Dick Venne

Range cow supplementation

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California annual rangeland pasture is generally poor in the fall and in short supply during winter. To correct deficiencies and maintain acceptable performance, ranchers usually provide supplemental nutrients to the range beef cow herd during the later part of the dry forage season (July to October) and the inadequate green forage season (October to January). Low profit margins, rising costs of supplemental feed and labor, and other expenses involved in distribution make the decision to supplement an important one.

Feeding an average of 380 pounds of cottonseed meal per cow per year resulted in 115 extra pounds of weaned calf per breeding cow in an 11-year research project at the San Joaquin Experimental Range. A five-year study, however, by J. G. Morris at the University of California Sierra Foothill Range Field Station indicated that supplementary feeding was unlikely to be profitable when the range was moderately stocked.

We conducted a three-year study beginning in July 1983 to evaluate the effects of four common supplemental feeds—alfalfa hay, cottonseed meal/salt mix, commercial block (made with molasses as the base, cottonseed meal, fish solubles, and urea) and commercial liquid supplement (molasses base plus urea)—on cow and calf performance, including reproduction and growth traits. The costs of handling, storing, and distributing the four supplements were also compared to determine the net cost of feeding each supplement.

Experimental range

The San Joaquin Experimental Range, where our trial took place, is near the center of the state in the Sierra Nevada foothills. It is in Madera County, 28 miles north of Fresno.

The terrain consists of grassy rolling hills with a scattering of oak and pine trees and occasional dense stands of brush. The most important forage species are soft chess (*Bromus mollis*), ripgut brome (*Bromus diandrus*), filaree (*Erodium* spp.), and clovers (*Trifolium* spp.). Seeds of most of these plants germinate with the first 0.5 to 1 inch of fall rain; they grow slowly during the winter, then rapidly when warm temperatures return in March. Most reach maturity in April and are dry by mid-May.

Winters are usually mild and rainy in this region, and summers are hot and dry. Rainfall and forage production during our trial were highly variable. In the 1982-83 season, rainfall was the highest ever recorded at the San Joaquin Experimental Range—37.4 inches or 197 percent of the average of 19.3 inches. Forage production that year was about 3,600 pounds per acre, or 51 percent above the average of 2,400 pounds. In 1983-84 and 1984-85, rainfall, at 16.3 and 13.6 inches, was 86 and 72 percent of normal, respectively. Forage production during those two seasons, at approximately 1,800 and 1,700 pounds, was 76 and 70 percent of the average, respectively.

During all three years, the germinating rainfall that marks the beginning of the forage season occurred in late September to mid-October, earlier than the 50-year average date of October 27. The green forage period in 1982-83, starting in late September and continuing well into May, was longer than in the following years. In 1983-84 and 1984-85, the germinating rainfall came in early or mid-October, and the green forage season ended in late April.

Study procedures

We used 120 fall-calving cows obtained from the California State University, Fresno, herd at the San Joaquin Experimental Range. At the beginning of the trial, 55 percent of the cows were three and four years old and the rest were seven to ten years old; all were English or English crossbreeds. Bulls were predominantly Brahman or Angus.

Management of the cows remained constant throughout the study except for supplement treatment. The cows were randomly allotted within age, breed, and expected calving date to four treatment groups of 30 animals each. The treatment groups were alfalfa hay, cottonseed meal/salt mix, commercial liquid supplement, and commercial block supplement (table 1). The group on cottonseed meal/salt mix served as the positive control.

The supplement period began each year in mid-July and ended in mid- to late January, when green forage growth was sufficient. All cows grazed annual range with a stocking rate of approximately 15 acres per cow. Treatment groups were rotated among pastures at every weigh day to reduce pasture effects.

Cow weights were recorded and body condition evaluated at the start of the supplemental feeding period, before calving, at the end of the supplement period, and at weaning of the calves.

The cottonseed meal/salt mix was regulated to allow a daily consumption of approximately 2 pounds per head. The commercial liquid supplement was fed in a lick tank and consumption controlled at approximately 2 pounds per head daily. Alfalfa hay was fed at a rate of 2.5 to 3 pounds per head daily during July and August, increasing to 6 pounds in September, then 10 to 15 pounds in October until the end of the supplement period in January. The alfalfa hay was reduced to 4 pounds in December in the second and third years, because some of the cows had been removed for artificial insemination, leaving more forage for the remaining animals. The commercial blocks were placed in strategic locations in the fields to permit consumption of 2 pounds per head daily.

Each supplement treatment group of 30 cows was bred in three groups at 10 intervals, beginning in early December. Cows were assigned to three groups of 10 head each, based on days postpartum. All cattle were synchronized with prostaglandin (lutalyse). After artificial insemination, cows were returned to the respective feeding groups and bulls were placed with the cows until weaning (June 1-15).

Cows culled for not conceiving during the normal breeding season or for other health reasons were replaced with three-year-old cows that had weaned one calf.

The data were statistically analyzed (by analysis of covariance) adjusting cow weight data for initial weight differences at the beginning of the trial. To determine supplement effect over time, the analysis included only cows that were in the trial for the entire three years.

Management of the calves was identical for all groups throughout the study. Between January 1 and 15 of each year, all calves were processed, following customary procedures. They were weighed at birth and in early May for 205-day weights. They were not weaned until early June, except in the third year, when all were weaned in early May.

During the dry forage period, usually July through early October, livestock use of the pastures was recorded by mapping residual dry matter (RDM) classes of high, moderate, and low. Visual estimates of RDM weight in pounds per acre was supported by clipping and weighing a few plots.

Results

Cow weight changes. On average, cows gained weight from July to September, lost weight from calving to the end of the supplement period, and gained weight during the nonsupplement, green feed period from January to June (tables 2-4). Compensatory gains may partially explain the high cow gains made during the nonsupplement period.

Cows in the liquid group lost significantly more weight during the supplement period than all other groups in the second and third years, and more than the block and hay groups during the first year (table 3). Cows in the liquid group also gained the most weight in the nonsupplement period in the second and third years (table 3).

Calf performance. Calf weaning weights varied significantly between years, as did adjusted 205-day weights (table 4). Male calves were significantly heavier than female calves, as would be expected, but there was no treatment effect on birth weight, weaning weight, or adjusted 205-day weight.

TABLE 1. Analysis of supplements

	Dry matter	Crude protein	Fat	Fiber	Ash
Hay	90.6	20.8	3.0	27.2	11.3
CMS	95.4	37.4	1.7	7.0	33.3
Liquid	54.7	63.7	0	0	27.6
Block	91.9	30.6	0	0	12.3

TABLE 2. Average daily gain per group

Year 1		Year 2		Year 3	
	lb		*lb*		*lb*
Precalving:					
07/15 - 08/30/83		07/17 - 09/04/84		07/17/85 - 09/05/85	
CSM	0.907 b	Block	0.567 c	Hay	0.595 a
Block	0.412 a	CSM	0.421 ac	CSM	0.555 a
Hay	0.401 a	Hay	0.163 ab	Block	0.485 a
Liquid	−0.030 c	Liquid	0.001 b	Liquid	−0.167 b
Postcalving:					
08/30/83 - 01/23/84		09/04/84 - 01/18/85		09/05/85 - 01/13/86	
Block	−1.012 a	CSM	−0.871 b	Hay	−1.013 b
Hay	−1.077 ab	Block	−1.009 ab	Block	−1.428 a
Liquid	−1.109 b	Hay	−1.113 a	CSM	−1.508 a
CSM	−1.387 c	Liquid	−1.301 c	Liquid	−1.522 a
Total supplement period:					
07/15/83 - 01/23/84		07/17/84 - 01/18/85		07/17/85 - 01/13/86	
Block	−0.671 a	CSM	−0.528 a	Hay	−0.586 b
Hay	−0.723 a	Block	−0.591 a	Block	−0.896 a
CSM	−0.838 b	Hay	−0.775 b	CSM	−0.935 a
Liquid	−0.850 b	Liquid	−0.956 c	Liquid	−1.145 c
Nonsupplement period:					
01/23 - 06/13/84		01/18 - 06/07/85		01/13 - 05/10/86	
Hay	1.015 a	Liquid	1.547 c	Liquid	2.680 b
Liquid	0.984 a	CSM	1.107 b	CSM	2.252 a
CSM	0.925 a	Block	1.037 ab	Block	2.165 a
Block	0.905 a	Hay	0.899 a	Hay	1.824 c

NOTE: Means marked with the same letter are not significantly different at the $P < 0.05$ significance level.

TABLE 3. Average weight losses and gains during supplement and nonsupplement periods

Group	Losses, July - January			Gains, January - June		
	Year 1	Year 2	Year 3	Year 1	Year 2	Year 3
	lb					
Hay	−139 a	−143 b	−105 b	143 a	126 a	213 b
CSM	−161 b	− 98 a	−168 a	130 a	155 b	263 a
Liquid	−163 b	−177 c	−206 c	139 a	217 c	314 c
Block	−129 a	−109 a	−161 a	128 a	145 ab	253 a

NOTE: Figures marked with the same letter are not significantly different at the ($P < 0.05$) significance level.

TABLE 4. Calf weaning and adjusted 205-day weights

Group	Average weaning weights			Average adjusted 205-day weights: Year 1		Year 2		Year 3	
	Year 1	Year 2	Year 3	Steers	Heifers	Steers	Heifers	Steers	Heifers
	lb								
Hay	496	496	487	499	461	539	492	521	500
CSM	482	480	519	495	448	524	461	537	484
Liquid	497	510	525	525	451	551	492	537	529
Block	481	514	531	478	464	561	491	550	449

Reproduction. During the three years, 26 cows were removed because of failure to rebreed, abortion, age, disease, or death. Overall pregnancy rates for the three years were: alfalfa supplement, 98 percent; cottonseed meal/salt, 97 percent; liquid, 96 percent; and block, 91 percent. The differences were not significant, except in the block treatment during year one. These differences in rebreeding rates were particularly evident in younger cows (three years of age).

No major differences in calving interval were observed in the four treatment groups. All four had a shorter calving interval at the end of the study, which can be attributed more to gestation length and timing of breeding than to an effect of feed supplementation.

Forage utilization. Over the three years, the area within residual dry matter classes was similar to the amount of area within land site classes. At the end of the dry forage period, generally October, swales and low slopes were left with low to moderate amounts of RDM, upper or steep slopes with high amounts, and the gentle open rolling slopes with low to high amounts. Supplemental feeding locations also were left with low to moderate residue amounts, as were watering and salting locations. Variations occurred in the percentages within RDM classes between years, but this general pattern occurred throughout the trial.

The changes in residue distribution were not due to differences in actual use of the pastures or supplemental feeding practices, which were similar across the three years. Contributing to the lower residue levels in 1983-84 was the highest grasshopper population in the preceding 40 years.

Mapping of residue throughout the dry forage period revealed the same pattern of use in all years. Cattle preferred the swales and low flat slopes; residues reached moderate or low levels on these sites but were still high on the gentle open rolling slopes. Residues on the rolling slopes were at least to the moderate level before use was detected on the upper steep slopes.

Economics. Amounts reported in table 5 for feed represent direct costs for average consumption of feed for the three years. The cottonseed meal/salt mix was the least expensive, followed by liquid, hay, and block.

Additional costs that need to be considered include labor, equipment, mileage, and general feeding practices. We calculated time and mileage from a central location to completion of a job. Many of these tasks, however, would be performed along with daily activities.

As expected, the daily feeding of alfalfa hay required the most time and mileage. Feeding alfalfa hay, however, provides the greatest control of intake and allows the producer to check the herd regularly. The hay group did stay fleshier during the feeding period, but this advantage was not reflected in condition score, reproduction, or weaning weight.

The cottonseed/salt group appeared to exceed the hay treatment in cost, if the material was picked up weekly. If a large supply could be obtained several times during the season, however, these costs could be considerably reduced.

Overall, block molasses was the most costly product to feed, followed by the hay, cottonseed meal, and liquid. The high cost of block feeding can be partially attributed to its unlimited consumption throughout the supplementation season. Also, feeding requires some labor and mileage. Block supplementation offers convenience, however, and allows the producer to change feeding areas easily. The block-fed cows had the smallest weight change of the entire group.

The alfalfa hay costs may be artificially high, since the cattle were fed during July, August, and September, which is not typical of most operations.

The cottonseed/salt mix was the least costly ration to buy but was more expensive to feed than liquid when labor and mileage were included.

The liquid supplement was the least costly for labor and mileage and comparable to cottonseed/salt mix with regard to product type. The liquid group also had the most consistent rate of consumption (2 pounds per head per day), but it had the highest average weight loss and the thinnest-looking cows.

TABLE 5. Estimated annual costs of supplements including costs of feed, labor, vehicle expense and handling

Group	Consumption	Protein	Cost	Addit'l feed oat hay	Cost	Total feed cost	Time	Time cost	Mileage	Mileage cost	Total cost
	lb/hd	*lb/hd*	*$/hd*	*lb/hd*	*$/hd*	*$/hd*	*hr*	*$/hd*	*mi*	*$/hd*	*$/hd*
Hay	1,019	212	45.85	—	—	45.85	60	10.00	508	8.47	64.32
CSM	264	99	20.48	251	9.41	29.89	81	13.50	791	13.18	56.57
Delivered	—	—	—	—	—	—	36	6.00	116	1.93	37.82
Liquid	287	182	22.96	268	10.07	33.03	15	2.50	112	1.87	37.40
Block (Madera)	281	86	48.47	268	10.07	58.54	57	7.90	292	4.87	71.31
Delivered	—	—	—	—	—	—	45	7.50	178	2.97	69.01

NOTES:
CSM calculated at loading point of California State University, Fresno, average three-hour round trip (45 miles) on a weekly basis.
Block calculated at loading point of Madera, average of four-hour round trip (38 miles) three times per feeding season.
Labor at $5.00 per hour.
Mileage at $.50 per mile.

Conclusions

In this three-year study of the effects of supplementing range beef cows and their calves with alfalfa hay, cottonseed meal/salt, liquid, or block, cow weight changes followed similar patterns among all four supplement groups. Cows on the liquid supplement, however, lost the most weight and were the thinnest of all groups during the test period. They also gained the most weight in the nonsupplement period in the second and third years.

There was no treatment effect on calf birth weight, weaning weight, or adjusted 205-day weight.

Type of supplementation also had no significant effect on reproduction of mature cows. At the levels fed in this trial, however, there was a negative effect on three-year-old cows' ability to rebreed, which was seen in the lower reproduction in the block group during the first year.

Changes in forage residue distribution were not due to differences in actual use of pasture or supplemental feeding practices, which were similar across the three years.

Economic analysis of the four treatments showed that, when labor and mileage costs were included, liquid was the least expensive supplement followed by cottonseed/salt, hay, and block.

In the final analysis, producers must evaluate labor and equipment resources, as well as the supplement cost, before they select a supplement program.

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