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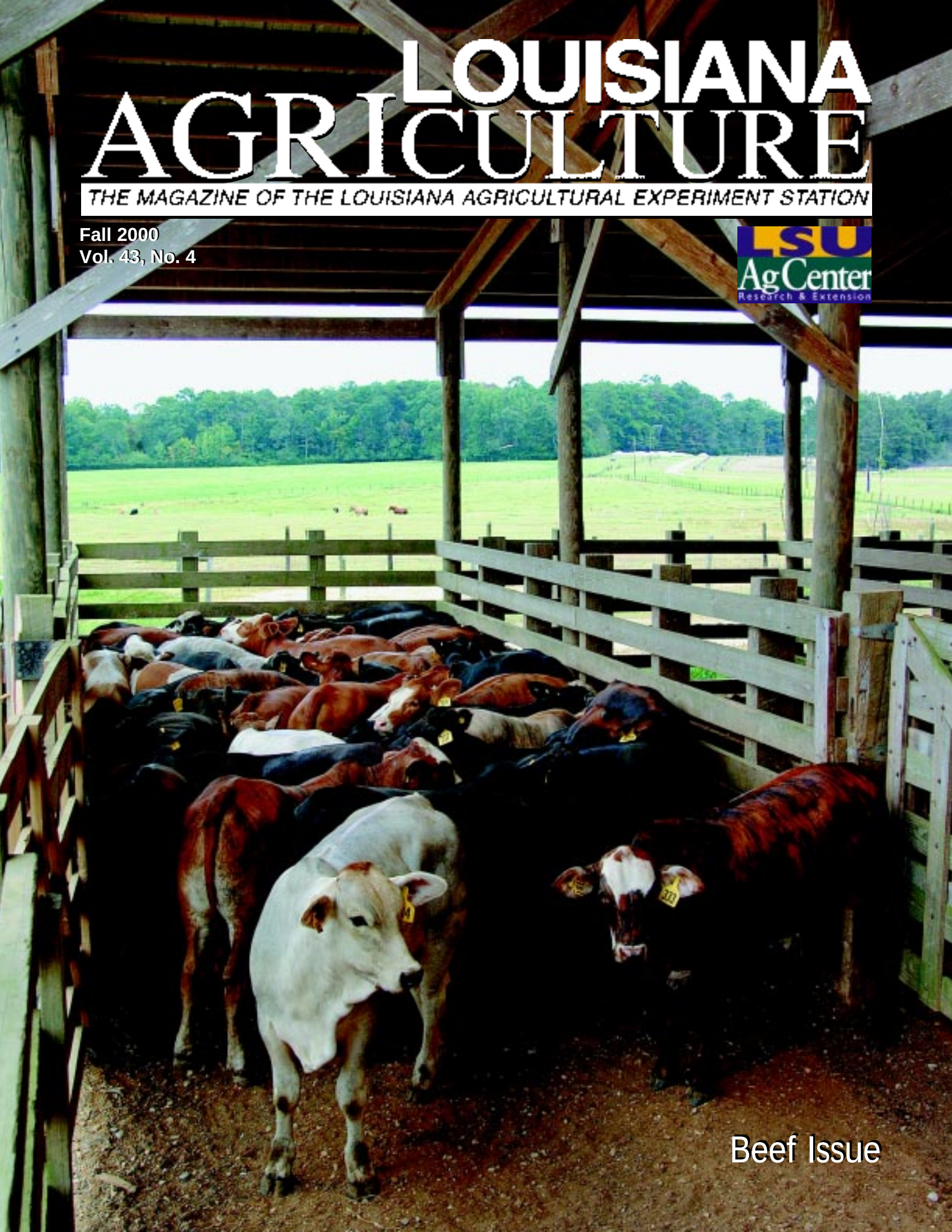

Beef Issue

On the cover: One day a year beef producers throughout the state who have signed up for the Louisiana Calf-to-Carcass program bring their calves in for preconditioning at one of three sites. These are the calves brought to the LSU AgCenter's Idlewild Research Station near Clinton on Sept. 7, 2000. See the article beginning on page 16. Photo by John Wozniak

Belgian Blue breed brings more 'lean' into beef

LSU AgCenter scientists are completing their fifth year of a five-year project to test the introduction of Belgian Blue breeding into Louisiana cattle. Belgian Blue is a breed produced in Europe, including Belgium, known for its dense muscle.

"We in the United States tend to like our steaks a little more marbled than Europeans," said Paul Humes, head of the LSU AgCenter's Animal Science Department. "Europeans like to buy very lean meat."

Leaner beef means less fat and cholesterol, which is becoming a more desired quality by American consumers. LSU AgCenter research indicates that Belgian Blue combined with Louisiana breeds yields leaner beef. Because the beef has less fat and marbling, it grades lower, which means less money for the producer. Louisiana producers who want to incorporate Belgian Blue into their breeding programs will have to aim for a specialty market who desire this trait. ■

Photo by Mike Futrell

Photo by Mark Claesgens

Members of the LSU AgCenter's Ag Leadership Program saw Belgian Blues first-hand in Belgium during a European tour. Belgian Blues can range in color from pure white to pure black. When the black and white furs are mingled, they give off a bluish hue, which is where the name came from. At left, Greg Daigle, research farm specialist at the Iberia Research Station, overlooks three heifers in the Belgian Blue research project.

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Linda Foster Benedict, Editor
Louisiana Agriculture
P.O. Box 25100
Baton Rouge, LA 70894-5100
phone (225) 388-2263
fax (225) 388-4524
e-mail lbenedict@agctr.lsu.edu.

www.lsuagcenter.com

Louisiana State University Agricultural Center, William B. Richardson, Chancellor
Louisiana Agricultural Experiment Station, R. Larry Rogers, Director

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Overview

Beef
A Diversified Industry Leader in Louisiana Agriculture

Wayne E. Wyatt and Paul E. Humes

The Louisiana beef industry is as diverse and complex as it is economically important to the state. The beef industry ranks within the top 10 Louisiana commodities in gross farm income (No. 6 at $237 million) and total value (No. 8 at $263 million) and is second only to poultry as the largest animal production enterprise in the state. The 13,000 beef producers are in every parish but Orleans.

Wayne E. Wyatt

Photos by John Wozniak

Paul E. Humes

Wayne E. Wyatt, Associate Professor, Iberia Research Station, Jeanerette, La., and Paul E. Humes, Professor, Department of Animal Science, LSU AgCenter, Baton Rouge, La.

Louisiana beef producers are a diverse group. Only about 40 percent consider farming as their principal occupation, and nearly 60 percent have other jobs. Also, more than 65 percent of those producers who considered farming as their principal occupation are retirement age (56 years or older); only 40 percent of producers with other occupations are retirement age. Of Louisiana's cattle producers, about 5.5 percent are minorities and 0.7 percent are women.

The Louisiana beef industry is diverse in farm and herd size. Pastureland, rangeland and pastured cropland account for 23.5 percent of the state's 7.9 million agricultural acres. Of those farms with cattle, 52 percent are on fewer than 100 acres. Similarly, 80 percent of the farms have fewer than 50 beef cows. About 37 percent of the total revenue generated by the sale of cattle and calves is from beef herds with fewer than 50 head of cattle.

Consequently, a large and economically important segment of the beef producers in the state are part-time, and their cow-calf enterprise competes with the demands of full-time employment and family life. Producers with large herds may benefit from economies of scale, but most beef producers in the state will not. Also, investments in technology, management or products having marginal net returns must compete with the other commitments of the part-time beef producer. In these situations, the research "payoff" must be significant if it is to be adopted or adapted by the producers.

The strength of the Louisiana beef industry is an abundant forage supply available most of the year. Reliance on forages introduces complexity, however, because forage resources (bermudagrass, dallisgrass, bahiagrass, fescue, ryegrass) and management of these resources vary considerably among our diverse soil types and climates. The many forage resources available to Louisiana beef producers are almost exclusively used for their nutritive value when harvested by grazing. Managerial inputs significantly influence the feeding value of these resources. They are marketed no other way. Research conducted at the LSU AgCenter provides direction and insight into the proper management of these forage resources across a wide array of environments.

The Louisiana beef industry is generally not vertically integrated, and producers employ diverse production systems. Of the farms that have beef cattle, 87 percent maintain beef cows. Those cows account for 56 percent of the total beef cattle inventory. The predominant production system is the cow-calf system, which is divided into commercial and purebred segments, and producers' goals differ for each segment. The abundant forage base also allows for a "stocker" industry, in which calves after weaning (6 to 9 months) are put on pasture to promote growth rather than fattening. The producer then sells these calves at about 14 months of age to feedlots. Similar to a stocker program, some producers participate in a replacement female (heifer) development program in which they market breeding animals.

Producers in each of these production programs face numerous managerial choices. Often it is difficult to know what long-range effect a management decision may have. For instance, a choice made by the cow-calf producer, while benefiting his or her production system, may not be the best choice for the stocker program to which weaned calves are marketed. LSU AgCenter scientists have the training and resources available to compare and evaluate many of the managerial choices beef producers face. Information derived from their

Photo by Mark Claesgens

Wayne Wyatt uses a rising plate meter to estimate the amount of forage available for grazing on a pasture. This is part of a research project at the LSU AgCenter's Iberia Research Station near Jeanerette to examine the net returns of grazing systems that either rotate grazing cattle among several smaller pastures or allow them to continuously graze on one larger pasture. Shown is a group of about 18 cow-calf pairs that rotationally graze eight 2-acre paddocks throughout the year.

research helps producers make informed decisions and provides insight for subsequent production and marketing systems.

The Louisiana beef producer has available a wide selection of breed resources, many of which are relatively new and must be evaluated in the context of a subtropical environment. Certainly breeds expressing adaptability to the subtropical heat and humidity and the attendant pest challenges have played and continued to play an important role in Louisiana beef production. While there is not a significant finishing or feedlot system in Louisiana, producers are becoming more aware that they participate in a national and global agri-food system to produce meat products that ultimately must meet with consumer acceptance. Consumer preferences are many and varied, but most important is the production of consistently safe, high quality beef products.

The diversity of herd and farm size, producers, soil and climate environments, production system goals and breed resources provides a complex challenge to beef scientists at the LSU AgCenter. Research relating to the beef industry is conducted by seven campus departments (Agronomy, Agricultural Economics and Agribusiness, Animal Science, Dairy Science, Entomology, Food Science and Veterinary Science) and nine research stations (Dean Lee, Hill Farm, Iberia, Idlewild, Northeast-Macon Ridge, Red River, Rosepine, Southeast and St. Gabriel). Academic backgrounds of the scientists participating in beef research include animal breeders and geneticists, economists, entomologists, food scientists, forage agronomists, beef management specialists, meat scientists, plant breeders, reproductive physiologists, ruminant nutritionists and veterinarians. LSU AgCenter scientists are involved in 36 beef research projects, the duration of which varies from three to six years. This research is divided into the following categories:

- Breeding and genetics, 5
- Nutrition, forages and grazing, 17
- Management, 3
- Animal health, 6
- Reproduction and physiology, 5
- Marketing, economics and business management, 3
- Meats and consumer acceptability of meat products, 6

We hope you enjoy this Louisiana Agriculture issue dedicated to beef. The mix of articles provides insight into the research conducted in support of the beef industry. A goal of the LSU AgCenter is to provide access to research and extension programs and personnel. To that end, we encourage you to visit the LSU AgCenter beef web page at www.agctr.lsu.edu/wwwac/beef/index.htm for a look at beef extension programs and ongoing and completed beef research. ■

Bullish on Beef

David G. Morrison

Animal agriculture is an integral part of food-producing systems and has been a significant contributor to farm profitability, consumer health and nutrition, and economic development for hundreds of years. Today, beef cattle production is the largest segment of all of American agriculture, generating more than $40 billion annually. In Louisiana, beef cattle production affects the economy in 63 of the state's 64

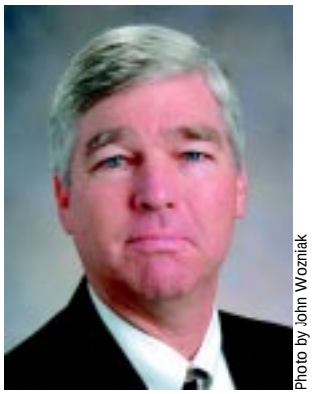

Photo by John Wozniak

David G. Morrison

parishes and is among the top three agricultural commodities in 35 parishes. Despite the current positive position beef occupies, it and the rest of animal agriculture are on the brink of tremendous growth.

According to the International Food Policy Research Institute, a "demand-driven" livestock revolution is under way in the developing world. This will have profound implications for global agriculture, health, livelihoods and the environment. During the next 20 years, world population will increase by 32 percent, and much of this increase will occur in the cities of developing countries. Per capita incomes are expected to increase in all major developing regions during this period. This increase in affluence and urbanization will be coupled with a rapidly increasing demand by people to eat more protein. Statistics show that as personal incomes go up in developing countries, so does the demand for meat, milk and eggs.

Total meat consumption is expected to double in developing countries by the year 2020 and will increase by 25 percent in developed countries. Overall, global demand for meat is projected to increase more than 60 percent of current consumption during the next two decades. Breaking this down by animal species, demand for beef is expected to increase by 50 percent; for pork, 45 percent; and for poultry, 85 percent. Net meat imports by developing countries will increase eightfold during this period to 6.6 million tons.

Another reason for optimism in the beef industry is increased per capita demand among U.S. citizens. In 1999, for the first time in 20 years, domestic consumers increased their demand for beef. Consumer spending for beef in 1999 was up about $2.5 billion from 1998. Per capita demand increased by 4.5 percent to more than $180, nearly an $8 gain and the largest increase since 1988. Consumer spending for beef increased despite slightly higher prices. Per capita consumption of beef jumped by 1.6 percent to 69.2 pounds per person, and beef's market share is expected to hold steady in the near future.

A third reason to be "bullish on beef" is the positive change in consumer perception and attitudes about beef. This shift has been slow in coming, but more and more research shows that beef should be a major component of a heart-healthy diet. At least three different studies provide direct evidence that lean red meat can be included regularly as part of a diet that reduces the risk of heart disease. The lead researcher in the most recent study stated, "The case against lean red meat has been misrepresented."

No doubt the increased global demand for meat and the increased domestic demand for beef will stretch the capacity of existing production and distribution systems and may exacerbate environmental concerns. But what an opportunity for LSU AgCenter animal, veterinary and food scientists! The "Livestock Revolution" points strongly to the need for new investment in animal research to develop new technologies and to apply known technologies to improve production efficiency, nutritional quality and safety of beef and beef products.

Louisiana Agricultural Experiment Station scientists are up to this challenge, as you will see as you read this publication. Animal scientists are working to improve beef tenderness through genetic selection, by taking advantage of breed complementarity and by applying various post-harvest practices. They are developing new assisted reproduction techniques to increase fertility and decrease embryonic death of livestock species. Nutritionists seek improvements to cow-calf and stocker cattle production efficiency through the judicious use of grain and byproduct feeds and through alternative grazing strategies, which may include new forage varieties and species. Veterinary scientists are discovering new and better disease detection, prevention and treatment methods for such diseases as bovine respiratory disease, brucellosis and anaplasmosis. Additionally, as the biology of external and internal parasites is better understood, treatment regimes aimed at effective control while minimizing the progression of resistance are being developed. Food scientists are working to develop new products with enhanced nutritional values while also researching and identifying effective mechanisms to ensure food safety.

Technological advances during the next two decades will find solutions and create opportunities to facilitate the increased need for beef and other meat products, both domestically and globally. But this will not occur without continued investment in animal agricultural research and in the extension of new technologies to appropriate users. The challenges are clear: increase productive output and do it more efficiently, and balance profits with stewardship and short-term productivity with long-term sustainability. ■

David G. Morrison, Assistant Director for Animal Sciences, Louisiana Agricultural Experiment Station, LSU AgCenter, Baton Rouge, La.

Crossbreeding Research Meets Needs of Louisiana Beef Industry

Sidney M. DeRouen, Donald E. Franke, Paul E. Humes and Wayne E. Wyatt

Crossbreeding is a highly productive, yet challenging, beef practice that can make a tremendous difference in determining the economic success of a beef enterprise. Crossbreeding is the mating of unrelated animals, such as different breeds or species of beef cattle, to produce an animal genetically superior to both its parents. This is called heterosis or, more commonly, hybrid vigor. Heterosis is the superiority exhibited by the crossbred individual for a particular trait relative to the average of the purebred parent breeds.

Levels of heterosis depend on the genetic differences of the parents. Crosses among British or European cattle (*Bos taurus*) are expected to express some heterosis, whereas crosses among Brahman (*Bos indicus*) and *Bos taurus* cattle are expected to express more heterosis because of greater genetic diversity among these breeds. LSU AgCenter researchers were among the first to document the greater levels of heterosis expressed by Brahman with British and European crosses.

Crossbreeding allows for breed complementarity. This means that desirable traits from one breed such as heat tolerance, which is important in Louisiana, are combined with desirable traits from another breed such as fertility, growth and carcass quality.

Another benefit of crossbreeding is that the effects of crossbreeding affect several traits positively and can thus result in large increases in overall productivity. Research has demonstrated that with planned crossbreeding, pounds of calf weaned per cow exposed can be increased by as much as 25 percent.

For these reasons, crossbreeding plays a vital role in serving the commercial beef cattle industry in Louisiana and throughout the United States.

Crossbreeding Value Recognized Early

The value of crossbreeding beef cattle, in terms of adaptation to specific environments and the vigor associated with hybrid animals, was recognized early by Gulf Coast beef producers. Subsequently, crossbreeding research in the southern United States was initiated in Louisiana in 1916, and in Texas in 1920. This pioneering research established a leadership role in beef cattle crossbreeding research for these two states. Findings from these early studies documented the beneficial effects of crossbreeding, particularly with Brahman cattle.

Evaluation of specific breeds in crossbreeding systems with beef cattle was initiated in the 1940s by the LSU AgCenter's Department of Animal Science at the Crossbreeding Unit, Ben Hur Farm. Mating systems involving Angus, Brahman, Brangus, Hereford and Shorthorn breeds were evaluated. The Charolais breed also was evaluated later in this study in the 1950s. Research findings from this project documented the superior performance of first-cross calves compared to purebred calves. Furthermore, Brahman first-cross calves were superior to *Bos taurus* first-crosses. These findings led into the next phase of crossbreeding research that was designed to evaluate the first-cross females. Brahman first-cross cows were found

First-cross Brahman crossbred cows are generally recognized as the more productive brood cow for Louisiana. Top left is a first-cross Brahman x Hereford cow with an Angus-sired calf. Above is a pair of first-cross Brahman x Hereford cows with Angus-sired calves. At left is a first-cross Brahman x Hereford cow with a Simmental-sired calf.

Photos by Sidney M. DeRouen

Sidney M. DeRouen, Associate Professor, Hill Farm Research Station, Homer, La.; Donald E. Franke, Professor, and Paul E. Humes, Professor and Head, Department of Animal Science, LSU AgCenter, Baton Rouge, La.; Wayne E. Wyatt, Associate Professor, Iberia Research Station, Jeanerette, La.

superior in fertility and maternal traits compared with *Bos taurus* first-cross females.

The potential for beneficial effects with crossbreeding, particularly with Brahman breeding, led to further investigations at research stations in north Louisiana. Crossbreeding research was conducted in the 1970s at the Hill Farm and Red River research stations. These two separate research projects investigated performance of purebred and crossbred cow-calf herds. Similar results were reported from each of these projects demonstrating improved productivity through crossbreeding. The greatest advantage came with the Brahman crosses. Not long after the results of these studies were published, Brahman cross cow-calf herds became the predominate breed type in north Louisiana.

Rotational Crossbreeding Research

Development of planned crossbreeding mating systems became increasingly important for maintaining acceptable levels of heterosis from one generation to the next. In the early 1970s, research was initiated to evaluate rotational crossbreeding systems for beef production at the Crossbreeding Unit, Ben Hur Farm. A major objective was to determine the ability of this mating system to produce replacement females. At that time Brahman first-cross females were difficult to obtain.

This long-term study evaluated purebred and two-, three- and four-breed rotational crossbred cattle. This research involved five generations of rotational crossbreeding over a 23-year period. This study has progressed through more generations of matings than has any other rotational crossbreeding study with beef cattle in the United States.

The research found that rotational crossbred cattle do perform at theoretical expectations and that rotational crossbreeding can serve the industry needs. Today, primarily as a result of findings from this project, several large U.S. ranches use rotational crossbreeding in their breeding plans.

Continental and Brahman Composite Breeds in Crossbreeding

Crossing Brahman cattle with British breeds (Angus, Hereford, Shorthorn) was a common practice for beef production before the 1970s. In the late 1960s, however, many Continental breeds (originating from continental Europe) were introduced into the United States even though little was known about their productivity under southern U.S. environments. A crossbreeding project was initiated in the mid-1970s at the St. Gabriel Research Station to evaluate Brahman and Continental (Chianina, Maine Anjou and Simmental) crossbred females. Findings provided additional evidence of the superiority of the Brahman crossbred female for cow-calf production.

In the 1980s, Brahman crossbred cattle were recognized as the most adaptive and productive type of cattle in the southern United States. This led to the expansion of Brahman composite beef breeds (Beefmaster, Brangus, Gelbray and Simbrah), which allowed producers to have more simplified mating designs (mating like to like) that took advantage of heterosis with Brahman breeding. Some of the Brahman composite breeds had been developed recently at this time, and little was known about their potential under Louisiana's subtropical conditions. In the late 1980s, a crossbreeding project was initiated to evaluate Brahman-British and Brahman-Continental composite breeds. This project was conducted jointly at the Iberia, Idlewild and St. Gabriel research stations. Findings were some of the first comparative results among these composite breeds, particularly for the Brahman-Continental composites.

Current Crossbreeding Research

Even though Brahman crossbred cattle are the predominant type of cattle in Louisiana, they are discriminated against because of the perception that beef from cattle with Brahman inheritance is less tender and of lower carcass or eating quality. Two research projects are evaluating beef tenderness and quality involving Brahman inheritance. Research at the Crossbreeding Unit is evaluating Brahman half-sib progeny groups (progeny produced from the same sire) to identify specific Brahman sires that transmit genes for improved meat tenderness and carcass quality. Research at the Hill Farm Research Station is determining the most desirable combination and proportion of Brahman breeding to use in crossbreeding systems. Female productivity also is being evaluated in this study. Findings will help producers identify and use Brahman sires with desirable genes for meat tenderness and eating quality as well as to identify certain breed combinations involving Brahman, British and Continental breeds with desirable carcass and palatability traits.

A new breed also is being evaluated. LSU AgCenter scientists are conducting a study at the Idlewild Research Station evaluating a heavily muscled Continental breed called Belgian Blue to determine this breed's potential in a crossbreeding system under Louisiana's environmental conditions.

Cooperative beef crossbreeding research is conducted at the LSU AgCenter. Scientists with the Department of Animal Science, Hill Farm and Iberia research stations work with other scientists across the southern United States in pooling their resources to collectively address research project objectives. Selection for milk yield and calf weaning weight are being evaluated to determine the effect these selection pressures may have on cow fertility as well as overall cow productivity.

Beef cattle crossbreeding research from the LSU AgCenter is rich with past accomplishments and continues to serve the needs of the industry. LSU AgCenter scientists look forward to providing research that enhances the competitiveness and profitability of the state's beef cattle producers and ultimately provides the consumer a safe, abundant and high quality supply of beef. ■

Feedlot and Carcass Traits of Crossbred Steers

The future success of the beef industry depends on its ability to produce cattle desired by the feeder and packer and ultimately beef products by the consumer. Therefore, emphasis on feedlot and carcass characteristics is becoming increasingly important in designing and evaluating breeding systems. The objective of this study was to compare straightbred- and composite-sired progeny that varied in percentage of Brahman inheritance for feedlot and carcass performance. British (Angus) and Continental (Gelbvieh) sire breeds were evaluated along with their Brahman derivative counterparts (Brangus and Gelbray).

Feedlot and carcass data from 231 steers were evaluated over a four-year period. All steers were produced by first-cross Brahman-Hereford cows at the LSU AgCenter's Hill Farm Research Station. Angus- and Gelbvieh-sired steers had 25 percent Brahman inheritance, whereas Brangus- and Gelbray-sired steers had 44 percent Brahman inheritance. After weaning, all were fed on grass before being transferred to the feedlot. The 114 steers born in 1993 and 1994 were shipped to feedlot facilities at the Iberia Research Station. The 117 steers born in 1995 and 1996 were shipped to a commercial feedlot in Guymon, Okla.

For steers fed in Louisiana, Angus- and Gelbvieh-sired steers were 64 pounds heavier entering the feedlot than Brangus- and Gelbray-sired steers. Likewise, Angus- and Gelbvieh-sired steers were 112 pounds heavier at the end of the feeding period. Gelbray-sired steers had the lowest feedlot gain compared with the other sire breeds when fed in Louisiana. Feedlot gain, initial and final feedlot weights were similar among sire breeds for steers fed in Oklahoma. Overall, feedlot gains were 50 percent higher in Oklahoma than in Louisiana.

Angus- and Gelbvieh-sired steers fed in Louisiana were 62 pounds heavier for carcass weight than Brangus- and Gelbray-sired steers. Ribeye area for Gelbvieh-sired steers was larger compared to the other sire breeds at both locations. Yield grades were considerably lower (leaner carcasses) at both feedlot locations for Continental-influenced steers (Gelbvieh- and Gelbray-sired). A higher proportion of Angus-sired steers graded Choice, whereas most Brangus-, Gelbvieh- and Gelbray-sired steers graded Select when fed at both feedlot locations.

Steaks from Angus-sired steers fed in Louisiana had lower shear force values (more tender) than steaks from Gelbvieh-sired steers. Brangus-sired steers had numerically lower shear force values than Gelbray-sired steers at both feedlot locations. Results from this study indicate that British-Brahman breed combinations had more tender meat than Continental-British-Brahman breed combinations, regardless of level of Brahman breeding.

In conclusion, findings from this study indicate that the use of Angus sires resulted in improved carcass quality compared with Gelbvieh sires when mated to first-cross Brahman-Hereford cows. Improved carcass cutability resulted from the use of Gelbvieh sires. Tenderness was similar among steers with either 25 percent or 44 percent Brahman inheritance. There was a tendency for improved carcass quality and tenderness with the use of Angus and Brangus sires compared with Gelbvieh and Gelbray sires. These combining abilities for feedlot and carcass traits among these sire breeds should be considered when designing mating systems for crossbreeding. ■

This is one of the Brahman bulls at the LSU AgCenter's Idlewild Research Station near Clinton.

Photo by John Wozniak

Sidney M. DeRouen, Associate Professor, Hill Farm Research Station, Homer, La.; Wayne E. Wyatt, Associate Professor, Iberia Research Station, Jeanerette, La.; Thomas D. Bidner, Professor, and Manuel A. Persica III, Research Associate, Department of Animal Science, LSU AgCenter, Baton Rouge, La.

Predicted Calf Birth and Weaning Weights from Rotational Crossbreeding Data

Among the 80 or more breeds of beef cattle in North and South America, only 10 to 15 are used routinely by Louisiana cattle producers. Breeds evaluated in crossbreeding systems are often those produced as purebreds in the area where the research takes place. Some breeds not common to the area may be evaluated if they offer potential for improved production in local herds. A rotational crossbreeding study was initiated at the LSU AgCenter's Ben Hur Research Farm in 1969 with Angus (A), Brahman (B), Charolais (C) and Hereford (H) breeds, the more popular breeds in Louisiana at the time.

Rotational crossbreeding is a mating system in which purebred sires are mated to crossbred females produced by sires of another breed. For example, an Angus x Brahman two-breed rotation mating system uses two breeds of sires, Angus and Brahman. Angus sires are mated to daughters produced by Brahman sires, and Brahman sires are mated to daughters produced by Angus sires. The mating of sires of one breed to daughters of another sire breed can continue for many generations. A two-breed rotation mating system maintains about two-thirds of the hybrid vigor possible in first crosses between the two breeds. The primary advantage of a rotational crossbreeding system is that the replacements are produced within the system, instead of outside the system.

Six two-breed rotational mating combinations and four three-breed rotational mating combinations are possible with the four breeds. Because of the limited size of the research station, all breed

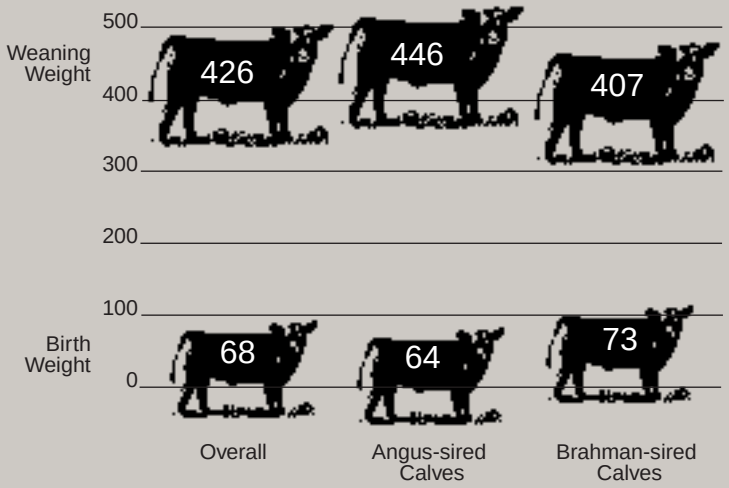

Figure 1. Predicted birth and weaning weights for Angus x Brahman two-breed rotation mating system.
Brahman-sired calves were heavier at birth than Angus-sired calves, but weighed less at weaning.

Where's the Beef Grade?

Beef sold in the United States is inspected for wholesomeness through the U.S. Department of Agriculture. Apart from wholesomeness, the beef you buy is usually graded for quality. Quality refers to palatability characteristics such as tenderness, juiciness and flavor. Beef grading is performed by USDA graders and is based on the amount of marbling (flecks of fat within the lean) and the age of the animal. Beef grading is optional and is paid for by the beef processors. The cost is reflected in the price of meat. Only the top three grades are identified and sold at retail. These grades are USDA Prime, Choice and Select.

The highest grade, USDA Prime, is used mostly by hotels and restaurants, but a small amount is sold at retail and in specialty markets. The grade most widely sold at retail is USDA Choice. However, consumer preference for leaner beef has increased the popularity of the USDA Select grade of beef. The label on fresh meat packages will tell consumers the cut and grade of beef.

The "select" grade of beef has led to some confusion particularly in seafood-selling states such as Louisiana, says Donna Montgomery, consumer food and nutrition specialist with the LSU AgCenter.

"Select is the highest grade for crabs," she said. "Some consumers don't understand that select is not the highest grade with beef."

Since the USDA grading program is voluntary, some retailers sell beef that is not graded. In this case, it is usually select quality, Montgomery says. Beef that is graded lower than select quality is used to make ground beef and manufactured meat items such as frankfurters, cold cuts, canned chili and soups.

The consumer is not likely to see these labels as shown on the cut of meat purchased at the grocery story, since these labels are placed on the larger cuts of meat. ■

combinations could not be evaluated at the same time. Breed combinations that included Brahman were evaluated, those being A-B, C-B, H-B, A-C-B, A-H-B, C-H-B and A-B-C-H.

These breed combinations were evaluated through four generations, and reproductive, birth, weaning, feedlot and carcass information was obtained. Nevertheless, questions still remained about the relative performance of breed combinations not evaluated.

In the late 1960s and 1970s, considerable research in the United States and abroad was directed to partitioning into genetic components variation in performance among and within breeds and various breed combinations. This resulted in procedures to partition the variation into that which was due to the cumulative effects of genes from breeds in individuals (direct effects) and in dams (maternal effects) and to the level of heterosis (hybrid vigor) expressed among breed combinations in individuals and in dams for specific traits. Using combinations of these direct and maternal breed additive and breed combination heterotic genetic effects, one can predict with a high degree of accuracy the performance of any mating system and breed combination for any trait.

Breed direct and maternal additive genetic effects and breed combination direct and maternal heterotic genetic effects were estimated from data obtained in the rotational crossbreeding study described above.

The three figures show the predicted birth weight and predicted weaning weight for the Angus x Brahman two-breed rotation system, the Angus x Brahman x Charolais three-breed rotation system and the Angus x Charolais x Hereford three-breed rotation system. Note that weaning weights of calves in the three-breed rotation systems are larger than in the two-breed rotation system. This is due mostly to a larger breed, the Charolais, being involved. Also, birth weights of Brahman-sired calves tend to be larger than birth weights of calves from other sire breeds, independent of the mating system. This is due to a larger heterosis effect in the Brahman-sired calf for growth rate during gestation than in calves by other sire breeds. A concern in some rotational crossbreeding systems is the variation among calves from different sire breeds. Note the larger amount of variation among weaning weights of Angus-, Brahman- and Charolais-sired calves in Figure 2 than the variation among calves from Angus, Charolais and Hereford sires in Figure 3. Larger weaning weights are desirable but so is uniformity. One can predict birth and weaning weights for various breed combinations and mating systems to determine which mating systems and breed combinations are more desirable for a given objective. ■

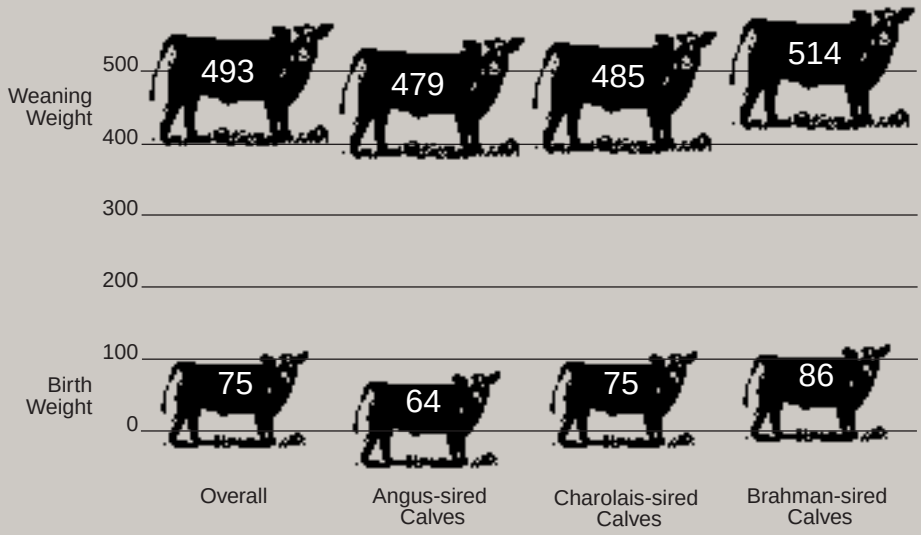

Figure 2. Predicted means for overall and for Angus-, Brahman- and Charolais-sired calves in the Angus x Charolais x Brahman three-breed rotation system.

In this mating system, Brahman-sired calves were 22 pounds heavier than Angus-sired calves, but only slightly heavier than Charolais-sired calves. Weaning weights were similar for Angus- and Charolais-sired calves and lower than for Brahman-sired calves.

Figure 3. Predicted birth and weaning weights for Angus-, Charolais- and Hereford-sired calves in an Angus x Charolais x Hereford three-breed rotation mating system.

The Angus-Charolais-Hereford three-breed rotation system was not evaluated in research effort, but means for this system were predicted with the genetic effects for these breeds. The birth weight and weaning weight means are more similar across sire breeds than in the Angus-Brahman-Charolais three-breed rotation system, and are more desirable because variability is reduced.

Donald E. Franke, Professor, Department of Animal Science, LSU AgCenter, Baton Rouge, La.

Improving Consumer Acceptance of Beef from Brahman Crossbred Cattle

Thomas D. Bidner

Early research at the LSU AgCenter indicated that although Brahman crossbred cattle were superior in many ways to other breeds for the climate and conditions of Louisiana, the steaks from these cattle were not as tender as steaks from other breeds. This fact led scientists to initiate several research projects on beef tenderness.

Tenderness is the most important factor affecting the eating quality of meat. Even though flavorful and juicy, a beef steak is considered unacceptable if it is too tough. Data from several breeding projects indicated that tenderness is directly related to the proportion of Brahman inheritance represented. Since feeder calves with a higher percentage of Brahman influence receive lower prices, the Department of Animal Science is conducting research to study the growth and carcass characteristics of steers with Brahman sires. Preliminary data indicate that significant genetic variation exists for tenderness among Brahman sires so that selection to improve tenderness will be effective. Sires with unacceptable tenderness can be culled.

Other research projects have examined the influence of length of feeding time on a grain ration, degree of fatness, growth rate and amount of marbling on tenderness. Since the external fat cover acts as an insulator during chilling of beef carcasses, lack of external fat can affect beef tenderness negatively. To study this relationship, a project was initiated to remove the external fat from the shortloins of 20 beef carcasses and compare them to intact shortloins. Fat removal increased the drip loss and made the steaks tougher compared to steaks from intact beef sides.

Additional studies have looked at the influence of stress before slaughter on tenderness. Conclusions show the less stress, the more tender the meat.

Because of social and economic changes during the early 1970s, there was renewed interest in producing slaughter beef from forage or limited amounts of grain. A cooperative research project with the Rosepine Research Station, School of Human Ecology, and the departments of Agricultural Economics and Agribusiness, Experimental Statistics and Animal Science was initiated to determine the feasibility of marketing beef finished on forage or grain-on-grass.

Beef produced from Angus or Hereford-Angus cross steers was evaluated by trained sensory panel and two types of consumer panels. Selected cuts were marketed through a cooperating regional retail food chain. Beef finished on these feeding treatments had reduced dressing percentages and lower marbling scores compared to feedlot

Thomas D. Bidner, Professor, Department of Animal Science, LSU AgCenter, Baton Rouge, La.

beef. The consumer panels could not distinguish between feeding treatments in evaluating the tenderness, flavor, juiciness and overall acceptability, but trained sensory profile panels detected differences between forage- and grain-finished beef.

Encouraged by the results of this cooperative project on forage beef and other forage-fed beef research projects in the Southern Region, scientists met in Atlanta, Ga., in 1979, to discuss the possibility of producing slaughter weight beef using forages throughout the year. The stipulations were that the beef carcasses should weigh 500 pounds or more, and the age of the slaughter cattle would be less than 24 months. A comprehensive research project with these objectives was initiated that included the Dean Lee, Iberia, Hill Farm, Northeast, Red River and Rosepine research stations and the departments of Agricultural Economics and Agribusiness, Animal Science and Experimental Statistics. This study showed that, in the South, lean beef can be produced throughout the year from cattle finished on forages.

Research findings with Brahman genetics and year-round forage-fed beef have indicated a need to control factors that ultimately affect the consumer acceptance and market value of beef. This stimulated research projects that could improve the acceptability of beef. Experiments that used high and low voltage electricity to stimulate beef carcasses postmortem were investigated. These experiments indicated that electrical stimulation of beef carcasses improved tenderness. When electrical stimulation was combined with a high temperature aging of beef carcasses, tenderness improved further. Another experiment was initiated that combined electrical stimulation of beef carcasses, blade tenderization and vacuum aging of steaks. Again, electrical stimulation improved beef tenderness and either blade tenderization or vacuum aging – in combination with electrical stimulation – created additional improvements in tenderness.

The LSU AgCenter is committed to work on behalf of the Louisiana beef industry. Scientists in the LSU AgCenter have conducted numerous research projects concerned with quality and acceptability of beef with the goal of increased acceptability of beef produced by Brahman-influenced cattle produced in Louisiana and the Gulf Coast. ■

Scientists Battle Cattle Diseases

Cattle in all beef herds are subjected to common diseases that may cause acute or chronic illness, interfere with pregnancy, cause abortion, and cause intestinal infection and systemic illnesses in newborn calves. Older calves, yearlings and mature cattle may develop warts, foot rot, cancer, chronic diarrhea and wasting, respiratory diseases, mastitis, lumpy jaw and eye and brain infections, among other conditions.

In addition to diseases already in the herd, infections may be introduced by purchased herd replacements, by show cattle returning to the herd and even across fences from herds in adjacent pastures.

Despite the numerous infectious diseases, most beef herds have a low incidence of morbidity and mortality. The economic impact of certain infectious diseases can be subtle and often not realized. Vaccines can give some degree of protection against several of the major diseases of cattle. Pastured cattle whose diets do not contain adequate levels of biologically available copper, zinc and selenium may not have optimum disease resistance. Secondary copper deficiency is a significant problem in cattle pastured on soils high in organic matter (peat) in coastal parishes.

The LSU AgCenter's Department of Veterinary Science has provided research support in response to the needs of livestock producers. Here are some of the areas in which research has been conducted.

Anaplasmosis This disease is an important cause of mortality in Louisiana cattle. It was studied for years by LSU AgCenter veterinarians and research entomologists. Mosquitoes and horseflies were identified as the primary transmitters of anaplasmosis in Louisiana cattle. Other biting flies, ticks, needles and surgical instruments also may transmit infected red blood cells from a carrier or from an acute case to susceptible cattle. Continuous feeding of chlortetracycline and preventive treatment with injectable oxytetracycline were often impractical measures. A vaccine was developed by LSU AgCenter researchers in the 1980s. Research trials were conducted in commercial beef and dairy herds, and the vaccine proved to be safe and effective. A commercial vaccine manufacturer introduced and marketed the product in 1994. Business mergers occurred, and the product was no longer offered. Today, a commercial vaccine is still not available. The Veterinary Science Department now prepares and provides a vaccine for distribution to Louisiana cattle owners. Vaccination of herd bulls, because of their value, is a standard recommendation. Some beef and dairy producers immunize cow herds also.

Brucellosis This bacterial infection is transmitted cow-to-cow by oral exposure to uterine discharges from infected cows at time of calving or abortion. People assisting cows at calving or drinking unpasteurized milk from infected cows are at risk, also. Sometimes known as Bang's disease, this costly infection has almost been eliminated in Louisiana through the cooperation of the cattle industry and state-federal animal health officials. Immunization of female cattle was an important facet in the effort. A major research effort helped establish the safety and efficacy of a vaccine that provides protection but does not interfere with blood tests. LSU AgCenter researchers helped develop the official brucellosis vaccine not only for Louisiana but for the United States.

Leptospirosis The role of skunks in transmitting leptospira bacteria to Louisiana beef and dairy cattle was established through research in the 1960s. Leptospirosis is an important abortion disease of cattle and a lethal disease of young calves. Skunks, cattle and other animals may shed the organism in their urine.

Bovine Leukosis The bovine leukemia virus induces formation of lymphoid tumors in some infected cattle. Infected cattle respond to the virus with increased levels of lymphocytes, but less than 10 percent eventually develop tumors. Tumors develop in the heart, abomasum and various lymph glands. An LSU AgCenter pathologist studied the disease in Louisiana commercial beef and dairy herds as well as research station cattle. Data were shared with a team at the National Veterinary Services Laboratory at Ames, Iowa.

Other Diseases LSU AgCenter research has led to a better understanding of the incidence of the bovine reproductive diseases trichomoniasis and vibriosis, respiratory virus infections and diseases of newborn calves. ■

Steven Nicholson, Veterinary Specialist, LSU AgCenter, Baton Rouge, La.

Beef: Structural Change in the Beef Industry

Jeffrey M. Gillespie and Alvin Schupp

In recent years, the structure of the U.S. beef industry has undergone significant change, though not to the extent of its competitor industries, pork and poultry. While cow-calf and stocker farms have become fewer and larger, the rate of change has been slow relative to its competitors. Along with the slow change, few efforts to coordinate the segments of the industry, from breeding to the consumer, have evolved.

The slower rate of change of the beef industry is a two-edged sword. On the positive side, small, family-run, independent beef operations continue to be the norm. Thus, cow-calf and stocker production, which constitutes almost all Louisiana production, remains a viable opportunity for those who desire to operate small, family operations. On the other hand, the slower rate of technological development and relative lack of coordination between segments have resulted in relatively higher costs of production, hence, higher beef prices at the supermarket, and less consistency in product quality than competitor meats. This has contributed to the national reduction in per capita consumption of beef for a number of years. Quality inconsistency in Louisiana and national beef industries is due to the many breeds of cattle being raised in vastly different environments, as well as the inefficient pricing system in the industry.

Beef Industry Pricing

Cow-calf producers are paid based on the weight of calf produced. Stocker producers are more concerned with calf weight than characteristics of the mother cow. Cattle feeders are concerned with sex, health and feed conversion. Packers typically buy cattle in pen lots; thus, fat cattle are sold on an average price basis. Further clouding of these price signals results from competing preferences of consumers, resulting in confusing price signals at each segment. The current industry structure is highly unlikely to achieve product quality consistency while simultaneously reducing production cost.

Supply Chain Structure

In a supply chain, formal organizational mechanisms direct the flow of product from input to consumption. For example, in the integrated broiler industry, if a fast-food restaurant chain demands larger chicken parts, it communicates the demand directly to a vertically integrated broiler producing and processing firm that owns all inputs and facilities from feed mill and hatchery to processing, with the exception of contracted broiler growout. The broilers raised are owned by the integrated firm, which directs the flow of inputs from the hatchery to processing. The hog industry is moving toward such a structure, with increased vertical integration from breeding to slaughter. The beef industry, however, has shown little evidence of coordination through a supply chain structure. While limited vertical integration between packer and feedlot has occurred through the use of captive supplies and while there is some coordination between other segments using retained ownership, the industry relies on the open market to direct the flow of products and inputs among the various production segments.

The slow rate of technological development and relative lack of coordination between segments have resulted in relatively higher costs of production, hence, higher beef prices at the supermarket, and less consistency in product quality than competitor meats.

The U.S. and Louisiana beef industries have not evolved to a supply chain structure for several reasons. First, economies of size have not developed in cattle production to the extent of its competitor industries; a cow-calf operation does not have to be large to be economically efficient. In the competitor industries, a significant capital outlay is required for production, including housing and feed, watering, heating and cooling equipment. To be economically efficient, this capital must be spread over a large number of animals, contributing to economies of size. Technological advances in both the poultry and pork industries continue to increase the economically efficient size of operation. This is not true in cattle production, however, where technological changes have not been capital intensive. Smaller economies of size mean smaller operations with relatively low capital investment. How is this related to supply chain structure?

Producers must have incentives to vertically coordinate or integrate with another segment, such as a packer. Broiler and hog producers have had many of these incentives. The increased monetary risk associated with a large, highly specialized operation with returns that swing with price fluctuations is the first incentive. Even under low output prices, the note on facilities and equipment must be paid. The producer rarely has another enterprise to diversify the operation to offset the low price. Discontinuance of production is not an option, because it leaves empty facilities useful for no other purpose. Thus, producers have the incentive to accept contracts that either guarantee a price or, at least, reduce price variability relative to the market. Beef cattle operations are more likely to be diversified since they do not have to be large. While low cattle prices present difficulties for cow-calf producers, they are less likely to lead to foreclosure, given that most cattle

Jeffrey M. Gillespie, Associate Professor, and Alvin Schupp, Martin D. Woodin Endowed Professor, Department of Agricultural Economics and Agribusiness, LSU AgCenter, Baton Rouge, La.

producers hold less debt than do their competitor livestock producers and can postpone some costs, such as soil fertilization for forage production.

Related to the economies of size argument is that transaction costs (costs associated with doing business, or conducting the transaction, not including the actual cost of the product purchased or sold) are not as high for most cow-calf and stocker producers as with hog and broiler production. In both of these competitor industries, feed must be regularly acquired. A broiler producer has birds ready for slaughter six times a year, and a large hog producer may move hogs weekly. Thus, significant incentive exists for pre-arranging input purchases and selling agreements to reduce these costs. Many cattle producers sell calves and stockers once or twice per year. Feed is not purchased as regularly as with the competitor industries since cattle rely heavily on farm-grown forages. This reduces their incentive to coordinate with sellers of inputs and calf and stocker buyers.

Packers have less incentive to enter into a supply chain relationship with cattle producers than with hog and broiler producers. In the competitor industries, a few breeds have been highly developed such that, under prescribed confinement housing conditions, animal performance is relatively predictable. Since the integrator provides most of the inputs and specifies the facilities, performance can be associated with producer management. The large number of breeds of cattle raised under vastly different and uncontrollable environmental conditions across the United States would lead to problems in setting up a fair contract in which cattle producers would be paid based on performance. The inability of the integrator to control the conditions of production precludes the development of such contracts. Packer or feedlot integration through ownership of the cow-calf and stocker segments is hindered by the large investment in land resources required for these segments. Ownership or leasing of the land adds another element of risk for the integrator.

Packers have less incentive to enter into a supply chain relationship with cattle producers than with hog and broiler producers.

More Coordination, Efficiency

A supply chain structure similar to that of the hog and broiler industries is unlikely to evolve in the U.S. and Louisiana beef industries. But, for beef to become more cost competitive with its competitors, more industry coordination needs to occur. We believe this coordination should originate at the packer segment, which is closest to the consumer. For packers to provide consumers with consistent products, they need to obtain consistent quality raw products. The packer must efficiently communicate to the feedlot the type of fed animal needed and pay prices based on these specifications, discontinuing the purchase of cattle in pen lots. With specific quality animals receiving premium prices, feedlots will, in turn, pay premium prices for top quality feeder calves.

To help instigate this process, packers need to communicate to the breeding segment the types and combinations of breeds desired. At least 15 major breeds of cattle are raised in Louisiana today, with many more throughout the United States. If the number of breeds used could be reduced and research devoted exclusively to the different blood lines in the remaining breeds, more consistency in animal traits from generation to generation could be obtained. Concentration on specific blood lines within a breed could improve both animal performance and end-product consistency. This would lead to improved product quality and reduced production costs, allowing for a reduction in beef prices at the retail meat counter. In the interim, cow-calf and stocker producers can form strategic alliances with other producers (such as with the certified Angus program) to raise similar high quality animals that can be marketed to packers through retained ownership arrangements.

Overall, while the beef industry has remained viable, its loss of market share to poultry and pork in recent years provides a challenge. The choice is either to become more efficient and attuned to the consumer, as have the competitor industries, or to continue to lose market share. While we don't advocate that a supply chain structure should evolve in the beef industry, better coordination among market segments, including cow-calf operations, will help build a more efficient industry. ■

LSU AgCenter Beef Reproduction Publications

Understanding EPDs (#2692). Fact sheet about expected progeny difference, an estimate of an animal's genetic potential.

Selecting and Developing Replacement Heifers (#2739). Raising heifers for replacements in your own herd or for sale to others requires attention to detail. 12 pages.

Crossbreeding for Beef Production (#2319). Explains the various methods of crossbreeding with detailed charts, references and vocabulary list. 16 pages.

Factors Affecting Reproduction in Beef Cattle (#2308). Biology information and question-answer format on reproduction. 12 pages.

Louisiana residents may obtain up to five free copies of any one publication by visiting their local parish extension office or clicking on publications at the LSUAgCenter's website at www.lsuagcenter. com.

Information-based Programs Prove Valuable to Beef Producers' Future

Ronald P. Del Vecchio, Glen T. Gentry Jr., Danny F. Coombs and Darin A. Hylan

Producers serious about their cattle business routinely try to find ways to make more money and ensure a better future for themselves and their families. For a long time, the beef industry has been steeped in the tradition that cattle are all pretty much alike and should sell on averages. That mentality has made it hard to find adequate compensation for cattle with superior growth and carcass characteristics. But, the beef industry is changing. Between 35 percent to 45 percent of all fed cattle are now sold on some kind of value-based system, which affects the price paid for calves.

To adjust to these changing market trends, producers, buyers and feedlot operators point to the merit of providing critical information on calves at the time of sale. This information includes:

Health Information. For years, members of the cow-calf industry have known the health-related benefits of properly preconditioned calves. Producers found no buyers willing to share the expense, however. Today that is changing as significant premiums are being paid for properly vaccinated and weaned (preconditioned) calves.

Post-weaning Performance Data. This includes documentation of a low, moderate or high incidence of health-related problems and average daily gain of those calves while on feed. If health-related problems are numerous, then a change in the health program may be considered. Likewise, if average daily gain (ADG) is low, then a change in animal selection within breed or a breed change may be in order.

Genetic Information. Feedlots are rapidly becoming aware of the effect of genetics on feedlot performance. Producers providing genetic information at the time of sale will find that it can make a difference on calf price. For example, steer and heifer calves from a quality terminal breeding program may demand higher prices.

Carcass Information. This information is valuable because premiums for cattle of superior carcass characteristics continue to increase.

Following are several programs designed to help Louisiana cattle producers get the information they need.

Louisiana Calf-to-Carcass Program

This educational program provides producers with valuable health, post-weaning performance and carcass information about their cattle. The objective is to create an opportunity for Louisiana beef cattle producers to evaluate feedlot and carcass performance of their cattle. The results can guide producers in evaluating their current breeding programs so they can make any necessary adjustments that will allow them to remain in the mainstream of the beef industry as that industry moves more into a value-based marketing system.

This program is not designed to promote one type of marketing, such as retained ownership, or to single out specific cattle breeds. In Louisiana, the typical cow-calf producer sells calves at weaning. The calf-to-carcass program allows the cow-calf producer to see what happens to calves after they are weaned. Data received by each producer address issues such as herd health, trucking fees, calf shrink, feedlot performance, marketing alternatives and carcass quality. Since 1992, more than 65 producers from more than 30 parishes have participated. They have consigned a total of 2,397 steers and heifers to the program.

Beginning with the 1998-1999 feedout year, a mandatory 45-day preconditioning plan was added to the Louisiana Calf-to-Carcass Program. This demonstrates the importance of a quality health program and helps producers evaluate cattle, make changes for improvement and meet industry specifications.

Most of the calves are preconditioned at one of the three designated sites: LSU AgCenter's Idlewild Research Station, McNeese State University and Louisiana Tech University. A few producers choose to precondition their calves on their farms. The preconditioning program includes vaccinations, supplemental copper injection and internal-external parasite control treatment.

The calves are fed a medicated concentrate ration at about 1 percent body weight and have good quality hay and clean water available free choice.

Photo by John Wozniak

Ronald P. Del Vecchio, Associate Professor and Beef Specialist, LSU AgCenter, Baton Rouge, La.; Glen T. Gentry Jr., Research Associate, Idlewild Research Station, Clinton, La.; Danny F. Coombs, Professor, and Darin A. Hylan, Research Associate, Dean Lee Research Station, Alexandria, La.

Preconditioning feeder calves not only benefits their health, but the cattle also become accustomed to people, become calmer, learn to eat from feed bunks and drink from automatic waterers. Once the cattle arrive at the feedlot, they are sorted into pens based upon weight, size, projected finish date and sex.

The average percent shrink (loss of body weight during transportation) for the cattle during the 1998-1999 and 1999-2000 years, calculated as the percent difference in the final weight in Louisiana and the starting weight in Oklahoma, was 3.31 percent. This is a marked improvement over the 1992 to 1997 period, when preconditioning was not mandatory and when the percent shrink averaged 5.38 percent.

The death loss of steers and heifers during the past two years was 1.1 percent. This is well below the average of 2.4 percent for steers sent to the feedlot through this program in the six years before preconditioning. Most of the losses were caused by enterotoxemia and pneumonia.

The average number of days on feed for the steers during the 1998-1999 and 1999-2000 feed-out years was fewer than the average from the previous six years (204 days vs. 216 days, respectively). The average daily gain for the past two years was 3.05 pounds, a marked increase from the 1992 to 1997 increase of 2.81 pounds per day.

Medical costs averaged $2.97 per head ($17.67 for every sick animal) during 1998-2000. This value is similar to the average for the previous six years ($2.94). During the two-year period (1998-2000), a total of 15.5 percent of the cattle became sick at the feedlot, which is lower than the previous six years (22.1 percent). When examining the profit/loss margin of the cattle that became sick vs. the cattle that remained healthy, we found that over the last two years, the cattle that became sick had a profit margin of $41.13 per head, while the cattle remaining healthy had a profit margin of $119.43 per head. These data indicate that healthy cattle will generate about three times as much profit as those that become sick.

The average number of sick pen head days (total number of days cattle were in the sick pen) was 143 for 1998-2000. This is a marked reduction in the average from previous years, which was 346 days per year. This reduction suggests that the preconditioned cattle were able to recover faster with treatment and return to their pens sooner.

Most cattle fell into the select quality grade category (69.2 percent); only 21.4 percent were choice. Among yield grade categories, the highest percentage of cattle fit into the yield grade category 2 to 3. Seventy-one percent of the cattle fit within yield grades 0 and 3, which coincides well with industry specifications.

Preconditioning is beneficial to cattle. They experience lower mortality rates, fewer sick pen head days, lower morbidity rates, lower percent shrink, fewer days on feed and higher average daily gains. Further, there was a tremendous amount of variation in net return, performance factors, carcass parameters and health costs among the steers entered in the Louisiana Calf-to-Carcass Program, a reflection of variability that exists in the beef industry. Upon receipt of this information, each producer is strongly encouraged to review the data on his or her cattle and take steps, including genetic selection and management, to reduce these variables and produce a product that meets the needs and specifications of the beef industry. Value-based marketing at all segments of the industry is becoming more of a reality, and those who know what constitutes value and have a product that meets those demands will be competitive in the marketplace.

Bruce Olcott, an associate professor at LSU's School of Veterinary Medicine, left, and his students, including Ann Davidson, right, help with the calf preconditioning program. At far right is Ron Del Vecchio.

Louisiana Forage Bull Test Program

In 1998, the Louisiana Forage Bull Test Program was established to evaluate the post-weaning performance of bulls raised under pasture conditions for future herd sire potential. This is a cooperative program with Prison Enterprises' Dixon Correctional Institution, and the evaluation/test site is at that facility's feedlot in Jackson, La.

Upon the bulls' arrival at the test site in early November, they are weighed, vaccinated, treated for internal and external parasites, given an ear tag ID, measured and sorted into two groups based on body weight. The bulls get a two- to three-week adjustment period before the start of the evaluation, during which they are maintained on a dry lot and fed a balanced ration at about 1.5 percent of their body weight and have free access to hay, water and mineral supplements.

Photos by John Wozniak

Dr. David Sewell, left, and Ann Davidson, both veterinary students, prepare vaccines to administer to the calves brought in for the Louisiana Calf-to-Carcass Program.

Ronald Del Vecchio fastens numbered name tags for identification. Louisiana producers delivered 360 calves to the three sites for the preconditioning program in 2000.

Dr. Jenine Avellini, a veterinar control treatments to each ca gain experience working with this LSU AgCenter program.

During this period the bulls adjust to their new environment, establish dominance within each group and recover from any illnesses associated with the transportation and relocation.

At the end of the adjustment period, the bulls are turned out on pasture planted in Jackson ryegrass for a two- to three-hour period for two to three days. The time is then increased gradually to help the bulls prepare to eat the ryegrass forage full-time. Jackson ryegrass is used because of its high level of production, cold tolerance and rust resistance.

On average the bulls lose a little weight during the adjustment period, as expected. The bulls are weighed again at the start of the test, after 90 days on test and at the end of the test period. Body weights are collected just these four times because of the disruptive nature of moving the bulls through the chute, which can lead to injury. Also, after moving around, a group of bulls appear to have to re-establish dominance, leading to rowdy behavior, which may result in injuries. The goal is to collect enough data to fully evaluate the bulls' performance while, at the same time, managing the animals to keep injury at a minimum. The maximum number of bulls that can be managed at the evaluation site is 100 head.

During the 1998-1999 evaluation period of November 23, 1998, to April 19, 1999, there were 99 bulls consigned by 33 different producers from 23 parishes. The average daily gain for all bulls ranged from 2.2 to 4.9 pounds per day. The overall average daily gain among all bulls was 3.45 pounds per head per day. The average total weight gain for the bulls was 511 pounds in 148 days. The age of the bulls at the end of the performance test period ranged from 13.5 months to 20.5 months.

During the 1999-2000 evaluation period of December 9, 1999, to May 11, 2000, there were 86 bulls consigned by 18 different producers from 12 parishes. The average daily gain for all bulls on test ranged from 1.7 to 4.2 pounds per day. The overall ADG among all bulls was 3.3 pounds per head per day. If we look at total weight gain, the bulls averaged 506 pounds of gain in 154 days. The age of the bulls at the end of the performance test period ranged from 13.5 months to 20.5 months.

At the conclusion of each forage-based performance test, rib eye area and fat thickness measurements were taken using ultrasound technology. A bull soundness examination (BSE), including a scrotal circumference measurement also was conducted on all bulls.

The first two years of this program have resulted in outstanding weight gains. At a flat rate cost of $275 per bull, the cost per pound of gain has averaged 54.1 cents. The factors that contributed to this include an abundance of ryegrass available to the bulls at all times, a high quality health program (booster vaccinations for respiratory diseases, two treatments for internal and external parasites, prompt veterinary care at the first sign of any given condition), free access to mineral supplemented with Bovatec and quality genetics of the bulls.

Performance Bull Test

The performance testing program of beef bulls at the LSU AgCenter's Dean Lee Research Station in Alexandria is designed to evaluate the post-weaning performance of bulls under a full-feed grain ration for future herd sire potential. This program is one of the oldest and longest running tests in the United States. More than 6,000 beef bulls representing more than 20 breeds and consigned by more than 400 Louisiana purebred beef cattle producers have been evaluated since the first performance test was conducted in 1958.

This program began as a joint effort between the Department of Animal Science and the Dean Lee Research Station. Twenty-nine bulls representing three breeds consigned by 19 breeders were entered in the first test. The three breeds were Hereford, Santa Gertrudis and Angus. Average daily gains ranged from 1.61 to 2.63 pounds per day. Only six were offered for sale at the end of the test, and only three were sold. These bulls were purchased for $490, $300 and $200.

Many changes have been made since then. In 1981, the decision was made to feed the bulls in a group rather than individually, which allowed more

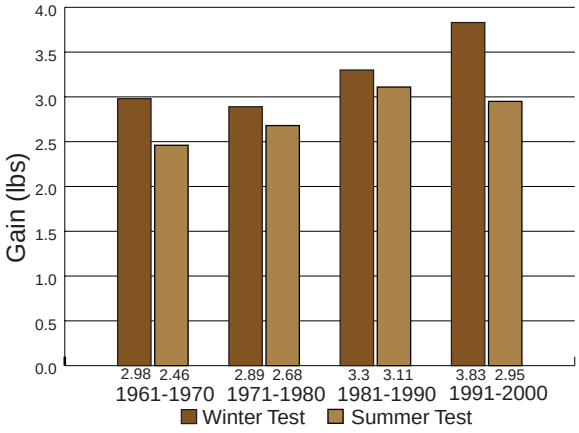

Figure 1. Average daily gains of bulls on winter and summer tests by decade.

y student, applies parasite lf. LSU veterinary students animals while helping with

Glen Gentry records the body weight of each calf with an electronic digital scale at the LSU AgCenter's Idlewild Research Station.

Gentry and Olcott record data on each calf. The other two sites in this LSU AgCenter program are McNeese State University and Louisiana Tech University.

bulls to be evaluated. The breed of bulls consigned to the test also has changed. Hereford bulls were popular in the late 1950s and 1960s. The Continental breeds, especially Simmental, began to increase in number during the 1970s and became the most numerous of the different breeds tested in the early 1980s. During the 1990s, the Angus and Charolais breeds have had the highest numbers of bulls on test.

Another change is that the actual performance of bulls on test, as measured by average daily gain, has improved over the years. As shown in Figure 1, during the 1960s average daily gains were approximately 2.5 pounds per day. Body weight gains have gradually increased to the point where today the bulls are gaining approximately 3.6 pounds per day. This shows that Louisiana purebred cattle producers have selected cattle that perform better and therefore are more efficient.

The ration used has been fairly constant over the years and is a complete ration categorized as a high fiber, growing ration. It consists of 40 percent corn, 20 percent crimped oats, 20 percent cottonseed hulls, 10 percent cottonseed meal and 10 percent molasses, minerals, vitamins and an ionophore. This ration contains 68 percent total digestible nutrients (TDN) and 13 percent crude protein. Both the ration and clean water are available free choice.

Two tests are conducted each year. Bull calves born in December, January, February and March are tested during November to March. Bull calves born in September, October and November are tested during June to October. Since 1981, at the conclusion of each test, a bidding sale has been organized. Bulls are compared within breed, and only the bulls that have an above-average average daily gain and adjusted yearling weight within their breed are eligible for the sale. As of March 2000, only one sale is held. The bulls that would have been offered in the October sale are eligible to return in March. This change will increase the overall number of bulls offered in the sale and allow buyers to purchase slightly older bulls along with the younger bulls just completing the November to March test. Figure 2 shows the average sale price received for bulls by decade from 1960 to 2000.

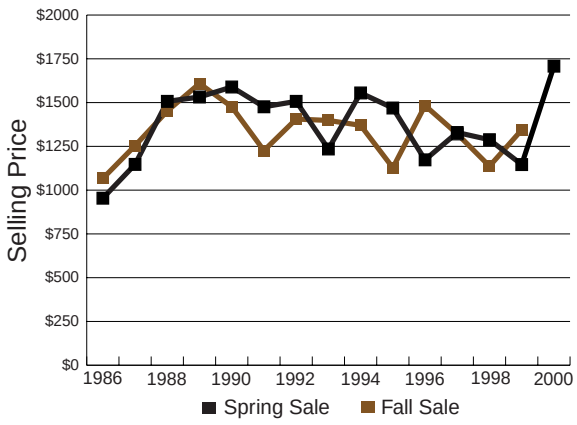

Figure 2. Average selling prices for spring and fall sales by year.

The cost of having a bull performance tested in this program is about $350. This includes a $50 nomination fee and feed charges of 70 cents per pound of weight gain. For example, a bull that gains 3.5 pounds per day would be charged $324.40. (3.5 pounds x112 days =392 x .7 = $274.40 + $50 nomination fee for a total charge of $324.40).

The testing program is under the control of the LSU AgCenter's Performance Testing Committee. This group is responsible for policies and procedures as it pertains to the actual performance testing procedure. A second group, the Louisiana Bull Testing Association, was organized in 1981. Its function is to sponsor and promote performance tested bull sales in Louisiana.

A new testing facility was completed in 1994. It is a feedlot facility containing 10 pens that are 20 feet wide and 200 feet long. Self-feeders containing the complete ration are under a barn that is 30 feet wide and 200 feet long. Shade cloth provides the bulls with an additional shaded area to help minimize heat stress. A sprinkler system and fans have been recently added.

Over the last couple of years two new services have been offered to producers to obtain additional data on their bulls. Breeding soundness exams and ultrasound measurements for ribeye area, fat thickness and marbling are now an integral part of the evaluation. These services are contracted with a private veterinary practitioner and a certified ultrasound technician. The additional cost for these procedures has been $25 each.

During each test period, performance information is mailed to the participants every 28 days. Bull performance information, along with the rules and regulations, a calendar, nomination forms and vaccination records, also can be found on the web: http://www.agctr.lsu.edu/wwwac/research/deanlee/bulltest ■


Controlling

Horn Flies

Lane Foil, Montgomery Alison, Sidney M. DeRouen, Millard Kimball, David G. Morrison, David W. Sanson and Wayne E. Wyatt

Although the horn fly is only one of many pests of livestock, it is the one that costs the cattle industry the most. Economic losses to the horn fly in the United States are estimated at more than $800 million annually, and cattle producers spend at least $60 million each year on insecticides to control this pest. Nationwide, the weaning weight of calves of cows protected from horn flies is at least 14 pounds heavier than that of calves of cows infested with horn flies. In Louisiana, horn flies can be found on cattle almost year round with population peaks in the spring and fall. Because of the high number of fly generations per year in the South, insecticide resistance develops more rapidly. Based on the price of $1 per pound, expending an estimated $2.50 for fly control would yield an extra $11.50 income per calf at weaning after adjusting for the cost of control.

LSU AgCenter scientists conduct studies on horn fly control techniques and their effect on beef production and on horn fly susceptibility to insecticides.

Doing research on horn fly control involves counting the horn flies on the animals. Some cows are tame enough that researchers can stand close enough to get the count. However, most are not calm enough for this, so researchers use binoculars to count.

Illustration by Elma Sue McCallum

Yearling cattle weight gain

In a study at the LSU AgCenter's Hill Farm Research Station in Homer, scientists found that with fly control, yearling cattle had a 27-pound additional weight gain average over 100 days. Under the conditions of this study, this weight gain was achieved with moderate levels of horn fly control. A total of 246 yearlings (196 steers and 50 heifers) were used in the study. Cattle with 25 percent or 50 percent Brahman breeding responded similarly to horn fly control. An average of 87 flies per animal was observed on treated yearlings versus 275 flies on animals not treated. This reduction influenced weight gains significantly, and these data do not contradict the currently accepted economic threshold of 200 flies per animal.

Fall-calving beef cow production

To measure the effects of horn fly control on fall-calving beef cow production, a three-year study was conducted at the LSU AgCenter's Rosepine Research Station at Rosepine. The objectives were to monitor horn fly populations on fall-calving cows from early spring to mid-summer and to determine the effects of horn fly control during the last three months before weaning on weight gains and weaning weights of fall-born calves. The 87 fall-calving cow-calf pairs used in the study were allotted into two equal groups. Cows in one group were treated with pyrethroid-impregnated ear tags while the other group received no treatment. Results indicated there was little or no effect of spring horn fly populations on the weaning weight of fall-born calves. Fall-born calves have access to high quality forage during the spring and spend large amounts of time grazing. Weight change of cows and calves was unaffected by horn fly control. Weight gain is more likely affected by forage quantity than by cow milk production.

This study at Rosepine was the first on the economic impact of horn flies on fall-calving beef cow production, and these studies should be repeated under different conditions (geographic, forage, breed, etc.) before any potential economic benefit of horn fly control in the spring for this production system is discounted.

Battling resistance

Since the horn fly spends almost its entire adult life on livestock, most insecticides and application techniques have been successful in controlling it at some point. However, these success stories are followed by significant loss of control or resistance development over time. Confirmed reports of resistance to organochlorines and organophophorus compounds occurred in the 1970s, and descriptions of resistance to pyrethroid ear tags were numerous in the 1980s. Recently, resistance to the newer organophosphorus impregnated ear tags has appeared. Therefore, it can be concluded that the horn fly develops resistance to persistent exposure to insecticides whether the persistence is due to the molecular structure of the insecticide or the release system.

LSU AgCenter studies demonstrate that continuous use of a single insecticide treatment is not an appropriate strategy. At the Red River Station in Bossier City, pyrethroid (Saber) tags were used from 1989 to 1991. In the first year of use, the tags provided 13 weeks

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Lane Foil, Professor, Department of Entomology, LSU AgCenter, Baton Rouge, La.; Montgomery Alison, Coordinator, Macon Ridge Research Station, Winnsboro, La.; Sidney M. DeRouen, Associate Professor, Hill Farm Research Station, Homer, La.; Millard Kimball, Research Associate, Red River Research Station, Bossier City, La.; David G. Morrison, Assistant Director for Animal Sciences, Louisiana Agricultural Experiment Station, LSU AgCenter, Baton Rouge, La.; David W. Sanson, Associate Professor and Research Coordinator, Rosepine Research Station, Rosepine, La.; and Wayne E. Wyatt, Associate Professor, Iberia Research Station, Jeanerette, La.

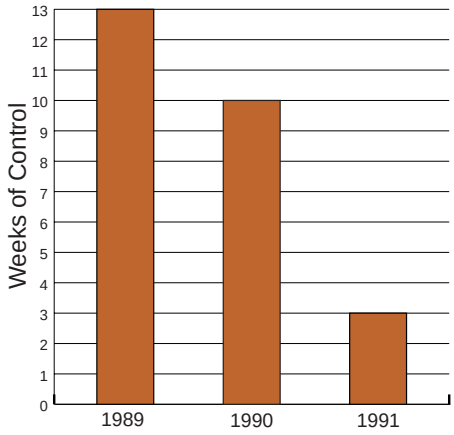

Figure 1. Weeks of control of pyrethroid ear tags at Red River
Saber tags were used from 1989 to 1991. The period of control was reduced from 13 weeks to just three weeks in three years.

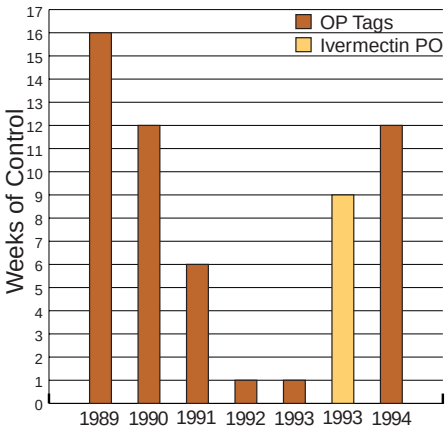

Figure 2. Weeks of control of organophosphate ear tags at Rosepine and reversal with pour-on addition
Terminator tags were used from 1989 to 1992. The period of control provided by these tags declined from 16 weeks to one week during the four-year study. A fall treatment with Ivomec in 1993 was followed by an apparent reversal of organophosphate resistance.

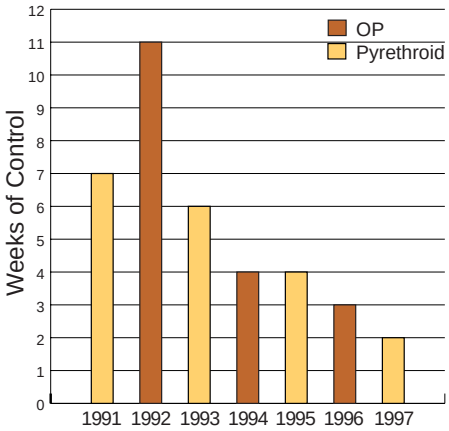

Figure 3. Weeks of control by yearly alternation between pyrethroid and organophosphate ear tags
Early recommendations for preventing development of resistance included alternating pyrethroid and organophosphate treatments yearly. After seven years of rotation studies, results did not support this strategy.

of control. But by 1991, the period of control was just three weeks (Figure 1). At the Rosepine Station, organophosphorus impregnated ear tags (Terminator) were used from 1989 to 1992. Control provided by these tags declined from 16 weeks to one week during the four-year study (Figure 2).

Studies at the Red River station continue to demonstrate that using pyrethroid tags results in selection for pyrethroid resistant flies within three years, regardless of the type of pyrethroid used. At Rosepine, our data indicate that continued use of organophosphate products for a four-year period can select for flies resistant to all of the organophosphate compounds available. Organophosphate resistance appears as a gradual loss of control from year to year, rather than the rapid loss of control associated with pyrethroid resistance. Some laboratory studies indicate that using mixtures of organophosphates and pyrethroids continuously may slightly delay the development of resistance. We have not tested mixtures in the field because selection for resistance to two chemistries at once could result in total loss of control.

Photo by Linda Foster Benedict

Lane Foil talks about horn fly control at a recent field day at the Rosepine Research Station in Rosepine, La.

Early recommendations for preventing development of resistance included the alternating of pyrethroid and organophosphate treatments yearly. After seven years of rotation studies at the Northeast and Macon Ridge research stations, we found no support for the strategy of yearly rotation between pyrethroid and organophosphate ear tags. Although ear tags had not been used for fly control at these stations before 1991, the pyrethroid tags provided only six to seven weeks of control in that year. The organophosphate tags provided nine to 11 weeks of control in 1992, but this did not help reverse the pyrethroid resistance observed in 1991. The efficacy of both tags declined over the next six years in spite of yearly rotation between chemical classes (Figure 3). Yearly changes in susceptibility to insecticides detected by the filter paper assay also indicated development of resistance.

Alternating chemical classes of tags yearly has been proposed as a strategy for slowing the development of insecticide resistance in local horn fly populations. Our data did not indicate that this was an effective strategy at the Northeast and Macon Ridge stations. This approach may be effective elsewhere, but our studies are the only actual field studies that have been conducted to test the recommended strategy of yearly alternating between tags of different chemical classes. Since alternating chemical class of tags yearly does not slow development of resistance, adding a year of fly control with products other than ear tags in a three-year rotation may be appropriate.

A current recommendation is that pyrethroid ear tags should not be used except once every three years. We have initiated studies at two locations to determine if this is an appropriate recommendation for horn fly control in Louisiana. In 1994 and 1997, pyrethroid tags (Atroban) were used at the Iberia Station; only organophosphate tags were used in 1995 and 1996. The organophosphate tags provided 12 to 18 weeks of control, a level of control indicative of an organophosphate-susceptible horn fly population. The pyrethroid tags provided zero weeks of control in 1994, but four weeks of control were observed in 1997. Our preliminary studies indicate that

pyrethroid tags should be used only once every third year in Louisiana.

LSU AgCenter scientists have conducted studies where separate herds were maintained on different pastures using different treatments for horn fly control. This allows more separation between pyrethroids and organophosphates. From 1989 to 1991, organophosphate and pyrethroid insecticidal ear tags were tested in this manner at the Hill Farm and the Iberia stations. Results showed no reduction in control.

LSU AgCenter scientists also have examined possible resistance management using mid-summer/fall treatments with pour-on endectocides. We have demonstrated the apparent reversal of organophosphate resistance with fall treatments of the pour-on endectocide, ivermectin (Ivomec), at Rosepine. The efficacy of the 20 percent diazinon (organophosphate) tag increased from one week in 1993 to 12 weeks in 1994 following an intermediate (fall) ivermectin treatment. The efficacy of the 40 percent diazinon tag went from two weeks in 1994 to 12 weeks in 1999 with the intermediate fall ivermectin treatment. LSU AgCenter scientists have had similar, but less dramatic, results with mid-summer treatments for managing pyrethroid resistance, and replicated studies are currently under way on that subject.

In summary, we have an active program on horn fly management that is made possible by cooperative research throughout the state. At least for now, several management strategies allow us to control the economic damage caused by horn flies. ■

Walk-through Fly Trap

The walk-through fly trap was designed 70 years ago and provides a simple, yet effective, way to help control for horn flies. It consists of a structure that allows only minimal light because the flies tend to leave the animal more readily in the dark. Few cattle producers use the traps, however, because the cattle must be trained to walk through them, and only mild-tempered animals will do this. The farmer must construct the trap gradually and train cattle to pass through it to get water and food. As the cattle go into the trap, some of the flies leave the animals and are trapped in the sides which have screen baffles. Strips of fabric hang from the top of the trap to brush off flies. The trap pictured was tested at the LSU AgCenter's Red River Research Station in Bossier City for four years. Horn fly counts for the cows using the trap were below the 100 flies per side economic threshold for the entire 15 weeks of the study each of the four years. Furthermore, the calves nursing the cows that used the trap gained more weight than calves nursing nontreated cows. Weaning weights were an average of 8 pounds heavier for the treated group.

Photos by Millard Kimball

LSU AgCenter Beef Management Publications

Horn Fly Control with Backrubbers (#1343). Fact sheet with instructions for building a cable backrubber.

Control External Parasites in Beef Cattle (#1418). Detailed charts on use of various pesticides for horn flies, horse flies, stable flies, mosquitoes, ticks, lice, cattle grubs, mange mites and screwworms. Includes information on herbicide resistance management.

Important Fly Pests of Louisiana Beef Cattle (#2617). Information about control and economic importance of blood-sucking insects.

Monthly Beef Cattle Management Calendar & Workbook (#2712). A listing of to-do's with space for personal notes. 28 pages.

Beef Cattle Management Tips (#2701). Economic information to help the cattle producer make decisions. Includes vaccines, diseases and chart for body condition scoring. 16 pages.

Louisiana Beef Cattle Production (#2239). A comprehensive guide, including pasture management, health, breeding and marketing. Diagram for cattle handling facility, cuts of beef and parts of beef animal. 28 pages.

Louisiana residents may obtain up to five free copies of any one publication by visiting their parish extension office or clicking on the publications' button at the LSUAgCenter's website: www.lsuagcenter. com.

Internal Parasites of Cattle:
Seasonal Patterns of Infection and Control

James C. Williams, Alvin F. Loyacano, Andy A. DeRosa and Jeffrey A. Gurie

In Louisiana, internal parasitism is a major impediment to efficient growth and productivity in cattle. Gastrointestinal nematodes and lungworm are prevalent throughout the state, and the liver fluke is a problem in the bottomlands along major river systems and tributaries and in coastal marsh areas.

A primary requirement for effective prevention and control of infection and disease caused by these internal parasites is to understand their population dynamics and the seasonal trends of infection in relation to weather and management. Such studies have been conducted in Louisiana. The first of these dealt with development and survival of nematodes outside of their host, called free-living stage, on small experimental pasture plots. Later studies looked at grazing to determine seasonal patterns of infection from different types of nematodes.

Conditions for nematode larval development on pastures are optimal in late fall and spring. Except in rare instances of extended periods of severe cold, winter conditions in Louisiana do not seriously impede nematode development and survival. Summer conditions do not favor long survival of larvae on pasture. Studies of seasonal prevalence of nematode infections in grazing cattle at three Louisiana locations confirmed and expanded results of small plot studies. These later studies showed that nematode infections of cattle generally increase in the fall, may be sustained or increase in winter and reach peak levels in spring. High temperatures and alternating wet and dry conditions in summer reduce the survival of most nematode parasite eggs and larvae on pasture.

Studies reveal that liver fluke infection in cattle is most prevalent in late fall and spring. Summer conditions are as harmful on development and survival of fluke immature stages in the snail intermediate host and on pasture as they are for free-living stages of nematodes on pasture.

Control Options

Options for control of internal parasites continue to be based on good animal and pasture management procedures and use of anthelmintics, which are dewormers. Clorsulon and Valbazen are the only drugs available for fluke control, and neither has any effect on immature flukes. Recommendations are to treat in fall and again in spring, if rainfall is heavy during winter and early spring.

There are more treatment options for nematodes than for liver flukes. These options include the older benzimidazole drugs – oxfendazole (Synanthic), albendazole (Valbazen) and fenbendazole (Safeguard). The avermectin/milbemycin drugs are newer and include ivermectin (Ivomec), doramectin (Dectomax), eprinomectin (Eprinex) and moxidectin (Cydectin).

A major feature of the newer products is a longer time or persistence of activity. These drugs can remain active in the animal for three to six weeks compared to only two to three days for the older products. Also, the newer products have a higher level of efficacy against most types of nematodes, and all help to control external parasites.

In addition, use of eprinomectin and moxidectin requires no withdrawal period before slaughter. Eprinomectin also has no milk withdrawal time.

In Louisiana, timing of treatment is critical. Although it is not the most convenient time for cattle producers, July and August can be the most effective period to treat adult cows. The more traditional treatment time in the fall is still effective for controlling nematodes, flukes and ectoparasites, and it coincides with weaning of spring-born calves.

In the case of younger cattle – spring-born calves and replacement stock – treatment in late fall is most appropriate. These calves need to be treated then because of their vulnerability to infection and their rapid growth rate that could be inhibited by infection. Following an initial treatment in late fall with one of the newer drugs, a second treatment 10 to 12 weeks later in spring provides good protection from infection during November through May, when young cattle may be exposed to high levels of infection on pastures.

Unlike parasitic nematodes of sheep and goats, nematodes in cattle have so far not developed resistance to anthelmintics. One reason may be that cattle are treated for parasites less often than sheep or goats. Cattle producers should still be cautious in their frequency of anthelmintic treatments.

Alternative methods for controlling parasites of cattle, such as vaccines and biological control, are being investigated. Technical problems in development and application remain unsolved. In any cattle herd, only a minority of cattle have the heaviest infections and contribute the most to contamination of a pasture with infective larvae. Some work has been conducted, but more intensive research by the U.S. Department of Agriculture has been initiated to understand the genetic makeup of cattle in relation to susceptibility and resistance to infection with nematodes and other infectious diseases. As an alternative or supplement to use of anthelmintic drugs in cattle nematode or fluke parasitism, progress in genetic research could produce a new era of parasite control through improved resistance of cattle to infection. ■

James C. Williams, Professor, Department of Veterinary Science, LSU AgCenter, Baton Rouge, La.; Alvin F. Loyacano, Professor, Dean Lee Research Station, Alexandria, La.; Andy A. DeRosa, Instructor, Department of Veterinary Science, LSU AgCenter, Baton Rouge, La.; and Jeffrey A. Gurie, Research Associate, Dean Lee Research Station, Alexandria, La.

Photo by Linda Foster Benedict

Comparing Beef Breeds by Birth, Weaning and Feedlot Performance

Cattle producers have long recognized the benefits of crossbreeding. Incorporation of a percentage of Brahman breeding into the cow herd has become a general practice in the South. Unfortunately, sustaining a particular percentage of Brahman breeding in the cow herd over several generations is difficult for many producers and almost impossible for producers with small herds.

Synthetic breeds, such as Brangus and Beefmaster, involving Brahman and British (Angus, Hereford and Shorthorn) breeding, were developed to be used as general purpose straightbreds (mating of bulls and cows of like breed makeup) to stabilize percentage Brahman breeding across generations for both large and small producers. Some of these synthetic breeds have been available to Louisiana producers since the 1940s and 1950s. New breed resources that have become available since then include synthetic breeds (Gelbray, Simbrah) involving Brahman and Continental (Gelbvieh, Simmental) breed composites.

Interest in these new breeds prompted a five-year (1988-1992) study in which Brangus, Beefmaster, Simbrah and Gelbray sires were used in purebred matings to dams of like breeds (Brangus bulls mated to Brangus cows) and in crossbred matings to Brahman-Hereford crossbred cows. This mating scheme provided a comparison of the British-derivative and the Continental-derivative synthetic breeds in both straightbred and crossbred situations.

Calves were born in the spring and weaned in the fall at the Idlewild Research Station. Difficulty with calving was low and similar for all cow types. Calf birth weights were heavier for Gelbray- (82 pounds) and Simbrah-sired (86 pounds) calves than for Brangus- (77 pounds) and Beefmaster-sired (77 pounds) calves. Brangus, Gelbray and Simbrah straightbred calves were heavier at birth than calves of Brahman-Hereford crossbred cows. Birth weights were similar for Beefmaster-sired calves of Beefmaster and Brahman-Hereford crossbred cows.

Preweaning daily gains and weaning weights were higher for Continental- (2.0 pounds/day and 483 pounds) than for British-sired (1.9 pounds/day and 453 pounds) calves. Simbrah-sired calves gained 0.1 pound more per day and were 35 pounds heavier at weaning than Gelbray-sired calves. Preweaning daily gains and weaning weights were lower for Brangus (1.65 pounds/day and 408 pounds) and Beefmaster (1.83 pounds/day and 439 pounds) straightbred calves than for Brangus- (2.1 pounds/day and 492 pounds) and Beefmaster-sired (2.0 pounds/day and 474 pounds) calves of Brahman-Hereford crossbred cows. Within both the Gelbray- and the Simbrah-sired calves, preweaning daily gains and weaning weights were similar for both straightbred and crossbred cow types.

Brangus (1,098 pounds), Gelbray (1,111 pounds) and Simbrah (1,208 pounds) cows were heavier at weaning than Brahman-Hereford crossbred cows (997 pounds). Brangus and Simbrah cows were also taller at the hip than Brahman-Hereford crossbred cows.

Following weaning, steer calves were shipped about 50 miles to the St. Gabriel Research Station, where they were wintered on hay and supplement rations and allowed to graze available ryegrass pastures in the late fall and the spring of the following year. Steers were then shipped in mid- to late-May about 90 miles to the feedlot facilities at the Iberia Research Station and placed on a high concentrate ration. Straightbred Angus steers from the Iberia Research Station were included in this phase of the evaluation. Steers were weighed and evaluated for fat cover over the 13th rib every 28 days. After a minimum of 84 days on feed, steers that had attained 0.4 inches of backfat were transported to the Department of Animal Science for processing.

Angus steers tended to be lighter initially (679 versus 716 pounds), required less time on feed (140 versus 195 days) and were 183 pounds lighter (1,034 versus 1,217 pounds) at the end of the feedlot trial than the Brahman-influenced steers. Initial weights (705 versus 728 pounds) were similar for British- and Continental-sired steers, but British-sired calves required fewer days (183 versus 207 days) to attain 0.4 inches of backfat and were removed from the feedlot at lighter weights than the Continental-sired steers (1,175 versus 1,259 pounds).

The heavier final feedlot weight of Continental-sired compared to British-sired calves was largely due to Simbrah-sired steers, which had heavier final feedlot weights (1,321 versus 1,198 pounds) than the Gelbray-sired steers. Initial and final feedlot weights and days on feed were similar for Brangus- (708 pounds, 1,177 pounds and 180 days) and Beefmaster-sired (701 pounds, 1,173 pounds and 185 days) steers. Daily gains during the feedlot phase were similar for all breed types (average gain of 2.6 pounds per day) and reflect that steers were removed from the feedlot at similar physiological points.

After transit to Baton Rouge and immediately before slaughter, steers were weighed again. Perhaps because of the relative lack of heat tolerance of Angus steers compared to the Brahman-influenced steers, Angus steers exhibited 1 percent more shrink than did the other breed types (3.8 percent versus 2.8 percent).

The Gelbray and Simbrah cows were either superior or equal to the Brangus and Beefmaster cows and were equal to the Brahman-Hereford crossbred cows. They were heavier, however, and would presumably cost more to maintain. The value of heavier weaning weights should be tempered with possible increases in herd input costs. An evaluation of feedlot performance should indicate the performance acceptability of these synthetic breeds of cattle for market outlets leading to commercial feedlots. The biggest differences between the Continental-sired steers and the British-sired and Angus steers are the longer time on feed and the heavier weights required to reach a desirable level of fatness. Although heavier weights at a prescribed level of fatness may be viewed as a benefit, the increased number of days in the feedlot is not. ■

Wayne E. Wyatt, Associate Professor, Iberia Research Station, Jeanerette, La.; Thomas D. Bidner, Professor; Paul E. Humes, Professor and Head; and Donald E. Franke, Professor, all Department of Animal Science, LSU AgCenter, Baton Rouge, La.

New Assisted Reproductive Technologies for Use in the Cattle Industry

Joel Carter, Oscar Perez, Richard Denniston and Robert A. Godke

Today, assisted reproductive technologies allow us to make marked changes in the genetics of farm livestock. One success story is artificial insemination (AI). Use of this technology from the 1950s through the 1990s increased average milk production per cow more than 300 percent in dairy herds in the United States. Yet, feed cost for the increased production was reduced by more than 30 percent. How did this happen? The top progeny-tested sires were used to inseminate a multitude of dairy cows, and their genetically improved daughters were used as replacement females for herds. Increased genetic selection for milk production using frozen semen for AI and improved herd management dramatically changed the North American dairy industry. This success story occurred because researchers developed the technology, and progressive producers used it to stay competitive in the marketplace.

Embryo Transfer

An assisted technology that received considerable interest from cattle producers beginning in the late 1970s was embryo transfer. Although the first embryo transfer that produced a live calf was reported in 1951 at the University of Wisconsin, not until 1976 were the nonsurgical transfer procedures developed for cattle. This led the way for commercial, in-field use of this technology. Although beef cattle prices, industry promotion and producer interest enhanced the use of this technology in the late 1970s and early 1980s, embryo transplantation today is more often used by dairy producers than by beef cattle producers.

Today, we use less of the follicle-stimulating agent over fewer days for our donor cows and fewer sperm cells per donor insemination. However, the actual methodology has changed little since the 1970s. With more experienced embryo transfer professionals in the field, the embryo recovery rates are expected to be higher than 75 percent, with five to eight good quality embryos per donor collection. Using good quality embryos, 65 percent to 75 percent transfer pregnancy rates are now expected using this procedure.

In recent years, a single embryo on-the-farm collection approach has become popular with progressive dairy producers. This approach uses no follicle stimulatory hormones in the donor cows. Single embryos are collected from the top milk-producing cows in the herd and then transferred to cows in the bottom portion of the milking herd. Producers can also buy and store frozen embryos for transplantation year round. Today, both dairy and beef cattle producers buy frozen embryos from private and commercial companies. This is predicted to be a market growth area in the future. The potential for using frozen embryos in breeding herds appears to be unlimited.

Ultrasonography

Other assisted reproductive technologies were developed in the 1980s and 1990s. Some are more mechanical than biological in nature. For example, ultrasonography was developed initially in the livestock industry to evaluate muscle mass in the live animal. With modifications, primarily in the probe structure and software, this technology has become an important multi-use instrument for livestock producers. Today, ultrasound field units are used to evaluate the ovaries for follicle development of cattle before and after AI to determine if the female ovulated. Ultrasonography also is used in pregnancy testing, including detecting fetal heart beat (starting after 22 days of gestation) and sexing the fetus during the first trimester of pregnancy.

Electronic Heat Detection

Another new technology reaching the commercial market in the 1990s was electronic heat (estrus) detection for cattle. With this system a small circuit switch transponder is glued on the rump of the cow. This transponder sends information to a transmitting tower and to a receiver attached to a computer in the house or barn. Since each electronic transponder is uniquely identified, the number of mounts made by herdmates and the duration of those mounts are stored in computer data files for that animal. This allows producers to identify the first time during a 24-hour period a female on the breeding list stood to be mounted by another animal. This technology takes a lot of the guesswork out of the timing of AI in both naturally ovulating and superovulated embryo donor cows. Although the initial cost of an electronic estrus detection system is high, its overall value is well worth the expense.

Embryo Sexing

The procedure for sexing embryos before transplantation is now available to commercial embryo transplant stations. This new DNA technology for embryo sexing is accurate, user friendly and can be completed within six hours after the embryos are harvested. At least one commercial company sells a complete cattle embryo-sexing kit for in-field use. The capability of sexing embryos in the laboratory gives producers the option of selecting bull or heifer calves for market and reproductive management purposes.

In Vitro Fertilization

For 15 years researchers have been developing *in vitro* fertilization (IVF) procedures for cattle. IVF technology has been commercially available to dairy cattle breeders only since the early 1990s. IVF is a multi-step process that requires a well-equipped laboratory and a skilled technician. The IVF procedure involves harvesting the eggs (oocytes) from the cow's ovaries and fertilizing them in the laboratory. The resulting embryos are held at cow body temperature in an incubator for seven or eight days and then transferred nonsurgically to recipient females at the same stage of their estrous cycle. The pregnancy success rate for good quality IVF-derived embryos is expected to range from 50 percent to 65 percent. Success

Joel Carter and Oscar Perez, both Graduate Students; Richard Denniston, Instructor; and Robert A. Godke, Boyd Professor, Department of Animal Science, LSU AgCenter, Baton Rouge, La.

rate is lower if the embryos have been frozen and then thawed before transfer.

The IVF procedure offers an alternative to cattle producers who have genetically valuable cows that, for some reason, are unable to produce viable embryos through standard embryo collection and transfer procedures. This technology can be used with oocytes harvested from older, nonovulating cows, females with physical injuries such as a broken leg, and problem cows with an abnormal cervix. Success has been reported using IVF procedures on supplemental oocytes obtained from cows with cystic ovarian disease.

Today, oocytes are harvested from the female by transvaginal, ultrasound-guided collection procedures developed by the LSU AgCenter and others. To retrieve the oocytes for IVF, a trained professional inserts an ultrasound-guided stainless steel needle through the vaginal wall near the cervix to extract oocytes from the follicles visible on the ovaries. The procedure is conducted on the small, medium and large follicles on both ovaries of the donor female. This approach also can be used on oocytes harvested from prepubertal heifers and during the first trimester in pregnant cows and horses.

With IVF, the potential exists for more embryos to be produced in a shorter period, because the procedure can be repeated on the same cow three to four times a month. At the LSU AgCenter, we harvest oocytes from early postpartum (less than 40 days) beef cattle, before the female begins cyclic activity. This allows for the production of one or more extra calves from the cow before she is mated for a natural pregnancy.

Semen Sexing

Another promising assisted reproductive technology is sexed semen for artificial insemination. Being able to sex semen has been a dream of scientists and livestock producers for decades. In the late 1980s, a USDA senior scientist at Beltsville, Maryland, reported a procedure that was capable of sorting sperm cells of rabbit semen using a high-speed, laser-controlled cell sorter. This methodology was also successful in farm animals. Briefly, sexing semen involves using high-speed cell sorters that direct sperm into batches containing either more than 90 percent X-chromosome (female-producing) sperm or more than 90 percent Y-chromosome (male-producing) sperm.

A Colorado-based company and Colorado State University are evaluating sexed cattle semen using deep uterine horn artificial insemination techniques. The results to date indicate that the offspring are the predicted sex more than 90 percent of the time. At the LSU AgCenter, a transvaginal, ultrasound-guided artificial insemination procedure is used to deep-uterine inseminate problem breeder cows and superovulated embryo donor cows. The next step will be to use sexed semen with these new deep-uterine insemination methods. These trials are under way.

Beef producers could use the X-chromosome bearing sperm when heifers are needed for herd replacements, thus increasing the rate of genetic improvement of the herd. First-calf heifers should produce smaller calves at birth, if they produce primarily heifer calves. Correspondingly, if Y-chromosome bearing sperm were used, then primarily bull calves would be produced in the same herd.

Animal Cloning

The cloning of adult sheep (Dolly and her sisters reported in 1997) stimulated a great deal of interest in nuclear transfer (cloning) technology by the livestock industry. One method of constructing cloned embryos is to take a cell from an embryo or a developing fetus and transfer it to an unfertilized oocyte from which the female genomic DNA has been mechanically removed. The oocyte is then "activated," as though it had been naturally fertilized, and the nucleus "reprogrammed" for subsequent normal embryo development to occur. Once the donor cell population has been prepared, hundreds of cloned embryos can be produced each week in the laboratory by using oocytes extracted from the ovaries of animals destined for slaughter.

Cloned sheep, goats and cattle were first produced from embryos more than 15 years ago by another type of cloning, termed embryo splitting. Using a fine glass needle or a razor blade chip to bisect the embryo, scientists can produce genetically identical offspring. The pregnancy rates using this embryo microsurgical technique are similar to those of intact embryos from the same donor female. Unfortunately, the best success rate came from bisecting the embryo into two halves, giving the opportunity for only two offspring to be produced from a single embryo.

More recently, there has been a major breakthrough in animal cloning. With Dolly, the famous sheep, cells for cloning were harvested from the mammary gland of an adult ewe. These mammary cells were incubated in a laboratory to produce a much larger population of these dividing cells for the

Photo by John Wozniak

Brett Reggio, graduate student in animal science, uses this equipment to perform microsurgery, such as embryo cloning. This equipment is part of the Embryo Biotechnology Laboratory, which is located at the LSU AgCenter's St. Gabriel Research Station.

nuclear transfer procedure. The production of Dolly in Scotland was important because it was the first mammal produced from an adult somatic cell (a cell other than an egg or a sperm). The potential for the use of this new technology amazed the world. Today, adult cell clones have been produced in mice, sheep, cattle and recently goats. Cloning will provide cattle producers an opportunity to reproduce genetically valuable founder animals (seedstock).

Cloning technology will provide cattle producers with ready access to production-tested breeding seedstock, thus increasing the accuracy of selection in their breeding herds. Cloning F1 terminal-breed males to produce males for market steers might be the ultimate beef production management system. With this scenario, fewer cows would be needed to produce annual replacement heifers, so more F1 recipient females could be available to produce the cloned F1 males for use as the market steers. This assumes that the new cloning methodology becomes more efficient and is economically feasible.

In summary, advances in assisted reproductive technologies have occurred rapidly in the last decade. Even scientists themselves are often amazed at the rate of progress made in the development and application of these technologies. The availability and the cost of some of these new technologies still remain in question. There is little doubt about their potential effectiveness to commercial cattle production, at least in the short run. It is obvious that including new technologies will require more intensive management by cattle producers. These new technologies appear to have, if economically practical, an opportunity for changing the genetic potential of farm animals at a faster rate than by conventional methods.

In the future, market-assisted selection for both single and multiple gene traits will become a potent assisted reproductive technology for embryos and newborn offspring. The challenge is identifying those traits important enough to merit the application of these new assisted reproductive technologies. Assisted reproductive technologies will likely play a larger role in embryo production and in the production of herd replacements. Our research approach is to develop those new assisted reproductive technologies that have economic, agricultural and medical applications. ■

Effect of Synchronization on Beef Cattle Estrus

The success of any artificial insemination program depends on the successful and accurate detection of the onset of estrus, or heat, in female animals. Injecting a herd of beef females with luteolytic agents (prostaglandins), such as Lutalyse and Estrumate, will synchronize estrus in most of the group. The ability to concentrate estrous behavior allows the producer more insemination opportunities in the herd during the course of the breeding season. Little research has been reported, however, on the effects of synchronization on beef cattle estrous behavior.

An experiment was conducted to determine if the use of luteolytic agents affected the behavioral parameters of the beef female compared with that of naturally cycling females. This study was conducted with beef cows and heifers at TransOva Genetics in Sioux City, Iowa, during spring and summer. A total of 1,812 estrous cycles occurring between April 15 through September 15 were analyzed, including 816 natural estrous cycles and 996 prostaglandin-induced estrous cycles.

Data were retrieved from the HeatWatch database, which is a computerized system used to detect estrus (DDx, Inc., Denver, Colo.). The mount data included animal identification, date, time of mating and duration of each mount. The system was used to determine the exact time of the onset of estrus.

The mean temperatures at the location of the study ranged from 77.3 to 83.2 degrees F. The exact breed types of these beef females were not available for this study, although approximately 80 percent of them were Angus or Angus-cross. The beef females were housed in dry lots and received corn silage daily. Based on observations of body condition, the females would have scores ranging between 7 to 8, on a 1 to 9 scale, with 9 considered obese. The cattle were observed twice daily, once in the morning and once in the afternoon, to appraise their health status and identify any animals with lost electronic patches.

In this study 4,800 estrous periods were identified and sorted using computer programs. Criteria used to determine the onset of estrus were four individual animal mounts within a six-hour period. Any females that did not meet this criteria were not included in the data set. The criteria for the cessation of estrus in females was the absence of at least four mounts within a six-hour period. The estrous profiles of naturally cycling females (controls) were compared with those profiles of prostaglandin-induced females (treated).

Females induced with prostaglandin exhibited a longer, more intense estrus than females with a natural estrous cycle. The prostaglandin-induced females exhibited significantly more total mounts (47 versus 42), more total seconds stood (163 versus 144) and a longer estrus (12.7 hours versus 12.2 hours) than females that had a natural estrous cycle.

In summary, there was a significant difference between the estrous profiles of the prostaglandin-induced and naturally cycling females for the parameters of estrus observed by the HeatWatch system. The values for number of mounts per hour, number of seconds stood per mount and number of seconds stood per hour, however, were similar between treatment groups.

The use of luteolytic agents was found to enhance the female's expression of estrus based on the increased duration, increased number of mounts per estrus and increased number of seconds stood per estrus when compared with naturally cycling beef females. This increase in estrous activity, coupled with the prostaglandin-induced synchronization of the breeding group, should make the detection of estrus more accurate and easier for the producer. ■

Glen T. Gentry Jr., Graduate Student, Department of Animal Science; Ronald P. Del Vecchio, Associate Professor and Beef Specialist; and Robert A. Godke, Boyd Professor, Department of Animal Science, LSU AgCenter, Baton Rouge, La.

Synchronizing Beef Females for Artificial Insemination

Glen T. Gentry Jr., Joe Lamb, Ronald P. Del Vecchio, Bruce M. Olcott and Robert A. Godke

Artificial insemination (AI) allows distribution of genes from a superior bull to many females without incurring the expense of buying the animal. Since the early 1950s, introduction of superior genetics through AI by dairy producers has resulted in an increase in milk production. Most purebred beef producers now use AI in varying degrees, either inseminating a few of their top females or depending solely on AI for their calf crops.

Although the genetic potential of a calf crop (increased weaning weights, increased weight gains, increased feed efficiency and desirable carcass traits) can be enhanced by using AI, this procedure takes a lot of time and effort. For AI to be effective and efficient, estrus detection and time of insemination are crucial. Research has shown that early and accurate detection of the female's estrus is directly related to pregnancy rates following AI.

Though time consuming, detecting estrus is not as difficult as most think. Estrus detection should be conducted at least three times per day (early morning, mid afternoon and late evening) for at least 30 minutes. For best results, insemination should take place 10 to 12 hours after the first signs of standing estrus. The time needed for insemination and estrus detection is substantial when females are not synchronized. The amount of time required could be reduced significantly if synchronization protocols are used, and females are inseminated based on time mating, not visual signs of estrus. For synchronization to be worth the time and cost, at least a 60 percent pregnancy rate in the herd needs to be achieved.

Results from research designed to determine what type of synchronization protocol yields the best pregnancy rates in a timed breeding protocol have been variable. Some researchers have reported pregnancy rates as high as 70 percent, but these findings are not typical. In most studies, pregnancy rates for females inseminated based strictly on time

A signal from the sensor attached to the cow is sent to the antenna on top of this tower and then transmitted to a computer. The system measures the time and duration the cow is mounted. This tower is at the LSU AgCenter's Idlewild Research Station and is used in research on estrous behavior.

Glen T. Gentry Jr., Graduate Student, Department of Animal Science, LSU AgCenter; Joe Lamb, Area Program Specialist, Genex Cooperative, Baton Rouge, La.; Ronald P. Del Vecchio, Associate Professor and Beef Specialist, LSU AgCenter; Bruce M. Olcott, LSU Veterinary School; and Robert A. Godke, Boyd Professor, Department of Animal Science, LSU AgCenter, Baton Rouge, La.

Photos by John Wozniak

This estrus-detection device is manufactured by HeatWatch.

It is placed in this orange pouch and attached to the cow's tailhead region with adhesive.

mating fall between 30 percent and 40 percent.

The variable pregnancy rates after timed insemination may be related to ovarian follicular waves. All females in a breeding group are at different phases of their follicular waves at the start of the synchronization protocol. Because of this, administering a luteolytic agent, such as Lutalyse, results in different durations of time between injection and ovulation, affecting pregnancy rates often negatively.

At the LSU AgCenter's Idlewild Research Station, an experiment was conducted to determine the effectiveness of breeding either on the visual detection of estrus or timed insemination on synchronized crossbred females. Two synchronization protocols were used, Syncro-Mate B and Ovsync, in 63 Brahman x Hereford first-cross beef females 55 or more days postpartum and all 6 years old. All were multiparous, meaning each had given birth to more than one calf. These females were stratified by days postpartum and body condition score and assigned to treatments either using Syncro-Mate B (28) or Ovsync (35). Females were fitted with HeatWatch rump-mounted transducers and monitored to determine the onset of estrus in each female.

Females allotted to the Syncro-Mate B group were implanted with norgestomet implants and injected with estradiol valerate and norgestomet on the first day of treatment. On day 9, implants were removed and females received prostaglandin. In the Syncro-Mate B group, calves were not allowed to nurse from day 9 until insemination. Syncro-Mate B females were time-inseminated 52 hours after implant removal.

Females in the Ovsync group were injected with a gonadotropin-releasing hormone on the first day of treatment, and on day 7, females received prostaglandin. At 30 hours, following injection with prostaglandin, the Ovsync females received another gonadotropin-releasing hormone and were inseminated 18 hours later. Calves were not allowed to nurse from day 7 until post-insemination.

Females in either treatment group that expressed estrus more than 24 hours before their designated time of insemination were inseminated approximately 12 hours after their first observed mount. Pregnancy in both treatment groups was determined by ultrasonography 30 to 35 days post insemination.

Overall pregnancy rates were similar between the two synchronization protocols. Furthermore, pregnancy rates of females inseminated either on observed estrus or at a predetermined time were not different across treatment groups. More females in the Syncro-Mate B group (57 percent) exhibited an early estrus compared with the Ovsync group (29 percent). Regardless of synchronization protocol, significantly more pregnancies resulted from females inseminated based on observed estrus (81 percent) compared with females inseminated based on time mating (35 percent) in this study.

The results of this experiment agree with other reports that pregnancy rates of between 30 percent and 40 percent can be expected when females are inseminated based strictly on time mating. To repeatedly achieve acceptable AI pregnancy rates, we feel females should be inseminated based on the visual estrus detection. Efforts will continue at these stations to search for ways to achieve consistently high pregnancy rates following timed insemination. ■

Photo by John Wozniak

The patch is placed on the tailhead region of the cow. Secure in a pouch is the estrus-detection device. These cattle are at the LSU AgCenter's Idlewild Research Station near Clinton, La.

Maintaining Adequate Body Condition Improves the Productivity of Young Beef Cows

Calving rate in Louisiana (number of live calves born annually per number of cows in the breeding herd) tends to be less than 80 percent. This low reproductive rate hurts profit potential. Body condition in beef cows at calving is considered an important factor influencing pregnancy rate, which is the number of cows becoming pregnant per total of number of cows in the breeding herd. Body condition scoring (a visual scoring of overall body fatness) of cows is something most beef producers can easily be trained to determine. Research conducted at the Rosepine Research Station and other research stations in the South examined the use of body condition scores (1 = very thin and 9 = very fat) as a method of improving pregnancy rates in mature cows (5 to 10 years of age). These researchers found that mature cows needed to be in moderate condition (a score of 5) to achieve acceptable rebreeding rates following calving.

Lifetime cow productivity is optimum when young cows calve initially at an early age and every year thereafter. Calving young cows at 2 years of age places a high demand on their body energy reserves (fat), because they are still growing. Because of an average gestation of 285 days and the desirability of rearing a calf within a 365-day period, a cow must become pregnant within an 80-day period after calving. The rebreeding of young cows has been recognized by the Louisiana Cattlemen's Association, the Louisiana Farm Bureau Federation and the LSU AgCenter as one of the major production problems of Louisiana beef producers.

Because of this concern, research was begun to evaluate changes in body weight and condition score before calving (90-day winter period) and body condition score at calving as they influence calving performance, rebreeding rates and calf growth of pregnant, 2-year-old, spring-calving heifers. This research was conducted at the LSU AgCenter's Central, Dean Lee, Hill Farm, Iberia, Rosepine and St. Gabriel research stations. Breed types of the 475 young cows varied and represented the breed resources available to Louisiana beef producers. Pregnant heifers were weighed and scored for body condition in the fall and fed one of three diets during the winter. The diets contained different energy levels (high, medium and low) and were designed to allow the heifers to either gain, maintain or lose weight and body condition score (BCS).

Neither changes in body weight nor changes in body condition during the precalving period had an influence on calving, rebreeding or calf preweaning average daily gain or weaning weight. BCS of the cow at calving influenced rebreeding, however. Average pregnancy rates for cows having BCSs of 4, 5, 6 and 7 at calving were 65 percent, 71 percent, 87 percent and 91 percent, respectively. Because a cow must rebreed within 80 days after calving to maintain a 365-day calving interval, it is important to note that the number of days from calving to rebreeding was 92, 82, 74 and 76 days for cows with BCSs of 4, 5, 6 and 7 at calving. Clearly, body condition score at calving should be no lower than 6 to realize acceptable rebreeding performance. Also, further examination of the research data revealed that it really did not matter whether a first-calf heifer was gaining or losing weight or body condition before calving, as long as she had a BCS of 6 or 7 at calving.

LSU AgCenter beef research scientists determined that 2-year-old cows calving for the first time have a significantly better chance of successfully rebreeding within an 80-day period after calving if they have a moderately high level of overall body fat (BCS of 6) at calving. This score is higher than that recommended for mature cows (BSC of 5) because of the greater energy demands of the growing young cow. Biologically, it mattered little if the young cow had gained, maintained or lost overall body fat in winter, as long as she scored the critical body condition score of 6 at calving. But, the additional winter feed cost of increasing fall body condition scores of 4 and 5 to the recommended calving level of 6 can be significant. Therefore, it is generally more cost-effective to keep heifers in moderately high body condition at the beginning and throughout the winter. ■

Wayne E. Wyatt, Associate Professor, Iberia Research Station, Jeanerette, La.; Danny F. Coombs, Professor, Dean Lee Research Station, Alexandria, La.; Sidney M. DeRouen, Associate Professor, Hill Farm Research Station, Homer, La.; Donald E. Franke, Professor, Department of Animal Science; Jeffrey M. Gillespie, Assistant Professor, Department of Agricultural Economics and Agribusiness; Paul E. Humes, Professor and Head, Department of Animal Science; David G. Morrison, Assistant Director for Animal Sciences, Louisiana Agricultural Experiment Station; and T.W. White, Professor, Department of Animal Science, LSU AgCenter, Baton Rouge, La.

Beef Cattle Nutrition Research Aims to Lower Costs, Improve Production

David W. Sanson and Danny F. Coombs

The single largest cost in a cow-calf system is providing nutrients to the animals. Between 40 percent and 60 percent of total cow cost goes into meeting the nutrient requirements. This large variation in cost is caused by many factors including the amount of nutrients the animal harvests compared to the amount of feed used, environmental factors such as heat and moisture, the efficiency of nutrient use by the cow herd, and the level and intensity of management. As a general rule, producers with lower nutrition costs graze their cattle more and feed them less processed feed.

Profitability in the cow-calf industry is affected by both the cost and amount of production. Inadequate feed can limit production by decreasing the number and weight of calves at weaning. In contrast, providing nutrients above the animal's requirement will increase production costs with no benefit. Understanding nutrition principles and forage use is critical for profitable production.

Photo by Linda Foster Benedict

David Sanson talks about the best methods for storing hay to retain nutrients at a recent field day at the Rosepine Research Station in Rosepine, La.

Forage Use and Grazing Nutrition

Louisiana beef producers have a tremendous potential for forage production because of the warm climate, but extreme heat and humidity in summer can limit forage quality and thus beef production.

The quality of a bermudagrass-dallisgrass pasture was evaluated during a four-year study conducted by the Department of Animal Science. Results documented the decrease in forage quality during the summer. Subsequently, summer forages were evaluated at the Rice Research Station using yearling steers. Results of four years of grazing indicated little difference in average daily gains among steers grazing common bermudagrass, coastal bermudagrass or dallisgrass, but steers grazing bahiagrass had lower average daily gains.

Research at the Rosepine Research Station revealed no difference in calf weaning weights when cow-calf pairs grazed either common bermudagrass or bahiagrass. Yearling steers grazing common bermudagrass, however, had a third pound higher average daily gains compared to steers grazing bahiagrass. In a subsequent study with yearling heifers, animals grazing common bermudagrass had higher gains than heifers grazing either Alicia bermudagrass or Pensacola bahiagrass, but stocking rate and beef produced per acre were lowest for the common bermudagrass treatment. In this study, a high rate of nitrogen (N) fertilizer was used, with applications of 50 pounds of N every 21 days. Results from these studies suggest that although bahiagrass may provide adequate nutrition, yearling cattle will gain more on bermudagrass pastures.

The development of hybrid bermudagrass offered southern producers a chance to increase production from cow-calf operations. Results from a long-term study conducted at the Red River Research Station demonstrated that, with adequate management and moderate fertilization, one acre of coastal bermudagrass will provide enough forage to meet nutritional requirements of one and a half cow-calf pairs. Additional research evaluating the potential for coastal and other hybrid bermudagrasses to provide the nutrients required for satisfactory production of cow-calf and stocker systems has been conducted at the Hill Farm and the Rosepine research stations. Results from these studies indicate that although production can be increased, management requirements and input costs will probably increase.

Several research stations have evaluated the nutrient potential of ryegrass and other cool-season annuals

David W. Sanson, Associate Professor and Research Coordinator, Rosepine Research Station, Rosepine, La., and Danny F. Coombs, Professor, Dean Lee Research Station, Alexandria, La.

Photo by Mark Claesgens

The single largest cost in a cow-calf system is providing nutrients to the animals. Between 40 percent and 60 percent of total cow cost goes into meeting the nutrient requirements.

for beef cattle. Studies have evaluated stocking rates, different grazing methods, different combinations and varieties of cool-season grasses, as well as other aspects of ryegrass grazing. Results have indicated that ryegrass is an excellent winter forage throughout the state and can improve both the production and economic efficiency of cow-calf producers and stocker producers. In addition to cool-season annuals, research at the Rosepine Research Station has evaluated the use of fescue as a cool-season forage to extend the grazing season. Results from this study using spring-calving cows indicate that the forage will provide adequate nutrients for maintenance of cow weight and calf growth. Conception rates are 20 percent to 25 percent lower, however, than for cows grazing ryegrass or hay plus a supplement.

Researchers at the Rosepine and Northeast research stations have completed several studies evaluating different forage systems for providing adequate nutrition for cow-calf production year round. These studies included different combinations of summer grasses and combinations of winter annuals and legumes. Results highlight the effect location and weather patterns have on forage production and subsequent animal performance.

Several research stations and the Department of Animal Science conducted a series of cooperative studies during the 1980s to evaluate producing slaughter beef on forage diets in Louisiana. In general, results showed that it is feasible to grow calves to slaughter weights on Louisiana forages, but it has not been economical for Louisiana producers to finish cattle on forages. They continue to send cattle to the Great Plains for finishing on grain.

Research is continuing on the effects of forage use on cow-calf production at research stations around the state. Researchers at the Iberia Research Station are evaluating the effect of stocking rate and grazing systems of both warm-season and cool-season grasses on performance of cows and calves. The effect of adding legumes to fescue is being evaluated at the Rosepine Research Station as well as a comparison of grazing bermudagrass to bahiagrass with mature beef cows.

Supplementation

Winter feeding accounts for more than half of the nutrition costs in a cow-calf system. This is primarily because of the cost of producing harvested forages and purchased supplements. Molasses-based protein supplements were evaluated by Dean Lee Research Station researchers using spring-calving cows consuming medium-quality bermudagrass hay. Supplements had no effect on cow weight change, calf weaning weight or calving percentage. Subsequent research at both Dean Lee and Rosepine research stations has indicated that a medium-quality grass hay will meet the requirements of a gestating cow and supplementing with either a grain-based or a molasses-based supplement with this type of forage has no benefit.

Researchers at the Dean Lee Research Station evaluated supplementing calves grazing lower quality standing bermudagrass in the fall before grazing winter annuals. Results from this study indicated higher gains by the supplemented calves during the supplementation period. The economics of supplementation were marginal to negative, however. Similar results were observed at the Iberia Research Station. Researchers there conducted a two-year study that indicated that feeding soybean meal to steers grazing coastal bermudagrass increased gains by a third of a pound. Research at the Iberia Research Station with steers grazing coastal bermudagrass supplemented with corn resulted in increased performance, but the economic benefit was marginal.

Research is being conducted at both the Rosepine and Dean Lee research stations to evaluate the effect of corn supplementation for mature cows during late gestation on utilization of low-quality hay. Researchers at the Hill Farm Research Station are evaluating poultry litter as a supplement for cows and stocker cattle. Also, Animal Science Department researchers are conducting supplementation studies at the St. Gabriel Research Station to evaluate sources of protein and energy on growth of stocker cattle. ■

Beef Processing, Products and Packaging

Kenneth W. McMillin and J. Samuel Godber

Beef products available to consumers have been changing in recent years and will continue to change. Processing techniques and packaging procedures have been developed to accommodate the consumer's desire for convenience, nutrition and safety of meat products.

LSU AgCenter research has played a major role in these changes. One area of focus has been ground beef, the No. 1 beef product in the United States. A lot of the meat technologies for ground beef purchased at the supermarket have been influenced by LSU AgCenter research. Experimentation has been conducted on using protein from other sources to improve the shelf life, flavor, color and safety of ground beef. For example, use of bovine blood plasma, red cells and decolorized red cells decreased the lightness and yellowness of ground beef patties.

In addition, the way the ground beef is packaged has been influenced by LSU AgCenter research. Much attention has been given to newer packaging technologies using atmospheres containing proportions different from the air around us, which is 20.9 percent oxygen, 70 percent nitrogen and 0.03 percent carbon dioxide. Modified atmosphere packaging (MAP) is increasingly used as more raw meat is centrally prepacked at the processing plant rather than packaged in the retail store. Still other studies have looked at use of ozone as an alternative way to kill pathogens in meat products.

Efforts to improve the utility of beef from cull cows involved collaborative efforts with Auburn University. The cows received a growth hormone, bovine somatotropin, which increases muscle protein. Beef from these cows had less fat, more moisture and a redder color.

Other research has focused on lipid and pigment oxidation in precooked beef products, which affects color, texture and flavor, and on improving binding of restructured beef. For example, research has examined the influences of heating conditions on precooked, restructured roasts.

Nutritional value of beef has been relatively controversial. Although beef is one of the most nutrient-dense foods, more attention has been paid to the negative nutritional concerns such as saturated fat and cholesterol. LSU AgCenter research has focused on positive nutritional aspects of beef and at improving beef's nutritional value.

One research focus has been the "meat factor" in which beef enhances the bioavailability of nutrients such as iron and copper. Bioavailability refers to the efficiency with which our bodies utilize a dietary nutrient. Evidence suggests that beef enhances the bioavailability of certain minerals and vitamins from sources that would otherwise be of low nutritional value.

That beef provides an excellent source of dietary iron in the form of highly bioavailable heme iron is well-known. Less well-known is that beef enhances the bioavailability of iron from nonmeat sources, such as spinach and rice bran, which are known to have high concentrations of nonheme iron. The meat factor is now well enough established scientifically that meat's presence in the diet is taken into account in the National Academy of Sciences' Recommended Dietary Allowances for iron. However, little is known about the potential effect of beef on nutrients other than iron. Thus, experiments have been conducted to determine whether the meat factor exists for other minerals.

In one project an animal model was used to evaluate mineral balance for iron, copper and zinc. The only mineral that evidenced increased absorption because of the presence of beef in the diet was copper. This research was the first to show that beef could improve the bioavailability of copper from a nonmeat source. This observation symbolizes the need to consider the overall nutritional value of a food when making dietary recommendations.

Other research has focused on incorporation of rice bran or rice bran components into beef products. Rice bran is an excellent source of many vitamins and minerals and has been shown to lower serum cholesterol, although mineral bioavailability is lowered by rice bran. Combining rice bran with beef has the potential to enhance nutritional aspects of each through complementary effects.

The research approach we used to enhance the nutritional value of beef was to develop functional beef products by combining beef with rice bran. A functional food is one that provides health benefits beyond its nutritional value. Thus, if a food product were found to reduce the risk of coronary heart disease or cancer, it would be considered a functional food. Typically, plant foods are viewed as the main source of functional foods. Rice bran oil contains high levels of antioxidant nutrients that have been shown to reduce serum cholesterol and reduce the risk of certain types of cancer. Our goal was to incorporate rice bran oil into a restructured beef product to improve from a healthful standpoint the lipid composition and at the same time reduce the tendency for cholesterol oxidation, which has been associated with coronary heart disease. Restructured beef roasts were manufactured from lower quality beef cuts. Beef was mixed with salt, water and rice bran oil (at the expense of fat trim) and formed into restructured roasts. Also, the vitamin E level increased as rice bran oil increased. Vitamin E is one of the antioxidant nutrients touted as having positive effects on the healthfulness of foods.

These and other studies on products, processing and packaging have benefited the industry by providing information to improve quality, nutritional value, palatability and safety of beef for consumers. ■

Kenneth W. McMillin, Professor, Department of Animal Science, and J. Samuel Godber, Professor, Department of Food Science, LSU AgCenter, Baton Rouge, La.

Reduction of *E. coli* in Ground Beef with Gaseous Ozone

Photo by John Wozniak

Kenneth McMillin, left, has been awarded patents for a technique he developed for using ozone to inhibit pathogen growth in ground beef. His research associate is Michael Michel.

The importance of eliminating foodborne illness from the food supply has prompted much research on control and destruction of pathogenic microorganisms. Pathogens often survive, and some grow at the refrigerated temperatures for meat processing and storage.

The popularity of ground beef, comprising about 45 percent of total beef consumption in the United States, makes the control of pathogenic microorganisms critical. Irradiation is effective in destroying pathogenic microorganisms, but obstacles include the number and expense of facilities to irradiate large amounts of ground beef, approval of packaging materials and exclusion of oxygen from packages to prevent off-odor development. Food scientists are seeking other effective preservation methods to destroy harmful bacteria.

A series of studies has been conducted to determine the efficacy of gaseous ozone on destruction of *E. coli* and other pathogenic microorganisms in meat. Preliminary results indicated that coliform indicator microorganisms, or *E. coli*, on ground beef patties were inhibited the same with ozone gas or 80 percent oxygen atmospheres compared with nitrogen or air atmospheres.

A study comparing half and maximal output of ozone, approximately 1,000 and 5,000 ppm ozone, on ground beef inoculated with *E. coli* showed no inhibition by ozone after 48 hours of storage compared with control (nontreated) beef patties. The inoculum concentrations of *E. coli* were much higher than would be found in commercial ground beef, which may have given some protective effect in buffering the microorganisms from the effects of ozone. When ozone was left in packages rather than being flushed with nitrogen gas immediately after treatment of patties, there was a reduction in *E. coli* concentrations after 24 hours of storage at 40 degrees F. Studies with ozone are conducted by flushing ozone gas into gas-tight packages containing the meat. This provides maximal exposure of the beef to the ozone while minimizing loss of ozone gas into the room atmosphere and exposure to laboratory workers.

Ozonated water is effective at killing bacteria with short exposure times. This led investigators to compare the effects of humidified ozone gas with dry ozone gas. Ground beef patties of about 100 grams were formed by hand and inoculated with *E. coli*. Ozone was generated at 500, 3,500 or 5,000 ppm. The ozone gas stream to be humidified was passed through a specially designed chamber before insertion into packages. Figure 1 shows that exposure to ozone decreased *E. coli* counts in ground beef patties, with increasing levels being more effective. Dry ozone gas was slightly more inhibitory than humidified gas.

The 10 total studies on ozone and ground beef have indicated that ozone has the potential to destroy pathogenic bacteria with specific environmental conditions and ozone levels. Because the concentrations of *E. coli* used in the studies were much higher than levels found commercially, the level of inhibition exhibited in these studies may prove beneficial for industry adaptation. Linking of ozone gas exposure with other bacterial growth hurdles, such as low temperatures or carbon dioxide gas, is being investigated. The availability of different processing technologies to ensure a safe supply of high quality food relies on continued scientific efforts. ■

Kenneth W. McMillin, Professor, and Michael E. Michel, Research Associate, Department of Animal Science, LSU AgCenter, Baton Rouge, La.

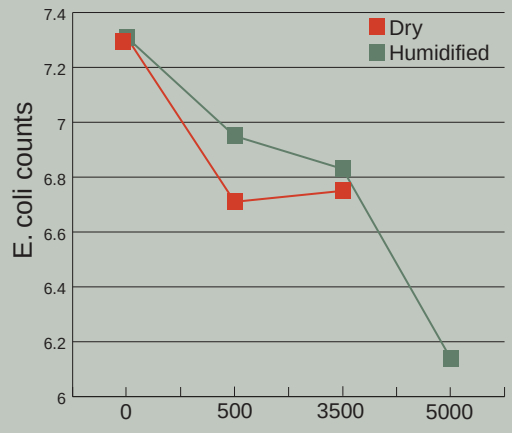

Figure 1. *E. coli* inhibition with ozone gas

From our archive

A Brahman bull from Palacious, Texas. April 1931

Early research in Louisiana indicated that Brahman crossbred cattle were superior in many ways to other breeds for the climate and conditions of Louisiana. See articles about crossbreeding on pages 7, 9, 10, 12 and 25.

Meat cutting demonstration in Ringgold, La., sometime in the 1930s.

Group of steers from the New Orleans Livestock Show. May 1936

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Louisiana Agricultural Experiment Station
Louisiana State University Agricultural Center
P.O. Box 25100
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