Shade for Improving Cattle Gains and Rangeland Use[1]

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Highlight

Shade increased summerlong gain of yearling Hereford steers on rangeland by a profitable 19 lb./head in a 4-year study. High summer humidity depressed steer gains much more than did high summer temperature. The combined effects of humidity above 45% and temperature above 85 F were especially harmful. Each "hot muggy day" reduced summerlong steer gains by 1 lb. Cattle eagerly sought shade during hot summer days. By manipulating shade, cattle were drawn to under-utilized areas of a pasture to reduce damaging spot grazing. Shade was nearly as effective as water location and supplemental feeding as a tool to promote uniform grazing within a pasture. South-facing, open sheds used as winter shelters did not increase steer gains, nor would the steers use them even during storms.

El Uso de Sombreadores para Mejorar las Ganancias de Novillas y Pastoreo de Animales

Resumen[2]

El presente estudio se llevó a cabo en la estación experimental de Planicios del Sur cerca de Woodward, Oklahoma, E.U.A., durante los años de 1959–1962 comprendiendo un período de cuatro años.

Este estudio incluyó sombreadores hechos a mano y novillas de la raza Hereford de un año de edad. Se encontró que los sombreadores no influyeron en la producción durante el invierno pero las ganancias en peso aumentaron en 8.6 Kgs. durante el verano. Dicho aumento amortizó en dos años el costo de los sombreadores a $9.00 (Dlls.) por novillo.

Se registró mas efecto adverso en humedades altas que en las temperaturas altas. Los aumentos en peso fueron menores con mas de 45% de humedad relativa y 30°C de temperatura. Los animales buscaron sombra durante el verano y por eso fué preciso poner en buena localización los sombreadores para tener uniformidad de pastorero del pastizal.

Tools to manipulate the grazing patterns of beef cattle within a pasture are badly needed. It has long been observed that cattle in the Southern Plains eagerly seek shade during hot summer days. This study was conducted to answer two questions: One, can shade, particularly artificial shade, be used as a tool to change grazing patterns? Two, can cattle gains in the Southern Plains be economically increased by use of summer shade or winter shelter?

Spot grazing is one of the most important factors that limits the production of beef on rangelands. This is especially true when a rancher uses conservative or moderate grazing on mixed grass or tall grass ranges or on ranges with variable soil and vegetative types. When severe spot grazing occurs, ranges are damaged by both overuse and underuse. We have found that spot grazing can also depress steer gains by as much as 80 pounds per head in summer (unpublished data).

Weather stresses are also important limiting factors to beef production (Ittner et al., 1954, 1958; Beakley and Findley, 1955a, 1955b; Cartwright, 1955). The climate of the Southern Plains is rigorous; extremes of temperature are especially great; and periods of high humidity, high winds, cold rains, and blowing snow greatly amplify temperature effects.

Weather stresses may help explain why weaner steers on the Southern Plains Experimental Range gained 360 lb./head while related steers (from the same herd) gained only 260 lb. the following summer. Quantity of forage, fully adequate in both years, was judged to be of near-equal quality.

Area, Livestock, and Methods

The Southern Plains Experimental Range is located in northwestern Oklahoma. Elevation is 2000 ft above sea level. Annual precipitation averaged 23 inches during the past 85 years, but it varied from 10 to 42 inches. Precipitation during the five consecutive driest years averaged 14.2 inches (1952–56), and the five consecutive wettest years averaged 30.6 inches (1957–62). The highest temperature recorded was 114 F and the lowest –27 F. The evaporation isogram (92 inches yearlong) that passes through Woodward also passes near Las Cruces, New Mexico, and into southeastern Arizona.

Soils are mostly sands and loamy sands on and between rolling dunes now stabilized with sand sagebrush (*Artemisia filifolia*), blue grama (*Bouteloua gracilis*), sand dropseed (*Sporobolus cryptandrus*), little bluestem (*Andropogon scoparius*), sand bluestem (*Andropogon hallii*), several minor short, mid, and tall grasses, and a few forbs. About 18 acres of rangeland is usually needed to graze a cow-calf unit for 1 year.

The gain-response data were obtained with 9- to 11-head lots of steers during the 4 years, 1959–1962. The study was conducted with three replications for the first 2 years and then with four replica-

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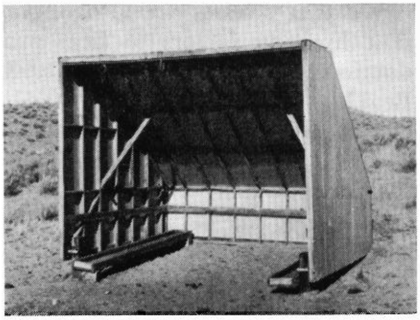

FIG. 1. Convertible, experimental, shade-shelter in position as south-facing winter shelter. Note cake bunks and typical absence of steers.

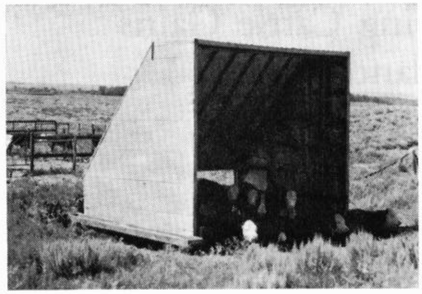

FIG. 2. Steers using north-facing shade. Note steep pitch of roof to permit radiant heat from the animals to be absorbed by the cool, "black," north sky.

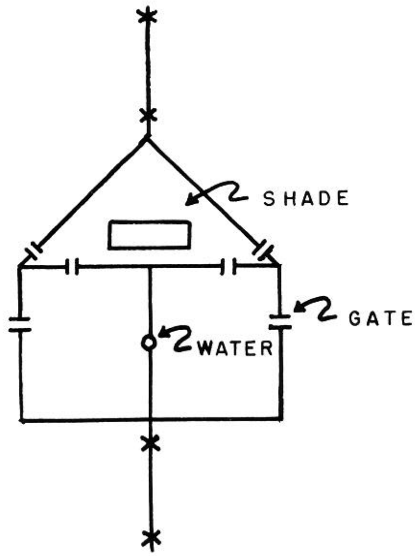

FIG. 3. Sketch of corral design to permit continuous use of shade or shelter by steers rotated each 2 weeks to minimize pasture differences.

tions. The Hereford calves, choice stocker grade, were obtained each year in October from the same ranch. They were weaned under uniform conditions, branded with individual numbers, vaccinated, and allowed to regain their gross weight at weaning before being allotted to treatment at random. Their average initial weight was 492 lb.

The steers were grazed continuously yearlong on about 8 acres/head of native range. Their only feed in addition to grass was a daily winter ration of 1.5 lb. of 41% protein cottonseed pellets, and salt free choice.

Treatments were shelter in the winter and shade in summer. Open-faced sheds (14 ft by 16 ft by 14 ft high) were built facing south for winter use. The roof was pitched steeply to allow the sun to shine to the back wall at midday (Fig. 1). For summer shade the sheds were tipped over toward the south so that the open face became the floor of the shaded area (Fig. 2). A panel was removed from the south side so the wind could help cool the cattle and extend the range of physiologically tolerable temperature (Thompson et al., 1954).

Each steer had access to about 30 ft^2 of shade at midday, only about half that suggested by Ittner et al. (1958). In the morning and afternoon the side walls also made excellent shade. The steers never appeared to be crowded when under the shade.

The sheds were constructed between paired pastures so that by opening or closing gates, the treated steers could be grazed in either pasture with continuous use of the shelter or shade (Fig. 3). Steers were rotated each two weeks throughout the year to minimize pasture differences. The pastures contained no trees or other major shade-producing objects.

Observations were made of cattle grazing habits to determine the value of shade as a tool to promote uniform grazing distribution. These observations were made on the Experimental Range and on neighboring ranches with different vegetative types such as shinnery oak, shortgrass, and river-bottom pastures. Some pastures had artificial shade, some had natural shade, and some were without shade.

To help understand and explain treatment differences, correlation coefficients were calculated for various combinations of steer gains on native range (without shade or shelter) and elements of weather for the period 1942–63. Correlations were first calculated between seasonlong gains of steers on moderately grazed (9 acres/head) and lightly grazed (13 acres/head) pastures. During the 10 years, 1942–51, the correlation of steer gains on the moderately and lightly grazed pastures was high ($r = .98$ in winter and .94 in summer). Therefore, the gains of moderately and lightly grazed steers were averaged and used as the basic steer-gain data. This minimized the possibility of lack of quantity of forage from unduly influencing the correlation between steer gains and weather factors. For this same reason, data were excluded for the three severe drouth years of 1952, 1954, and 1956.

Results and Discussion

Winter Shelter

The winter shelters had no measurable effect on steer gains. The 4-winter average gain of steers with access to shelter was 39 lb./head and without shelter it was 41 lb. (Table 1).

Even though all protein supplements were fed in the shelters, the steers did not use them during cold, windy days or during storms. Instead, they usually bedded down in sagebrush near the base of southeast-facing dune slopes.

It seems illogical that the cold winds and rains of winter do not produce environmental stress. Our correlation coefficients indicated that small stresses do exist, but apparently the shed shelters were ineffective because the steers did not feel as comfortable in them as they did in the protection of the

Table 1. Gain (lb.) of Hereford steers on rangeland as affected by availability of shelter in winter and shade in summer.

Year	Steers per treat-ment	Average gain per steer: Winter		Summer		Advantage of		Number of hot, muggy days
		Shelter	No shelter	Shade	No shade	Shelter	Shade	
1958–59	30	30	36	321	304	–6	17	40
1959–60	33	50	54	314	287	–4	27	60
1960–61	40	22	22	364	360	0	4	30
1961–62	36	56	54	291	261	2	30	50
Total	139							
Avg		39	41	323	304	–2	19	—

sage and dunes (Table 2). Other types of shelters might give different results and should perhaps be studied.

The correlations, with one exception, were surprisingly small. Contrary to expectations, the correlations indicate that low winter temperatures depressed steer gains little, whereas warm temperatures significantly increased gains. It appears that an economical method of keeping the cattle warm could be beneficial.

Summer Shade

In contrast to the winter non-use of shelters, steers consistently sought the protection of summer shade on every hot, sunny day. Steers with access to the artificial shades outgained steers without shade by 19

Table 2. Correlation (r) between steer gains during winter and elements of winter weather, November through March 1942–63.

Weather element	Steer gain
Total winter precipitation	–.21
No. days with above .25 inch of precipitation	–.07
Avg minimum winter temperature	–.04
Avg maximum winter temperature	.48*
Avg mean winter temperature	.17
No. days with max. temp. below 40 F	–.13

* Significant at 5% level.

pounds during the summer. The advantage of shade varied annually from 4 lb. to 30 lb./steer (Table 1). The advantage increased as the number of hot-muggy days increased.

Cartwright (1955) found that cattle from temperate zones begin to show signs of heat stress at about 85 F. Obviously, under conditions at Woodward, relative humidity by itself influenced steer gains more than did temperature by itself (Table 3).

High humidity in presence of high temperature severely lowered steer gains during 1942–63 (Fig. 4 and Table 3). Each "hot muggy day" (days when temperatures above 85 F plus humidity in percent totalled 130 or more) reduced summerlong steer gains by 1 lb. Ehrenreich and Bjugstad (1966) found that the temperature-humidity index, used by the U. S. Weather Bureau to express relative human comfort, was highly correlated (r = –.97) with hours spent grazing.

The increased sale value of added weight on each steer due to shade was about $5.00 at prices prevailing during 1965–69. The material costs for a well-constructed shade (creosoted poles, dimension lumber, and corrugated iron roofing) were about $9.00 per steer (allowing 40 ft²). The estimated life of such shade is at least 20–30 years. The material cost for the improvement should be recovered in about 2

Table 3. Correlation (r) between steer gains during summer and elements of summer weather, May through September 1942–1963.

Weather element	Steer gain
Total summer precipitation	–.05
No. days with above .25 inch of precipitation	–.04
Avg minimum summer temperature	.04
Avg maximum summer temperature	–.02
No. days with maximum temperature above 90 F	.00
Avg summer relative humidity	–.21
No. days with relative humidity above:	
50%	–.14
60%	–.53*
70%	–.45*
No. days with temperature-humidity index above:[1]	
120	–.42
130	–.61**
140	–.57**
150	–.42

* Significant at 5% level.
** Significant at 1% level.
[1] Index is degrees F plus percent humidity.

years and profits should result for many years.

Shades must be properly designed to provide maximum relief to the steers according to Ittner et al. (1958). In their studies, hay held between wire nets was more effective as a shade than was galvanized

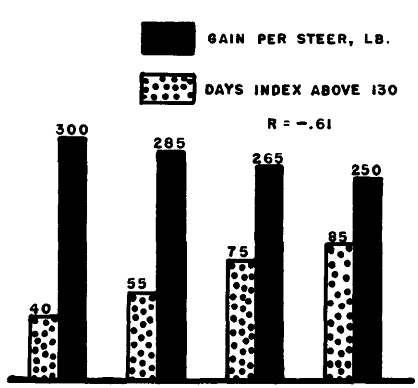

FIG. 4. Summerlong steer gains in relation to number of hot muggy days (temperature-humidity index above 130), 1942–63.

FIG. 5. Cattle in shade of a shinnery oak motte purposefully left untreated with herbicide when the pasture was sprayed for brush control.

iron, and construction costs should be less.

It is highly probable that too little shade per steer could cause crowding and body heat would offset cooling effects of the shade. Thin shades provided by slats or louvers (snow-fence type) were found by Ittner et al. (1958) to be of little value in increasing steer gains.

Grazing Behavior

Numerous observations of grazing behavior of cattle confirmed the value of shade as a grazing management tool. Cattle were strongly attracted by shade and even on cool days they frequently loafed in its vicinity.

Steers on the Experimental Range used every bit of natural and accidental shade that could be found—sagebrush, blowouts, steep dunes, brush thickets, cake houses, corral fences, and parked vehicles and machinery. Shade trees located one mile from water in one large pasture were consistently used in the summer. Steers in adjacent shadeless pastures spent the hot part of day near their watering places.

On short grass, sand sage, and seeded ranges where there was no shade, the cattle normally arrived at their watering places about 9:30 A.M. and stayed until about 4:30 P.M. Contrarily, when shade was rather abundant in pastures such as on shinnery oak ranges, the cattle stayed in the shade until about noon, walked into water, and then returned to the shade until the cool of evening (Fig. 5).

In our studies the combined use of several livestock distribution tools was always more effective in promoting uniform forage use than was their use singly. For instance, the use of shade, salt, and cattle rubbing posts (for insect control) at one location attracted steers much more consistently than when only one tool was used. Water location was the single most effective attractant, supplemental feeding away from water was next, and it was followed closely by shade.

Conclusions

Providing range steers in the Southern Plains with adequate, properly-designed shade is a profitable animal husbandry practice. In addition, shade placed in relation to overuse and underuse of forage within a pasture is an effective tool to obtain more uniform forage use.

Man-made shade has several obvious advantages over either natural or planted shade. The location of the man-made shade can be carefully chosen to maximize range use and ranch profits. With a little effort and some cost, it can be moved. It provides immediate results. It can and should be scientifically designed for maximum profits.

Planted or natural trees are usually an efficient source of shade since their radiosity is less than flat roofs and they have a larger low-temperature ground area with good exposure to the cool, north sky, according to Kelly et al. (1950). In some pastures it might be profitable to remove natural shade that is close to overgrazed areas, providing that adequate shade is available in the undergrazed area.

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