The TEXAS AGRICULTURAL AND MECHANICAL COLLEGE SYSTEM
GIBB GILCHRIST, Chancellor

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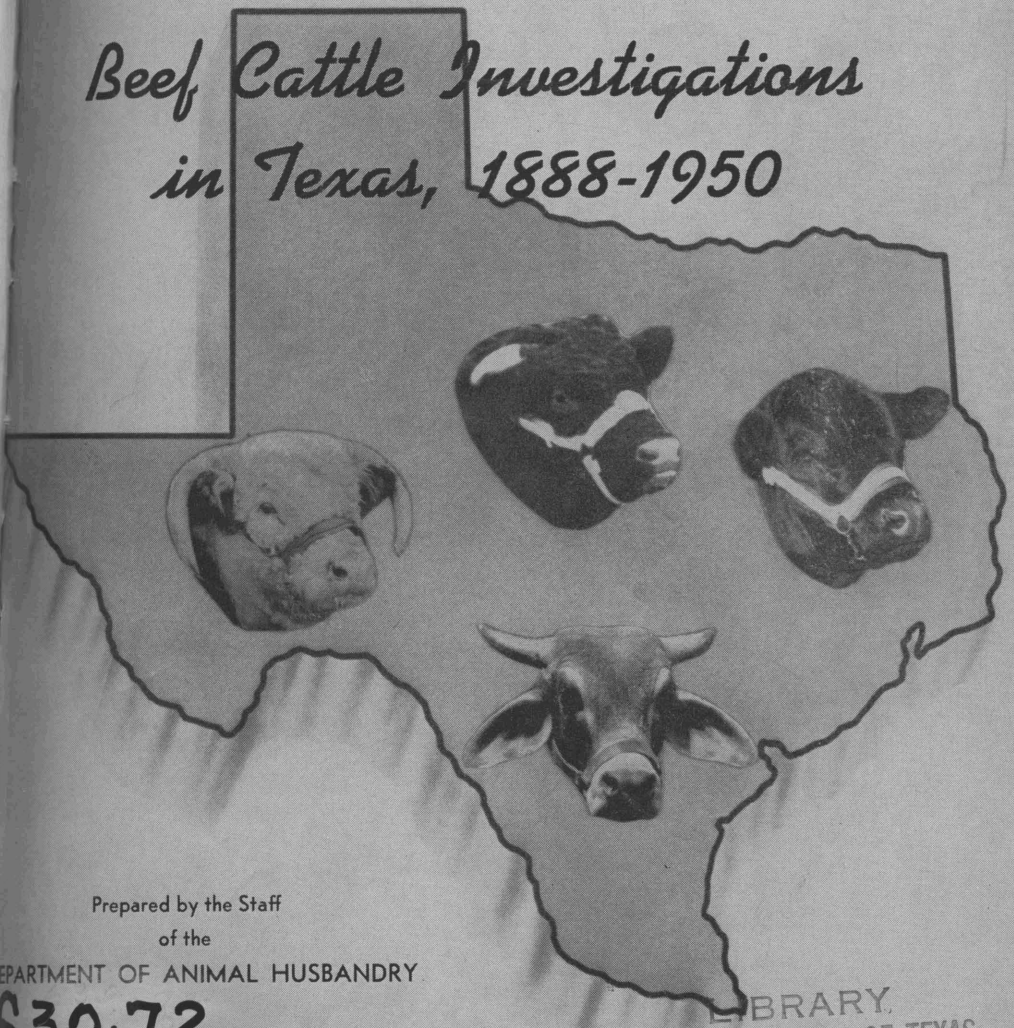
Beef Cattle Investigations in Texas, 1888-1950



Prepared by the Staff
of the
DEPARTMENT OF ANIMAL HUSBANDRY

TEXAS AGRICULTURAL EXPERIMENT STATION
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Foreword

During 1950-51, the Agricultural and Mechanical College of Texas celebrates its Seventy-fifth Anniversary. The dedication of the newly constructed Beef Cattle Center, September 29-30, 1950, is to be a significant feature of the anniversary. At this appropriate time, the Texas Agricultural Experiment Station, as the agricultural research part of the Texas Agricultural and Mechanical College System, presents this summary of its 62 years of investigations with beef cattle.

All Texans should know that beef cattle are a close second to cotton as an immediate source of cash income to farmers and ranchmen of Texas.

Three of the original seven research projects of the Texas Agricultural Experiment Station related to Animal Husbandry. From one of these projects came the first outstanding achievement of the Texas Station, the development by Dr. Mark Francis of means of inoculating cattle to protect them against splenetic or tick fever.

At its Main Station, substations and field laboratories there are now 25 active research projects directly concerned with beef cattle.

Also many experiments with grasses, legumes, production of feed grain crops, brush control, and marketing of livestock and livestock products are conducted at 18 of the field units of the Texas Station for the improvement of the livestock industry of Texas. Let us not forget that grass, its improvement and its proper utilization, are prime factors in the past, the present and the future of beef cattle in Texas.

This summary of beef cattle investigations is the first of a proposed series on several major topics which we hope will present the results of past and present investigations in terms of questions, situations and decisions that the farmer or ranchman may meet. This first attempt to assemble the presently significant and applicable results of research of the past 62 years is probably inadequate. We regard the summary as an experiment in which we would like you to join by telling us more of the type of information that you need.

As we dedicate the new Beef Cattle Center to the future of the cattle industry of Texas, we are pleased to present this record of achievement and information, and to pledge renewed service to the future development of that industry.

R. D. Lewis

Director

Texas Agricultural Experiment Station

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Beef Cattle Investigations in Texas, 1888 - 1950

MILESTONES OF THE TEXAS CATTLE INDUSTRY

COMING OF CATTLE

Probably the first cattle in Texas were brought from Mexico about 1690 by the founders of the early Spanish missions in East Texas. Another recorded and larger introduction, also in East Texas, was made in 1716.

A dozen missions had been established in East and South Texas by 1731. Cattle raising is listed as one of the leading industries directed from behind their heavily buttressed walls, and the presidios or forts built to protect them. Strongest of the missions, and leaders in cattle raising were the chain that formed the outpost of San Antonio and the mission around which grew the present Goliad. Nacogdoches was the eastern stronghold.

Ranches also were established on large land grants between the Nueces river and the Rio Grande from about 1750. Dolores (near Zapata) and Laredo long were ranch headquarters for their respective owners. By 1800, cattle in uncounted thousands roamed the valleys on both sides of the Rio Grande. On the Texas side, some 200 ranch grants covered the country north to the Nueces.

LARGE HOLDINGS ENCOURAGED

Land has ever been the cornerstone of Texas' wealth and of her economic and social progress. The ownership of large holdings was encouraged by Spain and Mexico, and later by the Republic and the State of Texas. It was the abundance, the ease of acquisition and the fertility of this land that attracted colonists from abroad and from the older states. Each early Texas government realized that grazing much of this land would yield a larger return than would be realized through their use for any other purpose known at the time. Barter of large blocks of land enriched the coffers of the Republic and the State and hastened the building of the Texas of today.

TRAIL DRIVING

Texas was the reservoir from which were drawn the beef for older states gone industrial. Here was the breeding ground for the Western Plains when the buffalo were killed off and the Indians were placed on reservations.

From the 1840's to the 1890's there was always some trail driving out of Texas. From 1866 to about 1895, some 10 million

Longhorn cattle valued at $200 million were driven to rail and range markets in the North, Northwest and West.

The westward push of home-seekers, the building of railroads through the State and the fencing of the range gradually forced the abandonment of the cattle trails.

BARBED WIRE

The range country was badly abused at the height of the open range era. These abuses were realized at the time by the better-thinking cowmen. To preserve the carrying capacity of th range, it had to be fenced; and to fence, it had to be owned. Wooden and smooth wire fences were too costly for general use.

The first carload of barbed wire known to have been shipped to Texas was sold out of Gainesville in 1875. Huge fortunes were made in the next two to three decades through the sale of barbed wire to ranchmen in Texas and other range states. Fencing alone cost the XIT ranch about $181,000 between 1882 and 1886.

THE WINDMILL

Many good Texas ranges where surface water was scarce lay idle for several years after the beginning of settlement. Some primitive windmills were brought in at great expense about 1870 to pump water from hand-dug wells. Well drilling on a large scale began between 1870 and 1880, when it was found there was an abundant and shallow ground water supply, and the American type of windmill was invented.

Had it not been for the windmill, much of West and South Texas could still be designated on maps as part of "The Great American Desert."

TICK FEVER

The discovery of a method to immunize cattle against tick or "Texas fever" by the late Dr. Mark Francis, the grand old man of Texas veterinary science, paved the way for the improvement of the quality of Texas cattle. The injection of blood from native cattle immune to tick fever made it possible for Texas cattlemen in tick-infested areas to import bulls of the British beef breeds long before systematic tick eradication got underway.

When the tick quarantine line of 1906 was established, 198 of Texas' 254 counties were "below" the line, or in infested territory.

Dr. Francis also was a pioneer experimenter with crude oil and arsenical solutions in killing the fever-carrying tick by spraying and dipping.

Today only a very few scattered pastures are under quarantine. These have been reinfested lately and soon will be "clean" again.

IMPROVED CATTLE

"Other states were carved or born; Texas grew from hide and horn," appropriately wrote Berta Hart Nance. The Longhorn, which seemed to find his natural theater of existence in early Texas, was a most excellent base upon which to build through the introduction of sires of Shorthorn, Hereford and Aberdeen-Angus breeding, and in later years the Brahman.

Shorthorn (Durham) cattle were the first to be crossed with the Longhorns in considerable numbers. Most Texas range herds of long standing at one time had a good percentage of Shorthorn breeding.

Among the early importers of Shorthorn cattle was Captain Mifflin Kenedy who, in the early 1870s, bought Shorthorn cattle in Louisiana for his Nueces county ranch. Charles Goodnight brought some purebred Shorthorns from Colorado in 1876 when he opened the Texas Panhandle to cattle raising.

The Texas Shorthorn Breeders Association has been active for many years.

Herefords, for many years the leading breed on Texas ranges, were first brought to Texas in 1876 by W. S. Ikard of Archer City. Mr. Ikard in 1885 established the first Hereford breeding herd in Texas to be immunized against tick fever.

The Texas Hereford Association was organized in 1899. It now has approximately 550 members.

Among the early importations of Aberdeen-Angus cattle was one in the early 1890's by the XIT ranch, the cattle empire in the western Panhandle established on 3 million acres given by Texas in payment for building our present State Capitol.

The Texas Aberdeen-Angus Breeders Association was organized in 1934. It now has about 430 members. It is estimated that the number of Angus breeders in Texas increased 200 percent since 1947.

Some of Texas' earliest Brahman cattle came in from Louisiana. J. M. Frost and Albert Montgomery in 1885 bought two Brahman bulls in India which were shipped to their ranch in Fort Bend county. The most important introduction of these cattle from their native India was in 1906 when the A. H. Pierce Estate and T. M. O'Connor brought in 33 bulls and heifers. Other large importations were made in the 1920's from Brazil via Mexico.

Brahman cattle are more numerous in a tier of counties along the Gulf Coast, but in late years they have gained popularity beyond the Coastal Prairie. It is estimated that 15 percent of Texas cattle today have some Brahman breeding.

Santa Gertrudis is the only recognized breed of beef cattle to be produced in the Western Hemisphere. It was developed on the King ranch in South Texas and is approximately 5/8 Shorthorn and 3/8 Brahman. These cattle are cherry red in color and have the good qualities of their parental stock.

"THE ASSOCIATION"

One of the first organizations of Texas cattlemen for mutual protection and benefit was the Stock Raisers Association of Northwestern Texas, which was organized February 15-16, 1877 at Graham.

Its title was changed in 1893 to the Cattle Raisers Association of Texas, and in 1921 to the Texas and Southwestern Cattle Raisers Association.

Widely regarded as one of the strongest and most influential organizations of stockmen in the country, the Association now has a membership of 8,455, who own or control over 4 million cattle.

CATTLE IN TEXAS' ECONOMY

For a century and longer Texas has been the leading cattle raising state of the Union. Even with the cultivation of millions of acres, at least 60 percent of the surface of the State still is devoted to grazing. Due to climatic conditions and to the topography of much of this land, it is probable for all time to come that Texans will devote a larger acreage to pastoral pursuits than to the production of cultivated crops.

Cattle and other livestock furnish a ready market for the almost State-wide feed crop industry. Controlled cotton production and soil conservation practices since the 1930's brought about a rebirth of cattle raising in the older areas of the State which were planted to cotton for 75 years and longer.

The 1945 Agricultural Census showed 141,337,744 acres of Texas soil in farms and ranches, of which 108,524,480 acres were grazed by livestock.

The Texas cattle population in 1830 was estimated at 100,000 head. There were 382,873 head of cattle assessed for taxes in 1846, the first year of statehood. By 1860, cattle numbers had increased to 3,786,443 head, while the human population was only 604,215.

Texas beef cattle in 1949 were just short of 7 million head and were valued at $675 million. Beef cattle accounted for 53.4 percent of the total cattle population of the United States that year, but in Texas they represented 84.4 percent of the total cattle population.

Cotton is still the leading money crop in Texas, but beef cattle run a very close second. Beef cattle account for almost 25 percent of the State's total receipts from agriculture.

Figure 1, derived from the 1949-50 Texas Almanac and Industrial Guide, shows the importance of beef cattle to Texas in 1948 in comparison with other sources of cash income from agriculture.

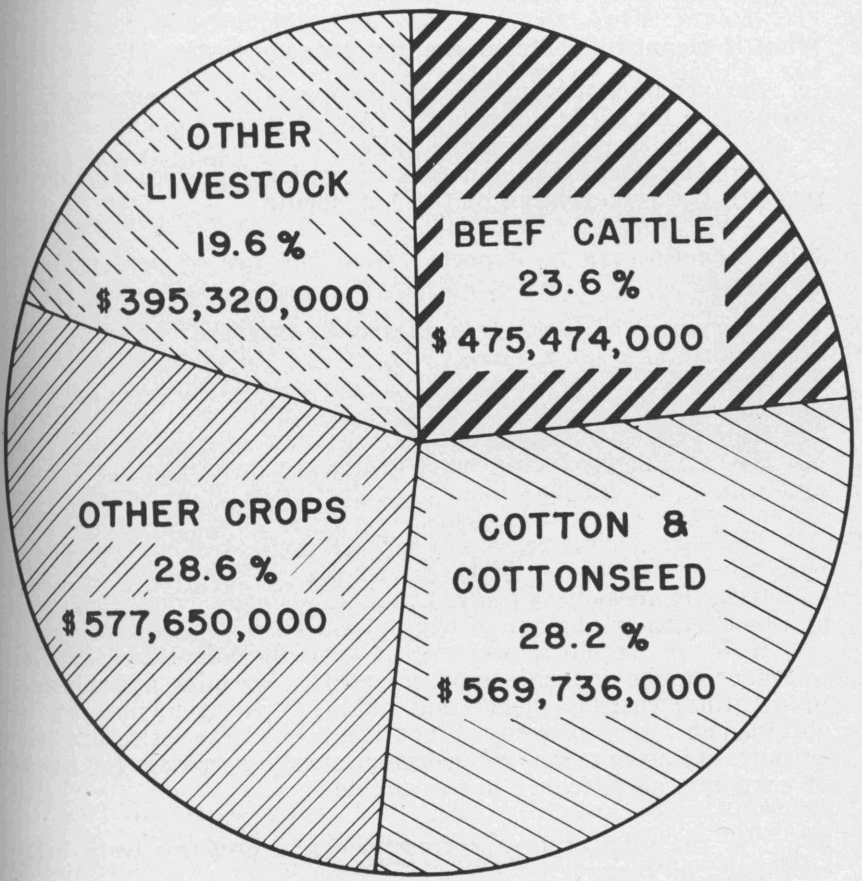


Figure 1. The importance of beef cattle compared with other agricultural cash income in Texas, 1948.

EARLY BEEF CATTLE RESEARCH

Three of seven projects selected for investigation in 1888, the first year of operation of the Texas Agricultural Experiment Station, were on cattle feeding, grazing and disease. One was a study to determine the most practicable and economical methods of feeding beef and dairy cattle. Another was to determine the adaptation of grasses and forage plants to different locations, and to determine their value for grazing and feeding. The third was on treatment of cattle as a protection against tick fever.

Cattle Breeding Studies

PERFORMANCE AND PROGENY TESTING

What is meant by performance and progeny testing?

Performance testing is the comparative measurement of prospective breeding animals for rate of gain, economy of gain or any other trait of economic value.

Progeny testing is a means of evaluating sires and dams through the performance of their offspring.

What benefits can be expected from the use of performance-tested and progeny-tested animals?

Dairymen have made remarkable increases in milk and butterfat production per cow by the use of bulls whose daughters have exceeded the productivity of their dams. Likewise, poultrymen have been able to step up egg production per hen by using the trap nest to measure the productivity of individual birds. Mating of high producing hens to males whose daughters have made good records has been an effective tool in breeding for higher egg production.

The same principles apply to beef cattle, but breeders have been slow to make use of them because of the lack of a sharp and definite measure of performance, such as pounds of milk and butterfat, or number of eggs produced.

However, rate and economy of gain and adaptation or heat tolerance can be determined on prospective breeding animals and, in addition, carcass yields and quality measurements can be obtained on steer progeny. Since these characteristics are hereditary, effective means of selecting breeding animals for points of economic significance are available.

What is the plan of the performance and progeny tests being conducted in Texas?

BALMORHEA—A cooperative project between ranchmen who own the cattle, the Texas Agricultural Experiment Station and the Agricultural Extension Service was started in 1942. This project became a part of the Southern Regional Beef Cattle Improvement Program in 1948 and is now cooperative with ranchmen, the Texas Agricultural Experiment Station, the Texas Agricultural Extension Service, and the Bureau of Animal Industry of the U. S. Department of Agriculture.

At the start of each experiment, all the animals are weighed, graded and divided into heavy, medium and lightweight groups. These weight groups are then subdivided into 3 pens each. Rations are made up largely of ground hegari bundles, chopped

alfalfa hay and cottonseed meal. A system of self-feeders has been developed at Balmorhea and feed is kept before the cattle at all times. The average ration for all cattle fed in the 1949-50 tests was 15 percent cottonseed meal, 20 percent chopped alfalfa hay and 65 percent chopped hegari bundles. These tests usually start about mid-November and end in early April. A field day and barbecue are held on the station at the close of the yearly tests. At this time, the cattle are exhibited by sire groups, and data on the cattle are available to visiting ranchmen and others interested in the work. Figure 2 shows the feeding pens and self feeders at Balmorhea. (TAES unpublished data.)

Figure 2. Feeding pens at the Balmorhea station.

Is gaining ability of cattle an inherited characteristic?

BALMORHEA—Since the start of the beef cattle improvement project in 1942, performance records have been obtained on approximately 1,100 bulls and heifers. Most of these cattle have been purebred Herefords but a few Brahman, Angus, Santa Gertrudis and "Beefmasters" have been included. Very large individual differences in gain have been found, and these experiments show that a major part of these differences is due to heredity. It has been shown that the ability to make higher than average gains, and also more efficient gains, in young animals is largely inherited from the sire and dam. A highly significant difference has been found for average daily gains between sire groups. The widest difference found in average daily gains for sire groups within any one year was from 2.52 to 1.41 pounds per head, a difference of 1.11 pounds. This may be compared with a range of 2.19 pounds per head per day difference between the highest gaining (3.05 pounds) and lowest gaining (0.86

pound) individuals within a year. (TAES unpublished data; Extensioner, May 1950.)

What use can cattlemen make of these performance and progeny testing programs?

The results so far obtained indicate that it should be possible to select lines of breeding which will combine high gaining ability with desirable carcasses and thus furnish the commercial breeder or feeder with more profitable cattle. Continued use of good, tested breeding stock should enable a breeder to predict the performance of his calves and insure a more uniformly high level of production from his herd. (TAES unpublished data; Extensioner, May 1950.)

Is this performance and progeny testing program being expanded in Texas?

BLUEBONNET FARM — The feedlot evaluation testing of calves is being used for selection purposes. The first 154-day test, involving 113 bulls and heifers, was finished in April 1950.

PANTECH FARMS—The program of evaluation of present and prospective sires of beef cattle at the PanTech Farms, Route 2, Panhandle, Texas, is an extension of the beef cattle improvement programs now underway at Balmorhea and Bluebonnet Farm. This will make available a sire and progeny testing service to breeders of beef cattle in the Panhandle as was done for extreme West Texas breeders at Balmorhea, and for Central Texas breeders at Bluebonnet Farm. The first test is due to get under way about November 1, 1950. The feeding period will continue for approximately 154 days.

A bulletin showing results of these performance and progeny tests is being assembled and should be available soon.

SELECTION FOR ECONOMICALLY IMPORTANT CHARACTERISTICS WITHIN PURE BREEDS AND CERTAIN CROSSES

What improvement can be brought about in beef cattle by selection for such characteristics as rate and economy of gain, breeding efficiency, heat tolerance and carcass value?

BLUEBONNET FARM—Experiments now underway are designed to supply information about improvement of beef cattle through selection. This work is a part of an interstate cattle breeding project, and is cooperative with the USDA Bureau of Animal Industry.

The objectives of these experiments are to study: (1) the improvement of beef cattle by selection based on rate and econ-

omy of gain, breeding efficiency and carcass value; (2) to evaluate cattle with regard to adaptation to environment, especially heat tolerance; (3) to develop strains of beef cattle especially adapted to Southern climatic conditions by a breeding program using Brahman cattle and one of the British beef breeds; and (4) to improve the carcass value of cattle of predominantly Brahman breeding by introducing characteristics from one of the British beef breeds.

This project was started in 1948 and over 400 purebred and grade Hereford and Brahman cattle are now being used.

Because of the time required for a generation cycle, progress will be slow. Breeders of registered Brahman cattle have generously supported this project by gifts and loans of breeding stock.

TYPE STUDIES

Does type effect the rate of gain in the feedlot?

The following data are based on one trial of 7 "Comprest" vs. 7 "Regular" Hereford steers from the same ranch. They were fed at Ysleta in 1949 and slaughtered in the College Meats Laboratory. This type study is being continued.

Figure 3 shows one of the "Comprest" and one of the "Regular" type steers a short time before being slaughtered.

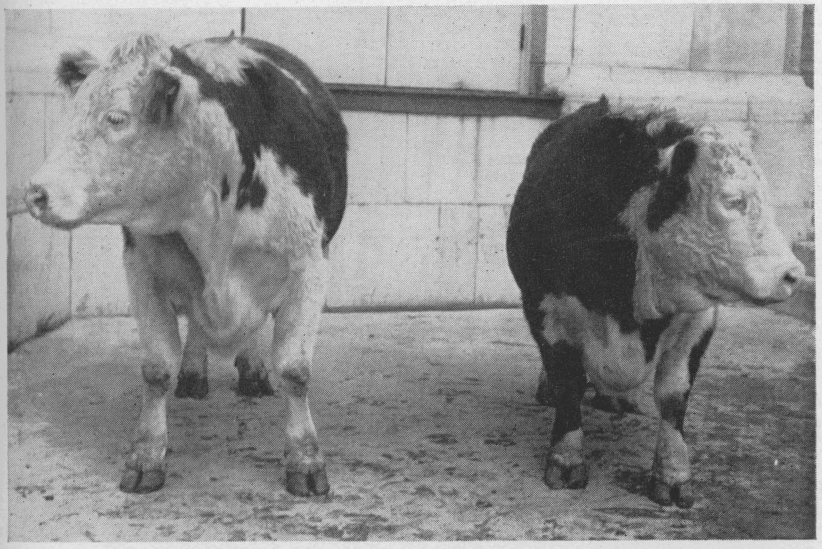


Figure 3. "Regular" steer on the left and "Comprest" steer on the right a short time before being slaughtered.

The steers were fed a growing ration for 112 days, then for 173 days received a fattening ration containing about 59 per-

cent concentrates. The "Regular" steers made a higher rate of gain than the "Comprest" steers throughout the test, Figure 4. Based on market weights, the "Regular" steers gained 1.72 pounds per head daily for the 285 days, while the "Comprest" steers gained 1.52 pounds per head daily. (TAES unpublished data.)

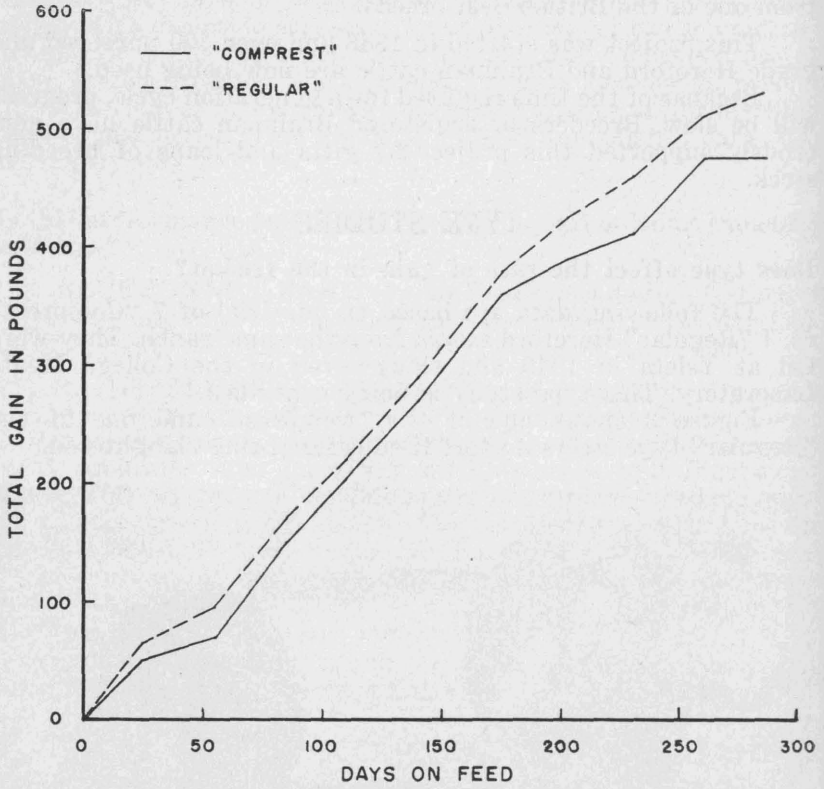


Figure 4. Cumulative gains of "Comprest" and "Regular" type Hereford steers fed 285 days. (Ysleta, 1949.)

Is efficiency of feed utilization influenced by type?

The "Regular" type steers required less total feed to make 100 pounds gain than did those of "Comprest" type. In fact, the "Regulars" gained 100 pounds on a total of 1,070 pounds of feed, of which 474 pounds were concentrates and 596 pounds were roughages. The "Comprest" steers required 493 pounds of concentrates and 627 pounds of roughage, a total of 1,120 pounds of feed, to gain 100 pounds. (TAES unpublished data.)

Does type influence carcass grade and dressing percentage?

On the average, carcasses from the "Comprest" steers fed in the test at Ysleta graded slightly higher than the carcasses from the "Regular" steers. These carcasses were graded by an official government grader. Of the 7 "Comprest" carcasses, 6

Figure 5. A "Regular" carcass on the left and a "Comprest" carcass on the right.

were graded Choice and 1 was graded Good. Four of the "Regular" carcasses were graded Choice and 3 Good. Figure 5 shows a "Comprest" and a "Regular" carcass. The average dressing percentage for the "Regular" calves was 64.86 percent; while that of the "Comprest" calves was 64.63 percent, a very slight advantage for the "Regular" calves. (TAES unpublished data.)

Is the yield of wholesale cuts affected by type?

The percentage of wholesale cuts was almost equal for both the "Comprest" and "Regular" type cattle, with the exception of the shank. Percentage of shank was slightly greater on the "Regular" carcasses. (TAES unpublished data.)

CROSSBREEDING

What are the purposes of crossbreeding?

The main reasons behind crossbreeding are to obtain hybrid vigor and to obtain combinations of the desirable characteristics of each parent breed used.

Are there any disadvantages of crossbreeding?

Yes, there are some problems arising from crossbreeding which may defeat its purpose unless it is used wisely. To accomplish the greatest good from crossbreeding requires continued usage of the two parent breeds. This involves alternate use of parent bulls on the cow herd. The difficulty of obtaining desirable replacement breeding stock, together with lack of uniformity in the herd, may be objectionable features.

How do crossbreds perform in feedlot?

KING RANCH—Cooperative experiments with the King Ranch and the Bureau of Animal Industry, USDA, in 1924-27, involving Shorthorn-Brahman and Hereford-Brahman steers as compared with typical Shorthorn and Hereford steers, yielded much information concerning feedlot performance. Brahman crossbred steers performed better in the feedlot and made more money per head when sold at the end of a 120-day feeding period. But after feeding periods ranging from 150 to 179 days, there was a tendency for this situation to be reversed. On account of gaining more and eating practically the same quantity of feed, the Shorthorns and Herefords made more economical feedlot gains than the Brahman crossbreds when fed for the longer periods. The dressing percentages of the Brahman crossbreds were slightly higher (2 to 4 percent) than those of the Herefords or Shorthorns. There was no significant difference in shrinkage enroute to market between the Brahman crossbreds and the Shorthorns and Herefords. (USDA Tech. Bul. 417.)

SPUR—A series of feedlot trails, 1922-29, involving Herefords, ½ Hereford-½ Brahman and ¾ Hereford—¼ Brahman calves, yearlings and two-year olds, show that the feedlot gains do not differ widely. With few exceptions, the Herefords had a higher average daily gain than the Brahman crosses. The ¾ Hereford-¼ Brahman cattle also, with few exceptions, made higher average daily gains than the ½ Hereford-½ Brahman cattle. Five feeding trials were conducted, ranging in length from 111 days to 120 days. Figure 6 shows the average daily gains made during these trials by the different age groups. (TAES unpublished data.)

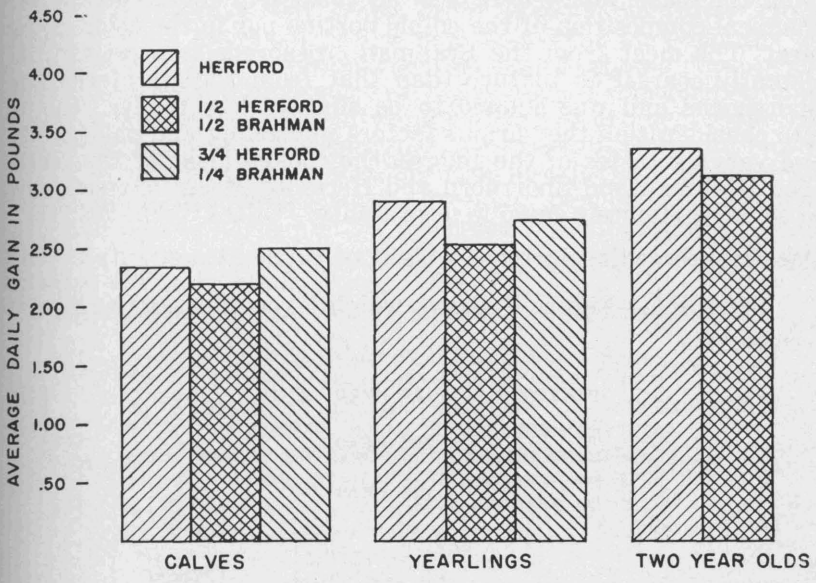


Figure 6. Average daily gains for Herefords and Hereford-Brahman crossbreds fed 111-120 days in drylot. (Spur, 1922-29.)

What about the market desirability of the crossbreds?

KING RANCH—The Brahman crossbreds brought more per hundredweight when sold at weaning time and at the end of 120 days feeding, but at the end of 150-179 days feeding, the Shorthorns and Herefords sold for more per hundredweight. There was no significant difference in the sale price of the cattle fed at Spur. (USDA Tech. Bul. 417.)

Are there any anatomical differences between Brahman crosses and the British beef breeds?

KING RANCH—The Brahman crossbreds had smaller heads, larger hides and smaller digestive tracts than the Short-

horns and Herefords. Differences were less on other parts and organs of the body. (USDA Tech. Bul. 417.)

Is there any difference in quality and palatability of the meat from crossbreds?

KING RANCH—The dressed carcasses from the Shorthorn and Hereford lots were appraised slightly higher than those from the Brahman crossbred lots, but this difference was too small to be significant. The rib cuts from the Brahman crossbred steers had a slightly higher proportion of edible meat and a correspondingly smaller proportion of bone than the rib cuts from the other lots. There was no consistent difference in the chemical composition of the edible portion nor in the color of the meat. The meat from the Brahman crossbreds was rather consistently coarser in texture than that from the Herefords and Shorthorns and was judged to be slightly less tender. Taking into consideration the various factors in cooking and palatability and varying tastes of the judges, the cooked meat of the crossbred Brahman and Shorthorn and Hereford steers is considered to be approximately equal in desirability. (USDA Tech. Bul. 417.)

Does crossbreeding increase weight of cattle at maturity?

SONORA—Figure 7 shows weights recorded at the Sonora

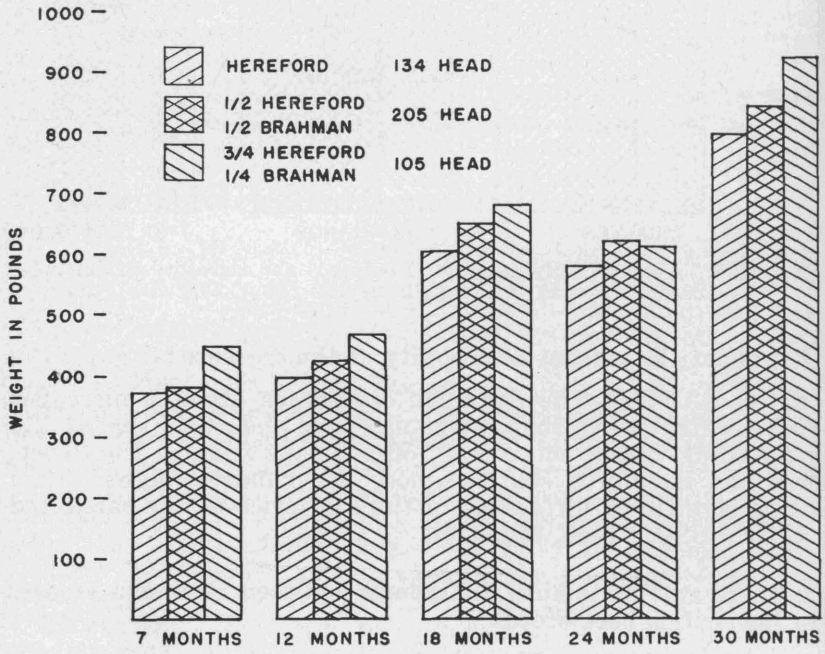


Figure 7. Weights by age of Herefords and Hereford-Brahman crossbreds. (Sonora, 1921-29.)

station (1921-29) on cattle from Hereford-Brahman combinations and straight Herefords (TAES Bul. 409.)

LUFKIN—Hereford-Brahman crosses showed consistent advantages in weight for age over grade Herefords at the East Texas Pasture Station. Cattle mothered by ½ Hereford-½ Brahman cows have been 100 pounds heavier at 30 months old than cattle mothered by Hereford cows and sired by a ½ Hereford-½ Brahman bull. (TAES Progress Report 1121.)

What about Hereford-Brahman crosses for slaughter calf production?

LUFKIN—In 6 calf crops, from 1944-49, 95 calves from Hereford cows averaged 334 pounds in weight at 7 months of age, while 45 calves from quarter and half-Brahman cows averaged 469 pounds, a difference of 135 pounds. From birth to one month of age, differences in weight of calves are negligible but grade is in favor of calves carrying more than ½ Hereford blood. From one month of age to weaning (200 days), there is a decided advantage in weaning weight, dressing percent and carcass grade for calves of ¾ and ⅞ Hereford breeding. The average weights of Herefords and Hereford-Brahman crosses at different ages are shown in Figure 8.

These data indicate clearly that the Brahman blood should

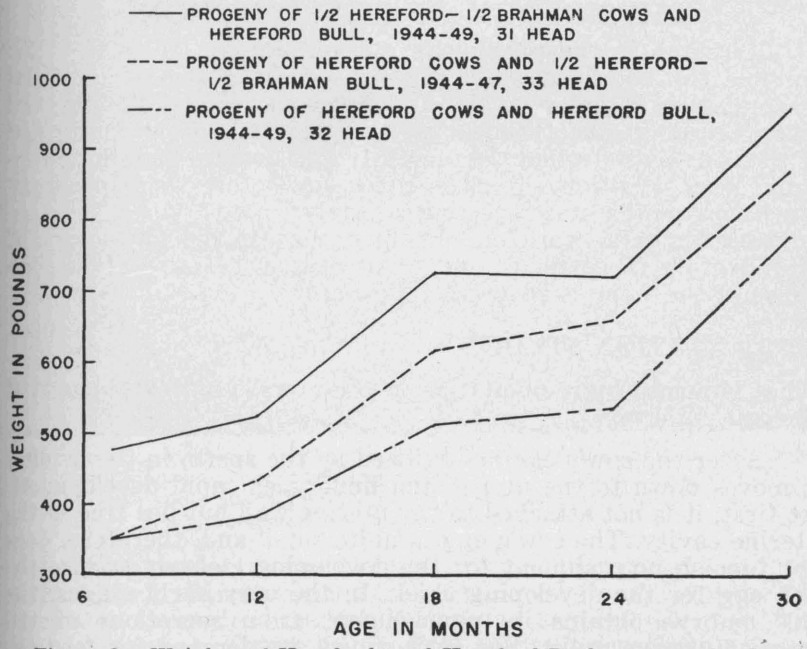


Figure 8. Weights of Herefords and Hereford-Brahman crossbreds at different ages. (Lufkin, 1944-49.)

be on the side of the dam for a heavier calf at weaning. (TAES P. R. 1206.)

Figure 9 shows a ½ Hereford-½ Brahman cow with ¾ Hereford-¼ Brahman calf.

Figure 9. A half-Hereford, half-Brahman cow with her calf sired by a purebred Hereford bull. (Lufkin, April 1950.)

PHYSIOLOGY OF REPRODUCTION

Research in the physiology of reproduction of cattle made possible the widespread and highly successful use of artificial insemination in dairy cattle, and its more limited use by beef cattle breeders. Such studies also contributed to our knowledge of the causes of sterility, low fertility and general breeding problems. Much additional work is necessary before these problems can be prevented or treated successfully.

Fundamental work on certain phases of the physiology of reproduction in cattle is underway at the Texas Station. One phase of the work is reported following.

IMPLANTATION STUDIES

What is meant by implantation in the process of development of the calf embryo?

After the cow's egg is fertilized by the sperm in the oviduct it moves down to the uterus and undergoes rapid development. At first, it is not attached to the uterine wall but lies free in the uterine cavity. The cow's egg is quite small and, therefore, does not furnish nourishment for the developing embryo as does the hen egg for the developing chick. In the very early stages, the calf embryo obtains its nourishment from secretions of the uterus (uterine milk). But as it grows, its demand for food becomes greater and another source of nourishment is established.

This is furnished by the formation of a direct union of the sac around the embryo with certain areas of the uterine wall. In the formation of such union, the embryo implants itself within the uterus.

How does implantation occur?

In its early development, the embryo surrounds itself with a long sac which is filled with fluid. Small finger-like processes develop in localized areas on this sac. These processes grow down into the buttons of the uterine wall, thus forming the cotyledons. These buttons, or cotyledons, first begin their formation in the region nearest the embryo, then gradually proceed in their development toward each end of the sac.

When does implantation within the uterus occur in the development of the unborn calf?

Implantation is a gradual process and continues for several months. The first signs of attachment of the calf embryo can be seen by careful observation on a 32-day old embryo. These attachment spots appear as small fleshy discs on the sac around the embryo. This attachment is at first very fragile, but as the

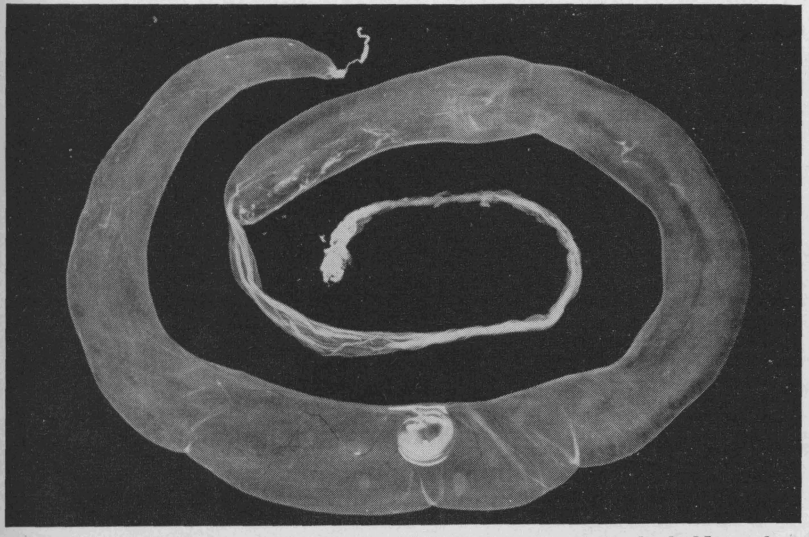


Figure 10. A 35-day calf embryo with membranes attached. Note the small disc-shaped spots on the sac near the region of the embryo. These spots are the early stages in the formation of a union between the mother and the calf.

calf grows, the cotyledons increase in size until some are as much as 3 inches in diameter when fully developed. Blood from the cow circulates through these cotyledons and supplies the calf with its nourishment. Figure 10 shows a 35-day-old calf embryo and its attachments. (TAES unpublished data.)

Feeds and Their By-products—Texas Grown

Because of changes in feeds available and feeding practices, some of the early work of the Station is not included. Data presented in this section are limited to what may still be useful to cattle feeders of today.

ALFALFA

Is alfalfa hay alone better than alfalfa hay and hegari fodder or alfalfa hay and cottonseed hulls as the roughage portions of a ration?

BALMORHEA—Steers fed a roughage mixture of alfalfa hay and hegari fodder for 154 days produced approximately 11 percent more gain and higher finish than those fed alfalfa alone. Dressing percentage was slightly higher for the steers fed alfalfa and hegari and they made 100 pounds gain on less total concentrates and required only 8 pounds more roughage. (TAES Bul. 604.)

YSLETA—Results of 5 feeding trials (1945-50) show that a roughage combination of cottonseed hulls and alfalfa is better than alfalfa alone in fattening rations for yearling steers. There was no reduction in gains or finish when cottonseed hulls replaced from 34 to 60 percent of the alfalfa in the ration. When alfalfa is fed as the only roughage in fattening rations, there seems to be a tendency for steers to bloat more frequently and the addition of cottonseed hulls to the ration serves as a safety factor. (TAES P. R. 1016, 1084, 1151 and 1194, and unpublished data.)

How does alfalfa compare with hegari fodder as the roughage in a ration when concentrates are full fed?

BALMORHEA—Steers fed hegari fodder were easier to keep on feed and, most of the time, had better appetites than steers fed alfalfa. More grain was required by the steers fed alfalfa but they ate less cottonseed meal in producing 100 pounds gain. The steers fed hegari required 223 pounds of milo, 142 pounds of cottonseed, 98 pounds of cottonseed meal and 402 pounds of ground hegari fodder to make 100 pounds gain while the steers fed alfalfa consumed 381 pounds of milo, 145 pounds of cottonseed, 28 pounds of cottonseed meal and 284 pounds of alfalfa in producing 100 pounds gain. The hegari fed steers however, made slightly greater gain, had higher finish, sold at a higher price and made considerably more profit. (TAES Bul. 604.)

What amounts of alfalfa hay can be used to best advantage in high roughage rations?

BALMORHEA—Results indicate that only small amounts

of alfalfa hay can be used to advantage in rations high in ground hegari fodder. This is true because reducing the hegari fodder reduces the intake of grain. Four pounds per head daily for heavy yearling steers is probably as much alfalfa as can be fed in such rations without reducing finish. Larger amounts, particularly of ground alfalfa, apparently decrease feed consumption as well. (TAES Bul. 604.)

As a source of carotene in beef cattle rations, how does dehydrated alfalfa leaf meal compare with sorghum silages?

SPUR—In general, dehydrated alfalfa leaf meal is considerably richer in carotene than sorghum silage. This carotene is apparently better utilized for vitamin A activity than carotene in either sweet sorghum or grain sorghum silage. During 2 feeding tests at Spur (1941-43), there was much less variation in pure carotene content of samples of dehydrated alfalfa leaf meal than in samples of sorghum silage. Cattle fed dehydrated alfalfa leaf meal as the source of carotene, were less affected by vitamin A deficiency at the close of the experiments, and showed more carotene in the blood plasma and liver than cattle receiving sorghum silage. (TAES Bul. 659.)

Other tests at Spur show that one pound of extra-green alfalfa hay per head daily will protect growing and fattening steers from vitamin A deficiency, and that the "mealy" condition associated with fattening cattle on cottonseed meal and hulls in drylot can be remedied by feeding extra-green alfalfa hay. (TAES Cattle Feeding Series No. 20.)

Is it advantageous to replace part of the sumac fodder with alfalfa hay in the ration of fattening steers?

BIG SPRING—Tests indicate that when sumac fodder is used as the only roughage in the ration of fattening yearling steers receiving ground milo heads and cottonseed meal as concentrates, the gains and finish attained will be practically the same as where 4 pounds of alfalfa hay have replaced a portion of the fodder and 0.8 pound of cottonseed meal. These results are valid for short periods of feeding during which body reserves of vitamin A meet the needs of the cattle. (TAES CFS No. 2.)

If alfalfa hay is used as a part of the roughage in a fattening ration, is less protein supplement needed?

SPUR—When 6 pounds of ground alfalfa hay per head daily were added to a fattening ration of sumac silage, cottonseed meal and grain for yearling steers, less cottonseed meal was required and there was an increase in gain and finish. On a per-steer basis, 939 pounds of ground alfalfa hay replaced 1,361 pounds of sumac silage and 206 pounds of cottonseed meal. Average daily

gain for steers fed alfalfa was 2.47 pounds compared with 2.32 pounds for the steers receiving no alfalfa. (TAES P. R. 962.)

CITRUS BY-PRODUCTS

CITRUS MOLASSES

Can citrus molasses be used as a feed for cattle; if so, at what level of feeding are best results obtained?

COLLEGE STATION—Results from 3 feeding tests show that gains made by steers fed balanced rations in which 2 to 4 pounds of citrus molasses replaced equal amounts of ground milo were about the same as gains made by steers fed milo without molasses. Citrus molasses had a relatively greater feeding value when fed at a level of 4 pounds per head daily than when fed at levels of 2 and 3 pounds. On the 4-pound basis, citrus molasses showed a feeding value 98 percent that of ground milo. Citrus molasses is often cheaper than milo; when this condition exists it may be used successfully to replace a part of the grain in a fattening ration for cattle. (TAES P. R. 1113, 1213 and 1252.)

What about palatability and laxative effects of citrus molasses when fed to cattle?

COLLEGE STATION—Rations containing citrus molasses have proved as palatable as those without it when it was fed at levels of 2, 3 and 4 pounds per head daily. A test group of 15 steers consumed up to 6 pounds of citrus molasses per head daily for a month without ill effect. In the amounts fed, it was not noticeably laxative and seemed to have good effect on the hair coat. (TAES P. R. 1113 and 1213.)

How does citrus molasses compare with corn molasses as a replacement for part of the grain in a cattle fattening ration?

COLLEGE STATION—A recent feeding test indicates that the feeding values of citrus molasses and corn molasses are about equal. Average daily gain, feed required per 100 pounds gain, dressing percent, carcass grade and net return were about equal for one group of steers fed citrus molasses and one group efd corn molasses at the rate of 4 pounds per head daily to replace 4 pounds of ground milo. (TAES P. R. 1252.)

DRIED CITRUS PULP

How does dried citrus pulp compare with ground ear corn with shuck in beef cattle fattening rations?

BEEVILLE—Dried citrus pulp fed as the carbohydrate concentrate portion of the ration to replace 25 percent of the daily allowance of ground ear corn with shuck in fattening

rations for beef steers, resulted in practically equal gains but slightly higher finish than ground ear corn with shuck. Replacing as much as 60 percent of the daily allowances of ground ear corn with dried citrus pulp produced a ration which was less palatable, had slightly greater laxative effect and reduced feed consumption, gains and finish. There was no difference in the color of the fat of steers fed the different rations. (TAES Bul. 613.)

CORN

How do corn and the grain sorghums compare as the grain portion of the fattening ration for baby beeves?

SPUR—Steer calves fed ground ear corn with shuck, along with cottonseed meal, alfalfa hay and sorghum hay, made an average daily gain of 2.02 pounds in a 165-day feeding trial. Steer calves fed the same type of ration but with the ground ear corn replaced by ground feterita heads, made an average daily gain of 2.06 pounds. Calves fed a ration in which the ground ear corn was replaced by ground milo heads made an average daily gain of 1.99 pounds. There was a very slight advantage in selling price and grade for the calves fed corn, but the calves fed the grain sorghums made more economical gains. This test proved that choice quality beef can be produced when grain sorghums replace corn in fattening rations for cattle. (TAES Bul. 296.)

BEEVILLE—Twenty-six steer calves fed ground ear corn with shuck in 3 feeding trials averaged 9 percent more gain on the basis of market weights than 26 steer calves fed ground hegari heads as the grain portion of a fattening ration. The average carcass weights of the steers fed corn were 5 percent greater and the corn produced quicker and more finish, as shown by higher dressing percent, higher carcass grades and a slightly higher selling price. On the basis of market weights, it required 16 percent more ground hegari heads than ground ear corn to produce 100 pounds of gain. (TAES Bul. 564.)

How good is ground ear corn in beef cattle wintering rations?

BEEVILLE—In winter feeding steer calves, 2 pounds of ground ear corn and 2 pounds of cottonseed meal fed per head daily produced more than 1.5 pounds daily gain when fed with either silage or small grain pasturage. These wintering periods were about 180 days long. (TAES Bul. 599.)

Is it advisable to supplement Sudan grazing with ground ear corn?

BEEVILLE—Heavy, fleshy yearling steers were well finished in 140 days when self-fed ground ear corn in addition to Sudan pasturage. Similar steers, unfed or self-fed cane molasses,

required an additional feeding period of 56 days in drylot to reach the same finish.

Financial returns at the time these tests were conducted (1938-40) did not favor supplying a supplementary feed to yearling steers during the Sudan grazing period. Probably the best method would be to feed a combination of ground ear corn and cottonseed meal in proportions to furnish sufficient protein and energy as needed while on Sudan pasture. The condition of the Sudan as well as the prices of these feeds would determine the amounts to use. (TAES Bul. 599.)

How do corn and grain sorghums compare in chemical composition?

Corn and the grain sorghums have very much the same chemical composition. Both feeds contain 70 percent nitrogen-free extract; they are low in fiber and high in total digestible nutrients. The grain sorghums have slightly more digestible protein than corn, but corn is higher in digestible fat. Current crop yellow corn is a good source of carotene, whereas the grain sorghums are very deficient in carotene.

COTTON SEED AND BY-PRODUCTS

The use of cotton seed and its by-products by Texas cattle feeders is widespread and much of the cattle feeding research done by the Texas Agricultural Experiment Station involved these feeds. Cotton seed, cottonseed meal and hulls comprised one of the earliest cattle fattening rations used in Texas and most of the early research was designed around such a ration. Cottonseed products are on the market today in many new forms. Research is still underway to determine the value of each of these new feeds, and to improve them.

COTTONSEED HULLS

Are cottonseed hulls better than sorghum silage or sorghum fodder as the roughage in rations for fattening steers?

BIG SPRING—In 3 tests (1923-25), sumac silage and sumac fodder fed to fattening calves produced larger and more uniform gains than cottonseed hulls. The average daily gain made by calves fed sumac silage was 2.00 pounds, that of calves fed cottonseed hulls was 1.61 pounds and that of calves fed sumac fodder was 1.90 pounds. More feed was required per 100 pounds gain and less finish was attained by the calves fed the hulls. This experiment shows that sumac silage and fodder are more satisfactory roughages for fattening calves than cottonseed hulls, when fed with ground milo heads and cottonseed meal. In comparing these feeds, it should be remembered that cottonseed hulls do not contain vitamin A. (TAES Bul. 363.)

SPUR—Gains made by yearling steers fed cottonseed hulls

as the roughage portion of the ration were practically equal to those made by steers fed chopped sumac fodder or milo silage. Steers fed sumac fodder or sumac silages and alfalfa hay outgained the steers fed cottonseed hulls. The steers fed cottonseed hulls had the lowest carcass grades. (TAES P. R. 962.)

COTTON SEED

What amounts of cotton seed may be fed successfully to fattening cattle?

SPUR—When fattening yearling steers, on a full feeding of grain and roughage, the maximum daily supplement of cotton seed should be about 0.5 pounds per 100 pounds live weight. When fed in such limited amounts, cotton seed has consistently produced gains and finish equal or superior to cottonseed meal as a supplement to the same rations. (TAES CFS No. 16.)

Is cotton seed better than cottonseed meal as the protein supplement in fattening rations?

SPUR—When 4.08 pounds of cotton seed were fed daily to yearling steers in comparison with 2.37 pounds of cottonseed meal, the gains were higher for the seed-fed cattle. (TAES CFS No. 3.)

Another feeding trial at Spur revealed that when 3.91 pounds of cotton seed were fed in comparison with 2.67 pounds of cottonseed meal, the gains based on market weights were almost the same. Steers fed cotton seed in this trial had a dressing percentage of 58.5 while those fed cottonseed meal dressed 57.2 percent. (TAES CFS No. 8.)

COLLEGE STATION — When cotton seed was fed in amounts to furnish the same protein level as cottonseed meal, yearling steers fed in 1932 and 1933 for 158 days gained more on the cottonseed meal ration than on the cotton seed ration. This difference in daily gain was only 0.1 pound and was probably due in part to a smaller grain and hay consumption by the steers fed cotton seed. (TAES CFS No. 11.)

BALMORHEA—Cottonseed meal and cotton seed were compared as supplements with a full-fed grain and roughage ration which included 3 pounds of alfalfa hay. The cotton seed was fed to replace the cottonseed meal and a portion of the grain. Yearling steers receiving cotton seed made a greater and cheaper gain, and had a higher finish than the steers fed cottonseed meal. (TAES Bul. 604.)

May cotton seed replace part of the grain in a fattening ration for cattle with no loss in rate or economy of gain, or finish?

BALMORHEA—Gain and finish were increased when cotton seed was fed to yearling steers to replace one-third of the

ground milo grain in practically full-fed concentrate rations supplemented by cottonseed meal. Gain and finish were also increased when seed was fed to replace one-third of the milo grain in high roughage rations. Results of trials at Balmorhea indicate that cotton seed can be used more efficiently as a replacement for a portion of the grain in a fattening ration than as a replacement for cottonseed meal. Cotton seed supplies a considerable amount of protein; when given as an energy feed, this protein value should definitely be kept in mind.

How does a mixture of cotton seed and cottonseed meal compare with cottonseed meal or cotton seed alone as the protein portion of a fattening ration?

COLLEGE STATION—Yearling steers made more gain on less total feed when the protein supplement of a ground milo and Johnson grass hay ration was a mixture of cotton seed and cottonseed meal rather than cotton seed or cottonseed meal alone. (TAES CFS. No. 11.)

BALMORHEA—In 2 out of 3 trials, yearling steers made better gains when fed a combination of cotton seed and cottonseed meal with milo, than when fed cotton seed and milo or cotton seed meal and milo. The roughage portion of these rations was alfalfa hay and hegari fodder. (TAES Bul. 604.)

Is palatability a problem when feeding cotton seed to cattle?

When fed in amounts too large, or when the amount in a ration is increased too rapidly, cotton seed may cause cattle to go off feed. When amounts of cotton seed fed are regulated and when a palatable roughage, a portion of which is a legume, is part of the ration, there probably will be no trouble with palatability. Palatability will probably not be a problem when cotton seed is fed at a rate not to exceed one-half pound per 100 pounds live weight daily. (TAES CFS No. 3, 8, 11 and 16.)

When can cotton seed be fed economically in fattening rations?

SPUR—Cotton seed as a feed, contains only about two-fifths as much digestible protein as 43 percent protein cottonseed meal, but has approximately the same energy value. Cotton seed is only slightly lower in energy value than milo grain. The economy in feeding cotton seed depends on the price of cottonseed meal in comparison with other protein supplements and grains. It can be fed to fattening steers when it does not cost more than ground threshed milo, and when cottonseed meal costs more than either cottonseed or milo. With such price ranges, cotton seed may be used to replace part of the cottonseed meal and part of the grain in fattening rations because it is comparatively high in both protein and energy. (TAES Bul. 622.)

COTTONSEED MEAL AND CAKE

Can yearling steers be fattened on a ration of only silage and cottonseed meal? What amounts of cottonseed meal produce the most economical gains with such a ration?

SPUR—Feeding experiments showed that heavy yearling steers of about 700 pounds initial weight can be reasonably well fattened in about 200 days on rations of cottonseed meal and sumac silage without additional grain. The feeding of silage with cottonseed meal may afford a profitable means of marketing large amounts of silage per steer when grains are scarce and high in price and silage is abundant and cheap. This method has the disadvantage of producing only moderate gains because it is impossible for cattle fed limited concentrates to consume enough silage to obtain the nutrients required to make high gain.

Considering the factors of gain, costs of gain, degree of finish, selling price, carcass weight and grade and net return, feeding approximately 5.5 pounds of cottonseed meal per head daily in addition to a full feed of silage, gave better results than the feeding of either 4 or 7 pounds of cottonseed meal. These amounts of cottonseed meal were greater than were necessary to meet the protein requirements of the cattle. Whether such amounts can be fed economically depends on the price of cottonseed meal as compared with grains. When cottonseed meal will supply energy at a cost no higher than grain sorghums or corn, it may be used in excess of amounts needed to meet the protein

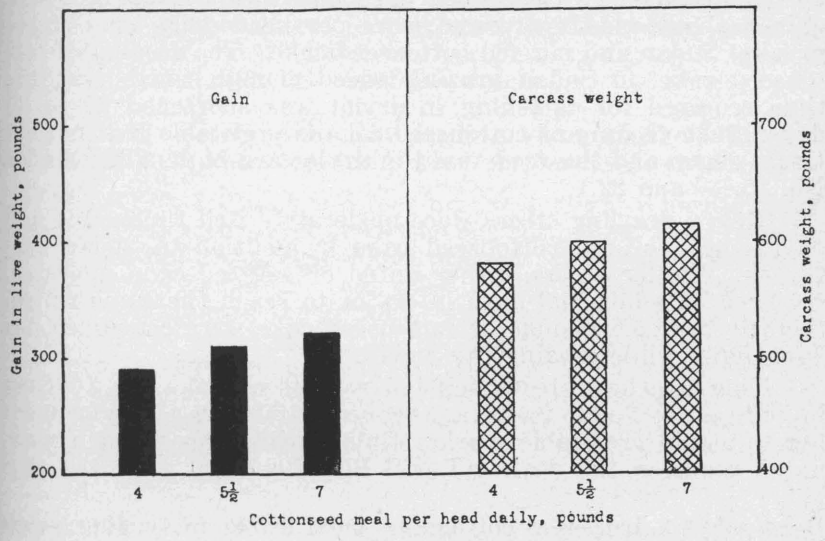


Figure 11. Gain and carcass weights of yearling steers fed 4, 5.5 and 7 pounds of cottonseed meal for 165 days, in addition to a full feed of sumac silage.

requirement. Figure 11 shows the gains and carcass weights of the cattle fed the different amounts of cottonseed meal in addition to a full feed of sumac silage. (TAES Bul. 622.)

What amount of cottonseed meal should be fed to yearling steers with rations high in ground milo heads?

SPUR—About 2.5 pounds of cottonseed meal was the practical amount to feed with ground milo heads and silage in fattening heavy yearling steers in 1938-39. Rations containing no cottonseed meal produced low-cost gain, but the gain on the basis of market weights was unsatisfactory. The steers had poor coats of hair and appeared to lack finish. When 2.46 pounds of cottonseed meal were fed, satisfactory gain was produced at low cost and the steers had high finish and were attractive in hair coat. When 4.91 pounds of cottonseed meal were fed, slightly greater gains were produced but at a higher cost. Gains made by the steers fed cottonseed meal were significantly greater than those made by steers fed no cottonseed meal. The performance of steers fed no cottonseed meal in this trial was probably better on the average than could be expected for steers handled in a similar manner. (TAES P. R. 602.)

How valuable is cottonseed cake when fed to yearling steers grazing Sudan grass?

BEEVILLE—During 3 years (1933-36), yearling steers fed about 4 pounds of cottonseed cake daily while grazing Sudan gained about one-third pound more per head daily than steers grazing Sudan and not fed cottonseed cake. The feeding of cottonseed cake on Sudan grazing added enough finish that the time required for fattening in drylot was shortened 20 to 30 days. Such feeding of cottonseed cake is profitable if it is relatively cheap and the feeds used in drylot are high. (TAES CFS No. 15, 17 and 22.)

Heavy yearling steers were moderately well finished in 140 days when self-fed cottonseed cake in addition to Sudan pasturage. Similar steers, either unfed or self-fed cane molasses, required 56 additional days in drylot to reach the same finish. Slightly over 6.5 pounds of cottonseed cake were consumed per steer daily while grazing the Sudan.

Thin yearling steers self-fed cottonseed cake for 70 days in addition to Sudan pasturage required 100 days of drylot feeding to attain creditable market finish, while those which were unfed required 139 days. (TAES Bul. 599.)

Does solvent processed cottonseed meal differ in feeding value from hydraulic processed cottonseed meal?

SPUR—Steers fed hydraulic processed cottonseed meal

made an average daily gain of 2.2 pounds during a 142-day feeding period, compared with 2.06 pounds for steers fed solvent processed cottonseed meal. Two lots of 7 Hereford steers each were used. The meals were fed to both lots at the rate of 4 pounds per head daily with 5.5 pounds of ground sorghum grain and 48 pounds of sorghum silage. Net returns from the two groups were practically the same due to the higher selling price for the steers fed the solvent processed meal. The main difference in the composition of the meals is in the fat content. The solvent processed meal used in this trial contained 3.44 percent fat, while the hydraulic processed meal contained 6 percent fat. (TAES P. R. 1191.)

BALMORHEA—A comparison of hydraulic and cooked and uncooked solvent processed cottonseed meal was made in connection with the winter feeding of bulls. The average daily gain among the 3 groups was practically equal, with a very slight advantage in favor of the groups fed the uncooked solvent processed meal. These bulls were fed a constant amount of cottonseed meal (2.86 pounds) and were self-fed a roughage-concentrate mixture. The bulls fed the uncooked solvent processed meal consumed slightly more feed than the other groups. (TAES unpublished data.)

How do solvent and hydraulic processed cottonseed meals compare for wintering beef breeding cows?

COLLEGE STATION—Feeding 2 pounds per head daily of solvent extracted and hydraulic processed cottonseed meal, in addition to sumac silage, to purebred beef breeding cows on pasture, resulted in no differences in weights during a 112-day wintering period. (TAES unpublished data.)

Is there any difference in the feeding value of 41-43 percent cottonseed meal and 28 percent whole pressed cottonseed cake?

YSLETA—In 3 out of 5 feeding trials, slightly higher gains were made by steers fed 41-43 percent cottonseed meal or cake over steers fed 28 percent whole pressed cottonseed cake. More pounds of the 28 percent cake must be fed to furnish the same amount of protein in the ration; therefore, less grain is needed to furnish the same energy as is furnished by 43 or 41 percent meal or cake and grain. Whether it is advisable to feed the 28 percent cake depends primarily on the relative price of grain and the cake, and also the relative price of the 41-43 percent meal and the 28 percent cake. (TAES P. R. 1016, 1084, 1151 and 1194, and unpublished data.)

Does a "special" cottonseed meal low in free gossypol differ from "ordinary" cottonseed meal in feeding value?

SPUR—According to feeding trials, a "special" cottonseed

meal, low in free gossypol, has no significant advantage over "ordinary" cottonseed meal for fattening steers. No difference in palatability was observed between the meals. The "special" cottonseed meal was 3.06 percent lower in crude protein than the "ordinary" cottonseed meal, but contained 0.4 percent more crude fat. The slight and insignificant difference in gain (.06 pound per steer daily) favored the "ordinary" cottonseed meal. (TAES P. R. 1101.)

What value does cottonseed meal or cake have in wintering rations for cattle, and how should each be used?

BEEVILLE—In winter feeding steer calves for about 180 days, 2 pounds of cottonseed meal and 2 pounds of ground ear corn fed per head daily were sufficient to produce more than 1.5 pounds daily gain when fed with either silage or small grain pasturage. (TAES Bul. 599.)

COTTONSEED OIL

What about feeding cottonseed oil to cattle?

SPUR—The addition of 0.4 pound of cottonseed oil to a ration composed of sorghum silage, 4.0 pounds cottonseed meal, 1 pound cottonseed hulls and .58 pound cottonseed oil, resulted in an additional gain of 0.1 pound per head daily by yearling steers. This shows that cottonseed oil or fat has high feed value. The factor that usually prohibits the feeding of crude cottonseed oil is its cost. Cottonseed oil was not laxative to steers when fed in amounts up to 1 pound per head daily, an amount of fat which would be supplied by about 5.6 pounds of cotton seed. The fat part of cotton seed is equally as valuable to the animal, whether furnished in the form of meal, oil or whole cotton seed; therefore, the best way to furnish protein and fat in the ration will be the method that is cheapest at the time. (TAES CFS No. 24; P. R. 27 and 31.)

What consideration should be given to the fat content of cottonseed meal as a cattle feed?

SPUR—Cottonseed oil was found to have a productive energy value of approximately 2.5 times that of milo grain, or 2.75 times that of average 43 percent protein cottonseed meal. A 1 percent increase in the oil content of cottonseed meal is equivalent to 20 pounds of oil per ton of meal. This is equivalent in energy value to 50 pounds of milo grain. Consequently, a cottonseed meal of higher fat content is preferred to one of lower fat content, provided the protein content is the same.

COTTON BURS

Can ground cotton burs be fed safely to cattle?

SPUR—Forty-two days after 458-pounds Hereford steer

calves were placed on a ration of 2.5 pounds cottonseed meal, 2.2 pounds ground white kafir grain and ground cotton burs free-choice, they were so weak they could not be continued on the burs. The calves fed the burs lost an average of 1.7 pounds per head in 42 days, while calves fed cottonseed hulls in place of burs gained 85 pounds per head. Five Hereford range cows were fed ground and unground burs with 3 pounds of cottonseed meal per head daily and lost weight. These cows did not eat more than 5 pounds of the burs per head daily. These experiments prove that cotton burs should not be fed to cattle. (TAES CFS No. 20.)

COTTON STALKS AND GIN TRASH

What is the feeding value of ground cotton stalks and ground gin trash when used in rations for growing yearling steers?

A recent feeding study at the Ysleta station shows that ground cotton stalks were inferior to ground gin trash, and both were inferior to cottonseed hulls as roughages in rations for growing yearling steers. The addition of ground cotton stalks or ground gin trash, or both, to a ration of alfalfa hay, ground sorghum grain, blackstrap molasses and cottonseed meal, decreased feed consumption and gain, and increased the feed required per 100 pounds gain and the cost of gain.

According to the results obtained in this feeding trial, cotton stalks and gin trash are probably too expensive in comparison with cottonseed hulls. The use of any material in feeding steers which tends to lower feed consumption and gain below what may be expected from a standard roughage, such as cottonseed hulls, is questionable. This practically eliminates the use of such material as cotton stalks. With fair gains from the use of gin trash and alfalfa hay (1.82 pounds per head daily in this trial), the gin trash may have some value as an emergency roughage. It did not seriously retard feed consumption when used as one-third of the ration, or at the rate of about 6 pounds per head daily. (TAES unpublished data.)

MOLASSES

Does the addition of molasses to a ration of cottonseed meal and hulls increase gains?

COLLEGE STATION—A series of experiments started in 1890 showed that the addition of molasses to a ration of cottonseed meal and hulls made the ration more palatable, more feed was eaten and gains were increased. The addition of one-fifth gallon of molasses to a ration of cottonseed meal and hulls fed to 2 and 3-year-old steers for 90-100 days, resulted in an increased daily gain of about 0.5 pound. (TAES Bul. 10, 76 and 86.)

Are gains increased when molasses is added to a "balanced ration?"

COLLEGE STATION—An experiment in 1906 with yearling steers showed that the addition of molasses to a ration composed of cottonseed meal, cottonseed hulls, corn chops and alfalfa hay, increased gains. Different amounts of molasses were fed for 100 days. The steers receiving the largest amount of molasses, .52 gallon per head daily, made the largest gain. These steers made an average daily gain of 2.71 pounds, while steers fed .32 gallon daily made only 2.21 pounds daily gain. All steers received the same amounts of the other feeds. (TAES Bul. 86.)

How does molasses compare with cottonseed cake or ground ear corn as supplements to steers grazing Sudan grass?

BEEVILLE—Gains made by yearling steers self-fed molasses while grazing Sudan grass for 140 days were considerably lower than those made by steers self-fed 43 percent cottonseed cake or ground ear corn while grazing Sudan. The steers self-fed the molasses gained only 0.16 pound more per head daily than steers receiving no supplement while grazing Sudan. Steers fed the molasses consumed an average of only 2.57 pounds per head daily, while a similar lot consumed 6.69 pounds of cottonseed cake and another lot consumed 12.26 pounds of ground ear corn. An additional drylot feeding period of 56 days was required by cattle fed no supplement and fed molasses to reach the same finish as those fed cottonseed cake or ground ear corn. (TAES Bul. 599.)

PEANUT MEAL

How does peanut meal compare with cottonseed meal as a protein supplement in steer fattening rations?

In 6 drylot feeding trials, 1940-46, three at Spur, one at Stephenville and two at Lubbock (in cooperation with the Texas Technological College), peanut meal was equal to cottonseed meal as a protein supplement in rations for fattening yearling steers. Both meals used contained 43 percent crude protein, but the peanut meal was higher in ether extract and fat content.

Steers fed peanut meal had a slight advantage in gain in 5 out of 6 feeding trials, and had sleeker coats of hair. The steers fed cottonseed meal, however, showed keener appetite and ate more feed. There was no appreciable difference in carcass grade between the steers fed the respective meals. (TAES Bul. 685.)

RICE BY-PRODUCTS

RICE BRAN

What is the value of rice bran when substituted for part of the grain in steer fattening rations?

COLLEGE STATION—Gains were increased and cost of

gains was decreased when dehydrated rice bran replaced 25 to 40 percent of the grain in rations for fattening steers. These results were obtained in 3 feeding trials when rice bran was used to replace a part of the ground threshed milo, ground threshed kafir or ground shelled corn as the grain portion of cattle fattening rations. (TAES CFS No. 11 and 19; TAES annual report, 1934.)

How much of the grain in a cattle fattening ration can be replaced by rice bran?

COLLEGE STATION—More gain, with less feed required per 100 pounds of gain, was obtained from steers fed a ration in which rice bran replaced 25 percent of the ground shelled corn, in comparison with a ration in which rice bran replaced 40 percent of the corn, 50 percent of the corn or none of the corn. When rice bran was fed in too-large amounts, the cattle had a tendency to go off feed. There was no difference in the carcass desirability of the steers. These results indicate that maximum returns may be obtained from rice bran when it is fed to replace 25 to 30 percent of the grain portion of a cattle fattening ration. (TAES CFS No. 19.)

When rice bran was fed with silage and cottonseed meal as a fattening ration for 2-year-old steers, gains were lower than when a ration of cottonseed meal, silage and ground milo heads was used. The ration containing the milo seemed to be more palatable than the one containing rice bran. Rice bran should be fresh as it becomes rancid with age, and in such condition cattle do not relish it. Its feeding value also deteriorates with age. (TAES Bul. 182.)

RICE HULLS

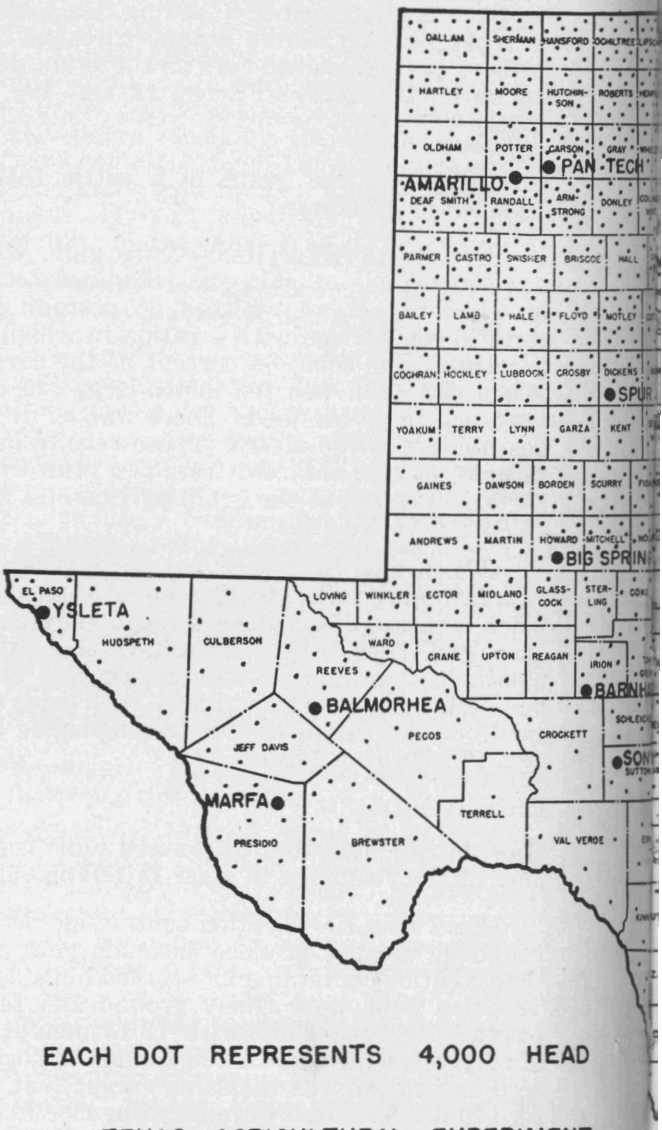
How do rice hulls and cottonseed hulls compare when used as a part of the roughage in steer fattening rations?

BEEVILLE—A ration containing rice hulls as a part of the roughage did not produce as much gain and was less palatable than a ration containing cottonseed hulls as part of the roughage. The rice hulls were finely ground and fed at the rate of 3.17 pounds per head daily with 12.18 pounds of corn, 2.81 pounds of cottonseed meal and 11.38 pounds of hegari silage. The cottonseed hull ration was the same except that 3.16 pounds of cottonseed hulls were used to replace the rice hulls. (TAES P. R. 546.)

COLLEGE STATION—Experiments conducted in 1904 prompted the following conclusions regarding rice hulls: Rice hulls are not satisfactory as a substitute for cottonseed hulls, as the steers do not relish them; rice hulls fed with cottonseed meal, rice bran and molasses are unsatisfactory, as the steers could not be induced to eat a fair ration. (TAES Bul. 76.)

Cattle Distribution in Texas and Field

Station Engaged in



EACH DOT REPRESENTS 4,000 HEAD

● TEXAS AGRICULTURAL EXPERIMENT STATION FIELD UNIT

Fie

Units of the Texas Agricultural Experiment in Beef Cattle Research

Figure 12

Cattle Distribution in Texas and Field Units of the Texas Agricultural Experiment Station Engaged in Beef Cattle Research

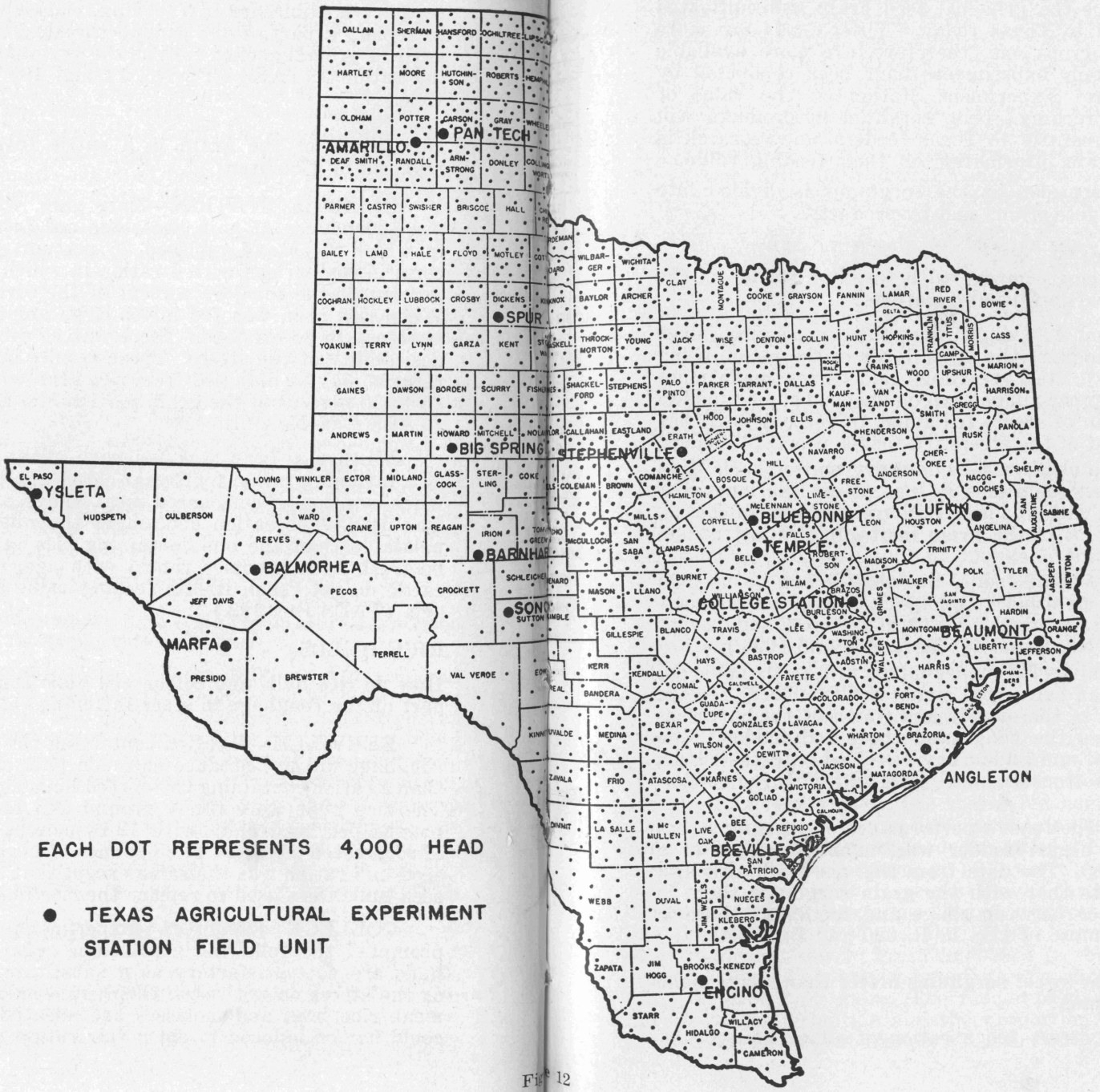


Fig. 12

SORGHUMS AND BY-PRODUCTS

The sorghums are the principal feed grain and cultivated forage crop produced in Texas today. These feeds are more abundant than other crops and, therefore, are more available for cattle feeding. Many experiments have been conducted by the Texas Agricultural Experiment Station on the value of sorghums for cattle feeding. New sorghum by-products will soon be available in quantity to Texas feeders, and research is now underway to obtain information on their feeding value.

The following discussion on the sorghums is divided into three phases: roughages, grains and by-products.

SORGHUM ROUGHAGES

How does sorghum silage compare with sorghum fodder as the roughage portion of cattle fattening rations?

SPUR—In 3 out of 4 feeding tests comparing sumac silage with chopped sumac fodder (the other feeds in the ration being fed in equal amounts), steer yearlings and calves made more and cheaper gain on sumac silage than on chopped sumac fodder. The average daily gain of steers fed silage in these 4 tests was 2.26 pounds, while that of the steers fed fodder was 2.18 pounds.

Silage is usually a cheaper feed on a dry matter basis than is fodder, and weather conditions do not affect the curing of silage as is the case with fodder. In some sections of Texas, there may be quite a lot of the grain in the fodder lost due to damage by birds.

Advantages in favor of fodder are that it can be used in self-feeders, and that no other roughage in the ration is necessary, while with silage a small amount of dry roughage seems helpful. (TAES CFS. No. 8 and 16; P. R. 962 and 1033.)

BIG SPRING—Calves fed sumac silage in 3 trials made 4.7 percent more gain than calves fed sumac fodder. There seemed to be little difference in the quality and finish of the carcasses between the calves fed the silage and those fed fodder. Milo heads, cottonseed meal and Sudan hay were fed with the silage, and milo heads and cottonseed meal were fed with the fodder. (TAES Bul. 363.)

BALMORHEA—The feedlot performance of yearling steers fed hegari silage or hegari fodder was much the same in a feeding trial in 1938-39. The data from this one trial, although not conclusive, indicate that with the grain sorghums there is not as much difference between silage and fodder as there is with the sweet sorghums. (TAES P. R. 620 and Bul. 604.)

Is silage made from the sweet sorghums better than silage made from the grain sorghums?

SPUR—Yearling steers fed a ration of silage and cotton-

seed meal made about the same gain whether the silage was sumac or kafir. About 1.7 yearling steers were fed per acre of sumac and 1.2 steers per acre of kafir. The main difference between these two silages appeared to be in the yields of green forage, the sumac yielding 8 tons per acre and the kafir 5 tons. (TAES annual report, 1938.)

Another feeding trial that compared sumac and milo silage produced results in favor of the sumac silage. Yearling steers fed sumac silage as the roughage part of a fattening ration made an average daily gain of 2.32 pounds per head while steers fed milo silage gained only 2.16 pounds daily per head. (TAES P. R. 962.)

An average daily gain of 2.52 pounds per head was made by steer yearlings fed sumac silage for roughage in a fattening ration, and yearlings fed hegari silage made a gain of 2.46 pounds per head daily. (TAES P. R. 1033.)

These experiments fail to show any justification for using grain sorghums for silage instead of sweet sorghums.

Is there any appreciable difference in feeding value of the various varieties of sorghum fodder?

SPUR—In a comparison of chopped sumac, kafir and hegari fodders as roughages, there was little difference in gains among steer yearlings fed these different varieties. These fodders were fed at a rate of 8.34 pounds per head daily along with 14 pounds of ground milo heads and 2.67 pounds of cottonseed meal. There seems to be little difference in the palatability of the different varieties when made into fodder. It is probable that under most conditions sumac will yield a larger tonnage per acre than the grain sorghum varieties. Differences in yield are probably more important than differences in nutritional value, pound for pound. (TAES CFS No. 3 and 8.)

BALMORHEA—Two feeding trials involving yearling and 2-year-old steers were conducted to compare ground hegari fodder and ground sumac fodder in high roughage rations. Four pounds of ground alfalfa hay were fed per head daily as a part of the roughage ration. The steers fed hegari had a slight advantage in gains, but this difference was not significant. Under normal conditions, fodder made from the grain sorghum varieties will have a higher percentage of grain than fodder made from the sweet sorghums. It seems logical that if cattle are fed a high concentrate ration, the kind of sorghum fodder to use would be the one that produces the largest tonnage of dry matter. But in rations low in grain and high in roughage, the feeding of a fodder with a good percentage of grain would be of advantage in producing gains. The fodder produced at Balmorhea is grown under irrigation and the proportion of grain to stalk is higher in the hegari fodder. (TAES P. R. 752 and 793.)

Does it pay to chop sorghum fodder when used in cattle fattening rations?

SPUR—Three feeding trials with yearling steers indicate that no great difference in gains is obtained when chopped or unchopped fodder was fed. The cattle fed the chopped fodder had a slight advantage in gain, and in one trial in which milo heads and unground fodder were fed, the steers receiving the ground feed made over 0.5 pound more gain daily. When only a few cattle are being fed, the purchase of expensive equipment for chopping and grinding is probably not justified. When hogs follow steers in drylot, more pork is produced when unground feeds are fed. Chopping or grinding is largely a matter of reducing waste. (TAES CFS. No. 3, 16 and 28.)

Is it possible to finish cattle successfully on rations containing mostly sorghum roughages?

BALMORHEA—During 8 years of cattle feeding (1931-39) 226 yearling steers were fattened on rations containing 71 percent roughages and 29 percent concentrates. These steers were fed an average of 190 days and made an average daily gain of 2.15 pounds, basis feedlot weights. Sixty-four percent of the carcasses from these steers graded Good and Choice, 28 percent graded Top Medium to Good, and only 8 percent graded Medium. Ground hegari fodder was the main feed in these rations, along with alfalfa hay, cottonseed meal, cotton seed, milo heads and ground threshed milo. Grond hegari fodder comprised approximately 60 percent of these rations. The use of self-feeders saved considerable labor. Longer feeding periods are required when high roughage rations are used, but a profitable outlet may be furnished for large quantities of sorghum roughages. (TAES Bul. 604.)

SPUR—The average daily gain of 1.88 pounds for 150 steers, an average dressed yield of 63 percent on the basis of market weights, and the carcass grades show that rations of silage supplemented with cottonseed meal will fatten heavy feeder yearling steers to a reasonable finish in about 200 days. These steers received an average ration of approximately 40 pounds of sorghum silage, 2.75 pounds of cottonseed hulls and 5 pounds of cottonseed meal. Nine percent of the carcasses graded Choice, 24 percent graded Good to Choice, 50 percent gradded Top Medium to Good and 17 percent graded Medium. This method of feeding, however, is considered largely as an emergency one for use when fattening grains are high in price, or for use with low-grade cattle which do not warrant a high finish. Such rations are excellent for getting cattle started on feed or for winter maintenance feeding; however, feeding for such purposes does not require the use of as much cottonseed meal as was fed in these trials. Rations of cottonseed meal and silage

alone are not well adapted to fattening calves because they tend to promote growth rather than finish.

Insofar as fattening is concerned, rations high in roughage do not permit a high rate of gain or quick finish, because the animals cannot consume enough nutrients to make high gains, particularly on silages of low nutrient content. Low gains in drylot feeding are accompanied by a high cost of gain, unless the feeds are low in price. Where the problem is one of marketing large amounts of roughage feeds to advantage, this system merits consideration in the farm feeding program, especially when fattening grains are scarce. Comparative gains made by cattle fed high concentrate and high roughage rations are shown in Figure 13.

SORGHUM GRAIN

The grain portion of cattle fattening rations in Texas is most often some kind of sorghum grain. Elsewhere in this bulletin, the sorghum grains are compared with corn, rice bran and molasses. In Texas, most of the sorghum grains fed to cattle are the varieties that can be harvested with a combine, the most popular of these being milo.

The following discussion concerns methods of preparation and feeding some of the sorghum grains.

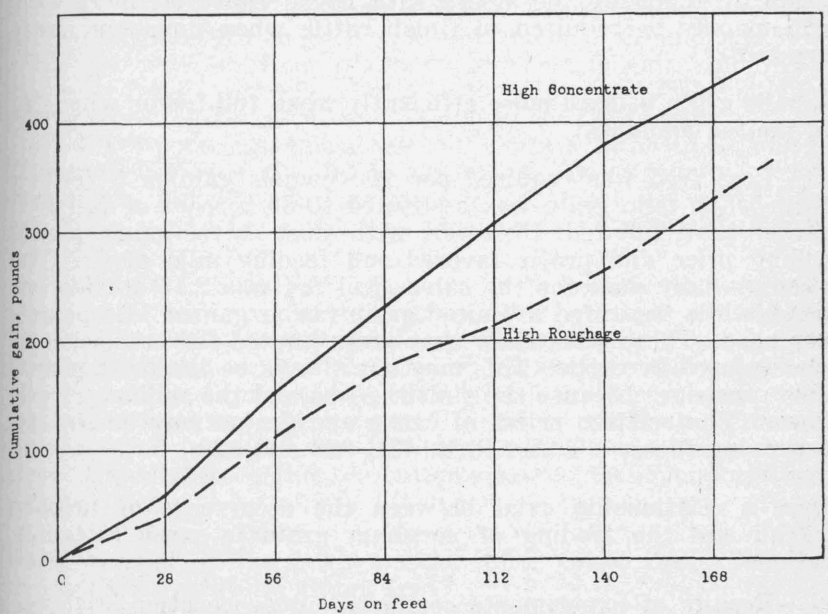


Figure 13. Comparative gains of cattle fed high concentrate and high roughage rations. Because of the lower daily gains, more time is required for fattening on high roughage rations.

Should sorghum grain be ground for cattle feeding?

BIG SPRING.—Steer calves fed ground threshed milo made 9 percent greater gain, required 12 percent less grain per 100 pound gain and sold for 6 percent more than similar calves fed unground milo. Calves fed ground milo heads made 12 percent more gain, required 16 percent less ground heads per 100 pound gain and brought 6 percent more than similar calves fed unground milo heads. Hog gains per steer for the cattle fed unground milo were approximately four times as great as those made by hogs following steers fed ground milo. When the hog and steer gains in these tests were combined, the total was greater for the unground grain. Feeders pigs weighing around 75 pounds at the beginning of the feeding period, can be used to follow feedlot steers. In these tests, one pig was required per steer to utilize the waste when unground milo was fed. A protein supplement should also be given the hogs for more efficient pork production Due to the more efficient utilization, ground grain should be fed when grinding equipment is available. (TAES Bul. 547.)

Although grinding the grain resulted in significant increases in steer gain, finish and prices received, this does not indicate that it is always profitable to grind the grain. The small stock farmer who is not equipped for grinding may salvage undigested grain by following the steers with hogs. However, more time will usually be required to finish cattle when unground feeds are fed.

Is milo grain utilized more efficiently when full fed or when fed in limited amounts?

Less feed was required per 100 pounds gain in 3 feeding tests when milo grain was restricted to 80 percent of full feed rather than full fed. However, with steer calves gains, finish, selling price and profit favored full feeding milo grain. The average daily gain for the calves full fed was 2.16 pounds per head, while those fed a limited grain ration gained 1.94 pounds per head. These tests show that grain limited fed is more completely used by cattle. This may not always be the most profitable procedure because the finish is less and the selling price is lower. The relative prices of cattle and grains may be the determining factor. (TAES P. R. 461, 628 and 629.)

Does a relationship exist between the occurrence of urinary calculi and the feeding of sorghum grain in steer fattening rations?

Results of experiments conducted in cooperation with the USDA Bureau of Animal Industry at Big Spring, indicated that calculi formation in the bladders of steers was closely related to the feeding of milo grain. When corn was fed to replace milo,

the appearance of calculi was controlled to a considerable degree, and was prevented in many cases. Although calculi were definitely associated with the feeding of milo, it was evident that its incidence was influenced by the form in which the milo was fed. Each year the amounts of calculi in the bladders of the steers fed ground milo heads were consistently greater than in those fed ground milo grain. (TAES P. R. 904 and 957; USDA Tech. Bul. 945.)

SORGHUM BY-PRODUCTS

Sorghum gluten meal and sorghum gluten feed, by-products of starch, sugar and syrup manufactured from sorghum grains, are destined to become common feedstuffs in the Southwest. A new refinery at Corpus Christi will process 25,000 bushels of grain daily. By-product feeds totaling 30 percent of the original weight are recovered in the form of gluten meal and gluten feed. Feeding trials have been conducted by the Texas Agricultural Experiment Station since 1947 to determine the value of sorghum grain by-products as feeds for fattening cattle.

When used as a protein supplement to sorghum grain in a cattle fattening rations, how does sorghum gluten meal compare with cottenseed meal?

BEEVILLE—In 3 feeding trials, steers fed 41 percent protein sorghum gluten meal as a supplement to ground sorghum grain and atlas sorghum silage, made as much gain and finish as steers fed 41 percent protein cottonseed meal. These supplements were fed to calves and yearlings at an average rate of about 2 1/3 pounds per head per day along with about 9 pounds of ground hegari grain and 15 pounds of atlas sorghum silage. These data indicate that sorghum gluten meal will substitute pound for pound for cottonseed meal in cattle rations. (TAES unpublished data.)

COLLEGE STATION—Calves fed 2 pounds of sorghum gluten meal with ground milo grain, sumac silage and alfalfa hay in a fattening ration, made an average daily gain of 2.14 pounds per head, as compared with an average daily gain of 2.06 pounds for similar calves fed 2 pounds of 43 percent protein cottonseed meal as a check group. The calves fed the gluten meal also required less feed per 100 pounds gain and showed more bloom and slightly higher slaughter grades. (TAES unpublished data.)

What percent of the grain portion of a cattle ration can be replaced with sorghum gluten feed?

COLLEGE STATION—Exploratory work indicated that sorghum gluten feed can replace 50 percent of the grain in a cattle ration with little effect on palatability or performance of

animals fed such a mixture. Sorghum gluten feed was added to a grain mixture of oats and milo grain and fed with cottonseed meal, sorghum silage and alfalfa hay.

Steer gains and finish were reduced when sorghum gluten feed replaced all the milo grain in a fattening ration. These reductions were probably due in part to a lower feed intake by the cattle fed the sorghum gluten feed. Sorghum gluten feed is apparently less palatable than milo grain, which may account for the lower feed consumption of cattle fed the gluten feed. (TAES unpublished data and P. R. 1212.)

What about the paltability of sorghum by-product feeds?

COLLEGE STATION—Sorghum by-product feeds used for experimental work have not been uniform, and palàtability observations have not always been consistent. It may be said that sorghum gluten meal is equally as palatable as cottonseed meal as the protein supplement in fattening rations. Sorghum gluten feed is not as palatable as the gluten meal. When it was fed as the only concentrate or the main portion of the concentrates in fattening rations, feed consumption declined. When sorghum gluten feed is used to replace not more than 50 percent of the grain portion of cattle rations, the palatability of the ration is not materially affected. (TAES P.R. 1212 and unpublished data.)

Does the "steep water" in sorghum gluten feed affect its palatability and feeding value?

COLLEGE STATION—Sorghum gluten feed as generally manufactured contains a substance called "steep water." This has a considerable amount of the tannin found in sorghum grains and imparts a rather acrid or sour flavor to the feed. A feeding trial was conducted with 2-year-old steers to determine whether the "steep water" in the sorghum gluten feed had any effect on its palatability. The feed with "steep water" added did not appear at any time as palatable as that without the "steep water." As a result, less feed containing steep water was consumed. However, gains consistently favored the steers on the "steep water" feed, and they averaged one-third pound more per head daily. In this trial, sorghum gluten feed without "steep water" was worth approximately 75 percent as much as sorghum gluten feed with "steep water" added in the process of manufacture. The addition of "steep water" to sorghum gluten feed makes it less palatable but, apparently, it also increases its feeding value. (TAES P. R. 1172.)

Should sorghum gluten feed be used as the only concentrate in rations for fattening cattle?

BEEVILLE—Sorghum gluten feed used as the only con-

trate with atlas sorghum silage did not make a satisfactory fattening ration in 3 feeding trials. Cattle fed sorghum gluten feed as the only concentrate made less than a pound average daily gain per head, based on market weights. (TAES unpublished data.)

COLLEGE STATION—Results of a 126-day feeding trial with steer calves indicate that sorghum gluten feed is not suitable as the only concentrate in a fattening ration, unless it is lower in price than grain, or is the only concentrate feed available. Calves fed sorghum gluten feed as the only concentrate with sumac silage and alfalfa hay, made an average daily gain of only 1.89 pounds per head, compared with 2.14 pounds for calves fed sorghum gluten meal and ground milo grain with sumac silage and alfalfa hay. A check group of calves fed cottonseed meal and ground milo grain with sumac silage and alfalfa hay gained 2.06 pounds per head daily. The calves fed the sorghum gluten feed consumed less feed per day than the other two groups, and had considerably less finish. (TAES unpublished data.)

SWEET POTATO MEAL

How does dehydrated sweet potato meal compare with ground shelled corn as the carbohydrate portion of cattle fattening rations?

COLLEGE STATION—Sweet potato meal has equal feeding value to corn when used to replace half the ground shelled corn in a fattening ration. Sweet potato meal is not as palatable and is more laxative than corn when fed in large amounts to cattle. Sweet potato meal is not equal to corn in a cattle fattening ration when it is used as the only carbohydrate concentrate, mainly because of lowered feed consumption and, therefore, lower gains. (TAES P.R. 748.)

UREA

What is urea and how may it be used by cattle?

COLLEGE STATION—Urea is a non-protein nitrogen compound which ruminants are able to convert to protein by the action of micro-organisms, which use it as a source of nitrogen for their own multiplication. This protein is broken down in the small intestine into amino acids, which are taken by the blood stream along with other digested material of the ration. Urea can be used to supply part of the protein in a ration for ruminants. It cannot supply all of it, because animals need certain amino acids which are in natural protein but are not furnished by urea. The protein equivalent value of a feed is increased by adding urea to feeds like cottonseed meal. The addition of urea to feeds should be done only by feed manufacturers who have

machinery for thoroughly mixing and accurately measuring small amounts of urea. (TAES P. R. 1136.)

Are protein supplements containing urea equal to natural protein supplements when fed to cattle?

COLLEGE STATION—Two feeding trials with steer calves and yearlings indicate that protein supplements containing urea are almost equal in feeding value to protein supplements from natural sources. Forty-three percent protein cottonseed meal was compared with a 56 percent protein cottonseed meal with urea added to make it 70 percent protein equivalent, and also with a 36 percent cottonseed meal with urea added to make it 43 percent protein equivalent. The supplements were fed in amounts to give the same quantity of protein to each group of steers. Grain was fed in amounts necessary to supply the same quantity of energy to each group. There was a slight advantage in feedlot performance in favor of the steers fed the natural protein supplements but the difference was not significant. (TAES P. R. 1136.)

SPUR—There was practically no difference in gain between steers fed 43 percent protein cottonseed meal, 43 percent protein equivalent cottonseed meal or 70 percent protein equivalent cottonseed meal—all rations having similar content of energy. The 43 percent protein equivalent meal was a 36 percent protein meal with urea added to make it 43 percent protein equivalent. The 70 percent protein equivalent meal was a 54 percent protein meal with urea added to make it 70 percent protein equivalent. (TAES P. R. 1126.)

As long as protein supplements are available at a reasonable price, there is no need to add urea to such feeds. However, during a protein shortage, urea can be effectively used to extend our protein supply. There seems to be no doubt that beef cattle can utilize the nitrogen of urea satisfactorily when it does not furnish more than 25 percent of the protein in the feed.

Range and Pastures Utilization Studies

UTILIZATION OF THE RANGE

Has the TAES studied the utilization of grazing lands?

Yes, both directly and indirectly.

The Amarillo, Angleton, Barnhart, Beaumont, Beeville, College Station, Lufkin, Temple, Sonora and Spur stations are actively engaged in research with cattle maintained principally on grazing lands. Stations at Amarillo, Beeville, College Station, Temple and Spur are involved in the farm production of steer beef using feeds, native pasture and a succession of field grazing crops, while Angleton, Barnhart, Beaumont, College Station, Bluebonnet Farm and Lufkin produce slaughter or stocker calves on native and improved pastures.

The mass of work involved in the preparation of reconnaissance and detailed soil and vegetative surveys, the analyses of thousands of soil and forage samples, the studies of types-of-farming areas, the statistics of livestock numbers and production by counties, the accumulation of data on the control of brush and poisonous plants, all afford pertinent information on the use and value of our grazing lands.

Is there anything particularly new in Texas livestock grazing management?

Insofar as the principles of grazing are concerned, the answer is no. We cannot have more cattle than feed, but we can work to develop and conserve feed.

In regard to patterns of grazing, the answer is yes. Texas has passed through a frontier ranching era and has a colorful history as a beef producing region. There is little cattle feeding tradition, but we are becoming more feed-minded. Once cattle were prepared for market solely by the use of pasture; now many receive feed. Lands once occupied by cattle were farmed for a generation or more and now have been returned to grass and cattle. Parts of the High and South Plains, only recently entirely in ranches, are now mostly in farms. Interest in cattle is as great or greater in South and East Texas as in West Texas. A big change is that cattle now appear on what were once straight row crop farms. These changes have had an influence on the work of the substations, principally within the past decade. It now seems that we will graze and fatten a considerable number of steers on farms and that a greater tonnage of beef will be produced under a stock farming and ranching system

than by ranching alone. The trend appears to be toward rather intensive grazing and stock farming practices.

What is the value in terms of steer gain from clearing land of mesquite?

SPUR—Specific answers are seldom possible except for given situations. Yearling steers on pastures cleared of mesquite averaged 15 percent more gain in a 5-year period than steers on uncleared pastures. In 1948, a year with below normal rainfall, steer gains were 40 percent greater on land cleared of mesquite. Stands of desirable forage improved markedly on the cleared pastures. (TAES unpublished data.)

What is the effect of heavy versus light stocking rates on acre and steer gains, and on the subsequent performance of steers?

In general, we get high gains per steer with light stocking or light use. With heavier rates of stocking, gains per steer are decreased but acre gains may be increased, particularly for a short time. Absurdities can be obtained in either direction. For example, we may stock so heavily that animals will fail to gain or may lose weight. In such cases acre gains are not realized. With very light stocking or use, we fail to harvest the production of the pasture.

High gains per steer result in greater finish than low gains. The result with fleshy feeders, as compared with thin feeders, is that much less time and feed are required for finishing in drylot. Yearling steers summer-grazed over an 8-year period at Spur on lightly-stocked pastures, averaged 35 percent more gain than the steers on heavily-stocked pastures. Acre gains also were slightly greater for the lightly-stocked pastures, 27 to 26 pounds, respectively. (TAES unpublished data.)

What water conservation practices are most desirable?

The Texas Agricultural Experiment Station has not done work upon which explicit answers can be based. However, the Spur station is in the process of developing a 200-acre flood plain by the use of water-spreading structures and the eradication of mesquite brush. It is apparent that this acreage may easily pasture as many or more cattle than the entire section of land in which it is located before improvement began. The Spur station also has an 8-year grazing record with steers on 4 pastures contour listed at 39-inch intervals, 4 pastures contour listed at 78-inch intervals and 4 pastures not listed. All pastures were cleared of mesquite brush. Average gains per acre and per steers are practically equal, regardless of treatment. (TAES unpublished data.)

Have successful methods of seeding adapted grasses on range been developed?

Information in this field is limited. The Spur station tried pelleting grass seeds with clay, cottonseed meal and other materials several years ago, but met with only slight success. Grass seedings with both native and introduced grasses have been quite successful at the Amarillo station on land retired from wheat because of wind erosion. Ordinary grass seed drills were used and fall platings were made when moisture conditions were suitable for planting wheat. (TAES Bul. 717.)

UTILIZATION OF PASTURES

How much can be expected from winter pastures?

Results show that winter pastures are almost invaluable. Data at the Beeville station over a 4-year period show that cheaper gains are realized from oats than from any other grazing crop produced on the station. Weaned calves gain more than 1.5 pounds per head daily from oats, wheat, barley and rye pasturage. The practice of using small grain for pasture is new in South Texas but has been used many years in North Texas. The development of rust-resistant varieties have greatly benefited the South Texas winter grazing program. (TAES M.P. 56, unpublished data and Bul. 717.)

What is the general pattern of the farm beef production program with a succession of field grazing crops?

As practiced at the Beeville, College Station, Temple and Spur stations, the plan is to buy steer calves in the fall, winter insofar as possible on small grain pasturage or cool season grasses, summer on native grass or Sudan, and finish in drylot following the close of summer grazing. The time required for

Figure 14. Steers grazing sudan at the Beeville station.

finishing depends on the flesh of the steers at the start of drylot feeding. Following good gains in both winter and summer, 120 to 140 days of drylot feeding are usually sufficient to produce steers of U. S. Good grade. Gains during winter and summer may vary widely from year to year. Steer calves have gained upwards of 200 pounds per head in winter, and yearlings upwards of 300 pounds during the summer. Drylot gains of 200 pounds following such winter and summer gains usually result in good market finish. Figure 14 shows steers grazing Sudan at the Beeville station. (TAES Bul. 717, M.P. 56 and unpublished data.)

What are the value and place of certain legumes in the farm beef production program?

The Brazos River Valley Laboratory and Main Station Farm at College Station, and the Temple and Beeville stations are using legumes. Bur clover furnishes an abundance of spring pasturage at the Brazos River Valley Laboratory in most years. Under certain conditions, it may cause fatal bloat. Losses may be eliminated largely by constant attention, the daily supply of a palatable dry roughage, and in instances by mowing rank growth. Except as a soil builder, hubam sweetclover has contributed very little to the production of steer gains at the Beeville station, whether interplanted with oats or in pure stands and grazed separately. It is not relished by cattle while in lush growth and may produce bloat. Cattle confined to pure stands of lush hubam should have access to roughages such as sorghum hay or silage. Hubam may be utilized to some extent as it approaches maturity. Sufficient work has not been done to determine the value or place of the deep-rooted summer legumes such as Madrid or Evergreen sweetclover, in the farm grazing program. They afforded some promise for the supply of good pasturage in late summer the second year after interplanting with small grains.

Most of this work is being conducted at the Temple station. (TAES P.R. 1114 and 1166; M.P. 56.)

What pasture improvement practices seem to be particularly valuable for the Gulf Coast Prairie?

The Angleton and Beaumont stations have made studies on various phases of the pasture improvement problem including varieties of pasture plants, drainage, mowing, amounts and kinds of fertilizer, seedbed preparation, method of applying fertilizers and management. The work is by no means complete.

It is evident that pastures cannot be highly improved without drainage, fertilization and seeding; also that half-way measures are rather unsatisfactory.

At Angleton, the principal limiting element appears to be phosphorus, insofar as the well being of both cattle and clovers

are concerned. In the heavy clay soils, it appears that the fertilizer should be worked into the soil; however, improvement occurs from a surface application of as much as 100 pounds of phosphoric acid per acre and a very superficial disturbance of the soil surface. Drainage, plowing, discing and seeding resulted in marked improvement in pasturage at Angleton. The improvement was much greater when superphosphate was worked into the prepared seedbed. White clover did not grow without phosphate. Lespedeza and Dallis and Bermuda grass grew well after seedbed preparation and made good summer pasturage.

Heifer calves grown out on improved phosphated pasturage outweighed similar stock grown out on native pasturage 200 pounds per head as bred 2-year-olds. Young stock and cows were wintered on improved pasturage with very little loss in weight. Prairie hay was fed only in storm periods. Similar stock on native pasturage required heavy feeding. Dallis, Bermuda and carpet are the principal grasses on improved mowed or heavily fertilized pastures. Common lespedeza and white and hop clover may be maintained in permanent and improved pasture grasses. The prairie, or native pastures, may be improved by mowing and light stocking. Weeds appear with heavy, continuous use. (TAES Bul. 570; P.R. 1018 and unpublished data.)

Are these pasture improvement practices profitable?

Native Gulf Coast pastures can be improved greatly, but it may be expensive. The initial value of the land, cost of labor, machinery, seed and fertilizer in relation to beef cattle prices will govern the amount of money that can be spent profitably on pasture improvement.

A 40-acre pasture on the Angleton station, highly improved in 1942 by plowing, draining, fertilizing, seeding and mowing, is supporting 10 cows and 10 calves in the summer of 1950. (TAES Bul. 570; P.R. 1018 and unpublished data.)

What are some of the factors involved in beef cattle and pasture improvement in the East Texas timber country?

The East Texas Pasture Laboratory at Lufkin was established in 1933. Twenty-nine heifer calves were brought to the laboratory in December 1934 and were inoculated against tick fever. They were turned to the scant pasturage available in the spring of 1935. That summer and fall they nearly died because of a heavy infestation of ticks, poor feed and perhaps lack of acclimatization. The laboratory now carries 50 breeding cows on approximately 160 acres of mowable pasturage. The cows—Herefords and Brahman-Hereford crosses—are fat enough and are producing a good grade of slaughter calves, some of which weigh as much as 500 pounds at 6 months of age.

The main problem at the outset and 17 years later is feed-pasturage. Dallis, Bermuda and carpet grass, white and hop clover and common lespedeza can be maintained through fertilization and management. Rye grass may contribute to winter pasturage. The Caley pea and Reseeding Crimson clover promise to contribute to the feed supply. Hay must be stored for winter feeding. It was not possible to establish white clover or to obtain satisfactory growth for Bermuda and Dallis grass without fertilization.

Hereford cattle of fair to good weight can be maintained but the ½ Brahman-½ Hereford cow bred to a Hereford bull has produced the heaviest slaughter calf. It seems to be a case of feeding the cattle through the soil insofar as possible. Putting up some winter hay and buying some cottonseed cake are necessary for good wintering, as is true in other parts of the State. (TAES Bul. 666 and P.R. 425.)

SUPPLEMENTAL FEEDING

What are the general recommendations in feeding concentrates to steers on pasture, as to when to feed, what to feed and how much to feed?

BEEVILLE—Again, we cannot be entirely specific. As a rule, it does not pay to feed a small amount of protein supplement to young cattle when they are on good green pasture. Two pounds of cottonseed cake on dry, dead grass is very advisable. Its effect would scarcely be noted with green pasturage.

In fattening aged steers on green pasturage, the general rule is to supply a full ration of concentrates. Steers full fed on pasture graze very little, but in such feeding the object is to improve rapidly the marketability of the steers. Grain feeds are recommended for fattening on green grass. This is because the grass is usually quite high in protein. Protein feeds are recommended for maintenance on dry, dead grass. This is because such grass is quite low in protein. (TAES Bul. 599.)

This brings us to the question on the use of 20 percent supplements as compared with 43 or 41 percent protein supplements. The feed to use in most cases is the one which furnishes the total digestible nutrients needed at the least cost. Where there is a particular need for protein, then use the supplement which furnishes it at the lowest cost.

Do the same general rules on the supplementary feeding of steers also apply to breeding cows?

The same rules do apply, with the exception that breeding cows have somewhat higher requirements for minerals and carotene than aged steers. For this reason, mineral and carotene supplements are often recommended during periods of privation.

Is creep feeding of nursing calves profitable?

ENCINAL—The farm creep feeding of calves is usually profitable from the standpoint of increased weight and finish of the calf, whether it is sold or kept on the farm for further feeding. Under certain conditions, the creep feeding of good to choice stocker steer calves on ranches has not been profitable. The cost and difficulty of creep feeding are somewhat greater on ranches than on farms. It sometimes happens that creep-fed calves, because of their additional weight, sell at a lower price per pound than lighter calves. This usually occurs when the creep-fed calves, although improved, still lack slaughter condition at weaning time. (TAES Bul. 470.)

Is the use of low-grade roughages, such as peanut hulls, rice hulls, gin trash, cotton burs, ground cotton stalks, prickly pear and sotol, generally recommended?

These materials, with the exception of rice hulls, are recommended with limitations. Rice hulls as now offered are not recommended. These materials, chopped in the case of sotol, singed in the case of prickly pear, and ground in the case of the others are recommended only as part of the roughage ration. Much better results are obtained if they do not form over half the roughage fed. They should be used only when low in cost as compared with cottonseed hulls or various hays. (TAES Bul. 240; CFS No. 20; P.R. 546 and unpublished data.)

How much salt and bonemeal (self-fed free choice) will range cows consume annually?

Salt consumption by range cows at the Sonora station averaged around 30 pounds per head anually (1944-46). Consumption throughout the year is relatively consistent, however, the period of heaviest consumption is June through September

Bonemeal consumption per cow annually may vary considerably in different areas or even on the same range. During a 5-year experiment on the King Ranch (1941-46), the average annual consumption of bonemeal per cow was 56 pounds, with a low of 27 pounds and a high of 99 pounds. The largest amounts of bone meal were consumed during drouth years. More bonemeal was consumed from May through August than during any other period.

Average annual bonemeal consumption by range cows at the Sonora station in 1944-45 was about 34 pounds per head. The amount consumed each year was almost the same, and the periods of highest consumption were December and January, and during dry summer months.

These data show how much variation exists in the consump-

tion of bonemeal in different areas and during different years and different months. (TAES unpublished data; USDA Tech. Bul. 981.)

Vitamins and Minerals

VITAMIN A

The work reported on vitamin A was conducted at the Spur station.

Why do cattle need vitamin A?

Vitamin A is essential for normal vision, growth, reproduction and the maintenance in normal condition of certain specialized tissues of the body. The latter has considerable influence in maintaining high resistance to infection and disease, thus keeping animals in healthy condition. An adequate supply of carotene in cattle feeds and forages is, therefore, of utmost importance to stockmen.

What are the symptoms of vitamin A deficiency in cattle?

The first indication of deficiency is night blindness, which can be detected by moving the animals about their pens after dark. Those that are night blind will bump into objects, while those only partially night blind will walk about cautiously. If the deficiency is corrected at this time no harm usually results. As time goes on and if no corrective measures are taken, night blindness becomes progressively worse until total blindness occurs. The cattle become sluggish, show eye discharge and possibly eye infection, nasal discharge, rapid respiration, swelling at the joints, staggering gait, convulsions and loss of appetite. Death will ultimately result if corrective treatment is not given. Loss of weight or failure to gain in fattening cattle is a result of failing appetite with consequent reduction of feed intake. Some symptoms of this deficiency are shown in Figures 15 and 16. (TAES Bul. 630.)

What are the sources of vitamin A for cattle?

The vitamin A requirements of cattle are supplied largely through carotene in range or pasture grasses and hays or silage. Grazing animals receive no vitamin A as such, which is found only in animal life. However, they are able to convert carotene to vitamin A. The liver serves as the chief storehouse for both carotene and vitamin A in the body.

Carotene is formed only in plants and occurs widely in nature. *In its pure form, it is an orange-red pigment, so named* because it was first isolated from carrots. It usually occurs along with active growth closely associated with the green coloring matter in plants. Generally, the amount of green color is

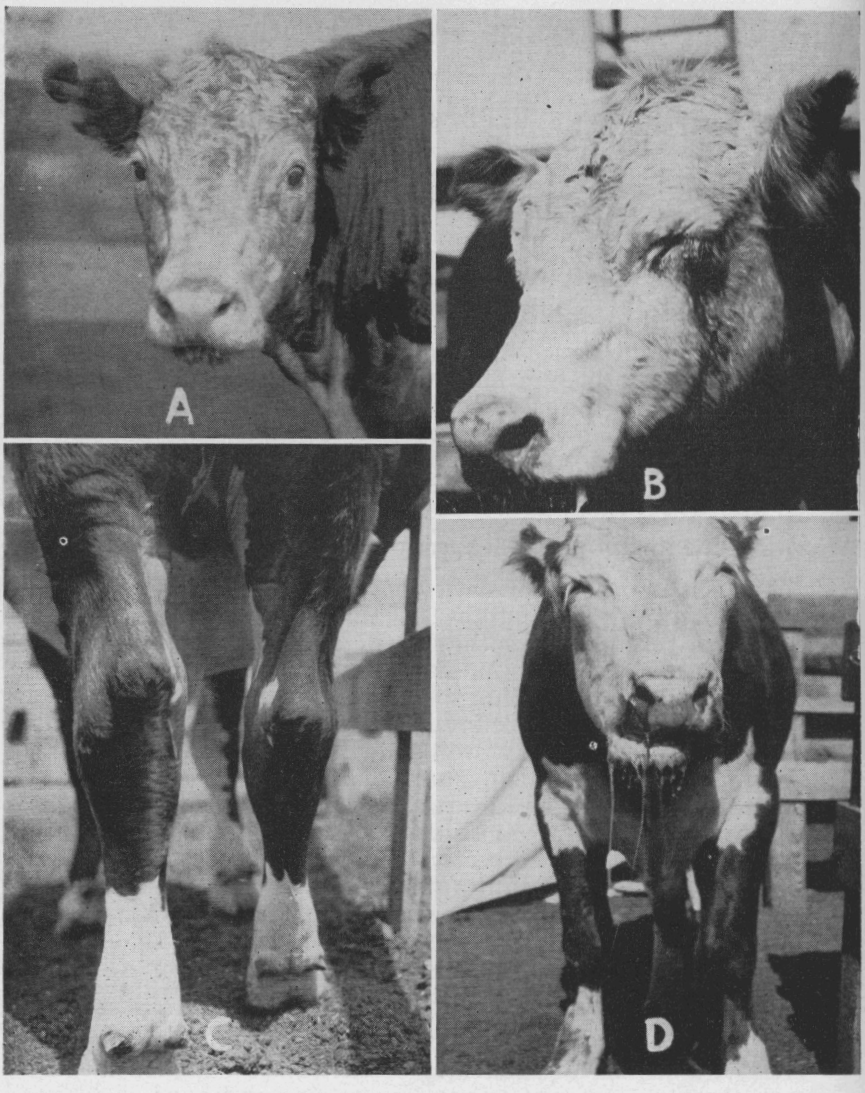


Figure 15. Symptoms of vitamin A deficiency in fattening cattle. Upper left, complete blindness. Note the staring appearance, retracted upper lids and alert ear carriage. Upper right, profuse "weeping" as a result of eye infection. Lower left, swelling of joints. Lower right, panting, slobbering and nasal discharge observed in numerous cases.

a good index of the carotene content of plants. Blanched shoots contain little carotene, while green shoots of young grasses and legumes are rich sources. The carotene content is almost completely lost when the leaves of plants dry up and die. Thus, under dry range conditions, forage becomes deficient in carotene, and vitamin A deficiency may develop in range cattle following long, severe drouths. The cereal grains, with the exception of yellow corn, and all protein supplements are very deficient in vitamin A potency. (TAES Bul. 630.)

Do cattle require a daily supply of carotene the same as they do for protein and carbohydrates feeds?

No. Cattle grazing on lush green pasture can store enough carotene and vitamin A in the liver and body fat to last for some time. The longer the intake of carotene is liberal, the greater becomes the storage in the body.

How long after cattle are taken off green pasture will their body reserves of vitamin A last?

The time required for depletion is determined by the amount stored in the body, which is affected by the age of the animals and the carotene content of the pasture forage. Young animals store smaller reserves than older ones because of a shorter period of grazing. Consequently young animals exhaust their reserves more quickly. Less time is required in drouthy years for depletion than in more favorable years, because animals on green forage accumulate greater reserves than those which have dry forage low in carotene.

In general, calves weighing 250 to 400 pounds may be ex-

Figure 16. A steer in later stages of vitamin A deficiency. Note blindness, dry, rough hair coat and stiffness.

pected to show night blindness after 40 to 80 days of feeding on rations deficient in carotene. Calves weighing 400 pounds or above will show the condition after 80 to 140 days, and yearlings after 100 to 150 days. Although they may go for considerable periods in the feedlot without suffering from vitamin A deficiency, it is evident that these periods are not long enough for fattening young animals to a high finish which may require 200 to 240 days. (TAES Bul. 630.)

What effect does the lack of vitamin A in the ration have on gains and finish of fattening cattle?

Lack of sufficient carotene, or vitamin A potency, in fattening rations appears to have little effect on the rate of gain or finish as long as the cattle have reserves of the vitamin in the body. When these reserves are depleted, the cattle will show the symptoms, including loss of appetite, slow gains followed by loss of weight, convulsions and death, if corrective steps are not taken. Figure 17 shows the way gains break in cattle when vitamin A deficiency occurs. (TAES Bul. 630.)

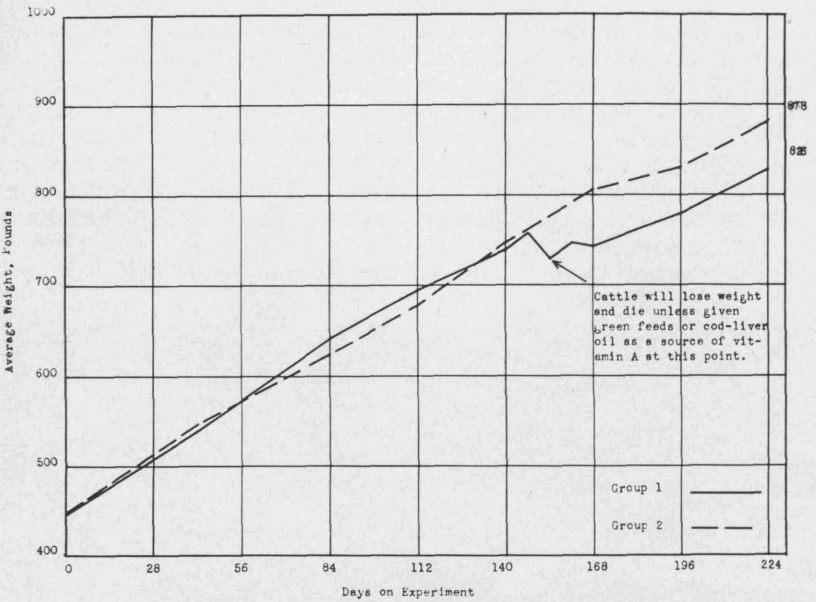


Figure 17. Cattle make satisfactory gains on a ration deficient in vitamin A until their body reserves are exhausted. Group 1 was fed the deficient ration while Group 2 received the same ration plus 2 pounds of leafy green alfalfa hay per head daily.

PHOSPHORUS

The earliest experimental phosphorus feeding of range livestock in Texas was done in the early 1920's by Dr. H. Schmidt of

the TAES Division of Veterinary Science. Feeding bonemeal to supply phosphorus to range cattle was a by-product of investigations into the nature and prevention of loin disease, which results from animals eating decayed carcass debris in an effort to obtain phosphorus. This disease is caused by a toxin of the clostridium botulinum-type organisms ingested with the putrid flesh. It was found that the bone-chewing habit of cattle deficient in phosphorus could be broken by feeding bonemeal, and that animals receiving this phosphorus supplement made larger gains and reared better calves. "Creeps" in range cattle was prevented by feeding bonemeal and losses from non-infectious diseases were greatly reduced. This very important early work has been a guide to later work concerning phosphorus feeding to range cattle. (TAES Bul. 319 and 344.)

What are the symptoms of a phosphorus deficiency in cattle?

The first symptoms of a phosphorus deficiency in cattle are a decrease in the amount of phosphorus in the blood stream, lowered fertility, loss of weight, reduced milk production and loss of appetite. The efficiency with which cattle utilize their feed, particularly protein, is also lowered. These effects are followed by a depraved appetite, with the animals chewing on wood, bones and rocks, and eating dirt. If rotten carcass debris is available, it may be eaten. This may lead to a secondary disease,

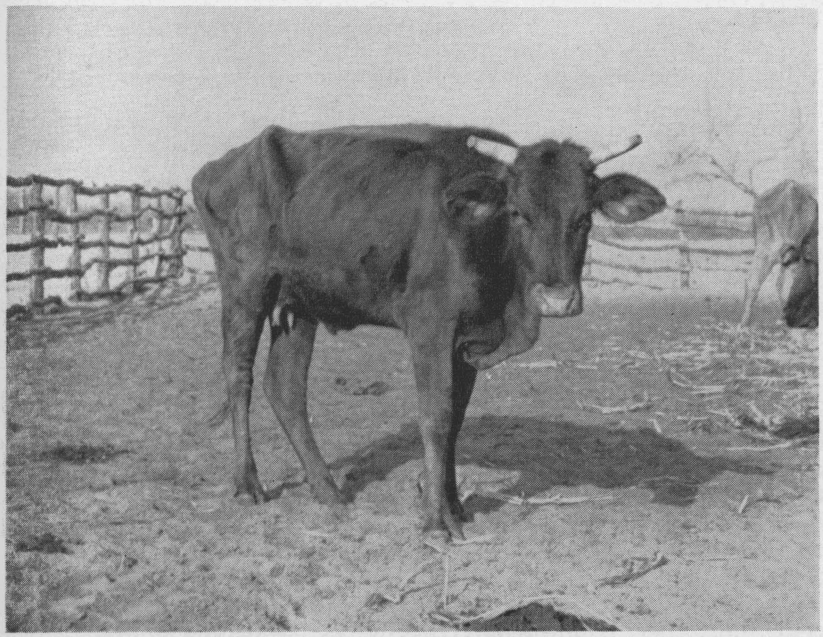


Figure 18. A "creepy" cow showing the effects of phosphorus deficiency.

characterized by paralytic symptoms, known as "loin disease." Long continued phosphorus privation among lactating cows results in "creeps," which is characterized by bone changes, lameness and stiffness of the joints. "Creeps" is usually the final stage of phosphorus deficiency in South Texas.

Cows in this condition will often die unless their calves are weaned or they are supplied additional phosphorus. The greatest economic loss to the cattleman whose cattle suffer from lack of phosphorus is a low percent calf crop and underweight of calves weaned. A cow showing the effects of a phosphorus deficiency is pictured in Figure 18.

When and where do phosphorus deficiencies occur in Texas?

Native forages in the Gulf Coast and the East Texas timber regions do not contain enough phosphorus, even when they are green and growing, to meet the needs of cattle. This is also true of other smaller areas in the State. The forage produced in other sections of Texas may become phosphorus deficient when it is dry and mature during certain seasons. In areas where the soil is very deficient in phosphorus, the deficiency in cattle becomes worse when forage is dry and mature. Phosphorus supplementation is advisable at all times in regions where there is deficiency of the mineral in the soil. Phosphorus supplementation in other areas may become necessary only when the forage is dry and mature.

What are the benefits of supplying phosprous to range cattle?

KING RANCH—Experiments designed to determine the effect of phosphorus supplements to cattle grazing on a range deficient in this mineral were started in 1937 by the Texas Agricultural Experiment Station, USDA Bureau of Animal Industry and the King Ranch. The first phase of these experiments was terminated in 1941.

The primary benefit from feeding phosphorus to the cattle in this experiment was an increased percents calf crop and greater weights of calves at weaning. Based on a 2-year average, only 64 percent of the cows not fed a phosphorus supplement (called "control" cows) produced calves, as compared with 85 percent for those fed a phosphorus supplement. The control cows weaned only a 58 percent calf crop, the supplement-fed cows weaned 81 percent. Only slightly more than 30 percent of the control cows calved in 2 consecutive years, the cows receiving supplement averaged about 73 percent calving. Based on the 2-year average, the weaning weight per calf in the supplement-fed group was 69 pounds greater than in the control group. The calves from the cows fed the supplement also sold for one cent more per pound than the calves from the control cows. Heifers from the supplement-fed cows weighed 126 pounds more

per head at 18 months than heifers of the same age from the control cows. A larger weight at maturity will mean a higher sale value on cows and bulls when they are culled from a herd.

The period between calf crops was shortened by feeding a phosphorus supplement. At the end of a 5-year experiment started in 1941, the groups furnished additional phosphorus had dropped 4 calf crops and part of the fifth, while the control group had barely completed its fourth calf crop. Under the conditions of these experiments, it was decidedly more profitable to feed a phosphorus supplement. (USDA Tech. Bul. 856 and 981; TAES P. R. 746 and 1100.)

How may phosphorus be supplied to cattle on the range?

KING RANCH—An experiment was conducted from July 1941 to November 1946 to compare methods of supplying phosphorus to range cattle. Three groups of cows were grazed on unfertilized native range. Group 1 (controls) received no additional phosphorus; group 2 had access to bonemeal in well distributed self-feeders; and group 3 was supplied phosphorus through disodium phosphate dissolved in the drinking water. A fourth group grazed a range fertilized in July 1941 with 200 pounds per acre of triple superphosphate. The pastures grazed by groups 1, 2 and 3 were stocked at the rate of approximately 1 cow to 15 acres; the fertilized pasture was stocked at a rate of approximately 1.5 cow to 15 acres. A decrease in percent calf crop in the control group from year to year indicated a cumulative effect of phosphorus deficiency. The calf crop was rather constant throughout the experiment in the groups getting additional phosphorus. As compared with the percent calf crop of the control group, bonemeal feeding increased the calf crop by 33 percent, disodium phosphate in the drinking water by 39 percent and pasture fertilization by 42 percent. The weaned calf weight per cow per year, on the basis of 4 calf crops, was increased 149 pounds by the use of bonemeal as a supplement, 181 pounds by disodium phosphate in the drinking water and 208 pounds by fertilizing the range.

All methods used in this experiment to supply phosphorus to range cattle were satisfactory, when compared with the performance of cattle not receiving supplemental phosphorus. However, each method has its advantages and disadvantages.

Supplying phosphorus to cattle through fertilization of the range gave the greatest returns per acre, although it is necessary to refertilize at least every 4 years. Soil type, extent of phosphorus depletion of the soil and especially the amount of rainfall will largely determine the effectiveness of supplying phosphorus to range cattle through fertilization of the range. The use of disodium phosphate dissolved in the drinking water resulted in the highest net return per cow.

Where it is possible to control the water supply of cattle,

it is believed this is the most economical method of preventing phosphorus deficiency. Figure 19 shows a water tank on the King Ranch in which disodium phosphate has been added. Observations made during these experiments indicate that phosphorus deficient cattle show a preference for phosphated water, even when other sources of water are available. Phosphates, in the instance of small herds, may be added by hand to a trough in which the water supply is controlled; or, in the case of larger herds, by the use of an automatic dispenser. Disodium phosphate placed in drinking water at the rate of 20 pounds per 1,000 gallons of water should supply adequate phosphorus.

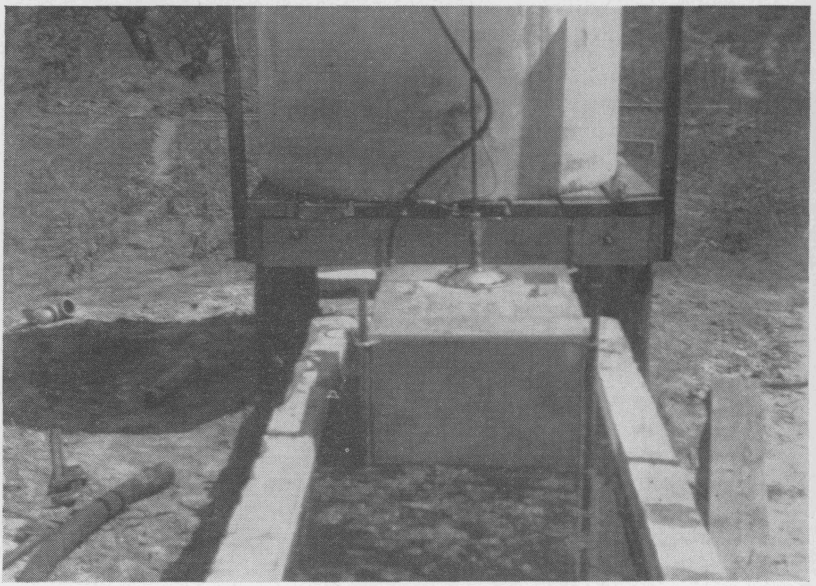


Figure 19. Water tank on the King Ranch in which phosphate has been added to the water.

If cattle obtain their water from streams or reservoirs, where it cannot be controlled, the liberal use of self-feeders with either bonemeal or disodium phosphate (crystalline) is recommended. A combination of these two methods can be used to advantage on many ranches. By studying the conditions on each ranch where a phosphorus supplement is needed, it should be possible to work out the best method to use. (USDA Tech. Bul. 981: TAES P.R. 1100.)

What effect does phosphate fertilization have on yield and nutritive value of forage?

In another phase of the experiments on the King Ranch, 1941-46, small areas were fertilized with 100, 200, 400 and 800

pounds of triple superphosphate per acre. The fertilized plots produced more grass and more nutritious grass than the unfertilized areas. The green grass on the unfertilized plots averaged only .09 percent phosphorus, which is not enough for normal growth and reproduction of range cattle. The grass on the fertilized plots averaged .16 to .27 percent phosphorus; according to present standards, these amounts are adequate for normal requirements of range cattle. The fertilized plots produced from 42 to 67 percent more vegetation than the unfertilized plots.

Where cattle have had access to both fertilized and unfertilized range, they show a definite preference for the forage produced on the fertilized range. (TAES P.R. 1100.)

CALCIUM

Is it necessary in Texas to feed a calcium supplement to range cattle?

Generally speaking, the answer is no. Range and pasture grasses in Texas seem to have enough calcium. The legumes are considered excellent sources of this element. In areas where a phosphorus supplement is needed, no additional advantages were realized when a calcium supplement was also furnished. When steamed bonemeal is used to supply phosphorus to cattle, calcium is also furnished, as bonemeal contains approximately twice as much calcium as phosphorus.

What about calcium supplements in cattle fattening rations?

There may be an advantage in adding a calcium supplement to fattening rations that contain no alfalfa hay or other legume roughage, and when the water consumed is low in mineral content. This statement applies especially to younger cattle fed high concentrate rations, but even so the benefits are not great. Alfalfa hay is an excellent source of calcium. When it is included in the ration at the rate of 2 pounds or more per head daily, no additional calcium is needed. Calcium supplements are usually cheap and the feeding of 0.1 pound per head daily of ground limestone or pulverized oyster shell in rations high in grain and grass hay, sorghum hay or silage, will probably result in slightly greater gains.

Results of four 182-day feeding trials at the Big Spring station, with steer calves fed a ration of ground milo, cottonseed meal and sumac silage, show that the addition of slightly less than 0.1 pound of ground limestone per head has produced an average of 13 pounds more total gain per head on the basis of market weight.

No benefit resulted at the Balmorhea station from feeding 0.1 pound of pulverized oyster shell when hegari fodder was used as the sole roughage. These tests involved yearling cattle

fed rations high in grain and also rations high in roughage. Compared with the Big Spring work, these results indicate that more benefit is realized when calcium supplements are added to fattening rations for calves than for yearling or older cattle. (TAES P.R. 904, 957, 1083, 1089 and 1190; Bul. 604.)

URINARY CALCULI

Under the discussion of sorghum grain, (page 46), it was pointed out that feeding corn in place of ground milo grain or ground milo heads reduced the incidence of urinary calculi in bladders of steers on these feeds. The following question also may be asked concerning urinary calculi formation in steers.

Does feeding a phosphorus or calcium supplement influence the formation of urinary calculi in steers fed sorghum grain?

Results of experiment at Big Spring indicate that calculi formation in the bladders of steers could largely be controlled by supplying bonemeal. Over the 3-year period of these tests, a high percentage of the steers fed approximately 0.43 pound of bonemeal per head daily were free from calculi in their bladders.

Although the formation of calculi was not significantly influenced by the calcium level of the ration, there was a tendency toward a smaller amount of calculi in steers fed 0.12 pound of limestone per head daily than in those fed 0.06 pound. (USDA Tech. Bul. 945.)

Diseases, Parasites and Poisonous Plants

The investigations of diseases, parasites and poisonous plants reported following were conducted by the veterinary research staff of the Texas Agricultural Experiment Station and the School of Veterinary Medicine, A&M College of Texas.

ANAPLASMOSIS

What is anaplasmosis and how does it affect cattle?

Anaplasmosis is a serious blood disease in cattle caused by a microscopic parasite that attacks the red bloods cells. It is not a new disease. It was associated with tick fever for many years. The tick that transmitted the fever also transmitted anaplasmosis. When a means for immunizing cattle against Texas fever was developed and the fever tick was eradicated, anaplasmosis became more prevalent and was recognized as a separate disease. The average death rate usually varies from 25 to 60 percent of the infected animals. Recovery from the disease is slow. One of the greatest losses to the cattleman, besides the animals that die, is the poor condition of the animals that may possibly recover.

How is anaplasmosis transmitted and when and where does it occur?

Under natural conditions, the parasite that causes anaplasmosis is carried from infected to healthy animals by horseflies, mosquitoes, ticks and other biting insects, and also by the use of unclean surgical instruments. Outbreaks are more common in the summer and fall when the insect population is highest. The disease seems to occur more frequently in areas of heavy rainfall where insect pests are prevalent. Animals that have had the disease and recover remain carriers and are a source of infection to healthy animals.

Is work underway in Texas to find methods of controlling anaplasmosis?

Many drugs have been tried as a means to control anaplasmosis but to date none has given satisfactory results. The objectives of a project now in progress at the Texas Station are to develop methods of controlling the disease by the use of chemicals to destroy the causative organism and yet not harm the animal, and to develop methods of control of the agents of transmission.

KERATITIS (PINK EYE)

What causes pink eye in cattle and how is it transmitted?

Pink eye in cattle is a highly contagious disease transmitted

from animal to animal by direct contact. It is caused by a very small bacillus, known as *Hemophilus bovis*. The eyes of the cattle are primarily affected. Temporary loss of vision may result from the acute stage. (TAES annual report, 1944).

How may pink eye be prevented and controlled?

Control animals at the Veterinary Research Laboratory at Angleton, have shown some immunity to pink eye when vaccinated with material containing the specific bacterium, *Hemophilus bovis*. This work is still in the experimental stage and extensive field trials will be necessary before large scale use of such a vaccine will be recommended. Such field trials are now under way. Until definite recommendations can be made concerning use of such a vaccine, strict segregation of the healthy from the infected animals and protection from sunlight and dust will help in the control and treatment of the disease. After the infection has developed in an animal, it may be worthwhile to treat the eyes with some non-irritating antiseptics. Several agents have been used with varying degrees of success. Some of these are 1.5 percent aqueous solution of silver nitrate, sulfthiazole ointment, sulfonamide, yellow oxide of mercury and a 3 percent zinc sulphate solution. (TAES unpublished data; Texas Reports of Biol. and Med. Vol. 3, page 187, 1945.)

WHEAT POISONING OR GRASS TETANY

Where does wheat poisoning occur in Texas and what are its causes?

Wheat poisoning occurs among cattle grazing lush, succulent, rapidly growing wheat. It is closely associated with a disease found all over the State called grass staggers or grass tetany. Animals of all ages are affected, but pregnant cows or cows nursing a calf seem more susceptible. Mortality is high and death may result in a few hours after visible symptoms begin.

The cause of wheat poisoning is not definitely known, although there are a number of possibilities that may be mentioned. Animals suffering from wheat poisoning show a decided drop in total calcium of the blood, along with an increase in the total protein. The lush, succulent wheat plant has a high potassium content and it is thought this may interfere with the calcium absorption in the digestive tract. It is also possible that the wheat plant contains some substance or combination of substances that make the potassium more readily available. The acid-base ratio of the blood in wheat poisoning cases is disturbed; this may be due to the high alkaline content of the drinking water in areas where wheat poisoning is found. It is evident that the hormone produced by the parathyroid gland (which is responsible for controlling the level of calcium in the blood) is not functioning properly. (TAES unpublished data.)

How does mineral feeding affect the occurence of wheat poisoning?

Studies conducted during the 1948-49 grazing season at the PanTech Laboratory near Amarillo, show that animals grazing on wheat, and receiving a supplement containing calcium and magnesium, have a decrease in total calcium and calcium ion concentration in the blood and also an increase in total protein, but not to the extent of animals receiving no supplement when grazing wheat. Animals grazing wheat, and receiving a calcium and magnesium supplement fortified with ammonium chloride, showed an opposite effect in that there was an increase in total calcium and calcium ion concentration in the blood and a decrease in total protein. These experimental results are promising but definitely inconclusive. Further research is underway to find a preventive for wheat poisoning. (TAES unpublished data.)

What treatments for wheat poisoning are now used?

Intravenous treatment with calcium gluconate and magnesium gives satisfactory results in many cases in cattle in the early stages of wheat poisoning. The exact mode of action of the calcium gluconate is not known at this time.

Dry roughages and mineral supplements have been used by cattlemen using wheat for grazing cattle. This practice apparently has helped in preventing the occurence of wheat poisoning. (TAES unpublished data.)

X-DISEASE (HYPERKERATOSIS)

What is X-disease and what are its symptoms in cattle?

As a rule, young animals, usually one month to one year old are affected, but mature animals also contract the disease. The disease may develop during any season of the year. Affected animals usually live from 6 weeks to several months, even up to a year, but more acute cases occur where the affected animals die within several weeks.

The first symptoms observed are watering of the eyes and a nasal discharge. Patches of dead-looking tissue are seen on the mucous membranes when the mouth is examined. It is generally agreed that although these symptoms are the first usually observed by the owner, they probably are not the initial stages of the disease. It is believed that these signs are preceded by a fever stage that usually passes unnoticed. These symptoms are soon followed by a progressive thickening of the skin, loss of hair, emaciation and intermittent diarrhea.

What about the occurence of X-disease in Texas?

X-disease has been found in 50 Texas counties, many of which are widely separated. The number of animals affected

on a premise ranges from one to the whole herd. Several instances are on record where every animal in a herd, sometimes numbering 100 or more, have been wiped out. The mortality among affected animals in Texas is very high, probably exceeding 95 percent. X-disease has been reported from 37 states.

The cause of X-disease is unknown. No satisfactory treatment has yet been developed.

What is being done about X-disease?

A project to determine the cause, nature and mode of transmission, and to formulate methods of control of X-disease in cattle is being conducted by the Department of Veterinary Medicine in cooperation with the USDA Bureau of Animal Industry. This work is primarily to investigate the possibility that the cause of the disease is infectious in nature.

STOMACH AND INTESTINAL WORMS

Do cattle in Texas suffer from stomach and intestinal worms?

In many parts of Texas, particularly in the warm, humid areas of the Coastal Plain and in East Texas, worm infestations in cattle are of decided economic importance. The common, or large stomach worm, and the medium, or brown stomach worm occur regularly in cattle in Texas. In addition, hookworms and small intestinal worms (known as cooperids) are present in many sections of the State. One species of tapeworm (the broad tapeworm) occurs in cattle in Texas and is transmitted by means of an intermediate host, a tiny free-living mite which lives on dead ground vegetation.

Are cattle of all ages equally susceptible to worm infection?

Younger animals are much more susceptible than older ones. Rarely do older animals become infected, although they may continue to harbor small numbers of the parasites which they acquired as calves.

What are the symptoms of worm infection?

Symptoms usually produced are loss of weight or failure to gain properly. General weakness, rough hair coat and paleness are constant symptoms. In later stages, cold swellings may occur under the jaw and along the line of the brisket.

Is there a satisfactory treatment for worm infections in calves?

There is no single treatment that will remove all worms from all animals. Phenothiazine is particularly effective against the common stomach worm, but has only limited value against

the small intestinal worm and the medium stomach worm. A solution of copper sulfate-nicotine sulfate is probably more effective against the medium stomach worm. Tetrachlorethylene is also of value.

Copper sulfate-nicotine sulfate, as used for the medium stomach worm, is of value for treating tapeworms. Lead arsenate in appropriate dosages also is effective against tapeworms.

Does it pay to treat cattle for internal worms?

Yes, particularly if enough worms are present to produce symptoms. It should be emphasized that all worm treatments are poisons and are not without danger. However, where the infection is heavy, treatment may be required to save the animal's life.

Animals usually increase in weight rapidly following needed worm treatment. In a study made at Beeville a few years ago, calves which had been making an average daily gain of slightly less than 1 pound per head for 239 days, averaged 1.57 pounds per head daily for more than 100 days following treatment with a copper sulfate-nicotine sulfate solution. In a more recent study, treated calves made more favorable gains in a feedlot test than did untreated calves. (TAES P.R. 1131 and unpublished data.)

LIVER FLUKES

Where are liver flukes found in Texas?

The liver fluke is found wherever the conditions for completion of its complicated life cycle exist. This parasite is most prevalent in Texas along the Gulf Coast. The intermediate host for the liver fluke is a water snail. Pastures containing stagnant water are excellent places for the liver fluke to flourish. Pasture drainage is one method to help control the occurence of the snail and, hence, to control the fluke infection of cattle.

Can liver flukes in cattle be controlled by medication?

Liver flukes can be destroyed effectively and economically with hexachloroethane.

The drug should be prepared as an aqueous suspension and given as a drench. The suspension is prepared by mixing 1 pound of finely ground hexachloroethane and 1½ ounces of bentonite with slightly over 1½ pints of water. The addition of about ¼ teaspoon of white flour makes mixing easier and improves the mixture. Mixing should be thorough to insure complete distribution of the ingredients. About 1 quart of the drench is produced by this formula. A measured dose of 6½ ounces of the mixture for cattle, and 4½ ounces for calves over 3 months old, should be given by means of a metal dose syringe of 4

ounce capacity. Calves under 3 months old need not be treated since any flukes they may have would be too young to be killed by the treatment. (TAES annual report, 1944.)

How often and when should cattle be treated for liver flukes?

One dose of hexachloroethane is usually sufficient to kill the adult flukes. Young flukes are somewhat resistant to the treatment, so at least 2 treatments are required to destroy all flukes in the animal. One treatment given in the spring or at the beginning of the dry season and a second treatment in the late fall before the onset of the wet season, give good results. (TAES annual report, 1944.)

POISONOUS PLANTS

What are the more important plants in Texas poisonous to cattle and where are they found?

LOCO WEED (Astragalus earleyi, and A. mollissmus)

Research on plants poisonous to cattle, sheep and goats, has been in progress for a number of years at Sonora, Alpine, Marfa and College Station.

Among the more important research has been the study of loco poisoning of cattle. During the dry winter and spring seasons when other vegetation is scarce, cattle will eat loco and often develop a definite craving for the weed. Cattle consuming slightly over 3 times their body weight of green loco plants have died as a result of eating the plants. These plants are found in the Panhandle, Trans-Pecos and Edwards Plateau regions of Texas. (TAES Bul. 456.)

GROUNDSEL (Senecio ridellii and S. longilobus)

Heavy losses of cattle are due to poisoning by eating groundsel in the Big Bend area of Texas. These plants are usually eaten by cattle in the absence of more suitable grazing. Losses seem the heaviest during the summer. The amount of groundsel necessary to kill an animal may be as little as 20 pounds. Symptoms may not occur until some weeks or even more than a month after eating a lethal dose of the plant. The disease is characterized by continuous walking, the sudden appearance of nervous disturbances, diarrhea, accompanied by straining, and other symptoms of illness. No means of combating the disease have been developed. (TAES Bul. 481.)

MESCALBEAN (Sophora secundifolia)

A plant called mescalbean, which occurs in the Edwards Plateau region during the late fall and winter, is poisonous

to cattle. Cattle die within a few hours after eating relatively small amounts of the leaves of the plant. Poisoning by mescalbean is not common, but may occur during periods when grasses and other desirable range plants are short. Supplemental feeding of range animals is a preventive measure where poisoning is apt to occur. (TAES Bul. 519.)

OTHER POISONOUS PLANTS

Following is a list of additional Texas plants that are poisonous to cattle. They are found mainly in the Trans-Pecos and Edwards Plateau regions:

Paper flower (*Psilostrophe tagetinae* and *P. gnaphaloides*)
Peavine (*Astragalus emoryanus* and *A. nuttallinanus*)
Poison hemlock (*Conium maculatum*)
Broad leafed milkweed (*Asclepias latifolia*)
Horsetail milkweed (*Asclepias galioides*)
Whorled milkweed (*Asclepias verticillata*)
Shin oak (*Quercus havardi*)
Drymaria (*Drymaria pachyphylla*)
Sneezeweed (*Helenium microcephalum*)
Lecheguilla (*Agave lecheguilla*)
Larkspur (*Delphinium spp.*)
White Snakeroot (*Eupatorium urticaefolium*)
Hairy caltrop (*Kallstroemia hirsutissima*)
Sacahuista (*Nolina texana*)
Rayless goldenrod (*Aplopappus heterophyllus*)
Phyllanthus (*Phyllanthus abnormis*)
African rue (*Peganum harmala*)

Losses of cattle due to eating these plants are low when more suitable grazing is available. (TAES annual reports, 1929 and 1942.)

Meat Studies

The meat investigations reported following were conducted by the Department of Rural Home Research with the cooperation of the Department of Animal Husbandry.

TENDERNESS OF BEEF

Is there a relationship between rate of gain in beef cattle and tenderness of beef?

Recent experiments at the Spur station and in the Meats and Foods Laboratories at College Station support the theory that rapid gains in beef cattle have a desirable effect on the tenderness and palatability of the meat. Tenderness and palatability information was obtained on uniformly cooked rib roasts from paired, drylot-finished steers having made high and low gains during 16 months of observation. The main differences in steer gains occurred in a 6-month summer grazing period during which 4 of the steers had good grazing on lightly-stocked pastures, while the other 4 had inadequate grazing as a result of deliberate overstocking.

Rib roasts from the fatter, higher-gaining steers were more tender and there were slight indications of more desirable flavor in the lean meat. There were no apparent differences in juiciness or aroma of the meat, or in the flavor of fat. (TAES P. R. 1125 and 1189.)

METHODS OF COOKING BEEF

Does oven temperature affect the tenderness of beef?

Paired cuts from the left and right sides of the same animal were cooked at constant oven temperatures, one at 260° F. and the other at 440° F. The roasts were taken from the prime ribs, arm-bone chuck and rump. They were tested for tenderness by a committee of judges. Roasts cooked well-done at 260° F. were significantly more tender than those at 440° F. Roasts cooked rare at 260° and 440° F. however, did not differ significantly in tenderness. (TAES Bul. 542.)

Does the low oven temperature method of roasting need more time for cooking than the high oven temperature method?

The low oven temperature roasts in this study required longer to cook than the high oven temperature ones. With the arm-bone chuck, the time was nearly an hour per pound longer for the low oven temperature. (TAES Bul. 542.)

Does the low oven temperature method of cooking use more gas than the high oven temperature method?

With some cuts of meat, less gas was used for the low oven temperature method. With arm-bone chuck roasts, however, the low oven temperature method needed more gas, but it cost less than one cent per roast more than the high oven temperature method. (TAES Bul. 542.)

Do skewers affect the tenderness of roasts?

Skewers are pieces of metal which are stuck into the meat to make it cook faster. When paired cuts of meat were cooked well-done at the same oven temperature (260° F.), the roasts with the skewers cooked faster but were significantly "less tender." (Food Research 6:233, 1941.)

Is there a difference in shrinkage due to oven temperature?

When paired cuts were cooked well-done at oven temperatures of 260° F. and 440° F., the roasts cooked at the high oven temperature lost slightly more weight than those cooked at the low oven temperature. This was true even though the cooking time for the roasts at the low oven temperature was more than twice as long. (TAES Bul. 542.)

NUTRITIVE VALUE OF BEEF

Is roast beef a good source of the B-vitamins?

The Food and Nutrition Board of the National Research Council has recommended dietary allowances for 3 of the 4 B-vitamins in this study. One serving of roast beef was calculated to furnish approximately 7 percent of the thiamine, 6 percent of the riboflavin and 37 percent of the niacin recommended for 1 day. Roast beef, therefore, is a very good source of niacin, but only a fair source of thiamine and riboflavin. (J. Nutrition 27: 363, 1944.)

Are the B-vitamins retained better in rare roasts than in well-done roasts?

Two-rib roasts were used in this study. They were cooked by the method recommended for home use. They were placed on their sides on a rack in an uncovered pan without water or flour. A meat thermometer was inserted so that the bulb rested in the center of the meat. They were cooked at a constant oven temperature of 300° F. until the temperature at the center of the roast reached 176° F. for well-done roasts and 60° F. for rare roasts. The temperature of well-done roasts does not rise after they are out of the oven but that of the rare roasts does. This

rise may be from 5 to 10° F. A half-hour was allowed for this rise to take place. The rare roasts retained slightly more thiamine and pantothenic acid than the well-done roasts, but the difference was not great enough to be important in human nutrition. Riboflavin and niacin were retained equally well in rare and well-done roasts. (J. Nutrition 27:363, 1944.)

Does beef roasted at high oven temperature lose more nutritive value than that roasted at low oven temperature?

The actual losses of thiamine, riboflavin, niacin and pantothenic acid are slightly greater in the roasts cooked at the high oven temperature, but the differences are of practical value only for niacin. (J. Amer. Diet. Assn. 25:949, 1949.)

Does browning beef for stews destroy some of the B vitamins?

An extensive study of stews showed that it did not matter whether the meat was browned or not browned. (J. Amer. Diet. Assn. 23:962, 1947.)

Does the amount of water in which the stews are cooked influence the loss of B-vitamins?

Cooking may be done in enough water to completely cover the meat at all times, or in just enough water to keep the meat from sticking to the pan, without a practical difference in the loss of thiamine, riboflavin and niacin, if all of the cooking liquid is used. (J. Amer. Diet. Assn. 23:962, 1947.)

Does the liquid in which stews are cooked have any nutritive value?

In this study, from one-third to one-half of the total riboflavin, niacin and pantothenic acid, and about one-eighth to one-fourth of the thiamine was in the cooking liquid. The higher value in each case was found when the large amount of liquid was used for cooking. Throwing away the liquid in which stews are cooked, therefore, causes a serious loss of these vitamins. (J. Amer. Diet. Assn. 23: 962, 1947.)

Do beef stews lose less nutritive value when they are cooked by simmering, boiling or in a pressure saucepan at 15 pounds pressure?

If the beef is cooked by each method until it is just tender, there is no practical difference in the amounts of thiamine, riboflavin or niacin lost. (J. Amer. Diet. Assn. 23:962, 1947.)

Is beef stew a good source of the B-vitamins?

A serving of beef stew without vegetables, but with all of the cooking liquid, furnishes 6 to 9 percent of the thiamine,

recommended per day, about 10 to 15 percent of the riboflavin and about 37 percent of the niacin. Beef stew is, therefore, a very good source of niacin, but only a fair source of thiamine and riboflavin. (J. Amer. Diet. Assn. 23:962, 1947.)

What influence do feed and breed have on the color of fat of a beef carcass?

Research at the Spur station showed that the amount of carotene in the feed or pasturage is a controlling factor in the amount of carotene stored in the body tissues. Texas produces a large number of cattle fattened on grass, wheat, Sudan and legume pastures, and most of the yellow color in the fat of these animals is due to carotene, the substance which also causes the yellow color in butter. Carotene is essential for proper nutrition since it can be converted to vitamin A by cattle. While consumers prefer beef with white fat over beef with yellow fat, yellow color should be accepted in beef fat, provided other factors of quality are equal.

The results of drylot feeding tests with Hereford, Jersey and Hereford-Jersey crossbred steers show that the amount of carotene in the feed affected the color of the fat in all these cattle. Meat with yellow-colored fat may come from a Hereford, a Jersey or a crossbred animal fed a ration high in carotene. However, there was more yellow color in the fat of Jersey steers than in the fat of Hereford or Hereford-Jersey crossbred steers. (TAES P. R. 1126 and 1191.)