Growing Cattle On Grass

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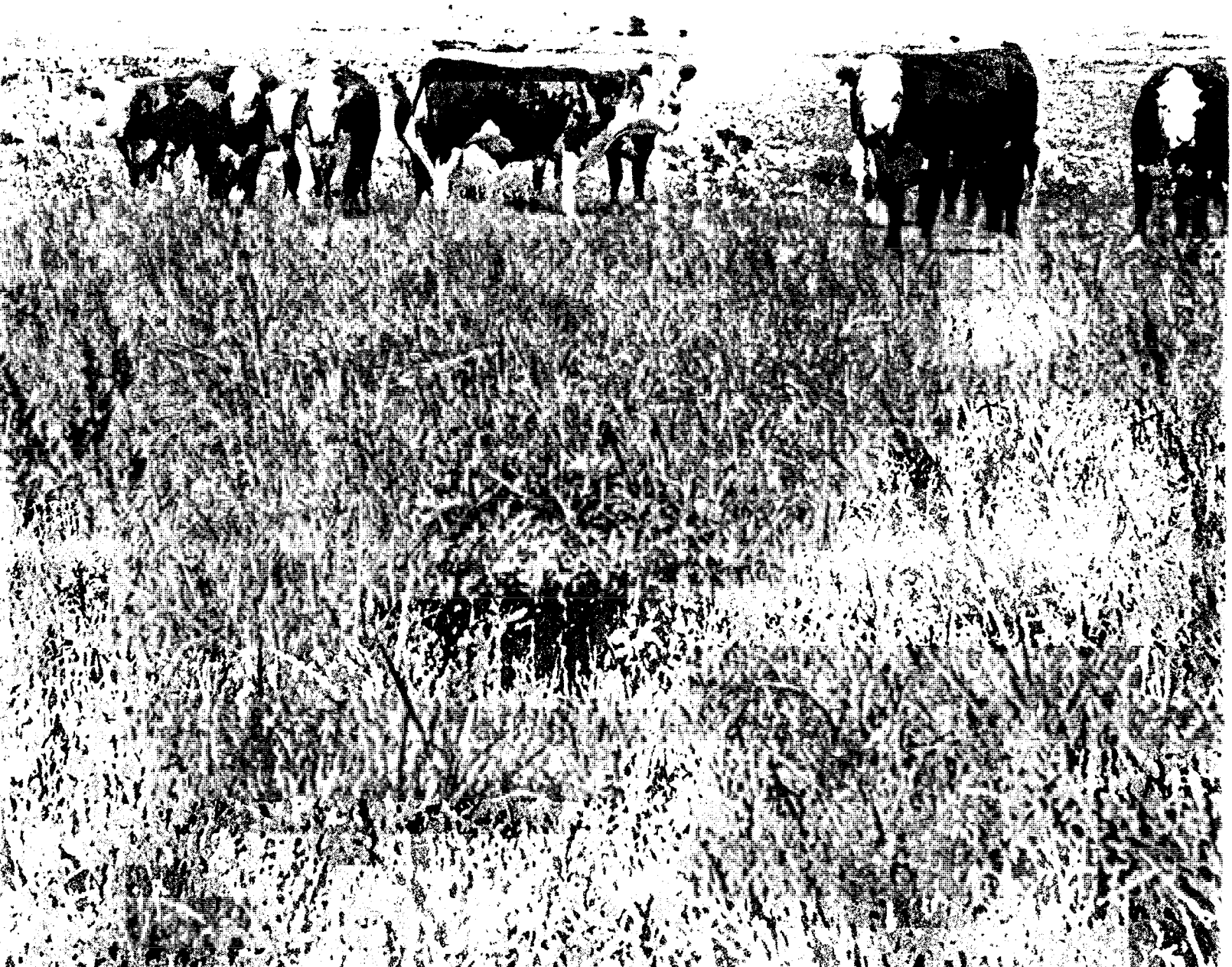

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GROWING CATTLE ON GRASS[1]

Ed F. Smith[2]

Introduction

Most grasses commonly grazed by cattle are highest in nutritive value in their early, immature growth stage, then steadily decline in nutritive value through dormancy and weathering. So growing cattle make their greatest gain when plants are immature and actively growing. As data in Table 1 show, daily gains by steers grazing native bluestem pasture were 1 lb. a day more in May then in September.

As the plants matured, crude fiber increased from 26 to 34 percent and protein decreased from 17.7 to 4.3 percent. These values indicate energy value declined drastically as the forage matured. Energy is the nutrient that grass furnishes in greatest quantity. The animals' response to the energy supplied by the grass depends on: digestibility and palatability of the forage, management of the animals and grass, supplying nutrients, like protein or phosphorus that the grass may lack, using growth stimulants, and method of supplementing animals on pasture. This publication reports research that is applicable to growing cattle on grass in the Central United States.

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Table 1. Monthly steer gains and nutritive values of clipped bluestem pasture forage'

	May	June	July	Aug.	Sept.
Daily gain per steer, lbs.	2.28	1.93	1.64	1.23	1.29
Crude protein, %	17.74	11.62	5.96	4.47	4.31
Crude fiber, %	25.92	30.48	32.82	30.80	33.98

'Dry matter basis.

Section 1:

Grazing Winter Bluestem Pasture Compared with Feeding Bluestem Hay

Standing, mature, native range forage in the central United States generally has been considered low in nutritive value. One method of measuring its value is to compare the gains of young cattle grazing it with those fed the same type of forage harvested as a normal hay crop at mid-summer. Results from the Kansas Agricultural Experiment Station are shown in Table 2.

Three groups of Hereford steer calves were fed native bluestem hay (5.8% protein) and concentrates in pens, a fourth group was fed concentrates on winter bluestem pasture with hay when snow covered the grass. All were grazed on native bluestem pasture during the summer with no supplemental feed. Salt or a mixture of salt and bonemeal was available free choice to all groups.

Steers grazing winter bluestem pasture gained less during the winter than those fed native grass hay and soybean meal. Their lower gain probably resulted from lower energy intake as they consumed less forage of lower energy value. But their total gain (winter and summer) equalled that of steers fed hay and 1 lb. of soybean meal per head daily.

The method of management, since total gain was about the same, would depend on availability and cost of grass and hay. Producers with ample grass could use standing mature grass for winter feed with no loss in total gain; others, with limited grass, could use hay.

Feeding 2 lbs. of grain per steer daily to the hay-fed steers (Table 2) required 296 lbs. of grain and increased winter gain 29 lbs. per steer. But hay intake was reduced by 1.3 lbs. per steer daily, a total of 192 lbs. for the winter.

Assuming the energy in the hay was about half that in the grain, the 192 lbs. of hay would be equivalent to about 96 lbs. of grain. The grain required per lb. of additional gain (considering the reduced hay intake) would be 296 lbs. - 96 lbs. ÷ 29 (lbs. of increased gain per steer) = 6.9 lbs.

Feeding 4 lbs. of grain per steer daily to the hay-fed steers increased winter gain 72 lbs. per steer compared with feeding no grain. That required 592 lbs. of grain per steer and reduced hay intake 1.9 lbs. daily or 281 lbs. total. The grain equivalent per lb. of additional gain would be 6.3 lbs. (following the procedure above).

The decision on feeding grain during winter depends on the relative price of grain and cattle. The value of 6.3 to 6.9 lbs. of grain (grain equivalent) per lb. of additional gain appears reasonable. When grain prices are low and cattle prices high, feeding additional grain should be advantageous. An important factor to consider is whether the steers are to be grazed the following summer. On the basis of total gain (winter plus summer), it would be less advantageous to feed grain because summer gains were inversely proportional to winter

Table 2. Winter native bluestem pasture and native bluestem hay compared for growing steer calves (feed in lbs./head/day)[1]

	Winter			
	Winter pasture and 2 lbs. soybean meal	Hay and 1 lb. soybean meal	Hay and 1 lb. soybean meal and 2 lbs. grain	Hay and 1 lb. soybean meal and 4 lbs. grain
Hay, lbs. per steer daily, winter only	.5	12.3	11	10.4
Gain, lbs. per steer				
Winter (148 days)	111	147	176	219
Summer (151 days)	266	232	217	194
Total (299 days)	377	379	393	413

[1] Three-year avg., 30 Hereford steer calves per group averaging 413 lbs. initial wt.

gains, and total gains were about equal. Fourteen lbs. of grain equivalent was required per lb. of additional total gain when the winter feeding rate was 2 lbs. of grain per steer daily, and 13 lbs. of grain equivalent with a winter feeding rate of 4 lbs. daily. Those high values indicate that it may not be profitable to feed grain during the winter to steers that are to be grazed the following summer. Using implants such as Ralgro® or Synovex® and feeding additives like Rumensin® should improve the feed conversion rates but implants and additives would also increase costs.

In summary, steers gained less during the winter feeding period when grazed on winter bluestem pasture than when fed hay. Steers fed grain in addition to hay responded favorably, requiring 6.3 to 6.9 lbs. of grain equivalent for each additional pound of gain during the winter feeding period. When summer grazing followed the winter feeding period, feeding grain during winter appeared less favorable. Then grazing steers on winter pasture or feeding hay without grain appeared to be best because the additional gain required too much grain.

Section 2:

Feeding Hay to Calves Grazing Winter Bluestem Pasture Compared With Feeding Hay in Pens

Some producers prefer to feed roughage to cattle on pasture during winter rather than penning cattle and feeding the same roughage there.

At the Kansas Agricultural Experiment Station, Manhattan, steers or heifers fed hay (1/3 alfalfa and 2/3 prairie hay) free choice gained more during winter when confined to a small pen (50 x 120 ft.) than when fed in the same manner on bluestem pasture (Table 3). The cattle on pasture had adequate mature winter grass (grazed moderately during the summer) available on 10 to 14 acres per animal.

To a large extent, the hay fed on pasture substituted for grass the cattle might have eaten if hay had not been available because they consumed only 15 percent less hay than the cattle in pens. Where adequate harvested forage for feeding is available, it may be desirable to feed cattle on pasture as a convenience, for manure distribution, or some other reason, but they likely will gain less than if fed in a pen.

Table 3. Results from feeding hay to cattle in pens and on winter bluestem pasture[1]

	Pen	Pasture
Trial 1		
Gain per heifer, lbs.	87	12
Hay consumed, lbs./heifer/day	14.7	12.3
Trial 2		
Gain per steer, lbs.	46	36
Hay consumed, lbs./steer/day	14.2	12.3

[1] Ten heifers per treatment in Trial 1 for 150 days; 14 steers per treatment in Trial 2 for 112 days. Avg. wt was 497 lbs.. Hay was 1 1/3 alfalfa and 2 1/3 native grass.

If followed by summer grazing, compensatory gains should tend to equalize total gain.

Section 3:

Level of Protein and Energy Supplements for Calves Grazing Winter Grass

When the primary source of nutrients is standing, mature range forage supplementation should vary with the kind of grass, gain desired, condition of cattle, weather, and other factors.

At the Kansas Agricultural Experiment Station, three different rations were fed each winter for three years to Hereford steer calves grazing winter bluestem pasture (Table 4). Hay was fed only when snow covered the grass (average, 1.5 lbs. per steer daily). Salt was available to all groups, and in the winter, a bone meal and salt mixture. All groups grazed together on a native bluestem pasture during summer until the first week in August.

For the winter, steers fed 1 lb. of soybean meal and 1 lb. of corn per head daily gained 19 lbs. per steer more than those fed only 1 lb. of soybean meal (SBM). They consumed 126 lbs. of corn or 6.6 lbs. of corn per lb. of additional gain (126 ÷ 19 = 6.6). Those fed 2 lbs. of SBM gained 30 lbs. more than those fed 1 lb. of SBM and consumed 126 additional lbs. of SBM, requiring 4.2 lbs. of SBM per lb. of additional gain. Both values indicate additional feed beyond 1 lb. per head per day usually

would be desirable. Whether to make the additional feed soybean meal or grain would depend on the price relationship. Past prices have usually favored grain.

Since early summer gains were about the same, conclusions in regard to winter feeding based on total gain would be similar to those based on winter gain.

In summary, steer calves grazing winter bluestem pasture responded to additional concentrate feeding beyond 1 lb. per steer daily; usually it would' be economically feasible to supply the concentrate as grain.

Research on how much higher the winter feed level should go in Kansas is not available. Schoop and McIlvain (1969) at Woodward, Okla. increased the winter feed level of cottonseed cake on winter native range from 1.5 lbs. per head daily to 4.0 and increased winter gain 50 lbs. per steer and yearly gain 40 lbs. per steer. That would be 8.25 lbs. of feed per additional pound of winter gain, and 10.3 lbs. of feed per additional pound of total gain (winter and summer).

South Dakota researchers (Lewis *et al.,* 1966) at the Cottonwood Range Field Station, near Philip, increased winter supplements for steers grazing native range from 1.5 to 3.5 lbs. and increased winter gains from .56 to .77 lbs. per steer daily. That would be 9.5 lbs. of feed per additional lb. of winter gain (175-day winter period). They got a 14-lb. gain advantage for the higher level by the end of the summer grazing period, so the higher level would not be economically feasible when steers were to be summer grazed.

Until additional information is available on supplemental feeding on winter native range, the following recommendations seem appropriate for the Central United States. Steers to be sold after the winter grazing season gain 1 lb. for about 9 lbs. of supplemental feed (165-day winter period) when fed up to about 4 lbs. of supplemental concentrate per steer daily. Steers to be summer grazed following the winter period respond economically to only about 2 lbs. of supplemental winter feed per steer daily.

Grazing cattle usually respond to additional concentrate feed, but do they respond enough to make it economically feasible? The cost of the additional feed, the cost involved in feeding it, and how the additional weight affects the price received for the cattle must be considered. If more than 4 lbs. of supplemental concentrate feed is fed during the winter, consider moving the cattle off the grass and into feeding pens. With high levels of supplemental feed, grass consumption will be reduced considerably, and, as reported in Section 2, cattle tend to perform better in pens than on pasture when fed the same feed.

When high levels of grain or energy are fed with low-quality forage diets, additional protein and other nutrients may be needed to use the additional energy efficiently.

Section 4:

Method of Feeding on Winter Pasture

Cattle grazing winter forage and fed a protein or energy supplement usually are fed daily. But producers may wish to consider other methods.

Smith *et al.* (1953) compared feeding yearling steers grazing winter bluestem pasture

Table 4. Protein and energy levels for steer calves grazing winter bluestem pasture (feed in lb./steer/day)[1]

	Winter		
	1 lb. soybean meal	1 lb. soybean meal and 1 lb. corn	2 lbs. soybean meal
Gain, lbs. per steer:			
Winter (126 days)	46	65	76
Summer (109 days)	206	207	204
Total (235 days)	252	272	280

[1] Three-year avg., 30 Hereford steer calves per group averaging 507 lbs. initial wt.

soybean pellets daily, every other day, and with a self-fed, salt-soybean meal mixture. They used enough salt with the soybean meal to restrict soybean meal intake. The every-other-day feeding gave the same response as daily feeding. The salt-soybean meal mixture reduced winter gain from 58 to 23 pounds per steer. It took .63 lb. of salt per steer daily to restrict intake of soybean meal to 2 lbs. daily per steer. At the close of a short summer grazing period with no supplement, the steers fed the salt-soybean meal weighed 25 lbs. less than the steers fed daily.

McIlvain *et al.* (1955) reported steer calves hand-fed 2 lbs. of cottonseed cake daily during the winter gained 334 lbs. each for the year on native grass; steers fed a salt-cottonseed meal mixture gained 318 lbs., 16 lbs. less. The 16-lb. reduction during the winter feeding period persisted through the summer. It required about 5/8 lb. of salt to each 2 lbs. of cottonseed meal to limit meal intake to 2 lbs. per steer. No ill-effects from the high salt intake were noted.

From the above two trials, it appears that one willing to accept slightly reduced gains may use salt to limit intake of feed by young cattle on winter pasture.

Smith *et al.* (1960 and 1961) compared feeding salt-protein blocks with salt-protein loose mixtures to calves on winter bluestem pasture. Both groups merely maintained their initial weights during the 137-day period. The blocks and mixtures were nearly identical in composition, containing mainly soybean meal and salt. Total intake per head daily varied from 1.74 to 2.42 lbs. Salt content varied from 0 to 20% in the blocks and 10 to 25% in the loose mixture in an attempt to keep intake equal and under 2 lbs. per head per day.

Rowden *et al.* (1960) reported winter gains per head of 59 lbs., 62 lbs., and 76 lbs., respectively, for calves grazing native range supplemented with alfalfa hay daily, twice weekly, and weekly (the average intake was 4 lbs. per head per day). Winter and summer grazing gain (no hay in summer) combined was 331 lbs., 310 lbs., and 326 lbs., respectively.

Rothlisberger *et al.* (1962) found no difference in gain by calves fed protein cubes daily or weekly when grazing native winter range. The calves fed daily received 1 lb. of cubes/head/day; those fed once weekly received 7 lbs., with no digestive disturbances. Their comparison of feeding alfalfa hay daily (4 lbs./head) with once weekly feeding (28 lbs.) gave a small difference in favor of those fed daily, 97 lbs. gain/head for the winter vs. 78 lbs.. For winter and summer (grass only in summer) combined, it was 313 lbs./head vs. 295 lbs.

McIlvain and Shoop (1962) fed cottonseed cake daily, every third day, and weekly to steer calves on native winter range. The rations per feeding usually were 1.5, 4.5, and 10.5 lbs. per steer, respectively. All lots of steers received the same weekly quantity of feed regardless of feeding interval. Average winter gains were 49, 44, and 38 lbs. per steer, respectively; with year-long gains on grass of 348, 340, and 342 lbs., respectively. No digestive disturbances were noted. The lots fed daily and every third day ate all their feed immediately, while those fed weekly usually ate all their ration the feeding day on cold rainless days, but on some rainy or warm days it was eaten by the 2nd or 3rd day.

The above tests showed that young grazing cattle responded nearly as well to every other day or weekly feeding of winter supplement as to daily feeding. Fewer feedings save time, energy, and equipment.

Section 5:

Supplemental Phosphorus and Vitamin A for Calves Grazing Bluestem Pasture

Grasses vary widely in phosphorus content. Clippings of Kansas bluestem pasture forage usually contain about .1 % phosphorus in summer and about half that amount in winter. Young cattle's requirement for phosphorus varies with rate of gain; .18% (6 grams/head/day) for zero gain to .28% (16 grams/head/day) for 1.5 lbs./head/day, and more phosphorus for faster growth rates.

Supplemental phosphorus usually is supplied by materials that also supply calcium, such as dicalcium phosphate or bone meal. And supplemental feed like protein concentrate, grain, or roughage fed during the winter also contains phosphorus. A pound of soybean meal supplies 3 grams of phosphorus; a pound of grain 1.5 grams; and a pound of alfalfa hay, 1.0 gram.

In two trials at the Kansas Agricultural Experiment Station (Smith *et al.,* 1964, 1965) calves grazing winter bluestem pasture were

fed daily per head, 1 lb. of soybean meal and 1 lb. of grain with and without dicalcium phosphate as an additional phosphorus source. The intake of phosphorus from the grain and soybean meal was 4.5 grams daily, the dicalcium phosphate increased the intake to 13 grams daily. No gain response was obtained from the dicalcium phosphate. Other work in Kansas (Drake, 1965) with young growing cattle supplied different levels of phosphorus showed no gain response. Low performance by the cattle may be a reason for lack of response. Additional phosphorus may not be needed when little gain is expected, and supplemental feed for higher gains would supply some additional phosphorus, whether enough or not is unknown.

In two trials at the Kansas Agricultural Experiment Station, Manhattan, calves fed native range forage harvested as hay in August (.11% phosphorus) and fed with 5 lbs./head/day of concentrate feed (Smith *et al.,* 1963 and 1964) gave no significant response to dicalcium phosphate, which increased the phosphorus content of the ration from 14 grams to 22 grams/head/day.

Although the native forage sampled in the above trials was deficient in phosphorus for the animals' requirement, they did not respond when additional phosphorus was supplied. Until additional research shows otherwise, supplying supplemental phosphorus under the above conditions is questionable.

Phosphorus supplementation under range conditions is a regional problem. For example, Knox and Watkins (1942) reported excellent gain responses from supplemental phosphorus and calcium under New Mexico range conditions. However, Marsh *et al.* (1959) reported that phosphorus supplementation was not necessary under range conditions at Miles City, Montana.

We got no gain response from supplying vitamin A (10,000 IU/head/day) to calves grazing bluestem pasture in winter and fed soybean meal and sorghum grains. The requirement varies from 8,000 to 23,000 IU/head/day depending on gain. Carotene (provitamin A) in the grass and stored in the body apparently met the vitamin A requirement at the level of performance in these trials.

In other trials where native range forage harvested as hay in August was fed (Smith *et al.,* 1963 and 1964), there was no response to vitamin A supplements.

The response to vitamin A supplementation would vary depending on the content in the native range forage, amount stored by the animal, and other factors. In the trials reviewed here, there was no gain response from supplemental vitamin A.

Section 6:

Early Summer Supplementation

Most pastures peak in nutritive value in early summer so growing cattle are expected to make their best gain from forage then. There is not as much room for improvement in gains with supplemental feed then. Later gains drop as energy and protein levels in the grass become lower.

Brethour (1980) feeding 2 lbs. of wheat per head daily on short grass range from May 1 to August 29, increased steer gains .17 lb./head/day (Table 5). Clanton (1971) reported feeding 2 lbs./head/day of a concentrate to steers on grass at North Platte, Nebr. (Table 5).

Table 5. Results from early summer supplementation of young grazing cattle (May-August)

	Gain lbs./head/day	
	No supplement	Two lbs. concentrate hd/day
Brethour (1980)	1.45	1.62
Clanton (1971)	1.80	2.07
Average	1.63	1.85

He increased protein content of the supplement from 8 or 10% early in the season to 12% at mid summer and increased gains .27 lb./head/day from late May to August. Average increase in gain for the two trials from supplementing grass in early summer was .22 lb./head/day.

Baker (1937) who fed steers on native range at North Platte, Nebr. (7.74 lbs. of corn per head daily) from May to July (79 days) got 1.62 lbs. of daily gain per steer compared with 1.16 lbs. for unsupplemented steers. The steers had gained 1.65 lbs./head/day in the winter and were fleshy at the start of summer. Corn in-

creased early summer gain .46 lb./steer/day, so it took 16.8 lbs. of corn/lb. of gain (7.74 ÷ .46 = 16.8 lbs.), not efficient conversion of concentrate to gain. Less supplement is more efficient.

Denham (1977) fed various levels of energy in a 26% digestible protein feed on short grass range in Colorado for 30 days at the start of the grazing season (late May and early June) and increased gain per steer from 1.39 to 1.78 lbs./head/day with 1 lb. of supplemental feed; 2 lbs. of supplement increased gain to 1.96, but more supplement gave no additional gain. Response was excellent to early-summer, short-term feeding on grass. Based on this limited information, lower levels for a short period in early spring may have the greatest merit.

Section 7:

Late Summer Supplementation

Young cattle grazing late summer grass usually perform better when supplied a concentrate feed like grain, a protein supplement, or combination, but the response may not offset the expense of feeding.

Smith *et al.* (1957) got an average increase in gain of .30 lb./head/day on bluestem pasture at Manhattan, Kans., by feeding 2 lbs. of feed/head/day for 70 days from August to October (Table 6). Unsupplemented steers gained 1.28 lbs. head/day, those fed soybean meal 1.66 lbs. head/day, and those fed corn 1.49 lbs. head/day.

Launchbaugh (1957) fed 1.5 lbs. of cottonseed meal per steer daily from August to October on native short grass at Hays, Kans., and increased steer gains .50 lb./head/day over those grazing unsupplemented grass. In one year of eight, when rainfall was above normal and the forage was green, the cattle failed to respond to supplemented feed. Brethour and Duitsman (1966) at Hays reported sorghum grain gave as good response as cottonseed meal in years of average or below average precipitation.

McIlvain *et al.* (1955) reported that feeding 1 lb. of cottonseed cake per steer daily from July to October increased gain .26 lb./steer/day on native range at Woodward, Okla., with no advantage when the grass was green all summer two of the eight years for them. In trials by Brethour and Duitsman (1970, 1974, 1975), very little response was obtained from feeding 1.5 lbs. per head daily of a protein concentrate to steers on native short grass pasture or from self-feeding a urea-ammonium, polyphosphate-molasses mixture.

Table 6 summarizes some of the above trials. It shows an average response of .35 lb./steer/day from late summer supplements of 1 to 2 lbs. of feed daily per animal. Because many variables are involved, response may vary with condition of the cattle, pasture, type of feed, and level fed. When the forage remains green all summer, there may be no response from late summer supplements.

Table 6. Response to late-summer supplementation

	Increased daily gain (lbs./head/day) from feeding 1-2 lbs. of supplement feed per animal/day in late summer, July or August to October
Smith *et. al. (1957)*	.30
Launchbaugh (1957)	.50
McIlvain *et al.* (1955)	.26
Average	.35

Heavier supplementation has not given the economic response of lower levels. Brethour and Duitsman (1966) fed 4.8 lbs. of rolled sorghum grain and 1.5 lbs. of cottonseed meal daily per steer in August and September and increased daily gain only .38 lb. over that by steers receiving 1.5 lbs. of cottonseed meal. It took 12.6 lbs. of grain/lb. of gain with the heavier supplement. Grass consumption may not be affected appreciably by light supplements, while heavy supplementing combined with a feed additive like monensin may reduce grass intake enough so heavier stocking rates could be used. That would enhance the value of heavier supplementing.

Denham (1977) supplemented steers with .5 lb. of soybean meal and 1.5 lbs. corn/steer/day on native range in eastern Colorado for 32 days at the close of the grazing season in September when protein was 7 to 10% in the grass. Daily gain increased from .59 lb. for unsupplemented steers to 1.12 lbs./steer/day, an

excellent response for a short period. Additional protein and energy gave no more favorable gain response.

Based on information to date, the most desirable feeding level for late summer probably is 1 to 2 lbs. of a grain-protein mixture feed/head/day.

Feeding costs and cattle prices often determine if late summer feeding would be profitable.

Table 7 shows the return above feed costs under various prices. For example, if the weight gain produced by supplemental feeding would be .35 lb./day/steer, at 60 cents/lb. the value of the daily increase in gain is: .35 x $.60 = $.21. If daily feed cost is 16 cents for 2 lbs. of feed, the return for labor and feeding equipment would be: $.21 - $.16 = $.05, or $2.50 a day for 50 steers.

A summary of research trials (Section 9) shows the feed additive, monensin, increased cattle gains an average of .11 lb./head/day. If that increased gain is added to the additional gain (.35 lb./head/day) from feeding 2 lbs. of supplemental feed/head/day on pasture in late summer, the total would be .46 lb./head/day increased gain over nonsupplemented cattle grazing late summer range.

The additional costs of the monensin, feed, and feeding need to be considered when deciding to supplement. Table 8 shows the return above feed and material cost for feeding

Table 7. Return above feed costs for late-summer feeding on grass, cents/head/day[1]

Feed cost cents/head/day for 2 lbs. feed	Value of additional gain, cents/lb.						
	30	40	50	60	70	80	90
8	2	6	10	13	17	20	24
10	1	4	8	11	15	18	22
12	- 1	2	6	9	13	16	20
14	- 3	0	4	7	11	14	18
16	- 5	- 2	2	5	9	12	16
18	- 7	- 4	0	3	7	10	14
20	- 9	- 6	- 2	1	5	8	12
22	-11	- 8	- 4	- 1	3	6	10
24	-13	-10	- 6	- 3	1	4	8

[1] Assuming 2 lbs. feed/head/day increases gain .35 lb./head/day.

Table 8. Return above feed costs for late-summer feeding on grass with feed additive like monensin included in the supplement, cents/head/day[1]

Feed cost cents/head/day for 2 lbs. feed	Value of additional gain, cents/lb.						
	30	40	50	60	70	80	90
8	6	10	15	20	24	29	33
10	4	8	13	18	22	27	31
12	2	6	11	16	20	25	29
14	0	4	9	14	18	23	27
16	- 2	2	7	12	16	21	25
18	- 4	0	5	10	14	19	23
20	- 6	- 2	3	8	12	17	21
22	- 8	- 4	1	6	10	15	19
24	-10	- 6	- 1	4	9	13	17

[1] Assumihg 2 lbs. feed/head/day containing a feed additive like monensin increases gain .46 lb./head/day.

monensin with 2 lbs. of supplemental feed in late summer on grass.

For example, if gain is increased .46 lb. per head daily in late summer by feeding 2 lbs. of feed containing monensin daily and the gain is worth 60 cents/lb., the return per head is $.276 (.46 lb. x $.60 = $.276). If the 2 lbs. of feed (containing monensin) cost is $.18/head/day, then the return per head to pay for labor and equipment is $.096 ($.276 - $.18 = $.096) or nearly 10 cents, or $5 for 50 head.

Each producer may find it best to use his estimates of gain and prices for his conditions.

Section 8:

Supplementing Pasture All Summer

The best of grazed forages are usually lower in energy than cereal grains so there is potential to increase gains of young cattle on pasture by supplying additional energy and other nutrients.

Clanton *et al.* (1971) fed steers various levels of supplement containing from 8 to 36 percent protein on native grass at North Platte, Nebr., from late May or early June to August or September (Table 9). Lane *et al.* (1974) fed various levels of energy (mostly corn) for 120 days to steers grazing irrigated pastures of orchardgrass, bromegrass, and alfalfa (Table 9). Embry (1973 and 1976) and Embry and Bush (1979) fed various levels of corn to steers and heifers grazing irrigated alfalfa, bromegrass, and intermediate wheat grass (Tables 9, 10, 11, 12). The above trials reviewed (Table 11) show the best response (gain per lb. of feed consumed) to supplemental feeding on grass all summer was from 1 to 2 lbs. of feed per head daily. But the number of trials reported under each level are few and results variable. For example, in Table 9 where 1 lb. of supplement per head daily was compared to grass only, Clanton (1971) demonstrated increased gain of .29 lb. per head daily on native grass. However, Lake *et al.* (1974) reported only a .16 lb. increase from animals grazing irrigated pasture, so the average for the two trials is .23 lb. per head/day.

Monensin added to the supplement being fed on grass (Table 12) increased average gain .14 lb./head/day. When added to the gain of .12 lb. (Table 12) from grain, the gain increase averaged .26 lb./head/day from feeding a supplement containing monensin all summer on grass.

These results differ from those reported in Section 9 where monensin increased gain .11 lb./head/day and from Section 7 where it was assumed that late-summer supplementation of grass would increase gain .35 lb. per animal/day, making a total increase of .46 lb./head/day. A larger response from supplementing would be expected from late-summer feeding than from feeding all summer. Late-summer forage usually is lower in nutritive value.

Section 9:

Feeding Monensin

Monensin (Rumensin®) is a biologically active compound produced by streptomyces cinnamonensis and when consumed by cattle alters the volatile fatty acid profile and improves feed efficiency of feedlot cattle. Its effectiveness under various grazing management situations has been tested at many research stations. Supplying monensin to grazing animals has been a problem because many are supplemented with only salt or minerals. This reviews some grazing trials in which quality of vegetation and method of supplying monensin were considered.

Table 13 shows an average gain increase of .11 lb. per animal daily for a 19-trial average for hand feeding a monensin-containing supplement of 1 lb. or more per head daily. Gains were affected negatively and positively, from .44 lb./head/day loss to .35 lb./head/day gain advantage for an average advantage of .11 lb./head/day (Table 13). Vegetation type did not seem to affect response to monensin. A similar gain increase was obtained when a monensin supplement was self-fed to animals grazing good quality forage.

When a monensin-containing supplement of 1 or more lbs. per head daily was hand-fed to cattle grazing low quality forage (Table 13), the increase in gain was about the same as in previous reviewed tests, but total daily gains were lower, .67 lb. head daily versus .79 lb. for those receiving monensin.

From the trials reviewed here, a monensin supplement fed at the rate of 1 lb. or more per head daily gave about the same response whether hand-fed or self-fed to animals grazing good quality forage. Even when the self-fed

Table 9. Supplementing pasture all summer, feed and gain in lbs/head/day

	Daily		
	No supplement	1 lb. supplement	Increase in gain due to supplement
Clanton *et al.* (1971)	1.64	1.93	.29
Lake *et al.* (1974)	1.38	1.54	.16
Average	1.51	1.74	.23
		2 lbs. supplement	
Clanton *et al.* (1971)	1.73	2.05	.32
Lake *et al.* (1974)	1.38	1.54	.16
Average	1.56	1.80	.24
		3 lbs. supplement	
Clanton *et al.* (1971)	1.80	2.10	.30
Lake *et al.* (1974)	1.43	1.65	.22
Embry (1973)	1.41	1.75	.34
Average	1.55	1.83	.28
		4 lbs. supplement	
Lake *et al.* (1974)	1.38	1.88	.50
Embry (1976)	1.14	1.39	.25
Average	1.26	1.64	.38
		6 lbs. supplement	
Lake *et al.* (1974)	1.43	1.87	.44
Embry (1973)	1.41	1.91	.50
Average	1.42	1.89	.47
		8 lbs. supplement	
Embry (1976)	1.20	1.60	.40
Embry and Bush (1979)	1.10	1.51	.41
Average	1.15	1.56	.41

supplement intake was less than .5 lb. per head daily, response to monensin was favorable. Where low quality forage was grazed and 1 lb. or more of a monensin-containing supplement was fed, gains also were increased slightly, .12 lb. per head daily.

In two trials (Table 13) monensin self-fed to cattle grazing low quality vegetation improved gain little or none. Monensin intake was low in one of the two trials (Table 13).

Additional information is needed to explain why an excellent gain response to monensin is obtained in some grazing trials but not in others.

Table 10. Full feeding grain on pasture

	Gain lbs/head/daily			
	No grain	Full feed of grain	Increase in gain due to grain feeding	lbs. of grain consumed daily/animal
Embry (1976)	1.20	2.19	.99	14.1
Embry and Bush (1979)	1.10	2.10	1.00	14.6
Average	1.15	2.15	1.00	14.4

Table 11. Summary of levels of feeding[1]

Level of feeding on grass, lbs.	Pounds of feed required per lb. of gain based on gains in tables 9 and 10
1	4.3
2	8.3
3	10.7
4	10.5
6	12.8
8	19.5
14.4	14.4

[1] Values are averages from Table 9 and 10.

Section 10.

Methods of Feeding on Summer Pasture

Producers who grow cattle on summer pasture usually prefer not to supplement with other feed because of the labor and inconvenience involved in feeding the cattle each day. But for years they have been interested in using feed intake-limiting agents, such as salt, fat, or other materials to hold feed intake to a desired level without daily feeding. They also have been interested in periodic feeding, less often than daily, to reduce labor requirements.

McIlvain *et al.* (1955) reported steers gained about the same (6 lbs. per steer less) for a 90-day, late summer period on native grass when self-fed a salt-cottonseed meal mixture than when hand-fed cottonseed meal daily. It required about .5 lb. salt/head/day to limit cottonseed meal intake to 1 lb./head/day by yearling steers.

Wise *et al.* (1965) limited grain intake of steers grazing fescue-ladino clover pasture to 1 lb. of grain per 100 lbs. of body weight by adding 10% yellow stabilized animal grease to the grain ration.

When Berger and Clanton (1979) hand fed a supplement containing monensin and self-fed a supplement with and without monensin from May 31 to September 30 on native range, average daily gain/steer in lbs. was 1.95, 1.91, and 1.81, respectively. Salt controlled supplement intake by the self-fed groups to about 1 lb./head/day. Self-feeding was as satisfactory as hand-feeding. Less salt was needed to control intake initially for the monensin-fed steers,

Table 12. Feeding monensin all summer, feed and gain in lbs./head/day

	Daily gain		
	No grain no monensin	2 lbs. grain only	2 lbs. grain and 200 mg monensin
Brethour (1980)	1.45	1.62	1.59
Stewart *et al.* (1979)	.93	1.00	1.17
Oliver(1975)	1.01	1.23	1.55
Anthony *et al.* (1975)	1.39	1.43	1.54
Average	1.20	1.32	1.46

Table 13. Results from supplementing stockers with monensin

Hand-fed to stockers grazing good quality vegetation with 1 lb. or more supplement

		Supplement intake lbs/hd/day		Monensin intake mg/hd/day	Gain lbs/hd/day	
Researcher	Vegetation type	No monensin	Monensin	Monensin	No monensin	Monensin
Oliver (1975)	Bermudagrass	2.0	2.0	200	1.24	1.56
Anthony *et al.* (1975)	Bermuda	1.0	1.0	200	1.43	1.54
Potter *et al.* (1976)	Orchard,	1.0	1.0	200	.81	1.12
	Alfalfa-brome	1.0	1.0	200	1.23	1.58
	and ladino	1.0	1.0	200	1.50	1.72
		1.0	1.0	200	1.54	1.50
Schwartz *et al.* (1977)	Native short-grass	2.0	2.0	100	1.86	2.12
lbbetson (1978a)	Brome	4.0	4.0	150 or 200	1.89	2.05
Horn *et al.* (1978)	Wheat pasture	2.0	2.0	200	1.67	1.23
Stewart *et al.* (1979)	Fescue, orchard	2.0	2.0	200	1.00	1.17
Crosthwait *et al.* (1979)	Native	1.0	1.0	200	1.67	1.71
Armbruster *et al.* (1980)	Native tallgrass	5.0	5.0	200	1.84	2.00
Brethour (1980)	Native short-grass	2.0	2.0	200	1.62	1.59
Horn *et al.* (1979)	Wheat pasture	2.0	2.0	100	1.40	1.61
	Wheat pasture	2.0	2.0	100	1.23	1.38
Byers *et al.* (1979)	Alfalfa-orchard	1.0	1.0	200	1.65	1.87
	Alfalfa-tall fescue	1.0	1.0	200	1.70	1.63
	Alfalfa-tall fescue	1.0	1.0	200	1.70	1.65
	Alfalfa-tall fescue	1.0	1.0	200	1.89	1.87
Average daily gain per animal					1.52	1.63

Self-fed to stockers grazing good quality vegetation with supplement intake of about 1 lb. or more

	Supplement intake lbs/hd/day		Monensin intake mg/hd/day	Gain lbs/hd/day	
Researcher	No monensin	Monensin	Monensin	No monensin	Monensin
Berger and Clanton (1979)	.99	.83	166	1.81	1.91
Brethour (1976)	4.00	4.00	200	1.80	1.97
Av. daily gain per animal				1.81	1.94

Self-fed to stockers grazing good quality vegetation with supplement intake less than 0.5 lb. daily

	Supplement intake lbs/hd/day		Monensin intake mg/hd/day	Gain lbs/hd/day	
Researcher	No monensin	Monensin	Monensin	No monensin	Monensin
Schwartz *et al.* (1977)	.26	.32	123	1.32	1.60
Smith *et al.* (1978)	.29	.29	116	1.66	1.67
lbbetson and Johnson (1979c)	.40	.24	42	.89	1.06
Cmarik and Weichenthal (1979)	.36	.22	86	.74	.93
Ritter *et al.* (1979)	.26	.11	89	1.62	1.74
Ritter *et al.* (1979)	.31	.16	131	1.64	1.61
Av. daily gain per animal				1.31	1.44

Hand-fed to stockers grazing low quality vegetation with supplement intake of about 1 lb. or more

	Supplement intake lbs/hd/day		Monensin intake mg/hd/day	Gain lbs/hd/day	
Researcher	No monensin	Monensin	Monensin	No monensin	Monensin
lbbetson and Chyba (1978)	.90	.81	200	.62	.76
lbbetson and Johnson (1979b)	1.0	1.0	200	.84	1.04
Gerken and McClure (1979)	2.0	2.0	200	1.16	1.30
Apple and Gill (1977)	2.0	2.0	200	1.31	1.60
Crosthwait *et al.* (1979)	4.0	4.0	200	.94	1.01
Horn *et al.* (1980)	2.0	2.0	150	- .02	.12
Horn *et al.* (1980)	2.0	2.0	150	.24	.41
Armbruster *et al.* (1980)	3.0	3.0	200	.23	.11
Av. daily gain per animal				.67	.79

Self-fed to stockers grazing low quality vegetation with supplement intake of less than 0.5 lb. daily

	Supplement intake lbs/hd/day		Monensin intake mg/hd/day	Gain lbs/hd/day	
Researcher	No monensin	Monensin	Monensin	No monensin	Monensin
Horn *et al.* (1978)	.13	.09	36	.66	.70

Self-fed to stockers grazing low quality vegetation with supplement intake of a lb/hd/day or more

	Supplement intake lbs/hd/day		Monensin intake mg/hd/day	Gain lbs/hd/day	
Researcher	No monensin	Monensin	Monensin	No monensin	Monensin
Huston *et al.* (1979)	2	2	200	.34	.31

but eventually about 30% salt was needed for both self-fed groups to control supplement intake at 1 lb./head/day.

Ibbetson (1978b) compared hand feeding and self-feeding a monensin-(200 mg/head/day)-containing supplement to steers grazing brome pasture from July 7 to October 27. The hand-fed steers consumed 1 lb. per head daily of the grain-soybean meal mixture (18% protein). A mixture of 50% salt and 50% dicalcium phosphate was available free choice. The self-fed steers were started on a ration containing 76% grain mixture, 19% salt, and 5% dicalcium phosphate. Salt was increased to 30% and dicalcium phosphate to 8% to control intake of the self-fed group. Total intake of the self-fed group was 1.30 lbs./head/day. Soybean meal was removed from the mixture of both groups after the steers started eating. Daily gain per steer was .94 lb. for the hand-fed and 1.12 lb. for the self-fed group.

The above review indicates that salt may be used satisfactorily to limit supplement intake on summer pasture with little reduction in performance. Under most conditions that would save considerable time and equipment, but the extra salt consumed increases costs somewhat.

Ibbetson and Johnson (1979a) compared feeding 1 lb. of feed daily (200 mg monensin/lb.) with feeding 2 lb. of feed (200 mg monensin/lb.) every other day for 112 days on fescue pasture. Gains were about the same, 1.30 and 1.28, respectively. The supplement was composed of 73% corn, 10% dehydrated alfalfa, 10% wheat midds, 5% molasses, and 1% salt with and without monensin.

In another study, Ibbetson and Johnson (1979b) fed steers on brome pasture from September 30 to June 4: 1 lb. of cubes per head daily; 1 lb. of cubes per head daily and 200 mg monensin; or 2 lbs. cubes and 400 mg monensin per head every other day. Gains were .84, 1.04, and 1.03 lbs./head/day, respectively.

From those results, feeding every other day on summer pasture is as satisfactory as daily feeding.

Section 11:

Implants

Several growth-promoting agents have been administered in pellet form to grazing cattle by implanting under the skin of the outside surface of the ear to increase growth rate. Diethylstilbestral (DES) implants improved pasture gains 10 to 15%, but DES is no longer approved for use in cattle.

Boggs *et al.* 1976) compared DES, Ralgro®, and Synovex implants for steers grazing summer pasture and found gain responses to be the same. Ward (1977) summarizing growth trials with all three implants, reported a 15% improvement in weight gain with little difference among them. Several tests have shown steers grazing summer pasture implanted with Ralgro or Synovex gain 10 to 15% more than those not implanted.

Armbruster *et al.* (1980) compared a 30 mg DES implant with Ralgro and no implant for yearling steers grazing winter native range for 118 days; the gains/head/day were .24, .15, and .11, respectively. The DES increased gains, Ralgro had little effect.

No tests were found where Ralgro or Synovex were used in a year-round grazing program, implanting in the fall and again in the summer.

Pruitt *et al.* (1978) implanted 550-lb. steers grazing summer bluestem with Ralgro May 1

and July 15 and compared results with a May implant only. The growing season extended to September 30 (155 days). Daily gains were about the same, 1.5 lbs./head with no increase from reimplanting July 15. Sewell *et al.* (1980), who compared two Ralgro implants (initial and at 100 days) with three implants (initial, 65 days, and 100 days), reported equal gain responses on summer pasture.

Additional research is needed on implanting cattle on winter pasture and reimplanting in the spring and at mid summer on summer pasture.

Section 12:

Fly Control

In two trials where Brethour and Duitsman (1972 and 1973) forced steers to use dust bags, they gained an average of 22 more lbs. each for the summer. The fly-control dust bags were enroute to salt. McIlvain *et al.* (1955) reported that over a 5-year period an average 16 lb. summer gain increase per steer was obtained by spraying steers each month during the summer to control horn flies. According to these reports, controlling flies will increase summer gains of young grazing cattle.

Kohler and Embry (1979) obtained good horn-fly control with either 1 or 2 insecticide-treated ear tags per animal. Treated heifers gained .17 lb. more per head daily for the first 56 days, but .13 lb. at 90 days and only the same as untreated animals by 133 days. During the last 44 days, with few flies, heifers not treated compensated for their earlier lower gains. A redeeming factor about young, growing cattle is that they often compensate for depressed gains if given the opportunity.

Hall *et al.* (1980) reported controlling horn flies most of the season with a single insecticide-impregnated ear tag on one-third of the animals in a herd.

Section 13:

Burning

The results from planned burning of pasture vary so much by region depending on type of vegetation, soil and rainfall that the comments here will be limited to the bluestem pasture region of eastern Kansas and the effect on cattle performance.

In the bluestem pasture region of eastern Kansas (about 4 million acres) late-spring burning is a recommended practice. A major reason for recommending late-spring burning is the prevention of the establishment of woody species such as red cedar *(Juniperus virginiana* L.). It also has been shown to increase cattle weight gain as shown in Table 14. Late-spring burning (late April at Manhattan, Kansas) produced more weight gain than non-burning or early-spring burning (March). Burning date is important in regard to the effect on vegetation and cattle performance. It should be as late as possible so bare soil will be exposed for a minimum period, but not so late as to injure new grass growth. Based on the daily gains shown in Table 14, late-spring burning produced about 25 lbs. more weight gain per steer than nonburning. Late-spring burning is one management practice which gives an excellent return for the effort expended. For more information see: Anderson, K.L., E.F. Smith, and C.E. Owensby. 1970. Burning Bluestem Range. J. Range Manage. 23:8 1.

Section 14:

Intensive-Early Stocking

Grassland areas vary in their response to management practices such as intensive-early stocking. This practice entails placing twice as many cattle on an area in the early growing season as usually recommended for the entire grazing season and removing them from the

Table 14. Effect of burning on average monthly steer gains (lb./head/day) (16-year summary 1950-65)

	May	June	July	Aug.	Sept.	Avg.
Unburned	1.83	1.74	1.59	1.24	1.44	1.53a
Early-spring burned	2.42	1.90	1.56	1.13	1.23	1.57 ab
Mid-spring burned	2.50	2.01	1.64	1.28	1.19	1.64 bc
Late-spring burned	2.36	2.06	1.75	1.28	1.28	1.70 c

a,b,c Two means not bearing a common superscript differ significantly ($P < .05$).

pasture at mid-season to allow the pasture to recover.

This practice in the bluestem pasture region of Kansas maintained grass production and favored the more desirable warm-season perennial grasses. Cattle daily gains were slightly improved, 1.88 versus 1.75 lbs./head/daily (Table 15). Gain per acre was much greater, 83 versus 62 lbs., because this grazing practice used grass when it was highest in nutritive value. The gain per steer was lower for intensive-early stocking (May 2 to July 15) than for season-long stocking (May 2 to October 3) because they were grazed for only half the season. The cattle must be removed at mid-season for grass recovery and this may be a problem for some who wish to hold the cattle longer. The animals could be moved to other grazing or the feedyard. Certainly not all producers will find this fits their operation but it is an option to consider. For more information see: Smith, Ed F. and Clenton E. Owensby. 1978. Intensive-Early Stocking and Season-Long Stocking of Kansas Flint Hills Range. J. Range Manage. 31:14.

Table 15. Steer gains on intensive-early stocked and season-long stocked pastures.

	Intensive-early stocked	Season-long stocked		
	May 2-July 15 75 days	May 2-July 15 75 days	July 15 Oct. 3 79 days	May 2-Oct. 3 154 days
No. of steers, 3 yr total	104	52	52	52
Acres per steer	1.7	3.4	3.4	3.4
Gain per steer (lb.), avg.	141	131	79	210
Daily gain per steer (lb.), avg.	1.88a	1.75b	1.00c	1.36d
Gain per acre (lb.), avg.	83	39	23	62

a,b,c,d Values in same row with different letters differ significantly ($P<.05$).

Literature citations for studies mentioned in this bulletin are available on request from the author.

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