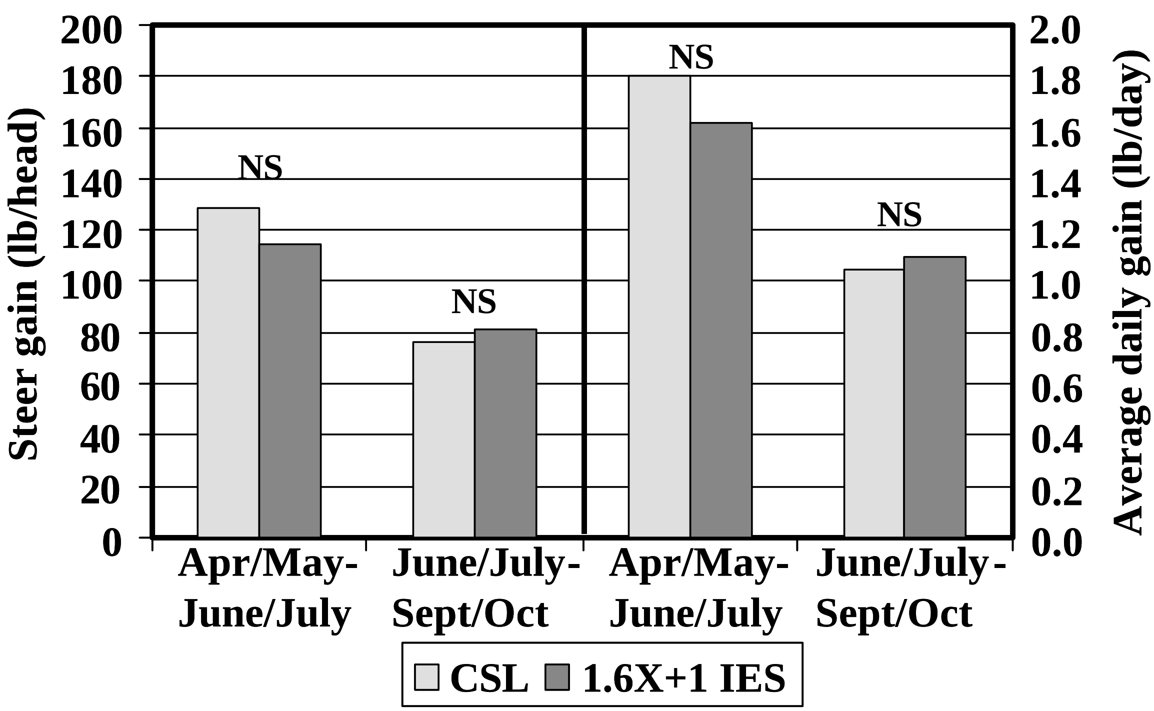
No difference was found in previous trials for beef production on a land area basis between continuous and intensive-early double stocking. Modified intensive-early stocking at a 2X rate also showed no improvement over continuous season-long stocking. The 1.6X modified IES produced more beef on a land area basis and also allows producers to market animals twice during the year, rather than once.

With current levels of production, applying animal market prices to previous years shows that price margin between initial purchase and time of sale greatly affects return on investment. There is more volatility and greater risk in intensive-early stocking with greater price margin. Returns from continuous season-long stocking tend to be more stable from year to year.

Future Work

Feedlot gain data and carcass data at slaughter will be taken for all steers involved in the grazing study during the 2000 season to see if trends follow 1999 observations. Carcass data will be the last data recorded and analyzed from this project. A similar project will begin in the near future to compare animal performance between continuous season-long stocking and modified IES, but with a greater emphasis on grazing effects from these two systems on native shortgrass rangeland plant populations and pasture productivity.

Figure 1. Steer performance on native range for continuous season-long and 1.6X modified intensive-early stocking systems.



NS= not significant.

Measurements for Predicting Performance of Feedlot Steers

John R. Brethour
Beef Scientist

Introduction

Ultrasound has been an effective technology to predict future carcass merit of feedlot cattle. However, measures taken with that technology such as backfat thickness and marbling score have not been correlated with feedlot gain. In clustering cattle for precision marketing, knowledge of future growth rate, as well as changes in carcass composition, would enhance the profitability of the procedure by enabling early marketing of poor-gaining cattle while retaining those with additional growth potential.

Frame score provides an indication of an animal's growth curve, which can be used to project expected finishing weight for slaughter cattle or mature weight for breeding cattle. Frame score and muscle score are the two attributes in the USDA Feeder Cattle grading scheme. In the Beef Improvement Federation guidelines are formulas and tables for calculating frame score from a measure of hip height and animal age. The classical formula for the conversion of hip height to frame score is:

Frame Score = -11.548 + .04878 (Height) - 0.0289 (Days of Age) + 0.00001947 (Days of Age)2 + 0.0000334 (Height) (Days of Age).

However, age of the typical feedlot animal is not known. But alternative estimates of frame score have been made from hip height and animal weight. Hip height, which can be conveniently obtained with a measuring stick constructed specifically for that purpose, is the predominate indicator of frame size, Hip height is also the primary measure used in video imaging systems that classify cattle into biological types and sort into outcome groups that are expected to finish alike.

This widespread interest in, and use of, frame score and hip height inspired this research to determine if the measure might complement information obtained form ultrasound that would make cattle clustering procedures more effective. The primary objective was to determine the ability of hip height measures to project future feedlot gains and carcass composition.

Materials and Methods

Four different groups of cattle were involved in this study:

Experiment 1. This included 139 head that were evaluated shortly after arrival when the steers averaged 811 pounds and were fed an average of 157 days after the evaluations were made. Age of cattle was not known but they were probably about 15 months old. The cattle were crossbred involving both British and continental breeds. In this particular experiment the cattle were also measured with a video imaging system built by Cattle Scanning Systems (Rapid City, South Dakota). It appeared that this system expressed a frame score from two height and one width measurement but the exact formulas are proprietary and not available. The cattle were then measured for hip height and ultrasound backfat and marbling.

Experiment 2. In this study 113 steers were measured just before harvest when they averaged 1261 pounds. They were about 16 months old and were mostly Angus and Angus-cross cattle. Measurements included hip height, ultrasound backfat, marbling score and muscle depth, and weight. Hip height was converted to frame score using an equation published by the Micro Beef Technologies (Amarillo) cattle management system.

FS = -18.09148+1.121666*HH+0.03365*WT-2.003599*WT/HH-0.012205*HH^2+13.133611*(WT/HH^2)

Where FS is Frame score, HH is hip height in inches, and WT is live weight in pounds.

A reason that these cattle were measured just before harvest was to determine the relationship of the various measures with dressing percent. Muscle depth was a measure derived from a sagittal ultrasound image taken across the longissimus muscle in the region of the first two lumbar vertebrae. It is the maximum linear distance through the muscle from the bottom of the subcutaneous fat layer to the transverse processes that extend from the vertebrae.

Experiment 3. This involved 68 more cattle from the group used in experiment 2 but were held for a 37-day interval from evaluation until harvest. The average weight of these deferred cattle was 1228 pounds.

Experiment 4. There were 178 steers in this experiment that were marketed in three groups 70, 86, and 100 days after evaluation (the statistical model used in the analysis corrected for effects related to these time intervals). The breed composition was variable representing the many crosses typical of feeder cattle in northwest Kansas. Average weight at evaluation was 1062 pounds.

Hip height was more variable in the first and last experiments, respective values for the standard deviation of hip height was 1.43, 1.09, 1.25, and 1.42 inches, respectively, in the four studies.

The most important dependent value in using frame score among feedlot cattle is the weight at which a target carcass composition is reached. In this study, we used the projected weight at which a carcass at harvest would have 10 mm backfat. Other studies have indicated good correspondence between this backfat measure and percent fat in the carcass. Data for each carcass was extrapolated by calculating the number of days between the actual carcass backfat thickness and 10mm (.4 inch) using the equation T = (logn(10) – logn(A))/k, where A is the carcass backfat, k is a rate constant - .01 was used – and T is the number of days in the interval between harvest and when 10 mm backfat would be attained. Weight at 10 mm backfat was obtained by the equation Y = (X + 2.2 * T)/ .64, where X is the carcass weight when backfat was measured, T is the interval to 10 mm backfat and Y is the weight at 10 mm backfat. This assumes a constant 2.2 pounds carcass gain in the interval around harvest and dressing percent = .64.

Other dependent variables considered included average daily gain from evaluation until harvest with final weight corrected to a standard dressing percent of .64, individual dressing percent, carcass backfat thickness, carcass marbling score, and carcass weight.

There has been some concern that manually measuring hip height may not be as accurate as video imaging because of the difficulty in positioning animals in a squeeze chute. However, Figure 1 indicates good correspondence between hip height and a frame score value estimated from video imaging in Experiment 1.

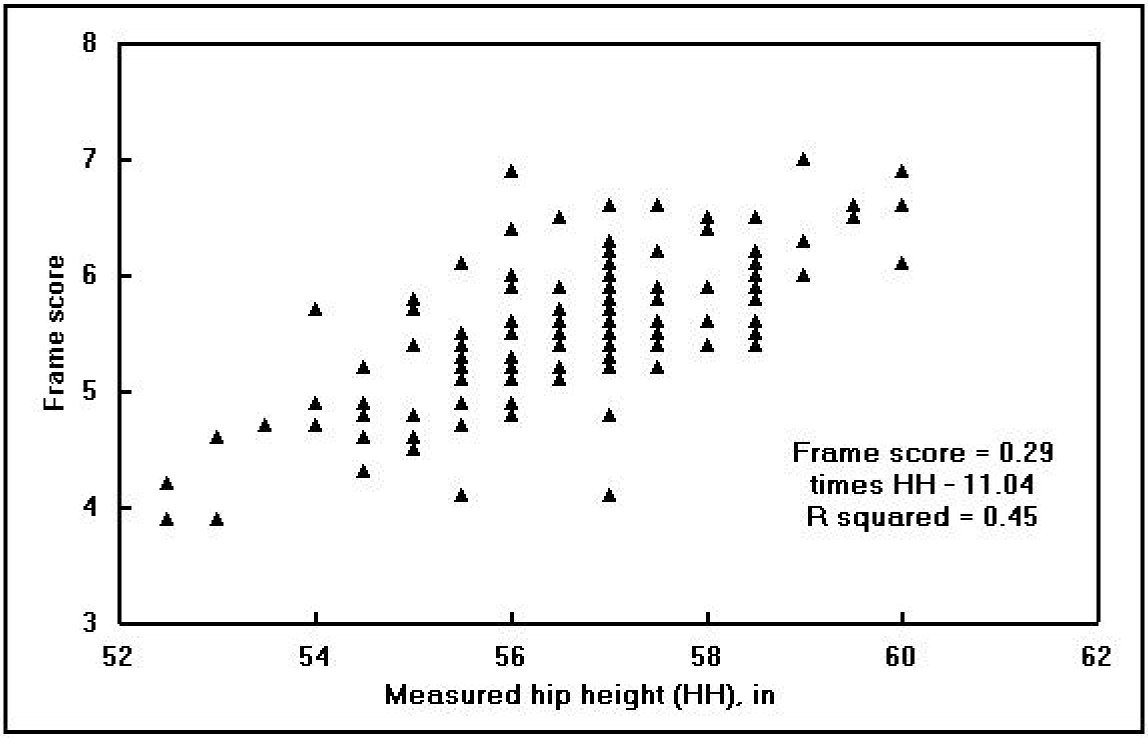


Figure 1. Relationship of measured hip height and frame score from video imaging.

Results

Four different Figure 2 summarizes the results of this study and presents the correlations as R square values, which express the percent of variation in the dependent variable that is accounted for by the predictor variable. Because of the large number of animals in the experiments, most of the correlations are statistically significant. However, a squared correlation coefficient usually must be above .4 or .5 to have much utility. For example Figure 3 portrays the relationship of hip height and weight at 10 mm backfat in Experiment 3. The correlation of .50 (square root of the R square parameter) is highly significant, but the standard deviation of 125 pounds seems unacceptably large.

Prediction variables	ADG	10 mm Wt	Carcass backfat	Carcass marbling	Dressing percent	Carcass weight
			Dependent variables			
Experiment 1						
Hip height	0.091	0.136	0.020	0.005		0.184
Frame score	0.059	0.132	0.056	0.021		0.159
Live weight and ultrasound backfat and marbling	0.074	**0.175**	**0.153**	0.208		0.341
Experiment 2						
Hip height		0.085	0.000	0.051	0.001	0.241
Frame score		0.086	0.001	0.084	0.001	0.236
Muscle depth		0.112	0.022	0.000	**0.161**	0.092
Live weight and ultrasound backfat and marbling		0.383	0.467	0.533	0.028	0.661
Experiment 3						
Hip height	0.009	**0.181**	0.019	0.006	0.008	0.307
Frame score	0.010	0.179	0.016	0.006	0.006	0.322
Muscle depth	**0.151**	0.020	0.000	0.039	0.104	0.086
Live weight and ultrasound backfat and marbling	0.050	**0.494**	0.393	**0.446**	0.034	0.778
Experiment 4						
Hip height	0.055	**0.246**	0.040	0.000	0.001	0.215
Frame score	0.052	0.225	0.045	0.000	0.001	0.181
Muscle depth	0.021	0.073	0.020	0.010	0.100	0.046
Live weight and ultrasound backfat and marbling	0.098	**0.601**	**0.448**	**0.382**	0.065	0.732

Figure 2. Correlations (R square values) between various predictor variables and performance and carcass attributes. Values in bold are discussed in the manuscript.

In Figure 2 the predictors of average daily gain are all poor. The highest correlation is from muscle depth in Experiment 3, but the value is only .15. This was especially disappointing because the ability to predict future gain would probably be the most useful tool from this project.

Hip height was significantly correlated with steer weight at 10 mm backfat, especially in Experiments 3 and 4, but the accuracy of that prediction was probably too poor for the model to be useful. In all but the first experiment, the combination of ultrasound backfat, marbling score and animal weight was more than twice as powerful in predicting a weight endpoint such as this and which represented a constant carcass composition. In the first experiment, the evaluations were made at arrival when backfat averaged only 1.8 mm. Other studies have shown that there is a need to delay ultrasound evaluations for projecting days to harvest until there has been adequate time on a high energy ration for genetic differences in fat deposition rates to be expressed and when the cattle average over 3 mm backfat. That accounts for the poor prediction of carcass backfat in Experiment 1.

The correlations based on frame score differed little from those based on hip height, apparently because frame score was calculated from hip height. Both were ineffective in predicting carcass backfat or carcass marbling, but ultrasound measures had high correlations with those traits in Experiments 2 to 4.

No satisfactory model was discovered for projecting individual dressing percent. That was disappointing because dressing percent varies immensely among individual animals with standard deviations usually exceeding 150 basis points. In addition to the regressions presented in Figure 3, many models that involved products and ratios of weight, hip height and muscle depth were tested without discovering significant increases in prediction accuracy. There tended to be increases in dressing percent as carcass weights increased:

Carcass weight, lb	Dressing Percent
700-800	63.21
800-850	63.62
850-900	64.38
900 +	64.60

Regression of dressing percent on animal size is complicated by the formula for dressing percent, carcass weight divided by live weight, which infers that dressing percent is inversely proportional to live weight.

Correlations with carcass weight were generally high with all predictors, but higher when based on live weight than on ultrasound or linear measures.

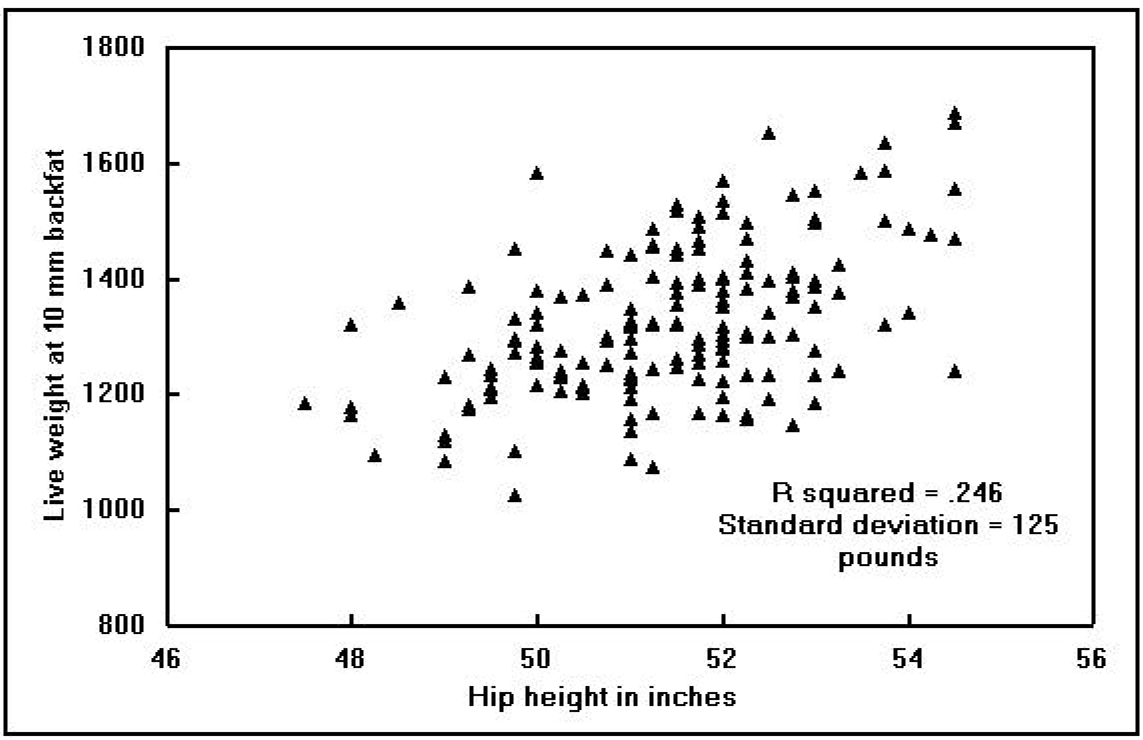


Figure 3. Relationship of hip height and weight at 10 mm backfat (Experiment 4). Even though the R squared is highly significant, the standard deviation seems too large for the prediction to be useful.

Implications

Hip height and frame score have been effectively used for many years in describing cattle for marketing and classifying seedstock individuals. However, applications involving those measures to predict important attributes in feedlot cattle were disappointing in this study. Several items might explain this. Possibly the cattle used in these experiments did not have the variability in frame score that might be encountered with animals from other regions. Frame score seems to effectively describe mature body size among breeds, but most of the steers in this study were crossbred. Selection for weight, per se, may result in body size that is independent of height. Also, selection for leanness and marbling may have resulted in carcass composition being independent of size. Cattle are marketed well before they reach mature body weight. The conclusion seems to be that there is need to search for measures that are more effective than hip height to describe and predict cattle growth and development.