

Efficiency of Combining Improvement Practices that Increase Steer Gains¹

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Highlight

Contrary to general expectations, four improvement practices used in combination increased yearlong gain per

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steer as much as the sum of the practices used alone. The improvement practices studied were moderate grazing, additional winter cake, late-summer cake, and stilbestrol. The basic practice was heavy grazing. The 100% efficiency of gain obtained with the combined practices indicates that an improvement practice should produce about the same increase in gain regardless of the number of other improvement practices used on a ranch or in an experiment.

La Eficiencia en la Combinacion de las Practicas que Aumenten las Ganancias de Novillo en Pastoreo.

Resumen²

Cuatro diferentes estudios anteriores en la estación experimental de Planicias de Sur, Woodward, Oklahoma, E.U.A., mostraron cuatro diferentes prácticas que aumentan las ganancias de novillos en pastoreo. Estas son:

- 1) Pastoreo con carga de 8 acres por novilla contra 6 acres por novilla.

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- 2) Suplementación durante el invierno con harinolina (42% proteína) dando 3 libras por novillo diario en comparación con 1.5 libras por novillo diario.
- 3) Suplementación de harinolina durante el verano cuando los zacates están secos, cantidad 1 libra por novillo diario.
- 4) Implantación de 12 mgs. de estilbestrol durante los meses de Noviembre y Mayo.

Se encontró en este estudio que las prácticas son aditivas. La aplicación de las cuatro prácticas combinadas aumentaron las ganancias de peso de 92 libras por res que fué igual a la suma de los aumentos por las prácticas aplicadas por separado.

None of the cattlemen or scientists we contacted knew how several improvement practices used in combination would affect cattle gains as compared with the sum of the effects when each practice was used alone. Furthermore, we could not find an adequate answer in the literature.

Obviously, ranch profits would be seriously hurt if the benefits of improvement practices were appreciably less than additive. Also, the outcome of single-practice grazing experiments could be biased or erroneous due to the level of cattle management applied. In addition, research findings obtained at one level of cattle management could be invalid when extended to ranches using other levels.

Simply stated, our research objective was to study the efficiency of applying improvement practices in combination as compared with applying them alone.

Background

Four practices were available that increased steer gains and were feasible for us to use in a large-scale grazing trial. These four, hereafter referred to as improvement practices, were moderate grazing, additional winter protein, late-summer cake, and diethylstilbestrol (stilbestrol). Moderate grazing was considered an improvement practice as compared with heavy grazing, which was the basic practice for the study.

Our 20-year grazing studies on native range showed that increasing stocking rate from 6 to 9 acres/steer (i.e., from heavy to moderate grazing) raised yearlong gain an average of 25 lb./steer in nondrouth years, and 80 lb. in drouth years (McIlvain and Shoop, 1965). Similarly, our winter protein-rate studies showed that increasing the daily ration of 41% protein cottonseed pellets (cake) from 1.5 to 3.0 lb./steer increased gains about 25 lb./steer yearlong, but the 3-pound rate is usually not profitable unless steers are sold in spring.

McIlvain (1956) found that feeding 1 lb. of cake/steer/day in late summer increased yearlong gain 30 lb./steer when forages were dormant, and did not increase gains when grass was green. Also, Shoop and McIlvain (1962) reported that implant-

Table 1. Treatments (per steer) given weaner Hereford steers on native range grazed yearlong, 1964-66.

Improvement level and treatment	Acres (no.)	Winter cake (lb./day)	Late-summer cake (lb./day)	Stilbestrol ¹ (mg)
Basic practice, no improvement				
Heavy grazing	6	1.5	0	0
One improvement practice				
Moderate grazing ²	9	1.5	0	0
Additional cake ³	9	3.0	0	0
Late-summer cake ³	9	1.5	1.0	0
Stilbestrol ³	9	1.5	0	12
Combined improvement practices				
3-practice combination ²	6	3.0	1.0	12
4-practice combination ²	9	3.0	1.0	12

¹ One 12-mg pellet injected Nov. 1 and another on May 1.

² Improvement over heavy grazing.

³ Improvement over moderate grazing.

ing steers with 12 mg of stilbestrol in November and again in May increased yearlong gain an average of 45 lb./steer.

Area, Procedure, and Materials

The study was conducted on the Southern Plains Experimental Range located in northwestern Oklahoma near Woodward. The 85-year annual precipitation is 23 inches, but it varies from 10 to 43 inches. Mean temperature is 44F during winter and 73F during summer. The Range is located on rolling, stabilized, sand dunes composed primarily of loamy sand soils that have a single-grain structure.

The native vegetation consists of a thin stand of sand sagebrush (*Artemisia filifolia* Torr.) and a mixed understory of short, mid, and tall grasses and a few forbs (Shoop and McIlvain, 1963). Annual forage production averages 1,050 lb./acre.

A uniform herd of Hereford steer calves was obtained each October from the same ranch. The calves were branded with individual numbers and weaned together on sorghum pasture. When they regained their weaning weight, about November 10, they were allotted to treatments at random within weight classes. Their initial weight averaged about 470 lb. each year.

To study the four improvement practices alone and in combination, we used seven treatments, as shown in Table 1. The study was conducted for 3 years, 1964-66, with a randomized complete block of three replications. Each of the seven lots of steers within a replication contained eight head. The analyses of variance were made on the average data for each lot of steers. To minimize forage differences among pastures, the steer lots within a block were rotated at 2-week intervals among pastures with similar stocking rates.

Stocking rates varied seasonally with the availability of forage. We stocked the moderately grazed pastures to leave about 350 lb. of ungrazed forage at the end of the grazing year on about May 1, and the heavily grazed pas-

Table 2. Seasonal gain (lb./steer) of weaner Hereford steers treated with four improvement practices applied alone and in combination, 1964-66.

Treatment	Winter	Summer	Total	Increase
Heavy grazing	45a ¹	301a	346a	—
Moderate grazing	56b	304a	360ab	14 ²
Additional cake	86d	292a	378c	18 ³
Late-summer cake	50ab	321b	371bc	11 ³
Stilbestrol	67c	339c	406d	46 ³
Total increase	—	—	—	89
3-practice combination	98f	324bc	422de	76 ²
4-practice combination	109e	329bc	438e	92 ²

¹ Means in a column followed by the same letter are not significantly different at the 5% level by Duncan's test.

² Increase over heavy grazing.

³ Increase over moderate grazing.

tures with 50% more steers. This resulted in stocking the moderately grazed pastures at a 3-year average of 9 acres/steer and the heavily grazed pastures at 6 acres. Forage production was 1,200, 1,230, and 740 lb./acre during 1964, 1965, and 1966, respectively.

All steers received cake throughout winter, November 10 through April 20 (Table 1). Salt was fed free choice.

Late-summer caking started when the grass became essentially summer dormant on about July 20, and continued until the end of the grazing year on about October 1. During 1964 and 1965 the forage was mostly dormant during late summer. However, during 1966 the forage was green in late summer.

Stilbestrol was implanted under the skin on an ear. One 12-mg pellet was used about November 1, and another on May 1.

The steers were weighed individually on 2 consecutive days at the start and end of each grazing season, and on a single day at bimonthly intervals. The steers were off water, but on pasture, for 12 hours prior to start of weighing.

Also, shedding of winter hair was scored as a measure of treatment response. Each steer was scored on July 1, 1965, and on May 18 and July 7, 1966. A score of "1" indicated no apparent shedding, and a score of "5" indicated complete shedding.

Results and Discussion

Steer Gains

The four practices used in combination increased yearlong gain per steer as much as the sum of the practices applied alone. The 4-practice combination increased gain 92 lb./steer above that of heavy grazing (Table 2). In comparison, the sum of the increased gains from each of the four practices applied alone was 89 lb.—essentially the same as the 4-practice combination.

Similarly, the 3-practice combination increased yearlong gain 76 lb., and the sum of the increases of the three practices was 75 lb. Also, the differ-

Table 3. Hair shedding scores¹ of steers treated with improvement practices applied alone and in combination.

Treatment name	7/1/65	5/18/66	7/7/66	Avg. 3 dates	Avg. increase
Heavy grazing	3.0	2.2	3.6	2.9a ²	—
Moderate grazing	3.4	2.8	4.3	3.5bc	.6 ³
Additional cake	3.5	3.5	4.5	3.8cde	.3 ⁴
Stilbestrol	4.0	2.8	4.4	3.7cd	.2 ⁴
Total increase	—	—	—	—	1.1
3-practice combination	3.9	3.9	4.9	4.2de	1.3 ³
4-practice combination	4.2	3.8	4.9	4.3e	1.4 ³

¹ Degree of shedding by each steer was rated 1-5, with 5 indicating complete shedding.

² Means followed by the same letter are not significantly different at the 5% level by Duncan's test.

³ Increase over heavy grazing.

⁴ Increase over moderate grazing.

ence in gain between the 3-practice combination and the 4-practice combination was essentially the same as the difference in gain between heavy and moderate grazing. This is further evidence that the gains of the combined practices were wholly additive.

The 3-practice combination produced excellent steer gains even though the range was severely damaged by overgrazing. Stocking at 6 acres/steer caused severe loss of plant vigor, death of plants on less favorable sites, and severe soil disturbance. When a range supports only weak, scattered, low-quality forage, both the cattle and the cattleman it supports are close to disaster. A cattleman should not conclude that he can afford to overgraze by using a combination of other improvement practices.

Hair Shedding

Cattlemen associate rapid shedding of winter hair with good winter nutrition and health. Both the 4-practice and the 3-practice combination increased rate of hair shedding more than the sum of the increases of the practices applied alone. Specifically, the 4-practice combination increased shedding 1.4 points, and the practices applied alone increased shedding only 1.1 points (Table 3). The 3-practice combination increased shedding 1.3 points, whereas the practices used alone increased shedding only .5 point. Thus, both gain and hair shedding showed that the practices used in combination were wholly additive.

Conclusions and Recommendations

The additive effects of the combined practices show that the steers did not reach their genetic potential to gain. Combining the improvement practices did not cause diminishing returns. For

example, the 4-practice combination increased gain nearly 100 lb./steer over heavy grazing (Table 2). Since the cattle, rangeland, and improvement practices used in the experiment were highly similar to those used on ranches, cattlemen can generally expect similar results from combining these and other improvement practices.

However, the effect of combined practices cannot be additive if a limiting factor exists. For example, a rancher who has bred the best genetic potential into his cattle could not expect the gain response to be additive from combining shade, parasite control, needed minerals, and stilbestrol when insufficient pasture is the factor limiting gains.

This study of four practices does not establish a principle that gains from other combined practices will be additive. However, it does indicate that ranch operators, in general, need not fear they are approaching the point of diminishing returns for increasing steer gains. Instead, cattlemen and managers of public lands should endeavor to com-

bine all improvement practices that are profitable when used alone. Also, scientists and extension personnel should consider that combined practices are generally additive, but they should also be aware that some combinations may be more than additive and that some may be influenced by compensatory gains.

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