Model studies of effectiveness of walls in radiant heat load reduction, 1960. (All models facing north.)

Walls Influence Interior Radiant Environment of

LIVESTOCK SHELTERS FOR SHADE

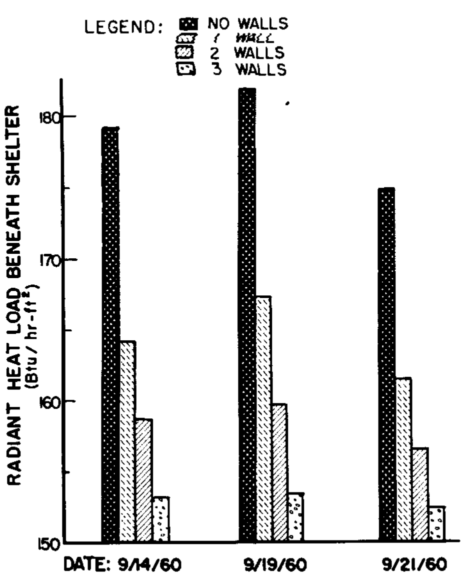
LEROY HAHN · T. E. BOND · C. F. KELLY

Placing a simple shade over an animal exposed to a hot environment and direct radiant energy from the sun, cuts the radiation heat load on that animal about 45%. Addition of one wall caused an additional 5% reduction, and each additional wall (up to three) caused an additional 2% reduction—making a total reduction in radiation heat load resulting from a three-sided shelter of about 54%, according to this report of Davis tests.

FARM STRUCTURES for livestock must be designed with major consideration given to providing a productive animal environment. During periods of hot weather, reduction of the radiation heat load is a primary factor in obtaining such an environment.

Simple shades serve to reduce the amount of radiation normally imposed on an animal by the sun, the sky, and the ground. Research to improve the design of livestock shades and the materials to be used as shade covers has been conducted for several years in the Imperial Valley. Proper materials and design accomplish a major reduction in radiation heat load beneath such shades. These tests were to investigate what further degree of reduction, if any, resulted from partially enclosing a shade to shield the animals from other radiation sources (sky, horizon, and the hot surrounding ground).

INFLUENCE OF WALLS ON INTERIOR RADIANT ENVIRONMENTS OF LIVESTOCK SHELTERS.



Four model hog shelters, previously determined to provide representative results in thermal studies of housing, were used in tests at Davis to determine the influence of walls on radiation heat loads. The one-third scale models, of a three-sided portable hog shelter in use in California, had aluminum roofs with a 2-in-12-inch slope, nominal 1 inch shiplap siding, and flooring of 2 × 10-inch planks. The siding was painted a buff color. The roof height of all models was the same. As shown in the photo, shelters were placed on bare, disked ground and arranged to minimize radiation and wind interference among the shelters and surrounding buildings or vegetation. Orientation was identical for all shelters; the open side of the three-sided shelter faced north. The shelter with two walls was open to the north and south; the shelter with one wall was open to the north, east, and south. The shelter with no walls corresponded to a simple shade.

Black globe thermometers measured the quantity of radiation, in terms of Btu/hr-ft², imposed on the surface of a simulated animal standing in the center of each shelter. Measurements were recorded at hourly intervals from 10 a.m. through 5 p.m. on each of the three test days.

Results of the measurements are summarized in the graph, which shows the average radiation heat load within each shelter for each test day. The average radiation outside the shelters during the test period, as measured by a total hemispherical radiometer in the sun, was

344.5, 331.2 and 324.2 Btu/hr-ft^2 for September 14, 19, and 21, respectively. The average air temperature for each test period was 91.9, 90.9 and 91.2°F., respectively. Cloud cover was negligible, although at times a slight haze existed near the horizon.

The initial reduction in radiation heat load due to a simple shade (no walls) was slightly less than half (about 150 Btu/hr-ft^2) the outside radiation level. Further reductions caused by adding walls to the shelter were of a much lower order of magnitude, though appreciable. One wall (west side) reduced the radiation heat load under the shelter an additional 15 Btu/hr-ft^2. Two walls (east and west sides) resulted in a 20 Btu/hr-ft^2 lower radiation heat load than under the simple shade, and for three walls (south, east and west sides), the radiation heat load was 26 Btu/hr-ft^2 lower.

Another factor clearly indicated by the graph is the decreasing variation in radiation heat load within the shelter as more walls are added. Much of the reduction in variation is probably due to the increased mass of the structure leveling out external environmental variations.

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This was a cooperative investigation between the Agricultural Engineering Research Division, ARS, USDA, and the U.C. Agricultural Experiment Station.

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Ethyl Alcohol Supplement NOT *Beneficial to Cattle in Feedlot Tests*

THIS TRIAL was conducted to evaluate observations by a supplier of industrial alcohol indicating the possibility of a beneficial production response when feedlot cattle were given small amounts of ethanol in their water. The experiment was conducted for a 105-day period from July through October in 1962. Four pens of three Hereford steers received an identical ration with two pens (six steers) receiving alcohol in the water at a concentration providing 8 oz. of denatured ethanol per head daily. Dispensing apparatus was a 100-gallon tank supplied with a float valve and a small, 8 x 8 x 2-inch drinking pan to minimize evaporation. Water and the ethanol were added to the tank daily. Similar drinkers used in control pens were equipped with water meters to record water consumption.

Results of this trial (shown in the table) are on the basis of empty body weight—thus eliminating much variation due to digestive tract contents.

There were no differences in the response of the steers as measured by average daily gain, energy gain per day, carcass yield, carcass fat percentage or corrected carcass weight (identical caloric content). The control steers each consumed over a pound more feed daily than those receiving the alcohol. This difference was statistically significant. However, if an amount of feed is added to the intake of the steers given the alcohol, which is equivalent in digestible energy to that received in the form of ethanol (shown in parentheses in the table) then the difference in feed intake is no longer at a significant level. Feed efficiency, either in terms of weight gain or energy gain per 100 pounds of feed, was essentially the same for each group of steers. These data support the conclusion that a small level of ethanol added to the drinking water of beef steers has no production value other than what might be expected on the basis of its energy content.

Water consumption of the steers given the alcohol was slightly above the intake of the control animals. The data indicate that most of this increase occurred during the first six weeks of the trial when the alcohol steers were consuming 1.9 gallons per head per day more than control steers. The reason for this initial difference in water intake is not known. It was apparent, however, that alcohol did not decrease water intake even though the odor of the denaturing materials (mercaptans) was easily detected at the water surface and generally offensive to the human sense of smell.

EFFECT OF DENATURED ETHANOL ON THE FEEDLOT PERFORMANCE OF HEREFORD STEERS

	Control	Denatured ethanol	
Number of animals	6	6	
Initial weight, lb.	596	598	
Final weight, lb.	850	842	
Daily weight gain, lb.	2.42	2.32	
Daily energy gain, megcal.	6.15	6.05	
Daily feed intake[a], lb.	19.7**	18.3	(19.3)[b]
Weight gain/100 lb. feed, lb.	12.3	12.7	(12.0)
Energy gain/100 lb. feed, megcal.	31.2	33.0	(31.3)
Carcass data:			
Dressing percent	58.3	58.9	
Carcass fat, percent	24.0	24.2	
Corrected carcass, lb.	600	597	
Grades	2 Choice 4 Good	4 Choice 2 Good	
Water consumption:			
Gallons/day	13.1	13.7	
Gallons/100 lb. dry matter intake	0.66	0.75	
Denatured ethanol, oz./day	..	7.8	

** Significantly higher ($P < .01$) than denatured ethanol group.

[a] Oven dry basis. Ration: alfalfa, 25%; sudan, 10%; barley, 47%; molasses beet pulp, 15%; molasses, 3%.

[b] Figures in parentheses were obtained by adding an equivalent amount of ration for the energy in the denatured ethanol. Ethanol 7.1 kcal./gm. assumed 100% digestible. Ration has 3.2 kcal. digestible energy/gm. Therefore, 7.8 oz. of ethanol is equivalent to approximately 1 lb. of ration.

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