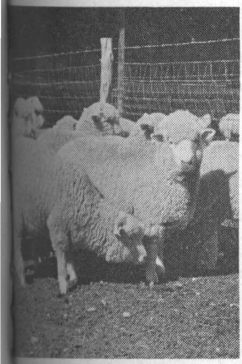
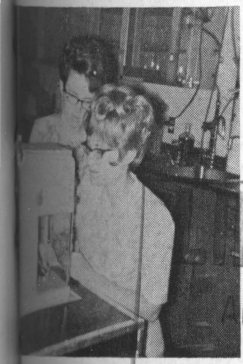
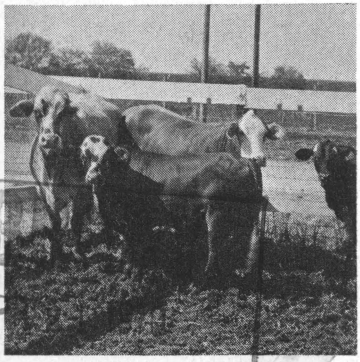
EMBER 1969

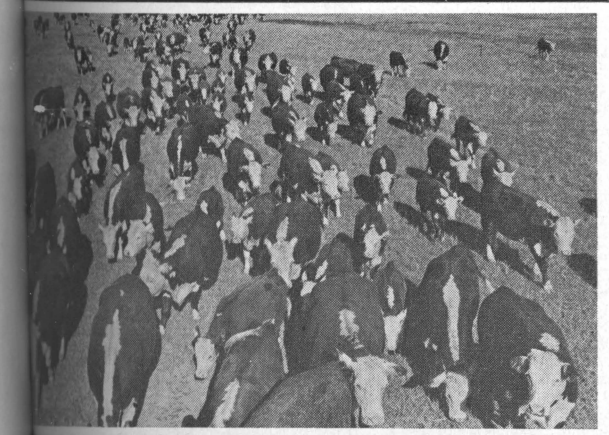
MP-193
(Revised)







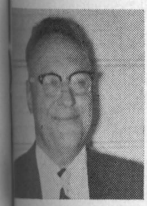
TEXAS A&M UNIVERSITY
Agricultural Research Center
at
McGregor



TEXAS A&M UNIVERSITY
AS AGRICULTURAL EXPERIMENT STATION
O. Kunkel, Acting Director, College Station, Texas

CONTENTS

STAFF



HENRY O. HILL, BS, CE, *superintendent*
Specialization: Soil Conservation and Structures

MILLARD C. CALHOUN, PHD, *assistant professor*
Specialization: Sheep and Angora Goat Nutrition

LLOYD B. FENN, PHD, *assistant professor*
Specialization: Soil Chemistry and Fertility

JAMES R. GALLAGHER, MS, *research associate*
Specialization: Wool

JAMES E. HUSTON, MS, *research associate (on study leave)*

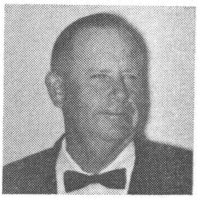
CHARLES W. LIVINGSTON, JR., DVM, MS, *associate professor*
Specialization: Sheep Diseases (San Angelo, Texas)

ROBERT F. LYNCH, BS, *assistant agro*
mist and field supervisor
Specialization: Cotton

M. J. NORRIS, MS, *associate profe*
Specialization: Grass, Forage and Gr
Crops

J. MAURICE SHELTON, PhD, *profe*
Specialization: Sheep and Angora Go
Genetics

RICHARD C. THOMAS, PhD, *assist*
professor
Specialization: Beef Cattle Genetics



W. H. CARTER, *accountant*

MRS. MATTIE GRAHAM, *senior secretar*

TEXAS A&M UNIVERSITY

Agricultural Research Center

at

McGregor

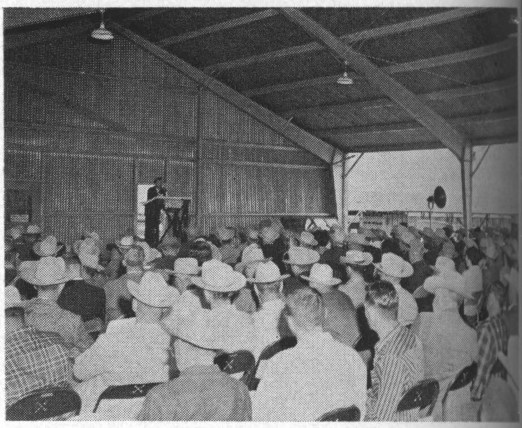
Both size and location of the Research Center are advantageous for research with large animals and forage crops.

The Center is probably one of the largest agricultural research farms in the world. It was established in January 1948 on Bluebonnet Ordnance Plant granted to the State of Texas by the federal government. It was originally called Bluebonnet Farm. The National Defense clause in the acquisition agreement allowed government repossession. This was exercised in 1952 for about two-thirds of the area, leaving full title to 6,372 acres for Center use. A large portion of the more than 10,000 acres of repossessed land is available by lease to the Center for agricultural use.

Location enhances research because there are two important soil types on the center. About one-third of the land is Blackland; the rest is Grand Prairie soil types.

Research is directed at improvement of beef cattle, sheep and goats; grassland improvement and grass breeding; small grain and foundation seed increase; soil fertility; and conservation and mechanization for crops, especially cotton, in an effort to reduce production cost per unit.

Some of the projects are conducted in cooperation with other units and departments of the Texas A&M University System, with the U. S.



Attentive audience at Sheep and Goat Field Day.

Department of Agriculture and with ranchers, farmers and industrial concerns.

The Center is 700 feet above sea level. Average rainfall is about 32 inches with a 245-day growing season ranging from mid-March to mid-November. Dry months are July and August.

A beef cattle field day is held annually in March at the end of the gain evaluation test. A sheep and goat field day takes place annually in April, and a soils and crops field day in late May.

Visitors are always welcome.

A group of visitors making a tour on a Grass, Soils and Crops Field Day.

BEEF CATTLE

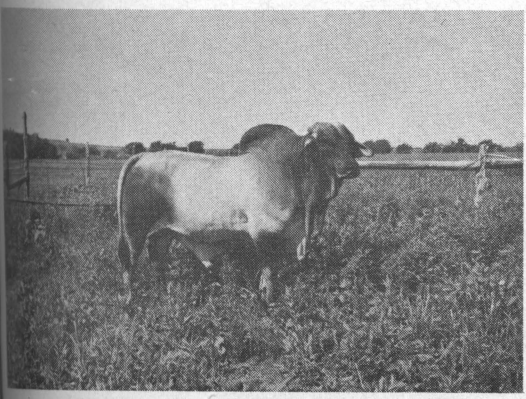
Important economic characteristics in beef cattle are reproductivity, weaning weight, feedlot or pasture gain, carcass value, feed efficiency and mature weight. The principal research objectives of the Center are to evaluate various causes of differences in these characteristics, seeking to determine the most efficient procedure for the breeding and selection of more productive, efficient and useful beef cattle both within breeds and among hybrids.

Cattle at the Center include about 650 cows and 40 - 50 bulls. They are of the following breeds: Hereford, Polled Hereford, Charolais, Brahman, Angus and crossbreds. Experimental data are gathered from each individual for genetic studies and for aid in selection.

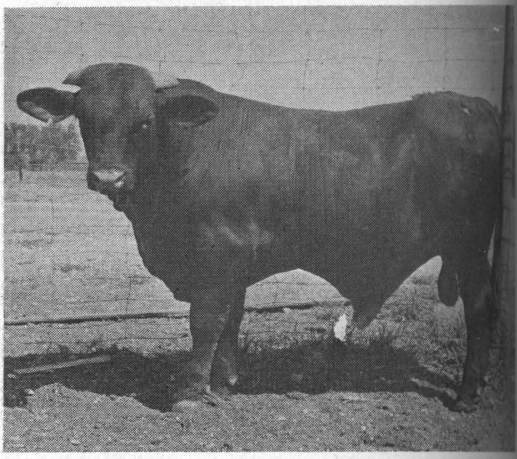
Gainability

Gaining ability is important in beef cattle production for these reasons: Market weight is of primary importance in determining total receipts. Large differences exist in the ability of individuals to gain weight. Gaining ability is highly heritable.

Weaning weight is an important indication of gaining ability and the dam's milking and mothering ability. Weaning weight has been found to be 30 percent heritable. Actual yearly increase for 18 years has averaged 5 pounds. This is cumulative. It represents a 50-pound increase in 10 years in average weaning weights for the Center herd.



An outstanding Brahman bull identified by performance testing.



A record gainer which has sired gain record breeding calves.

The predictions are 40 to 45 percent for heritability of rate of gain after weaning. If breeding selection is made for feedlot gain, a 6-pound yearly increase from selection can be expected during a 5-month feeding period.

To date, nearly 6,000 young cattle, including all major beef breeds, have been tested for gain-ability under uniform feedlot conditions here. Gain testing heifers after weaning on grazing appears to be as accurate as testing in a feedlot if the grazed forage is adequate in supply and nutritive value to produce satisfactory gains. The first calves from heifers gain-tested on grazing are heavier than those gain-tested in the feedlot.

Results of this selection research show that breeders who select superior breeding stock for both weight at weaning and gain after weaning can expect an 11-pound increase per year in yearling weights.

Efficiency

Determination of sources of variation in feed-use efficiency is a current project. Young cattle in a narrow range of age and weight are each offered an identical amount of a ration in drylot. Any refused feed is weighed back.

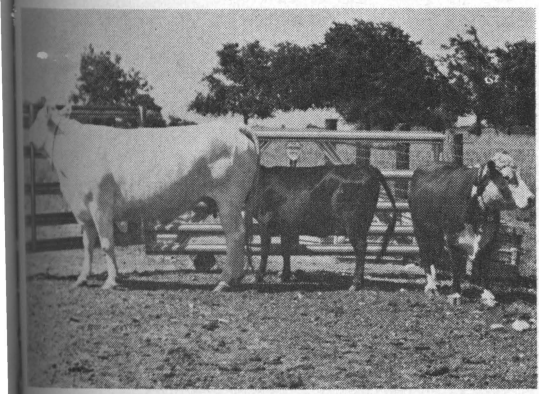
There has been a difference in daily gain with the highest gaining animal consuming the least amount of feed per pound of gain.

Individual pens for cows and calves in the cow size study.

Daily gain of the most efficient animal has exceeded that of the least efficient animal by 0.4 of a pound per day. The most efficient animal required only 7 pounds of feed per pound of gain, whereas, the least efficient animal required 11 pounds of feed per pound of gain.

Cow Size

What cow size is the most efficient? This is not only an important question between breeds but within breeds. In an effort to answer this question, Charolais and Hereford cows of different size and half-breed Angus x Jersey cows are being fed individually in drylot. The Charolais and Angus x Jersey cows are bred to Charolais bulls and the Hereford cows to Hereford bulls. The calves are individually creep fed until 210 days of age and then individually fed twice daily



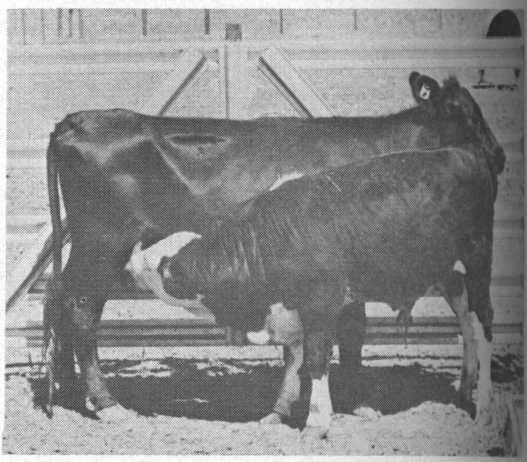
What size of cow is the most efficient producer of beef?

until a year of age. Results thus far indicate that there are no appreciable differences in efficiency of production in purebred cattle of different mature weights. However, combining breeds that exhibit desirable maternal traits (small size, fertile, ease of calving and good milkers) to be used as dams bred to large growthy bulls results in a large difference in efficiency of production.

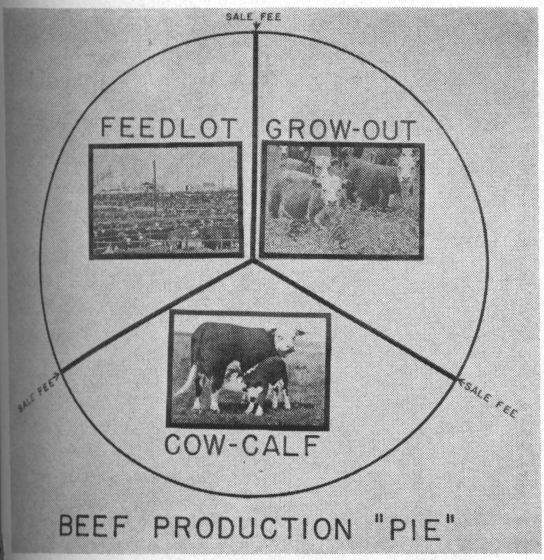
Experimental results indicate that a small (700-pound Angus x Jersey) cow requires through the year 36 percent less feed for maintenance than a larger (1200-pound Charolais) cow. The medium size cow (1050-pound Hereford) will require 15 percent less than the larger cow. Including the preweaning calf feed required with the required year's cow feed, a pound of calf at weaning was produced by the small crossbred cow bred to the larger bull (Angus x Jersey ♀) (Charolais ♂) on 12.8 percent less feed than that produced by the Hereford and on 9.5 percent less feed than that produced by the Charolais. When the calves were fed through yearling, 7 percent less feed was required to produce a pound of yearling from the crossbred cow than from the Hereford cow and 5.6 percent less than from the Charolais.

Fertility and Reproduction

The percentage calf crop is one of the most important factors in economical beef production. The average percentage calf crop weaned in Texas is estimated to be about 70 percent. Therefore, reduced calf crop due either to reduced



An Angus x Jersey cow weighing 640 pounds with her 7-month-old 479-pound Hereford-sired calf.



One owner from birth to slaughter for efficiency of production.

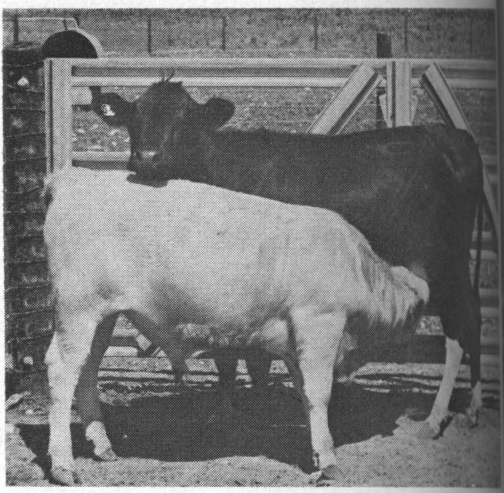
fertility or to embryonic and fetal mortality is a major production problem for Texas cattlemen. This is not only an economic problem, but it is also the chief factor limiting selection.

Recent observations show that approximately 30 percent of the 2-year-old heifers encounter difficulty at parturition and that approximately 35 percent of those calves involved in difficult parturitions are lost immediately or within 24 - 36 hours. Studies are in progress to determine causes of this problem and what can be done to alleviate it. Selection against difficulty in calving seems a possibility.

These studies include making monthly pelvic measurements of replacement heifers from weaning until they calve; establishing puberty date for the heifers; determining the effects of puberty and pregnancy on growth and development of the pelvic outlet; and determining relationships between shape and size of pelvic outlet, calf weight and circumference of calf's head and shoulders to calving difficulty within breeds and between breeds and crosses.

Hybrid Vigor

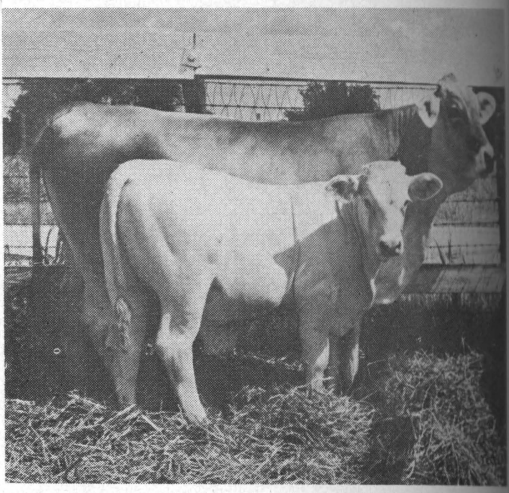
Hybrid vigor or crossbreeding studies have been carried on for two reasons: (1) To determine whether a portion of the inheritance or



Is this efficient production? An Angus x Jersey cow weighing 622 pounds with her 7-month-old 523-pound Charolais-sired calf.

breed characteristics of one breed can be transferred with advantage to another breed and (2) to determine whether hybrid vigor can be as important in beef cattle as it has been in many plants and some animals. Crosses have been made with the Brahman, Brown Swiss, Charbray, Charolais, Hereford, Angus, Jersey, Red Poll and Santa Gertrudis breeds.

Results indicate that purebred bulls should be used in a crossbreeding program. Advantages



A ½ Brown Swiss, ¼ Hereford, ¼ Brahman cow with her Charolais-sired calf.

include: (1) Increased weaning weight, (2) increased fertility and mothering ability in crossbred females and (3) greater hardiness, healthiness and longevity. Brahman-Hereford crossbred cows, for example, produced, on the average, more than 20 percent more total pounds of calf at weaning and 3.0 more calves in a lifetime than the better parent breed.

Carcass Evaluation and Eating Desirability

Steers from different sires are slaughtered at the Texas A&M University Meats Laboratory where their carcasses are evaluated. Cooking studies are made to determine tenderness, juiciness and flavor. The fact that carcass muscling and tenderness of meat are inherited characteristics offers hope of considerable improvement through continued study and breeding.

A "Hurry-Up" Program To Meet Market Demands

Five research findings were combined in a program to make the most beef from a cow herd. Using gain-performance tested breeding stock, crossbreeding, calving in the fall, implanting calves with growth hormones and placing them in the feedlot for the last 4 months have produced 1000-pound steers at 1 year of age. Such 1000 to 1050-pound steers will provide the size and grade of carcasses that are high in market demand. This program can be used by any

A breeding group with a Brown Swiss bull.

cattleman who has pens, feed and willingness to give his cattle daily attention.

Recommendations

From results of 20 years of beef-cattle breeding and gaining-ability tests here and with cooperating breeders, the following recommendations are made:

(1) Select breeding cattle from those raised under practical conditions.

(2) Identify cow and calf and record birth date of calf. Identify and record sire.

(3) Select breeding cattle at a practical age (usually market age). Use scale weights.

(4) Compare each animal on the basis of gain in relation to gain of others at the same time and under the same conditions.

(5) Select animals on the basis of weaning weight, gain on feedlot or pasture test and total pounds per day of age. This practice should be followed when making selection in your own herd or when buying bulls. Purebred breeders should progeny test their herd bulls for economically important carcass characteristics.

(6) When data are available, consider reproductive performance of dam and sire in selecting herd replacements.

(7) Select for conformation adequate to allow slaughter cattle to reach the choice grade with proper finish.

(8) Yearling bulls finished for slaughter gain 10 percent faster than steers, deposit less fat and produce acceptable carcasses competitive with steers. Consider finishing yearling males as bulls for slaughter.

(9) When crossbreeding, use purebred bulls on cows of another pure breed or on crossbred cows.

(10) Test bulls for fertility about 30 days before breeding season.

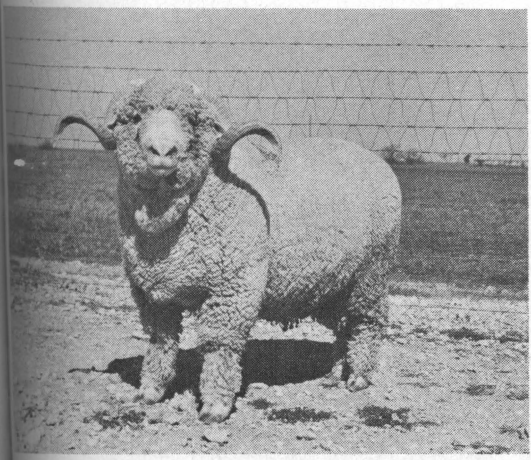
(11) Palpate cows for pregnancy 60 to 90 days after the end of breeding season; then sell open cows.

SHEEP

Lamb and wool production are important industries in Texas, and considerable research work at the Center is directed toward improving the efficiency of these industries. Work with sheep presently is concentrated at this Center because it is presently the only location where the Texas Agricultural Experiment Station has sufficient land area to maintain adequate numbers.

The Board of Directors of Texas A&M University in February 1969 announced the intention of establishing a Research and Extension Center at San Angelo with research to be devoted primarily to sheep and Angora goats.

Land area of McGregor Center is composed largely of farm land or land that has previously been farmed, and this hampers the ability to study and develop management practices applicable to range areas. Also, here on the eastern fringe of the sheep area, wolves or coyotes are a severe problem and presently constitute a major limitation to accomplishment of research goals. Fleece contaminants, especially cockleburs and bur clover, materially lower the market quality of any wool produced. On the other hand, problems relating to climatic adaptability are intensified at this location, and work on these problems is enhanced. Too, the large acreage devoted to



A fine wool ram with a good record. Fine wool sheep are now being selected for fertility on level of twinning in addition to rate of growth and wool production.

the production of feed permits studies relati to intensification of the sheep industry whe drylot maintenance may be necessary for a pa of the production cycle.

Research with sheep at McGregor is current organized under five projects.

Improving Reproductive Efficiency

In the sheep industry, improvement in repro ductive efficiency represents the primary oppo tunity for increased efficiency. The averag lamb crop weaned in Texas is on the order o 80 percent with the national average approx mately 10 percent higher. These values compa with a theoretical upper limit in the range o 200 percent. Thus, improvement in reprodu tive efficiency is a major area of research interes at this location. Earlier work has shown tha under range conditions, a major limiting facto is a lack of size and development arising from a low level of nutrition. It has been shown tha when body weights are below certain minimal values which represent physiological maturity for the breed (approximately 100 pounds for Ram bouillet ewes), a large number of dry ewes can be expected. When weights are above these minimal values, the percent of ewes lambing does not materially increase, but the lambing rate (number of lambs dropped per ewe lambing) continues to increase with increase in size. How ever, with extreme heavier weights (above 150

A good type of ewe for slaughter lamb production. No breed or cross of ewe has yet been identified which is consistently superior to the Rambouilett ewe bred to a fast gaining Suffolk ram.

An inherent form of dwarfism in fine wool sheep which has been identified and studied at this Center.

pounds for Rambouillet), the percent of dry ewes is likely to show some increase. When size or development is within the optimum range, environmental or climatic factors associated with temperature and length of the photoperiod become serious limiting factors.

Temperature extremes, especially high temperature, are a problem in livestock production in Texas, especially with sheep in those areas south and east of the Edwards Plateau. High temperature adversely affects both reproduction and rate of growth. It has relatively little influence on rate of wool production. At least four different pathways have been identified whereby reproductive efficiency is lowered. Earlier work has shown that high temperatures can cause (1) partial or complete sterility of rams, (2) a failure of ewes to show estrus, (3) early embryo loss among mated ewes and (4) fetal dwarfing with an associated increase in death losses. The degree to which each of these is a problem depends on the severity of the environment and the animals' adaptation to that environment.

Recent work at this station has been concerned wtih the fetal dwarfing effect of high environmental temperature. In extreme cases, the result can be a complete loss of the embryo causing a failure of the ewe to lamb. It has been determined that this phenomenon represents a direct effect of high temperature on animal physiology and that the only means to combat this loss is to eliminate the stress on the animal through change in the environment, superior adaptation on the part of the animal or breeding at a time so that the latter part of gestation does not occur during late summer months.

Studies on the effect of season on fertility show that it is possible to produce lambs from fine-wool ewes at any time of the year. The level of fertility is lowest in early spring and highest in the fall. The variation associated with season is reflected in both percent of ewes showing estrus and ovulation or lambing rate. The length of the photoperiod does not appear to affect embryo or lamb survival. Studies on the effect of both season and temperature are continuing. With the widespread acceptance of early weaning, it is no longer recommended that ewes be bred as early in the season as formerly, and this

A method of pregnancy diagnosis in sheep utilizing the Doppler Shift principle.

is of some benefit in circumventing both the effect of season and temperature.

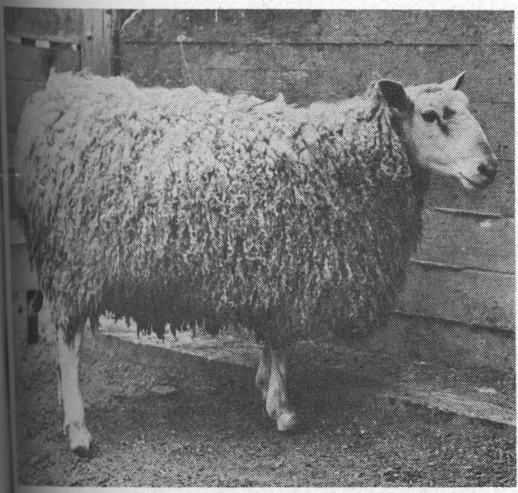
An easy method of determination of pregnancy or multi-fetation in sheep would be highly desirable. A method of pregnancy diagnosis, utilizing the Doppler Shift principle, has recently been developed at this Center. There appears to be some possibility of adapting this procedure to identifying twin bearing ewes, and work in this area is continuing.

Selection for Ewe Fertility

Recent research reports have suggested that good response can be expected from selecting directly for fertility or multiple births. A majority of the registered Rambouillet flock at the Center is currently devoted to a project to determine the response from selecting for or against multiple births in this breed. One line is selected for multiple births or twinning, and a second is selected for single. Preliminary results are encouraging.

Crossbreeding

Extensive work in crossbreeding for the production of market lambs has been conducted at this Center. The data obtained suggest a slight advantage in lamb survival, growth rate and slaughter grade for the crossbred lambs. Best results have been obtained with Suffolk,



A Leicester ram: one of the breeds being investigated in crossbreeding studies.

Hampshire, Suffolk x Hampshire and Columbia rams. This phase of the crossbreeding work has been essentially completed, and current efforts relate to the use of crossbred ewes. As of the present time, no crossbred ewe has been identified which has consistently proved superior to the Rambouillet ewe. These studies are continuing with current studies involving crossbred ewes out of Rambouillet ewes and sired by Dorset, Leicester and Dorset x Leicester rams. If none of these crosses proves satisfactory, efforts will be directed toward development of a breed or strain which will cross to advantage with the fine-wool ewe.

Multiple Lambing

A major new development in the sheep industry has been the proposal to lamb more frequently than once per year. Earlier work has shown that it is possible by this procedure to increase lamb production by about 50 percent. This practice requires that the ewes be on a higher level of nutrition than for conventional once-per-year lambing, and, for this reason, the practice should not automatically be adopted in range flocks without corresponding changes in management practices. Current research efforts in connection with multiple lambing are directed toward outlining the conditions under which accelerated lambing might be recommended and determining which system is likely to yield best results. Five programs are currently being investigated at this station. These vary from a single lambing annually to attempted twice-per-year lambing both on pasture and in drylot.

A group of fine wool ewes with their lambs in drylot. The possibility of producing lambs from ewes on multiple lambing programs in confinement is being investigated at this Center.

Nutrition

Work with sheep nutrition on this station has been concerned largely wtih drylot feeding of lambs, sources of protein for supplemental feeding and drylot maintenance of ewe breeding flocks.

Most Texas produced lambs still require a period of time in drylot in order to reach weight and condition desired by packers. Research at the Center has shown that high concentrate rations (80 - 100 percent concentrates) offer definite advantages over conventional rations for feeding during this period: (1) Less time is required in feedlot because lambs reach desired finish sooner. (2) Labor and feed handling equipment costs are reduced. (3) Lambs convert higher concentrate feed to meat more efficiently thereby reducing feed costs.

Excellent results have been obtained in recent years from feeding high-concentrate rations to early-weaned lambs (35 - 55 pounds). Under experimental conditions, young lambs adapt quickly to high-concentrate rations in drylot and make very efficient gains. More caution is required when older lambs (65 - 85 pounds) are placed on high concentrates. A successful method at the Center has been to hand feed older lambs 1½ - 2 pounds per head per day for about 5 days

The sheep shearing operation. The possibility of reducing labor requirements for sheep shearing by utilizing chemical agents which cause shedding of the wool is being investigated.

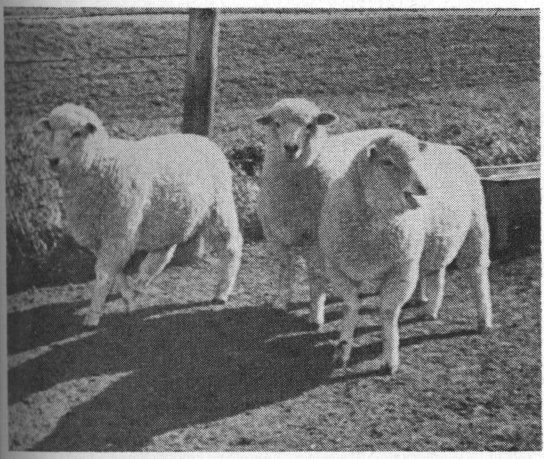
before giving them access to full feed. Urinary calculi, enterotoxemia and parasitism are potential problems, and precautionary measures should be considered.

Protein is generally the most deficient nutrient in dormant range grass. However, there are instances, such as on small grain pastures, when protein is more than adequate, and supplemental grain can improve utilization of the forage. At the Center, several protein sources have been evaluated as range supplements including cottonseed meals, soybean meal, hydrolyzed feather meal, blood meal, urea and biuret. All of the natural proteins were approximately equally effective in providing usable protein to the animal. Palatability problems may be encountered with the animal by-product protein feeds in trying to feed them at higher levels. However, these products can often be purchased at advantageous prices relative to the oil meals such as cottonseed meal, and, in this case, can be considered by producers. Urea and biuret were also of value, but indications are that they should furnish only a limited portion of the total supplemental protein.

Studies related to drylot maintenance of ewe flocks are underway. These investigations involve both all-concentrates and conventional roughage rations.

Carcass Improvement

Carcass evaluation programs are carried out in cooperation with personnel of the Meats Laboratory of the Department of Animal Science at College Station. Early work has dealt with the identification of desirable qualities of lamb carcasses and determination of the effect of sex, breed and sire on expression of these traits. These studies have shown that when slaughtered at an early age, ram lambs produce carcasses as good as or superior to those obtained from wether or ewe lambs. Other data are currently being analyzed. Current work in this area is directed toward determining what size lambs or lamb carcasses can be most efficiently produced by the industry. Efforts are also being directed toward determination of the relation of size or age to suitability of carcasses obtained from rams. *The purpose of these investigations*

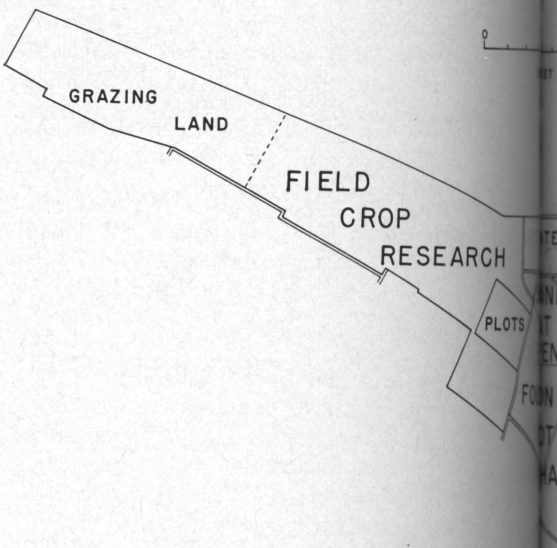


A good type of slaughter lamb. These lambs were sired by Columbia rams out of Rambouillet ewes.

is to determine the ram size or age which justifies packer discrimination against ram carcasses. Further work is also underway to reduce the rate of fat deposition and to increase growth of early-weaned lambs on high-concentrate rations.

Texas A
Agricultural Resear

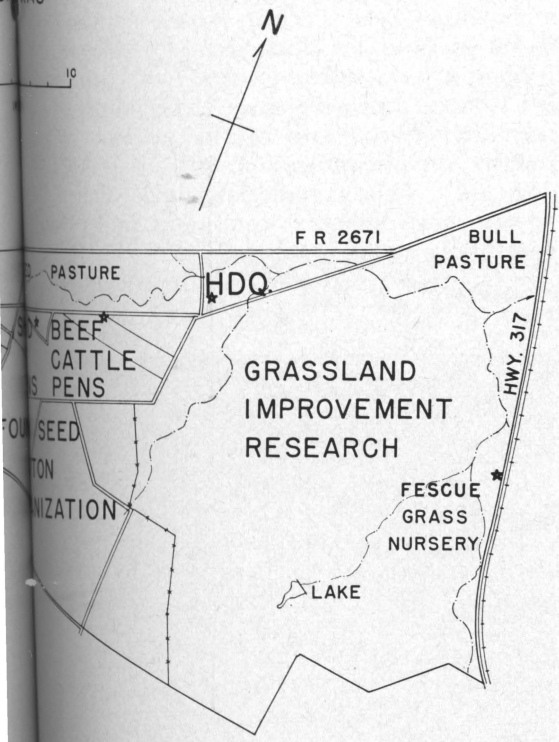
TEXAS AGRICUL



niversity
nter at McGregor

TMENT STATION

AS

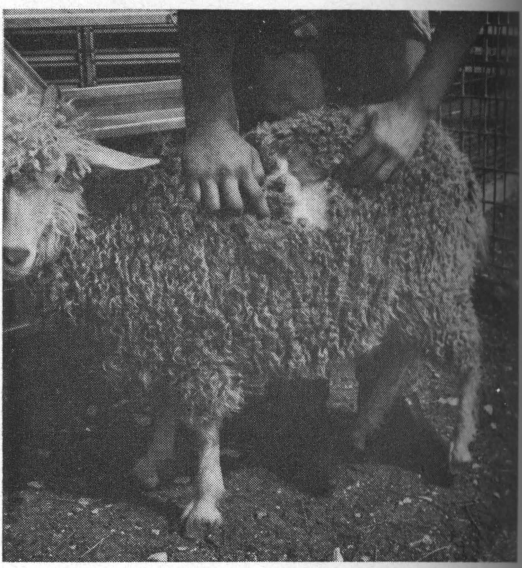


ANGORA GOATS

Texas produces 90 - 95 percent of all the Angora goats and mohair produced in the United States. This Center is one of the very few in this country or in the world which has research work with the Angora as a major objective. The limited amount of previous research on this animal makes almost any investigation worthwhile, but the audience for the results is more limited than for research on other species. Three formal projects and other less formal investigations are underway with goats.

Improvement Programs

Preliminary work in performance testing at this Center resulted in the establishment of a more extensive program at the research station at Sonora. Early genetic analyses of data collected at both locations seem to indicate that it should be possible to modify the characteristics of the Angora goat or the qualities of the mohair produced with relative ease but that to increase mohair production is likely to be more difficult. This is especially true under the adverse environmental conditions under which goats are frequently produced. One project relating to genetic studies with Angora goats,



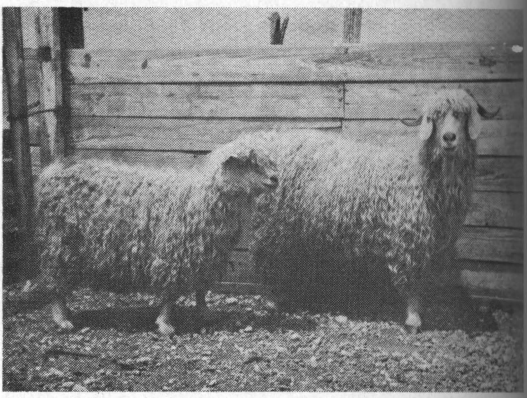
A "sheepy fleece" (short hair with excessive crimp) is a genetic defect in Angora goats being studied.

underway here for 5 years, is being transferred to the Sonora station.

Reproductive Efficiency

A major research effort has been directed toward improvement in reproductive efficiency because realized fertility in Angora goats is low. Analysis of earlier data helped to identify factors which affect fertility in the Angora doe such as age, size and face cover. From these studies, it was evident that lack of size and development of the does provided the major limitation to a high level of reproduction. Early work also indicated that the nervous system has a considerable effect on reproduction of this species and suggested some ways in which this information might be used to advantage. The most noted effect was that the presence of the male tended to terminate anestrus in the doe, and, under proper conditions, this can be used to bring about a high degree of synchronization of mating. Thus, kidding dates could be controlled if the intense supervision desirable at kidding time would be available. These studies also showed

Excess hair covering on the face contributes to lack of satisfactory development and poor reproductive performance of goats.



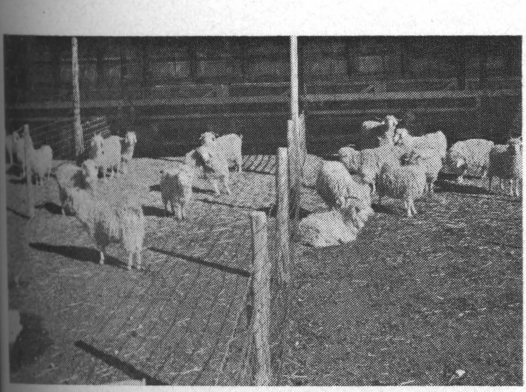
Lack of size and development of Angora does, as indicated here, is a major cause of poor reproductive performance and increased death losses.

that, in contrast to many other species, Angora does are fertile at first ovulation of the season but that ovulation and kidding rates are higher at the second estrus. Matings on this second cycle can be brought about by stimulation with a vasectomized male for a sufficient period of time to insure that the first estrus has passed.

Abortion of Angora does results in substantial losses, and this problem is being investigated. Little progress has been made in identifying the physiological mechanisms involved, but two important methods of reducing this loss have been suggested. The first is to maintain adequate size in the doe flock and to prevent stress condition during the last 40 to 60 days of gestation. Also, because there is a tendency for repeat abortions among does showing this problem, identification or culling of those with an abortion history is beneficial in reducing losses. Since current low mohair prices have resulted in limited demand for replacement goats and a resultant low price for surplus individuals, information relating to methods of improvement in reproductive efficiency has little demand. Therefore, the Angora goat is being used for study of some fundamental questions which might yield beneficial results at a later date.

Nutrition

The high level of fiber production relative to body size by the Angora suggests higher nutritive requirements than those of sheep. Studies are



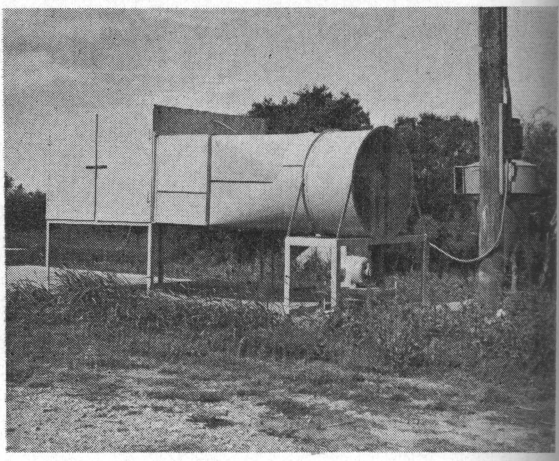
Angora does being maintained in drylot on nutritional studies with this species.

being conducted at the Center to determine protein and energy requirements for all sex groups and stages of production. A preliminary standard of protein requirements for open does and wethers, pregnant does and lactating does has been constructed. The pattern of variation relative to size and productive purpose is very similar to accepted standards for sheep, but about 10 percent higher.

Research is being done to determine factors which affect mohair growth and how these could be used to stimulate mohair production. Feeding studies with Angora males on dormant range have shown that feeding supplemental protein stimulates mohair production. Such a practice does not appear economical during periods of low-priced mohair and high-priced protein unless conditions are such that the health of the goat would otherwise be impaired. Results of studies with low-cost byproduct protein concentrates (blood meal, hydrolized feather meal) are promising, and formulations including these have a definite price advantage over conventional supplements.

Other Studies

In addition to the major research areas, other investigations may be conducted from time to time as problems arise or as areas of work appear to offer opportunities for fruitful study. One such problem area is that of freeze losses. Although this problem has been studied, no simple or easy solution has been identified. Another



Freeze loss, one of the major problems with Angora goats, is studied by use of this machine which simulates wind and moisture conditions that contribute to this loss.

area that has been studied is the frequently observed but unexplained problem of anemia resulting in edema along the underline, legs and other areas of Angora goats. The problem of control of internal parasites, including coccidia, has been investigated. The relative effectiveness of various drugs has been determined, and results of these studies are available on request.

The edema along the underline of this goat is a mysterious malady of this species being studied here.

PASTURE GRASSES AND FORAGE CROPS

Perennial Grasses

Vigorous-growing perennial grasses that will withstand drouths and wide range of winter and summer temperatures are needed for the permanent pastures of the area. These grasses should also have good seedling vigor, be easy to establish from seed and produce the quality of forage that will result in good livestock performance. The development of grasses with these characteristics is a major objective of grass improvement research at the Center. TAM Wintergreen hardinggrass, kleingrass and green sprangletop are grasses that have demonstrated their outstanding qualities. Selection and adaptability work is in progress with buffelgrass to develop varieties that will withstand local winters.

Winter Pastures

Oat-grazing research with beef cattle steers since 1959 has given realistic estimates of stocking rates, animal grazing days per acre, average daily gain per animal and livestock gains per acre. Use of oats as a pasture crop under average weather conditions and without supplemental feed required 2.7 acres per steer to produce satisfactory gains during the winter and 1.9 acres per animal from March 1 to about June 1. Livestock gains averaged 190.8 pounds for the oat-grazing season, with 96.6 animal grazing days per acre and an average daily gain of 2 pounds

TAM Wintergreen hardinggrass, a new perennial winter-growing pasture grass with good summer drouth resistance.

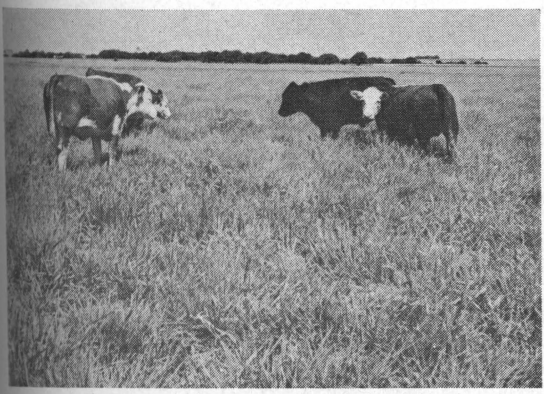
Pasture grasses are evaluated by the performance of grazing cattle.

per steer. During a more favorable growing season, such as 1961, the stocking rate was increased to 2 acres per animal during the winter and 1 acre per animal after March 1, with a production of 312 pounds of animal gains per acre and 135 animal grazing days per acre during oat grazing.

Satisfactory animal gains were obtained on both freeze killed dry and mature oats forage.

Grazing results on oats with different early growth habits and different stocking rates were conducted during a 3-year period. Included were Alamo-X, a vigorous upright-growing variety; New Nortex, a variety that is semiprostrate in early growth; and Bronco, a variety that is prostrate in winter growth. The stocking rate had a greater influence on animal gains per acre than varietal growth types. A medium stocking level that maintained a visual surplus of forage on 25-30 percent of the pasture area resulted in good animal performance and highest livestock gains per acre. Pastures sown to the upright-growth-type variety, Alamo-X, showed highest animal gains during the winter when pasture forage was usually limited.

Grazing trials with TAM Wintergreen hardinggrass, a new perennial winter-growing grass with cold tolerance and good summer drouth resistance, were started in the fall of 1966. Results indicate satisfactory performance for beef steers grazing Wintergreen. Steers on this perennial wintergrass have not produced as high per-acre gains as steers on oats during a good oat-growing



Pasture grazing research on TAM Wintergreen hardinggrass.

season, but animal gains have been higher on TAM Wintergreen than on oats during seasons of drouth. Since TAM Wintergreen is a perennial, its annual cost as pasture should be lower than that of oat pasture.

Summer Pastures

Coastal bermuda, johnsongrass and sudangrass-type sorghum x sudan hybrid have been evaluated as improved pasture grasses since 1964 using beef cattle steer gain performance as the measure. Animal gains per acre for the season averaged 197.7, 162.8 and 143.6 pounds, respectively, for the sorghum-sudangrass hybrid, Coastal bermuda and johnsongrass. Although livestock gains per acre ranged from 153.6 pounds to 197.7, the net returns from the different grasses may be more nearly equal than livestock gains indicate when all expenses involved in establishment and annual maintenance are considered. All three of these grasses appear to have a place in pasture systems in Central Texas.

Kleingrass and green sprangletop pastures have been established, and animal grazing performance was started in May 1968.

Cultivated Forage and Pasture Crops

Livestock in Central Texas feed primarily on cultivated forages. Small grains are the most important winter pasture and sudangrass the most important summer pasture. Forage production research is conducted on small grains,

Vigorous growing forage type small grains.

sudangrass, green chop and silage sorghums, annual grasses, perennial summer grasses, perennial cool-season grasses and legumes.

Hybrid sudangrasses are the most outstanding recent development for cultivated pastures. They produce hay yields of 7,000 to 9,000 pounds per acre. This is 30 to 50 percent more than that produced by the sudan varieties they are replacing.

GRAIN CROPS

Corn and Grain Sorghum

Grain sorghum has been described as the area's "Cinderella-crop." It exceeds cotton in total value for the area, and it ranks second to cotton in value per acre. Research on grain sorghum resulted in doubling yields in 10 years. Yields of 1,200 - 1,400 pounds per acre were common 10 years ago, and top yields then were 2,000 pounds per acre. Now yields of 2,000 to 3,000 are common, and top yields are 4,500 to 5,000 pounds per acre.

This revolution has been possible because of the following research: Development and use of hybrid grain sorghum, proper use of fertilizer, earlier planting and planting in narrow rows. The most recent improvement has been the development of headsmut-resistant hybrids such as RS 625, RS 626 and RS 671.

Planting grain sorghum in narrow rows produces yield increases up to 30 percent more than planting in conventional 38 - 40-inch rows. Double-row planting on single beds 40 inches apart is the most practical adaptation of narrow-row spacing. The planting rate for double or narrow-row grain sorghum should be 6 to 7 pounds of seed per acre, the same as for conventional rows.

Extensive evaluation of grain sorghum breeding material, in addition to cultural research on fertilizers, row spacing and planting rates, is done at the Center.

Narrow rows or double rows have increased grain sorghum yields about 30 percent in row-spacing experiments.

Small-grain nursery includes about 800 trial plots annually.

Corn work consists of performance tests and preliminary tests of inbred lines used in the production of new corn hybrids. Texas 28 has been the highest yielding corn hybrid with an average yield of 62.5 bushels.

Small Grains

The Center is located in Texas' leading oat-producing region. Research on small grains is a part of the coordinated state and federal work on improvement of barley, oats and wheat. It involves work on increasing yields, milling quality of wheat, disease and insect tolerance and resistance and forage production; increasing seed of new strains; and maintaining foundation seed of varieties developed by the Experiment Station. Foundation seed stocks of Alamo-X and Cortez oats were increased and released from this Center.

Rusts and smuts are serious diseases of wheats and oats in this area and require a constant,

Differential winterkill of small-grain varieties.

Head smut disease in grain sorghum was controlled by the development of resistant varieties.

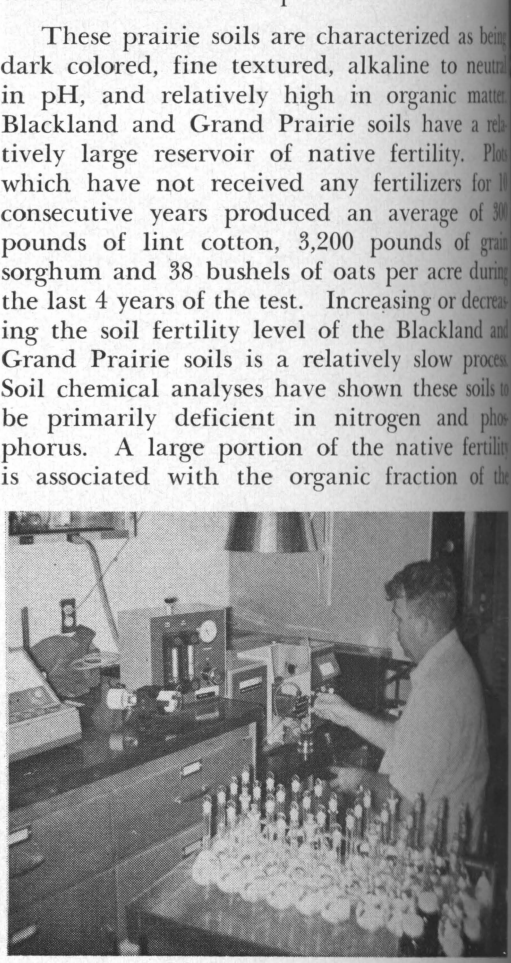
intensive breeding program to avoid losing ground to these diseases. Samples of new wheat strains are subjected to milling and baking tests to determine their commercial value.

SOIL FERTILITY AND CROPPING SYSTEMS

Soils

The types of soils found on the Center are representative of both the Blackland Prairie and the Grand Prairie regions. The Blackland Prairie of Texas covers, in whole or in part, 6[illegible] counties and includes about 11 million acres. The Grand Prairie covers in whole or part of 21 counties and is about seven million acres in extent. These two Prairies constitute about 1[illegible] percent of the total area of Texas. The Research Center lies astride the boundary between the Blackland and Grand Prairies and is situated about midway between the northern and southern limits of these two prairies.

These prairie soils are characterized as being dark colored, fine textured, alkaline to neutral in pH, and relatively high in organic matter. Blackland and Grand Prairie soils have a relatively large reservoir of native fertility. Plots which have not received any fertilizers for 10 consecutive years produced an average of 300 pounds of lint cotton, 3,200 pounds of grain sorghum and 38 bushels of oats per acre during the last 4 years of the test. Increasing or decreasing the soil fertility level of the Blackland and Grand Prairie soils is a relatively slow process. Soil chemical analyses have shown these soils to be primarily deficient in nitrogen and phosphorus. A large portion of the native fertility is associated with the organic fraction of the



Small quantities of minor elements are determined by atomic absorption spectrophotometer.

soil. Thus, when conditions are optimum for microbial decomposition, there are ample amounts of the organic combined nutrients which are becoming mineralized and available for plant growth. When these soils are cold, dry or exceedingly wet, organic decomposition and mineralization are sharply reduced, and there is a corresponding decrease in nutrient availability.

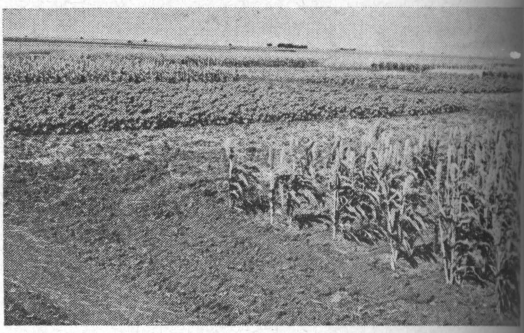
Row crops are usually planted on lister beds in the Blackland and Grand Prairies to help control surface drainage and to provide a more easily warmed and better drained seed at planting time. Thus, when the bed is warmer and better drained, the rate of mineralization increases.

Soil Moisture

Probably the single factor that most frequently limits crop growth on the Blackland and Grand Prairies is the lack of soil moisture during the summer growing season. The heavy, clay-type soils are capable of holding up to 6 inches of water in each foot of soil. Nearly half this amount is held by the clay so tenaciously that plants are unable to absorb it. Modest amounts of water applied during periods of moisture stress can produce excellent yields. Two sprinkler irrigations totaling 4.5 inches, applied during June and July 1966, produced cotton yields as high as two bales of lint per acre. Similarly, an irrigation of 3 inches increased grain sorghum yields as much as 1,000 pounds per acre at the Center in 1967. Irrigation in the Blackland and Grand Prairies is presently limited to a few fortunate farmers who have access to a local supply of surface impounded water or to a shallow well. Consequently, most of the farmers in the Blackland and Grand Prairies will have to utilize moisture conservation rather than irrigation to improve the soil moisture level. Rotations conserve moisture, increase native fertility and reduce the plant-disease and insect incidence.

Rotations

One of the more successful rotations at the Center is small grains followed by cotton followed by grain sorghum. This 3-year rotation places the crop that produces the highest economic return (cotton) to follow the longest period of fallow and moisture accumulation. The high-value crop (grain sorghum) precedes the small



Crop rotation results in increased yields, soil and moisture conservation and better control of diseases and insects.

grains and necessitates application of at least 20 pounds per acre of nitrogen and phosphate. Other rotation systems are being studied at the Center. Among these are rotations including pasture and selected green manure crops. The low price of fertilizer makes impractical the growing of green manure crops solely for improving the fertility of the soil. However, fertilizer cannot directly improve soil structure, and the judicious use of green manure crops, pasture or high-residue producing crops can improve the level of organic matter and the aggregated or granular structure. The economics of using pasture in rotations is unknown, but a study is underway at this time.

Time of Land Preparation and Fertilization

Early land preparation has been found beneficial for the Blackland and Grand Prairie soils.

Custom built fertilizer distributor and plot planter.

Fertilized oats, right, grow faster, mature sooner and produce more grain than unfertilized oats.

Immediately after harvest the stalks are shredded and plowed under. If row crops are scheduled as the next crop, the land is bedded and fertilized after the soil temperature drops below 55° F. Below this temperature, there is little loss of nitrogen through denitrification. The heavy clay texture of the Blackland and Grand Prairie soils reduces nitrogen leaching losses. Consequently, the minor loss of fertilizer from winter fertilization is more than compensated for by the gain in stored soil moisture that would otherwise be lost in the process of spring fertilization. Tests are underway to evaluate the phosphorus losses associated with winter fertilization. Data indicate that there is little difference between the uptake of winter and spring-applied phosphate.

Investigations are also being conducted relative to the banding or the broadcasting of fertilizer. Banding fertilizer is superior to broadcasting but is also more expensive to apply.

Preliminary studies have indicated that heavy applications of phosphorus fertilizer can induce a zinc deficiency in some Grand Prairie soils. A zinc deficiency in grain sorghum is manifested by shortened internodes, interveinal chlorosis and lack of head exsertion. Additions of 5 - 7 pounds per acre of zinc sulphate can correct this deficiency. The residual effect of added phosphorus and zinc is being measured in order that the long term effect of these elements can be evaluated. Among other studies underway are the problems of arsenic accumulation in Blackland and Grand Prairie soils from dessicants and herbicides and the increased arsenic availability to plants caused by phosphorus fertilization.

Johnsongrass Control

The methanearsonates (DSMA, MSMA) have proved to be effective selective herbicides for controlling johnsongrass in cotton. These same herbicides control johnsongrass - bermudagrass waterways. Dalapon and naptha oils have also given good control of johnsongrass.

Fence Row Weed Control or Soil Sterilization

Effective general weed control around buildings and/or fence rows has been achieved with dalapon or the methanearsonates mixed with 2,4-D, dicamba, cacodylic acid or pentachlorophenol in kerosene. Weed control with soil sterilization for a season has been achieved with monuron or bromacil. For controlling a heavy growth of green weeds and sterilizing soil, a mixture of TCA and bromacil has been effective.

Pasture Weed Control

Chemical control of broadleaf weeds with 2,4-D or dicamba has been one of the most beneficial pasture management practices. Acre costs are usually lowest with 2,4-D, but dicamba has given better control on mature or woody-type weeds. Cockleburs and green burs were effectively controlled with ¼ pound per acre of dicamba.

Soil sterilization along a fence row.

COTTON

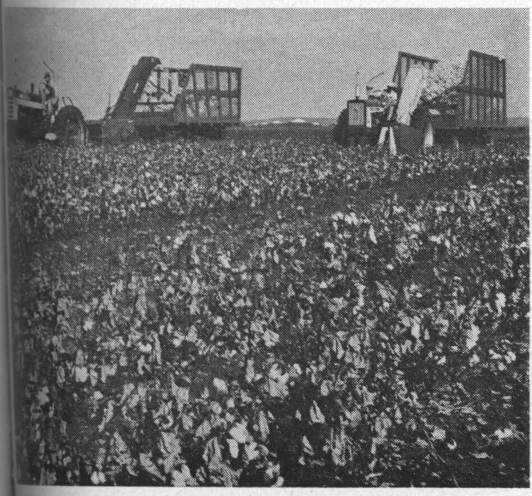
Blackland Cotton Improvement Program

Blackland cotton improvement research is done at the Center, and Center personnel also conduct off-station tests in the southern Blacklands near Seguin and the northern Blacklands near McKinney. A major objective of the work is to increase fiber quality without decreasing lint yields. Another important area of research is the earliness complex of cotton production. This involves work on a number of problems that will permit the planting, production and harvest of cotton at earlier dates to better fit the rainfall pattern and avoid losses from cotton root rot and late cotton insects. Research on the earliness complex includes the following: development of cotton varieties that germinate and grow rapidly at low temperature and have vigorous plant fruiting and early maturity; date-of-planting tests; infurrow fungicide tests; and fertilizer tests.

Mechanization

The prime objectives of cotton research are to lower production costs and improve the quality of the product. Cost and scarcity of labor have justified research on the mechanization of all operations.

Cotton mechanization begins with seedbed preparation. The bedding of uniform rows aids



Stripper harvest of stormproof cotton.

mechanical operations. Early preparation conserves moisture for planting.

Planting a thick stand, four plants per foot on a slightly raised seedbed aids in getting a stand, cultivating, controlling weeds chemically and stripping.

The preferred method of harvest is once-over wtih a mechanical stripper.

Cultural Studies

In date-of-planting tests during the 5-year period 1962-66, cotton planted early, March 15, produced highest lint yields every year except in 1964. In general, yields were progressively lower wtih later planting dates.

Cotton was planted in three skip-row systems to investigate the yield potential and the effect on cotton characteristics. The "plant 1–skip 1" and "plant 2–skip 2" systems respectively yielded 776 and 696 pounds of lint cotton per acre of cotton area excluding the skip. The solid planted check produced 365 pounds. These yield advantages of producing cotton in skip-row systems may be offset by difficulties in mechanically stripping ranker growing plants or limby varieties.

Cotton Root Rot

Cooperative research with Texas A&M University Department of Plant Sciences is being conducted on cotton root rot. Where root rot is a problem, improved practices have included: (1) a crop rotation system that provides large amounts of organic matter to mix with the soil, (2) deep plowing (6 - 12 inches) early in the summer, (3) good fertilizing practices and early land preparation for planting and (4) early-maturing varieties to have as much matured cotton as possible before the disease attacks.

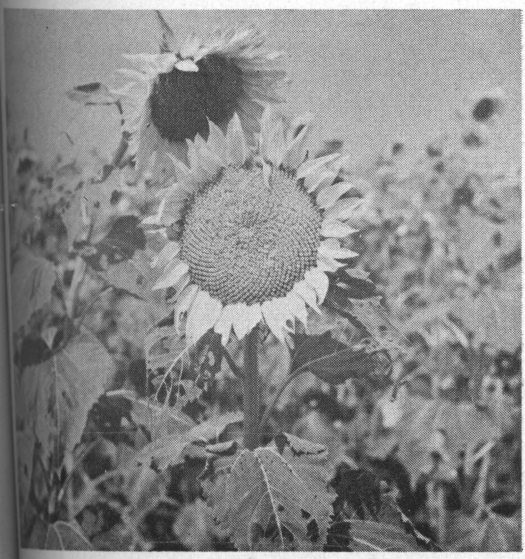
General view of sunflower nursery.

OTHER STUDIES

Sunflowers and Other Oil Seed Crops

Sunflowers are a promising crop for this area, but are not yet proved for commercial production because of lack of consistently performing varieties and approved insecticides to control head moths, stalk girdlers and borers. Research on this crop includes breeding for improved varieties, chemical insect control and studies of the life cycle and habits of insect pests.

Adaptation and production research is being conducted on guar and soybeans. Similar research has also been conducted on okra, sesame,



Closeup of sunflower head.

flax and safflower. Yields, markets and prices have not yet made these crops competitive with cotton and grain sorghum.

Fence Posts

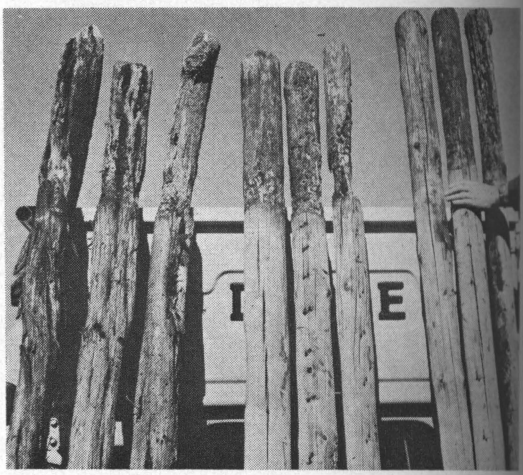
Since 1952, three kinds of fence posts have been tested at the Center in cooperation with the Texas Forest Service as part of a statewide fence post service test. The test includes ash, juniper or mountain cedar, pressure-creosoted pine and nonpressure-pentachlorophenol-treated posts 7 feet long with 4-inch tops. After 15 years of field service, 3 percent of the ash juniper, 22 percent of the pressure-creosoted pine and 9 percent of the nonpressure-pentachlorophenol-treated posts have been removed because of decay.

Conservation

The Center is cooperating with the McLennan County Soil Conservation District in planning conservation practices. Observations are being made on different grasses for use in vegetative waterway control.

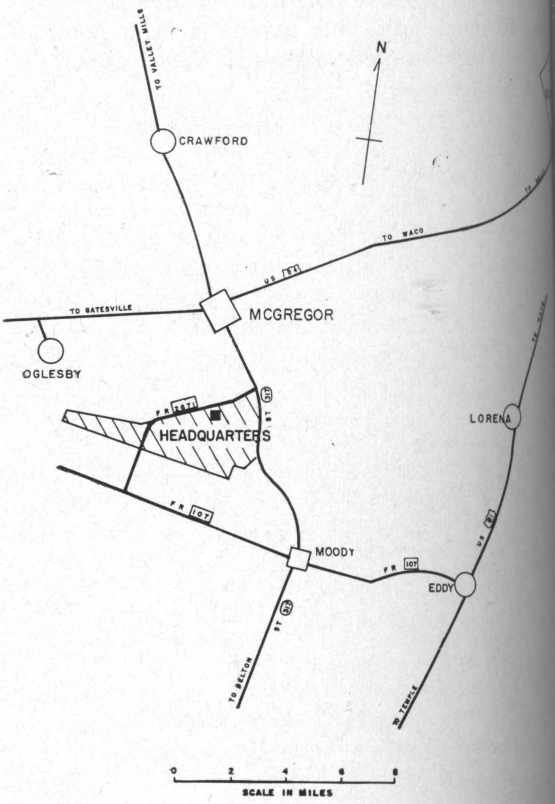
Stock Ponds

As pasture water facilities, seven stock ponds, ranging in size from 1/6 acre to several acres, were prepared. The ponds were stocked with



Fencepost test, mountain cedar, left; pressure creosoted pine, center; and nonpressure cholorphenol treatment, right.

fish and fertilized, and some spoiled grain sorghum was used as supplemental feed. Large crops of catfish have been harvested under heavy fishing pressure. Based on these results, there appears to be a great potential for fish production and much enjoyable fishing if farm ponds of Texas are stocked with fish and properly managed.



Texas A&M University Agricultural Research Center at McGregor

Texas Agricultural Experiment Station
Box 447 Telephone 475-2878