

# Bovine Trichomoniasis

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Bovine trichomoniasis (“trich”) is a **venereal disease** of cattle caused by the protozoan *Tritrichomonas foetus*. Infections with *T. foetus* can cause pregnancy loss and abortions throughout pregnancy, and in herds with a long breeding season, it may also extend the calving interval of cows.

Although losses are observed in the cow, *T. foetus* lives on the surface of the penis and prepuce of the bull and in the reproductive tract of the cow. Trich prefers a reduced oxygen environment, and it multiplies on the tissue on the bull’s penis. Because older bulls are more susceptible to infection, using young bulls is part of a disease management strategy. There are no outward signs of trich in bulls, and pregnancy loss is the only sign of the disease in heifers and cows.

Transmission of the disease occurs during natural breeding. A bull can infect a cow, and a cow can infect a bull. Once a bull is infected, it remains so for life. However, most infected cows eventually clear the infection. The male is the sentinel for disease control, and control programs focus on detecting and eliminating infected bulls. There is no treatment for infected bulls.

During mating, organisms from the surface of the penis are left in the vagina where they multiply and invade the uterus to create an infection. Cows can still conceive because it may take a few weeks for the uterine infection to develop. Once the organism causes sufficient damage to the lining of the reproductive tract, the cow will abort. Cows will naturally clear the infection over a few weeks to several months and experience a brief period of immunity to the disease. After clearing the infection, cows can rebreed to an infected bull and deliver a live calf. The period of immunity is short and will not protect subsequent pregnancies if the cow is re-exposed to an infected bull.

Managing cows exposed to trich is problematic. Despite pregnancy status, all newly acquired cows of unknown history cannot be considered infection-free and should not be added to the resident herd until they have calved.

Because approximately 2 to 5 percent of infected cows with trich will have a swollen uterus that contains pus (pyometra) and remain infective, all open cows should be examined by a veterinarian. Cows with pyometra should be sent to slaughter.

Trich should be suspected in herds with poor conception rates and extended calving seasons. Infected herds can produce conception rates that range from slightly subnormal to 50 percent or lower, depending on the length of time the disease has been in the herd and the number of animals infected. Conception rates in herds with controlled breeding seasons of 90 days or less will be even poorer. Shorter breeding seasons expose the problem more dramatically and can reduce the long-term production and economic losses caused by herd infection.

Because trich can enter a herd and disease is not readily apparent, it is better to prevent exposing the herd to the disease rather than managing an infected herd. Trich only enters a herd or ranch via infected bulls, cows, or heifers. Again, transmission is from infected bulls to cows or from infected cows to bulls. If a neighbor’s or other outside bull comingles with your cows, ensure the bull is tested for trich, preferably at least a week after removal from your herd.

To eliminate trich from a herd, work with your veterinarian to manage infected cows and eliminate infected bulls.

A vaccine is available for healthy cattle to aid in preventing disease caused by *T. foetus*. Use of this vaccine in herds with high risk of exposure has been shown to help reduce the economic impact of trich when administered properly and in exact accordance with the label. It has also been shown to help infected cows recover more rapidly. This vaccine does not

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prevent infections or abortions; however, using it in addition to other biosecurity practices will minimize reproductive losses.

Economic losses caused by bovine trichomoniasis can be avoided or minimized by practicing sound biosecurity principles.

1. Maintain good perimeter fences to segregate cattle of unknown status. Fences are the first line of defense in preventing the introduction of trich in the herd.
2. Keep the bull inventory as young as possible. Buy only virgin bulls and heifers, preferably from the original breeder. Unless the virginity of bulls can be positively confirmed, test all bulls before adding them to the herd. Bulls of unknown status may require multiple negative tests using PCR or culture before they are confirmed as not being infected. These tests should be administered at least 1 week apart, and bulls should have no contact with cows within 1 week of the initial test and until all testing is complete.
3. Implement a defined breeding season. Trich can go undetected in continuous-breeding herds.
4. Identify herd sires and record the breeding group of each bull. If the herd becomes infected, this will make it easier to isolate the problem and start management protocols to eliminate the disease.
5. Consider keeping bulls in the same breeding groups for several seasons. If an infected bull is present in the battery, this will prevent other cattle from being exposed.
6. Consider small sire groups (but not necessarily single sire) versus large sire herds to avoid infecting several bulls in a single season. Monitor pregnancy closely in one-herd grazing systems and implement an annual bull testing program to detect the introduction of trich during the breeding season.
7. Consider artificial insemination to prevent the introduction of trichomoniasis or to help break the cycle of infection in a herd. Reputable semen companies repeatedly test bulls for many diseases, including trich, to ensure the semen is not contaminated.
8. Manage newly purchased cows regardless of pregnancy status as potentially infected until proven otherwise. If you buy replacement cows, isolate them from the existing herd during the first breeding season. If possible, only expose these cows to young bulls.

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# CHOOSING THE TIME OF YEAR TO BREED AND CALVE BEEF COWS IN TEXAS

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As any cattleman knows, the time of year when cows calve directly affects many herd management practices:

- ▶ The start of calving is dictated by the start of breeding.
- ▶ Cows calving in the fall normally need more supplemental feed in the winter, unless cool season pastures are used, than do cows that calve in the spring.
- ▶ Fall-born calves will be marketed in the spring and calves born in the spring will be marketed in the fall unless the producer can retain ownership of calves past weaning.

These few differences in management indicate that a producer should give careful consideration to the time of year in which to calve cows. The decision of when to calve is complicated by numerous factors and, in many instances, inattention to details can dramatically affect costs of production, animal performance, income and profitability.

## THINGS TO CONSIDER

The first thing to realize is that there is no single date that is best for the start of calving. However, there are breeding and calving dates that probably should be avoided because differences in climate in regions of Texas can affect the availability and conditions of pasture needed for nutrition of pregnant cows and calves.

There are a few principles about fertility in cows that a producer should consider in deciding when to breed and calve the herd.

### Principle 1

Regardless of management influences, fertility among cows is variable. Table 1 shows that fertility is highest in cows that conceive at first service, and it is clear

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that cows requiring more than two services during the breeding period are the least fertile in the herd.

Table 1. Pregnancy rate in cows requiring multiple services.

Number of services	Number of cows	Pregnancy rate
One	220	77.3% <sup>a</sup>
Two	28	35.7% <sup>b</sup>
More than two	67	16.4% <sup>c</sup>

<sup>a,b,c</sup>P < .005, Sprott et al., 1998, PAS 14:231

### Principle 2

It is important to properly feed cows so that they can show estrus early in the breeding period. Table 2 shows that cows that display estrus within the first 21 days of breeding have higher pregnancy rates compared to cows displaying estrus after the first 21 days of breeding. Consequently, pregnancy rates are high in herds that have a high proportion of cows showing estrus early in the breeding period.

Table 2. Pregnancy rate in cows showing estrus early in the breeding period.

Number of cows	Time of estrus	Pregnancy rate
220	First 21 days	81.8% <sup>a</sup>
65	After first 21 days	58.5% <sup>b</sup>

<sup>a,b</sup>P < .005, Sprott et al., 1998, PAS 14:231

### Principle 3

Most of the pregnancies within a herd occur in the cows with highest fertility. Table 3 shows that 95 percent (Trial 1) to 97 percent (Trial 2) of all pregnancies are attributed to cows conceiving at their first or second estrus. Only 3 percent (Trial 2) to 5 percent (Trial 1) of

pregnancies are attributed to cows that conceive at their third estrus.

Consider these principles regarding cow fertility in deciding when to start breeding. It could increase the chances that the most fertile cows will conceive and ensure high pregnancy rates.

**Table 3. Cows generating the most pregnancies in the herd.**

Trial	Number of cows	Number pregnant	Percent (%) of all pregnancies occurring at:		
			1st estrus	2nd estrus	3rd estrus
1	285	229	208/229 (91)	10/229 (4)	11/229 (5)
2	251	216	177/216 (82)	33/216 (15)	6/216 (3)

Trial 1 - Sprott et al., 1998, PAS 14:231  
 Trial 2 - Sprott, 1999 (unpublished)

## FERTILITY IN SUMMER MONTHS

Temperature and humidity during certain months are stressful and can reduce fertility. Table 4 shows that if cows exhibit their first estrus after the month of May in Central Texas (Trial 1) or April in the Gulf Coast region (Trial 2), the chances of conceiving are dramatically reduced.

**Table 4. Fertility at first estrus during spring breeding as affected by month (Texas).**

Trial	April	May	Percent (%) of all pregnancies occurring at:		
			June	July	July - Sept.
1	—	180/220 (81.8)	38/65 (58.4)	11/67 (16.4)	—
2	31/41 (75.7)	13/29 (44.8)	10/22 (45.4)	—	3/19 (15.8)

Trial 1 - Sprott, et al., 1998, PAS 14:231; May vs June, P < .005, June vs July, P < .005 (number of cows - 285);  
 Trial 2 - Sprott, 1999 (unpublished, Brazoria County, TX), P < .005 (number of cows - 111)

Results, at either location, showed pregnancy rates were less than 17 percent in cows displaying their first estrus during July through September. That indicates that summer breeding in these two regions of Texas is not recommended.

Research has shown that this reduction in fertility is a result of heat stress brought on by high temperature and humidity that combine to raise the temperature/humidity index. Heat stress in cows is known to cause hormone imbalances, reduced quality of ova, early embryo death and reduced blood flow to the uterus. These factors, either singly or in combination, result in low fertility.

Likewise, bulls also are affected by heat stress that causes sperm cell quality to decline. As a result, when heat stress occurs, its negative effects on fertility in both the cows and bulls reduces the chance of pregnancy.

Similar studies have not been conducted in other areas of Texas, but it appears that late summer rains and low humidity in areas of West Texas allow producers in that region to breed their cows during summer months without experiencing major reductions in fertility. In contrast, high humidity in eastern, southeastern and Gulf Coast regions of Texas suggests that summer breeding may not be advisable.

## FERTILITY IN WINTER MONTHS

Unfortunately, data concerning pregnancy rate at first estrus during the cold months in Texas are not available. However, Table 5 shows that Central Texas cows exposed for breeding during November, December and January have acceptable reproductive performance.

**Table 5. Pregnancy rates (%) in central Texas cows bred in the fall (Nov., Dec., Jan.).**

	Year					
	1988	1989	1990	1991	1992	1993
<b>Herd 1</b> (Fayette County)	—	74	76	86	94	93
<b>Herd 2</b> (Hays County)	87	83	92	91	—	—

Herd 1 - 107 cows  
 Herd 2 - 35 cows

Note that the lower pregnancy rates in Herd 1 (1989, 1990) and Herd 2 (1988, 1989) were attributed to nutritional problems. Pregnancy rates improved when the herd owners corrected their management practices. If nothing else, data in Table 5 indicate that proper nutrition is required and that temperatures during Central Texas winters are not so stressful that fertility is compromised.

from 56 to 124 pounds (Table 6) in summer-born calves probably is not economically acceptable to a producer.

In six other Texas trials, management steps to eliminate summer-born calves and concentrate the calving season in the cooler months of spring or fall resulted in an average 74 percent increase (range of 27 percent to 150 percent) in production.

It also is clear that fertility in cows bred in July through September (Table 4) drops. Depending on location, cows (Texas Gulf Coast region) bred in May and June had pregnancy rates approximately 30 points below those bred in cooler months, while cows in the central and Gulf Coast regions bred from July through September had pregnancy rates from 60 to 65 points below cows bred in cooler months.

The lack of data on calf performance and fertility for cows in West and North Texas prevents any statement about the appropriate months to calve and breed in those regions. But summer breeding and summer calving in eastern, central, southern and the Gulf Coast regions of Texas is not recommended.

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# New World Screwworm

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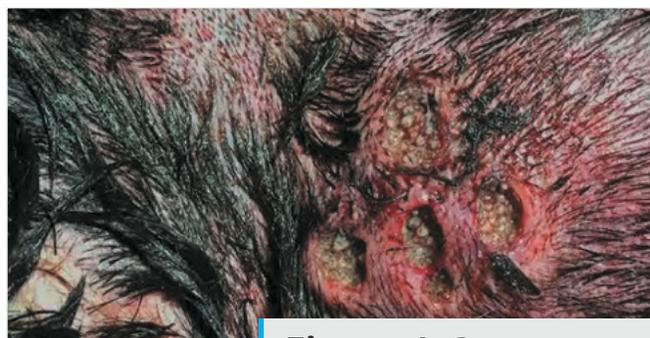
## Background

The New World screwworm (NWS, *Cochliomyia hominivorax*) is a parasitic fly native to the Western Hemisphere. It lays eggs in the living tissue of fresh wounds in warm-blooded animals. The larvae (maggots) feed on the host's flesh, causing severe wounds and often death if untreated. The pest was eradicated in the U.S. in the 1960s. Since then, it occasionally reemerges and has resurfaced in Central America and Mexico. They are controlled only through the release of sterile males, known as the sterile insect technique (SIT). This approach, along with regular active surveillance and livestock inspections, has proven highly successful. As of May 2025, renewed attention to this parasite is crucial, as it may pose future risks to livestock and wildlife.

## Signs of New World Screwworm in Animals

The name screwworm refers to the feeding behavior exhibited by the maggots as they burrow (screw) into the wound. These maggots and their feeding cause extensive damage by tearing at the hosts' tissue with sharp mouth hooks. The wound will become larger and deeper as more and more eggs hatch and larvae feed on the living tissue. This results in serious and often deadly damage to the animal if not discovered and treated.

Continual and regular monitoring and evaluation of all livestock are important for herd and flock biosecurity and health considerations. Producers should be alert for possible signs associated with potential infestation including:



**Figure 1.** Screwworm infestation in a dog.

- Foul-smelling wounds with visible maggots;
- Animals biting or licking at wounds;
- Lesions in navels, ears, and dehorning or branding sites; and
- Unusual restlessness or lethargy.

In the New World screwworm, the larval stage (Fig. 2) is responsible for inflicting significant injury and economic loss. These larvae inhabit the wounds of living animals, where they cause extensive tissue damage. Mature larvae can reach 17 mm in length (or  $\frac{2}{3}$  of an inch), and have spines that protrude from the body and wrap around in a spiral, giving them the name screwworm. Official identification of larvae is based largely on the presence or absence of dual internal breathing tubes. Confirmation of the fly identity can be determined only by a trained individual. Specimens must be submitted to the Texas Animal Health Commission.



**Figure 2.** Screwworm larva.

## Suspicious Cases Must be Reported

Immediately isolate any suspected animals and contact:

- Your local veterinarian or wildlife biologist;
- The Texas Animal Health Commission: (800) 550-8242; and
- The U.S. Department of Agriculture Veterinary Services: (512) 383-2400.

To prevent unintentional spread, avoid transporting any suspected animals until advised.

## Identifying Screwworm Flies

Adult New World screwworms (Fig. 3) are metallic blue blow flies, have three distinct stripes that run down the top (thorax) of the fly just behind the head, and have large orange eyes.

This fly resembles the closely related secondary screwworm, *Cochliomyia macellaria*, which is also a metallic blue blow fly with three distinct stripes. However, the stripes all begin at the same point behind the head. Adult secondary screwworms do not deposit eggs on living animals, and their larvae do not infest them. Therefore, they do not pose a threat to animal health.



**Figure 3.** Adult New World screwworm fly.

Adult flies of interest can be photographed. Please send pictures to the Texas A&M AgriLife Extension Service: [screwworm@ag.tamu.edu](mailto:screwworm@ag.tamu.edu)

Report any mammals or birds (wild or domesticated) with signs of irritated behavior or head shaking, that express a smell of decay but are alive, or that show evidence of flystrike and/or the presence of fly larvae (maggots) in wounds.

## Potential Control Products for Use in the U.S.

U.S. producers have not treated livestock for NWS in more than 40 years. Although this health threat has not been experienced in several decades, several treatment strategies exist today, and should always be used in consultation with your local veterinarian. Treatments could include:

- Preventive measures: treat wounds promptly and maintain sanitation; and
- Post-infestation treatments: topical larvicides (e.g., coumaphos and permethrin), and cleaning and removal of larvae.

Visit the U.S. Department of Agriculture Animal and Plant Health Inspection Service (USDA-APHIS) for a list of potential pesticides to use against New World screwworm:

<https://www.aphis.usda.gov/sites/default/files/pesticides-for-nws.pdf>

# Screwworm in the New World

Screwworm infestations occur in Jamaica, Cuba, and across South America. Increasing detections of this fly north of its containment barrier, the Darién Gap in Panama, were noted in 2023. Typical insecticide suppression of the New World screwworm is less effective than with other insect pests due to its wide host range and occurrence on wildlife.

## Online Resources

### **Texas A&M AgriLife Extension Screwworm Web Page**

<https://agrilifeextension.tamu.edu/new-world-screwworm/>

### **USDA-APHIS New World Screwworm Web Page**

<https://www.aphis.usda.gov/livestock-poultry-disease/cattle/ticks/screwworm>

### **Texas Animal Health Commission New World Screwworm Emergency Management Guide**

[https://www.tahc.texas.gov/animal\\_health/feverticks-pests/EMGuide-NewWorldScrewworm.pdf](https://www.tahc.texas.gov/animal_health/feverticks-pests/EMGuide-NewWorldScrewworm.pdf)

### **Texas A&M Veterinary Medical Diagnostic Laboratory**

<https://tvmdl.tamu.edu/>

### **History of the New World Screwworm in the U.S.**

<https://www.nal.usda.gov/exhibits/speccoll/exhibits/show/stop-screwworms--selections-fr/introduction>

## **New World Screwworm and Other Flies that Produce Myiasis in Animals**

<https://www.merckvetmanual.com/integumentary-system/flies/obligatory-myiasis-producing-flies-of-animals>

## **Biosecurity and Herd Health Considerations**

<https://www.aphis.usda.gov/livestock-poultry-disease>

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# Rethinking Livestock Management to Consider Screwworm

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New World screwworm (NWS) in Texas is reportable to the Texas Animal Health Commission (TAHC), 800-550-8242 (<https://www.tahc.texas.gov/>) for livestock and companion animals and Texas Parks and Wildlife Department (TPWD), 512-389-4505 (<https://tpwd.texas.gov/>) for wildlife. Producers should also inform and follow up with their private veterinarian. It is critical to report suspected cases to the proper authorities to minimize the spread and future threat of NWS.

## I. Introduction

The northern migration from Central America of the New World screwworm (NWS), *Cochliomyia hominivorax*, poses a renewed threat to Texas and U.S. livestock producers. Although this devastating parasite was officially eradicated from the United States in 1966 with the sterile insect technique (SIT), the risk of reintroduction persists, particularly along the southern U.S. border. The NWS inflicts economic losses and serious animal health challenges by infesting wounds and causing rapidly expanding tissue damage. Proactive, management-focused strategies based on seasonal timing, geographic awareness, and frequent herd and flock surveillance are critical for preventing NWS infestations. If this pest is found again in

the United States, SIT will be used again, but it is important to recognize that neutralization of NWS by SIT will not be instantaneous. Given that many livestock operations plan their production schedules months, if not years, in advance, this publication is intended to outline considerations that can be made in preparation for potential future detection of NWS in the United States.

## II. Screwworm Biology

The female NWS fly lays eggs in and around open wounds or sores within mucous membranes of warm-blooded animals.

The term “screwworm” refers to how the newly hatched larvae burrow into live tissue, feeding aggressively and causing a condition known as *myiasis*. The odor of screwworm feeding on live flesh is notoriously

distinct and often a first sign of detection. Livestock that have myiasis are immediately at risk of significant health and performance limitations and can die within a week or two of contracting the condition if not treated promptly. Once NWS become established on an animal, the larvae remain on that same animal (will not be transferred to other livestock) and complete their feeding period in 5 to 7 days before dropping to the ground to pupate and complete the rest of the NWS life cycle. The geographic spread of NWS is mostly attributed to infected animals being transported by humans and, to a lesser extent, adult fly mobility.

Detection of livestock with myiasis is critical. However, due to the rapid progression of the condition, this may prove especially difficult for large, extensively managed livestock operations. It is paramount for these

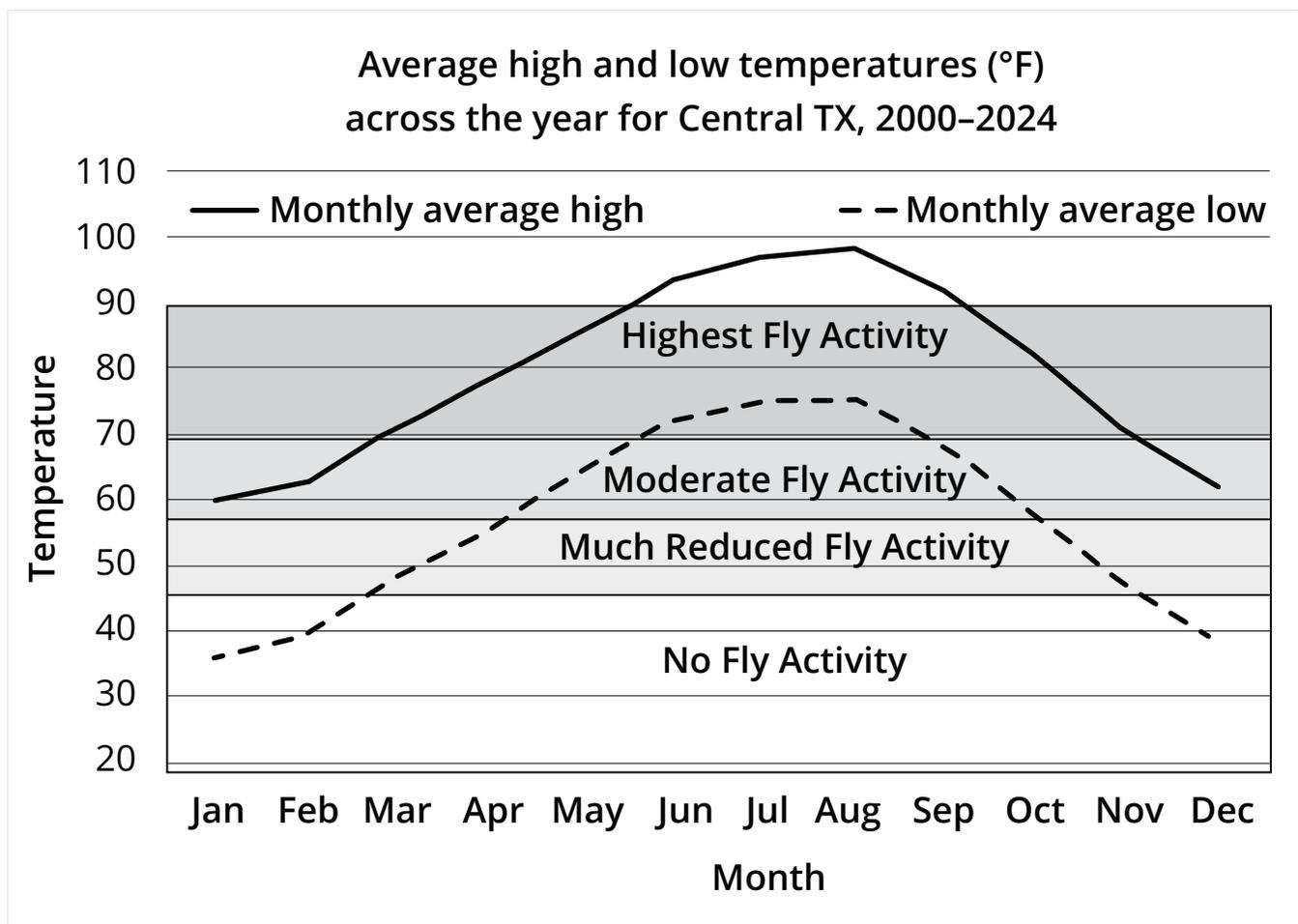


Adult New World screwworm fly (*Michael Miller/Texas A&M AgriLife*)

operations to limit management practices that create a higher NWS risk to times of the year when NWS flies are less active. To plan a production schedule with the threat of NWS in mind, it is helpful to recognize the impact of temperature on fly activity and development.

The NWS fly life cycle is highly sensitive to temperature:

- In **warm (80+ degrees F daytime highs) and tropical conditions**, the full *C. hominivorax* life cycle may be completed in **2 to 3 weeks**.
- In more **temperate conditions**, the life cycle may take **3 to 4 weeks**.
- In **cooler conditions**, the life cycle may take up to **2 to 3 months**.



Pupae are vulnerable to *soil temperatures* below **46 degrees F**, and there is limited activity of the adult NWS fly below **59 degrees F**. It is important to understand that flies do not die at these lower activity temperatures, but prolonged exposure to these temperatures can reduce populations or active infestations. The NWS ability to survive the winter is restricted to locations where low temperatures are regularly above freezing. Ideal adult fly activity occurs at **77 to 86 degrees F** and relative humidity of **30 to 70 percent**. Producers should coordinate management practices with weather patterns expected for their region.

### III. Preventative Management by Season

Integrated pest management considers the parasite life cycle, strategic use of treatment products, and limiting higher-risk management practices during times when NWS could be active to reduce the impact of NWS on livestock operations.

Historically, screwworms have been especially lethal to newborn livestock, with wet navels being especially attractive egg-laying sites for NWS flies. The vulnerability of newborns to NWS almost always resulted in death if they became infected and went undetected and untreated, posing serious economic losses. For operations that birth in pastures, the timing of breeding



and birthing may need to be adjusted to cooler times. Important to this effort is having defined birthing and breeding seasons, as opposed to leaving sires with females year-round.

Although having livestock give birth during winter or the early spring months limits the risk of NWS, it can pose challenges with the seasonality of breeding, dam nutrition, and predation (especially for sheep and goats). While this publication is not meant to be comprehensive with regard to cool-season birthing strategies, producers are encouraged to include NWS as one of the factors when making production schedule decisions. Livestock producers can draw a positive, though, from rescheduling to a winter-focused birthing schedule, as this may result in stronger market prices of offspring sold after weaning compared to the greater number of spring-born offspring, which can depress prices due to higher supply.

While newborn livestock may be at the greatest risk, it is also important to consider the management procedures often conducted in the first ~3 months of life that can create a suitable wound for NWS. Notably, castration, ear tagging, branding, dehorning, and tail-docking of lambs are all procedures that should be timed during cooler seasons (Table 1). This also means that rescheduling birthing to occur around the last frost date for a region may still put “spring works” during fly season. For producers with fiber-producing livestock (wool sheep and hair goats), potential nicks and cuts from shearing pose a NWS risk, enhancing the need for diligence in observation and treatment until recovery.

**Table 1. Schedule production practices to reduce NWS threat**

Cool season (low fly activity)	Warmer season (high fly activity)
<ul style="list-style-type: none"><li>• Birth season (newborn navels are very vulnerable)</li><li>• Castration</li><li>• Dehorning</li><li>• Branding, ear tagging, and ear marking for ID</li><li>• Implant placement</li><li>• Tail docking</li><li>• Shearing</li><li>• Planned surgical procedures</li></ul>	<ul style="list-style-type: none"><li>• Reconsider practices that create wounds.</li><li>• Frequent livestock checks</li><li>• Prompt application of insecticide application</li><li>• Ensure fly control measures are in place around livestock housing and working areas.</li></ul>

Though some management practices can be confined to seasons with lower fly activity, it is not realistic that every operation can immediately reschedule management during these times. The important take-home message is that if flies are active and livestock have wounds of any size, it is critical to be diligent in monitoring for pests and utilizing best management practices to promote healing.

## **IV. Identification of NWS**

Screwworms differ from other blow fly maggots in that they feed only on live flesh. Resources for identifying screwworms can be found in the AgriLife Extension New World Screwworm Fact Sheet ([tx.ag/NWScrewwormFactsheet](http://tx.ag/NWScrewwormFactsheet)).

It is only through rapid detection and reporting that an effective response can be implemented.

If NWS becomes established in the United States again, it is important to be knowledgeable about identifying suspected cases, and more specific collection recommendations will become available.

If NWS is suspected, report it to the Texas Animal Health Commission. Contact a local veterinarian and/or AgriLife Extension County agent. Follow the instructions of the veterinarian or animal health professional on next steps.

## V. Potential Treatment of NWS

Producers should always consult their private veterinarian. It is likely that new treatment strategies will be developed and recommended if NWS is found in the United States. Current treatment option considerations include:



**Topical:** Permethrin sprays for immediate wound treatment and prevention of fly attraction. Some aerosol products for screwworm control do not require a prescription and can be found at animal health suppliers. Permethrin ear tags can also be useful.

**Systemic:** Coumaphos is an approved systemic treatment for NWS. Although applied topically, its actions are systemic and its effects are longer

than those of permethrin. Due to potential toxicity, the formulation used for NWS is sold as a Restricted Use Pesticide. Thus, a certified applicator license is required for its purchase and use.

**Wound care:** Clean wounds thoroughly with an approved disinfectant and reapply as directed. Cover wounds if practical during higher-risk seasons.

Consultation with a veterinarian is strongly encouraged to develop an operational herd or flock health management and biosecurity plan (Table 2). Please do not be intimidated about reporting concerns to a veterinarian or any authority. While some may feel hesitant to report for fear of regulatory oversight of their operation if NWS is detected, it is important to remember that full-scale establishment of NWS in a region could have devastating impacts for many years. Although early detections might result in livestock movement in and out of a region being temporarily restricted, quick detection allows rapid response to initiate control of NWS before these populations grow. If NWS is found in the United States, specific animal protection and movement protocols will be provided.

A good practice for all livestock owners is to have a checklist of biosecurity measures (Table 2).

**Table 2. Livestock producer biosecurity checklist**

<ul style="list-style-type: none"> <li>✓ Identify a regional veterinarian to contact.</li> </ul>	<ul style="list-style-type: none"> <li>✓ Consider transportation schedules of animals relative to the operation type.</li> </ul>
<ul style="list-style-type: none"> <li>✓ Build a relationship with the local AgriLife Extension county agent.</li> </ul>	<ul style="list-style-type: none"> <li>✓ Use best management practices from quality assurance programs.</li> </ul>
<ul style="list-style-type: none"> <li>✓ Analyze risks and develop a plan of action.</li> </ul>	<ul style="list-style-type: none"> <li>✓ Monitor wildlife populations, hunting, and recreational activities.</li> </ul>
<ul style="list-style-type: none"> <li>✓ Surveillance: Be vigilant, stay alert, and report abnormal or suspicious events.</li> </ul>	<ul style="list-style-type: none"> <li>✓ Check the coats, ears, and feet of livestock/guard dogs and companion animals.</li> </ul>
<ul style="list-style-type: none"> <li>✓ Build relationships with neighbors for open conversations about suspicious events.</li> </ul>	<ul style="list-style-type: none"> <li>✓ Observe animals after castration or other surgical procedures until completely healed.</li> </ul>
<ul style="list-style-type: none"> <li>✓ Monitor for ticks and other external parasites.</li> </ul>	<ul style="list-style-type: none"> <li>✓ Keep squeeze chutes, alleys, etc., in good repair to prevent accidental wounds.</li> </ul>

## VII. Conclusion

Effective screwworm prevention and control hinges on aligning livestock management practices with seasonal risk patterns, local climate conditions, diligent surveillance, and following best management practices

recommended by quality assurance programs. By scheduling higher-risk procedures during lower-risk fly activity periods, maintaining vigilant surveillance, and implementing rapid response protocols, producers can help protect their animals, minimize economic losses, and help safeguard livestock industries and supply chains from NWS. Ongoing collaboration with neighbors, local veterinarians, state Extension services, and regulatory partners, such as state animal health commissions and the United States Department of Agriculture Animal and Plant Health Inspection Service (USDA APHIS), ensures coordinated and informed responses to minimize risks from current and future threats from this historically persistent pest.

## Additional Resources:

- USDA APHIS, <https://www.aphis.usda.gov/>
- Texas Animal Health Commission, <https://www.tahc.texas.gov/>

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# Texas Adapted Genetic Strategies for Beef Cattle I: AN OVERVIEW

Stephen P. Hammack, Ph.D.<sup>1</sup>, and Joe C. Paschal, Ph.D.<sup>2</sup>

To manage the genetics of beef cow herds, producers should consider several factors in a logical sequence. These factors are production conditions and marketing, types of cattle, breeding systems, breeds, and selection of individual breeding animals.

## PRODUCTION CONDITIONS

The initial considerations in a genetic strategy are not genetic. Beef cattle breeding programs should be based primarily on production conditions. These include the following:

- ▶ **Climate** – Texas climatic conditions range from hot to cold, humid to arid, and from sea level to almost 5,000 feet above. Cattle vary in their ability to adapt to different climates, and different types of cattle often respond in relatively different ways in different environments (i.e., genotype-environment interaction). For hot, humid climates, cattle types that originated in such conditions are best adapted. Cattle native to more temperate regions fit better in cooler climates.
- ▶ **Forage Conditions** – Most beef cows are maintained on forage, either native range, introduced types, or both. Geographic location and climate influence forage type and potential for growth. Beef cows can efficiently upcycle relatively poor-quality forages to high-quality animal protein. Forage diets can vary in quantity, from abundant to sparse, and in quality from nourishing to deficient. Cattle differ in grazing behavior and ability to efficiently utilize different types of forage.
- ▶ **Available Labor and Management Skill** – The complexity of a breeding program must not exceed the knowledge and capability of those asked to manage the herd. Some programs require more time and expertise than others.



Unlike swine and poultry enterprises, conditions under which beef cattle herds are maintained cannot easily be controlled. Therefore, in cow/calf production systems, it is most efficient and economical to select cattle that fit production conditions, rather than attempting to modify conditions to meet requirements of cattle.

## MARKETING

It is important to consider market timing, methods, and specifications. If calves are sold at weaning, producers are paid for weight, and in price per pound, for the buyer's estimate of value beyond weaning. Price can be affected by such things as condition, health, frame size, and thickness/muscling. On the other end of the production chain are financial returns for those retaining ownership to carcass. Some entrepreneurial producers even sell retail products directly to consumers, usually under their personal brand. Regardless, with retained ownership beyond weaning, revenue to producers is directly influenced by post-weaning gain and efficiency, carcass merit, and, possibly, direct consumer appeal.

Beef is marketed through wholesale, retail, Hotel, Restaurant, and Institute (HRI), and direct-to-consumer outlets.

- ▶ Some retailers market United States Department of Agriculture (USDA) Select grade. But a minimum

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of Low Choice grade is becoming a requirement for much of retail sale.

- ▶ HRI uses a wide variety of beef quality. Fast-food hamburger marketers can use products below USDA Choice grade. Higher-end “white-table-cloth” restaurants generally require at least USDA mid-Choice or, in some cases, USDA Prime grade, often from products of unique brand names.
- ▶ Direct-to-consumer markets require attention to actual eating quality (e.g., tenderness, juiciness, and flavor), and perhaps the story behind how product is produced.

Markets have unique specifications met most effectively by different types of cattle from different production systems. Consequently, one breeding strategy cannot adequately satisfy the variety of needs of all markets.

## TYPES OF CATTLE

When cattle are not matched to production conditions and markets, production is reduced and income drops. The choice of compatible types of cattle depends on these forage characteristics:

- ▶ **Sparse:** Small to moderate body size, earlier maturing cattle generally fit best.
- ▶ **Abundant:** Larger cows can be maintained. Or, smaller cows can be maintained at higher stocking rates, often resulting in greater overall herd performance and net returns.
- ▶ **Low-quality:** Cattle with lower milking production are best suited. Cows of high milking ability can lose body condition, and rates of reproduction can decline.
- ▶ **High-quality:** Cows can be of higher milking ability. Otherwise, forage potential may not be fully realized.
- ▶ **Inconsistent:** Easy-fleshing types with low to moderate milking potential are best adapted.

Although forage deficiencies can be offset with supplemental feed, cost must be weighed against return.

## BREEDING SYSTEMS

The next step is to plan a breeding system before considering breeds and selecting breeding stock. The two basic breeding systems are called continuous and terminal. The difference lies in their source of replacement females.

In continuous systems, heifers are retained and returned to the breeding herd. Therefore, in addition to traits important in calves marketed, consideration

also must be given to mature size, environmental adaptability, and maternal attributes of potential replacement heifers.

Because no replacement heifers are retained in a terminal system, terminal sires can be selected without regard for how their heifer progeny would perform as brood cows. Replacement females in terminal systems must either be purchased or produced in another herd. Regardless of source, replacements should be adapted to the environment and possess maternal characteristics that are appropriate for the conditions under which they will be maintained. In both terminal and continuous systems, producing (i.e., versus purchasing) replacements allows more control of their genetics.

Commercial production can be done using only one breed (i.e., straight-breeding). It has the advantage of being simple and easy to manage, especially for smaller herds. However, straight-breeding sacrifices advantages of hybrid vigor/heterosis (except for some retention of hybrid vigor in recently-created breeds developed by combining existing breeds) realized in well-planned cross-breeding systems. Hybrid vigor typically improves reproductive performance, growth rate, production efficiency, and net return. Useful cross-breeding plans can be developed for single-sire herds, those involving several breeding groups, and for large, multi-thousand-cow operations.

## BREEDS

After considering production conditions, marketing plan, cattle types, and breeding systems, the next decision concerns functional types and breed(s) within those types. Depending on the definition of “breed,” there are some 65 to 70 breeds of cattle in the U.S. (or even 85 to 90 if new combination breeds are included). *Bos taurus* cattle now found in the U.S. originated mostly in the British Isles, but also in recent times from the European continent. *Bos taurus* breeds perform best in temperate locales. *Bos indicus* (zebu or humped) cattle originated in India. They are best adapted to tropical and sub-tropical locales. The American Brahman breed was formed in South Texas and in the upper Texas Gulf Coast by combining four *Bos indicus* breeds.

Breeds logically can be grouped according to their environmental adaptability and key functional characteristics. These groups include: British Beef, Continental Beef, Continental Dual Purpose, (the latter two now commonly combined as Continental), Dairy, *Bos Indicus* (e.g., largely Brahman), and American. Specialty breeds cannot reasonably be placed in one of these groups because of their unusual genetic features.

Breeds in the American group were formed from a base of established breeds of two types: Tropical-adapted (usually Brahman, at levels of 3/8 to 1/2) and temperate-adapted (mostly British Beef, but also more recently some Continental). In addition to the American group, other composite breeds have been formed, some of which incorporate British and Continental breeds, with or without inclusion of American breeds or Brahman (the latter two generally incorporate less than one-fourth Brahman). Applicability of composite breeds rests largely on characteristics and percentages of constituent breeds.

Breeds should be chosen primarily on adaptability to climatic and other production conditions, but producers also should consider production and marketability. Considering both of these factors, in most parts of Texas calves can be produced most efficiently and without significant price discounts if they are one-half or more British, no more than one-half Continental, and no more than three-eighths *Bos indicus*, which could come from half-Brahman or American background. For high-quality markets, higher percentages of British are more applicable. For lean beef markets, less British and more Continental is more useful. Some operations primarily produce replacement females, so breeds incorporated should complement demand for replacements. In some situations, producers justly may deviate from these guidelines for content of functional types. But, depending on production conditions and markets, a variety of useful blends generally can be created within these approximate ranges.

## INDIVIDUAL SELECTION

The final step in a sound genetic strategy is to select individual breeding stock. Selection of females certainly affects genetic potential of a herd. However, even in a terminal cross-system, a sire has much more genetic influence than any female. A sire usually is the parent of at least 20 to 25 calves a year or possibly of more, especially via multiple breeding seasons or, in particular, artificial insemination. Also, in a continuous system, genetic composition of a cow herd is determined largely by sires used over the last three generations. Regardless of breeding system, sires are the most impactful element in genetic selection.

For both sires and dams, selection should be limited to economically important traits. Natural-service sires must be structurally sound, fertile, active and capable breeders, and of manageable temperament. Ease of calving also is important, especially to breed heifers for their first calves. In addition to these traits, and depending on breeding system and market, important traits for selection may include: environmental

adaptability, reproduction, livability, longevity, maternal qualities, mature size, rate and efficiency of gain, and carcass merit.

Some characteristics for selection must be evaluated visually, such as anatomical soundness and any visible physical traits that might affect market price. However, many traits can best be measured objectively, including reproduction traits (such as age at puberty, age at first calving, reproductive tract score, scrotal circumference, semen quality), weight, and body composition or carcass characteristics. Objective methods include performance tests, Breeding Soundness Evaluation (BSE), actual carcass or ultrasound measurement, and breed association programs for Expected Progeny Difference (EPD). Of these methods, EPD is the most effective tool for genetic selection.

Genomic/DNA techniques have been developed. The first mostly were limited to simply-inherited characteristics, such as hair color and a few genetic defects. Genomics is now primarily useful for incorporating into EPD to improve estimation and, especially, accuracy of EPD for young, unproven individuals. Most breed associations that have breed-wide genetic evaluation now calculate genomically-enhanced EPD (GE-EPD).

## GENETICS AND ECONOMICS

Net income from a beef cattle herd is calculated as:

$$(\text{Number of Head Sold} \times \text{Sale Weight per Head} \times \text{Sale Price per Pound}) \text{ minus Total Cost}$$

Any net income from sale of cull breeding stock also should be included.

Number of head is affected by reproductive efficiency and death loss. Numbers also vary depending on body size and management system. More cows of smaller size can be maintained, resulting in more calves to sell, but average sale weight is likely to be reduced. Yet, on the same fixed forage resource, if weaned calves are retained for grazing or replacements, then fewer brood cows can be maintained, sale numbers and price per pound will be lower, but average sale weight will be higher.

Weight per head is influenced by available nutrition (including from milk), environmental effects (such as climate, disease, and sickness), age at weaning, and potential for growth.

Price is determined by real or perceived value to a buyer. Health status also impacts price. Lighter-weight calves generally bring a higher price per pound, so the relative effects of weight and price on total value should be evaluated.

Accurate determination of total cost must include fixed, variable, as well as any appropriate opportunity costs. Approximately two-thirds of total often is due to fixed costs.

Highest net income almost never comes from greatest numbers, heaviest weights, highest price, or lowest cost. The most successful producers develop adapted breeding programs that **optimize** and balance these four elements to **maximize** net returns.

## FOR MORE INFORMATION

To obtain publications in the *Texas Adapted Genetics Strategies for Beef Cattle* series, and on other considerations for breeding programs and other subjects, visit the Texas A&M Animal Science Extension website: <http://beef.tamu.edu>.

# Texas Adapted Genetic Strategies for Beef Cattle – IV: BREEDING SYSTEMS

Stephen Paul Hammack<sup>1</sup> and Joe C. Paschal<sup>2</sup>

A logical genetic strategy for a commercial beef cow herd should include four steps:

- ▶ First, determine production conditions (e.g., climatic, forage, and marketing) and the levels of animal performance that fit those conditions.
- ▶ Second, choose a breeding system.
- ▶ Third, identify the biological types and breeds within those types that are compatible with the first two considerations. (There are about 75 breeds of cattle in the U.S., with about 15 being the most common.)
- ▶ Fourth, select for breeding the most useful individuals within those breeds.

## STRAIGHTBREEDING

Commercial cow/calf producers who confine themselves to one breed have *straightbred* herds. Straightbreeding simply means using the same breed for both sires and dams. Depending on the background of the breed, straightbreds generally have more uniform, visible characteristics than most crossbreds. Straightbreeding is the simplest system to operate.

When using straightbreeding, avoid selection of close relatives for mating, especially sires, as inbreeding can occur. Inbreeding occurs over time in any breed, particularly in breeds closed to outside breeding stock. This can reduce performance (i.e., inbreeding depression), especially in traits such as fertility, livability, and longevity.

## CROSSBREEDING

If more than one breed is used, the breeding program is *crossbred*. Crossbreeding begins with the mating of two purebreds of different breeds. This results in first-cross progeny, termed “F1” (first generation of any crossbred cattle). There are three potential benefits from

crossbreeding: *heterosis*, *favorable breed combinations*, and *complementarity*.

## Heterosis/Hybrid Vigor

Heterosis (or hybrid vigor) occurs when the performance of crossbred progeny is different than the average of their parents, as shown in Figure 1. This example illustrates direct heterosis, which is the effect of a crossbred individual’s genotype on its performance. There also can be maternal heterosis, which is the indirect effect of a crossbred dam’s genotype that influences her calf’s performance through the maternal environment she provides.

Heterosis is greatest in progeny of least related parents. For example: There is greater heterosis in crossing the less related breeds Hereford and Brahman than in crossing the more closely-related breeds Hereford and Angus.

Characteristics express heterosis differently. Heterosis tends to be highest in fertility, livability, and longevity; intermediate in milk production, weight gain, feed efficiency, and body size; and lowest in carcass traits. Even with the benefit of heterosis, crosses from mediocre parents usually do not perform as well as superior purebreds. Thus, the most productive crossbreds come from genetically superior parents.

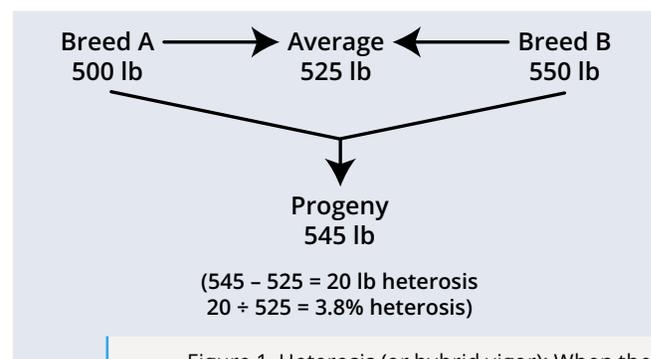


Figure 1. Heterosis (or hybrid vigor): When the performance of crossbred progeny is different than the average of their parents.

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## Favorable Breed Combinations

Even without heterosis there can be benefits merely from combining breeds. For example, breeds with high carcass quality may not be well-adapted to tropical/sub-tropical conditions, and those that have good tropical/sub-tropical adaptability may have relatively low carcass quality. Crossing breeds of these types can produce progeny with a desirable intermediate level of both traits. Such favorable breed combinations can be the most important benefit from crossbreeding. They are the primary motivation for creating new breeds by combining existing breeds, as discussed in the *Combination Breeds* section.

## Complementarity

Complementarity requires dissimilar sires and dams. Complementarity occurs not only from the favorable combination of different types, but also from the manner in which they are combined. As stated, progeny of a breed with high carcass quality crossed with a breed with tropical/sub-tropical adaptability have a blend of those traits. However, the most productive and efficient way to conduct this cross is to use sires with high carcass quality and dams that are adapted to tropical/sub-tropical conditions. The reverse is not as effective because the dams are not well-adapted and it is the dams that must perform year-round under prevailing conditions.

Another example of complementarity is the use of relatively large sires on relatively small dams. The result is that dams produce a higher percentage of their weight, and do it more efficiently, than if they were bred to sires of similar size. This type of complementarity also can be realized in straightbreeding by using genetic variation within a breed, but it is done more effectively with crossbreeding.

## TYPES OF BREEDING SYSTEMS

To answer a simple question: Will heifers be retained for replacements to go back in the herd? If *yes*, it is a *continuous* breeding system. If *no*, it is a *terminal* breeding system, requiring replacements from outside the herd. Both *continuous* and *terminal* systems can be either straightbred or crossbred.

Calves from continuous systems have two functions: Some heifers are saved for replacements and go back into the herd, while the rest of the calves are grown and/or finished to produce beef. But all calves from terminal systems have only one use: beef production. (A small segment of producers specialize in producing replacement females to be marketed to other producers.)

## Straightbreeding

Straightbreeding uses the same breed for both sires and dams. It is typically continuous, but can be terminal, and can be simple to manage. Traditionally, “straightbreeding” meant using a long, established breed, often one of the British breeds. However, in effect, straightbreeding could mean mating any animals of the same genetic background. This includes breeds formed by combining existing breeds of different types such as Brangus (formed from Brahman and Angus) and SimAngus (formed from Simmental and Angus) (Fig. 2). When cattle such as these are “straightbred,” some hybrid vigor remains, though it diminishes over generations if the population is closed and some inbreeding occurs.



Figure 2. Example of straightbreeding with Brangus.

## Continuous

Since a continuous system produces its replacement females, it requires only external sires (to avoid inbreeding). Because replacement females are retained, the cow herd has genetics from both sires and dams. If sires have genetics for traits that are undesirable in brood cows, those traits are perpetuated in the herd. Therefore, both sires and dams should have a similar level of expression of important traits (without any undesirable characteristics). Genetic extremes generally do not fit. Continuous systems can be either straightbred or crossbred.

## Terminal

In a terminal system, replacement females come from outside the terminal-cross herd. Replacements can either be purchased or produced in another herd. Since heifers are not retained for breeding, there is more flexibility in choosing types of sires and dams. Genetics for maternal ability are irrelevant in terminal-cross sires because their female progeny are not saved for replacements. However, genetics for maternal ability **are** important in sires that produce the females used for a terminal cross.

Terminal crossing is the only system in which complementarity can be realized. However, merely implementing a terminal system does not guarantee complementarity (sires and dams must be different and they must possess complementary traits). Specialized types can be used in terminal systems to take maximum advantage of complementarity by exploiting their strong points, while minimizing or eliminating weak points. Terminal systems usually are crossbred but can be straightbred.

## CONTINUOUS CROSSBREEDING SYSTEMS

### True Rotations

True rotation systems use two or more breeds and the same number of breeding groups (Fig. 3). The simplest true rotation uses two breeds and is sometimes called a “crisscross” (Fig. 4). A different breed of sire is used in each of the two breeding groups. Replacement heifers are moved (i.e., rotated) from the group where they were produced to the other group, where they are mated to the breed that is not their breed of sire to minimize loss of heterosis in the system. Females

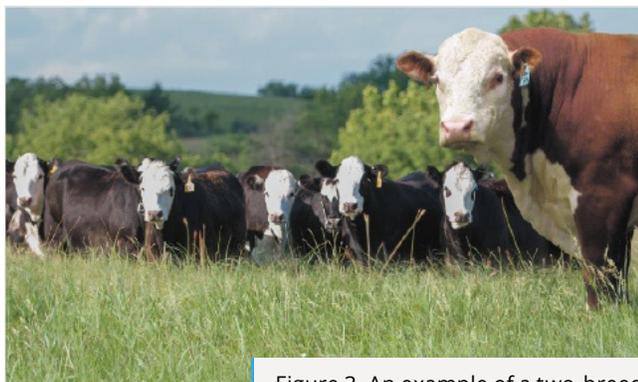


Figure 3. An example of a two-breed rotation, using Angus and Hereford.

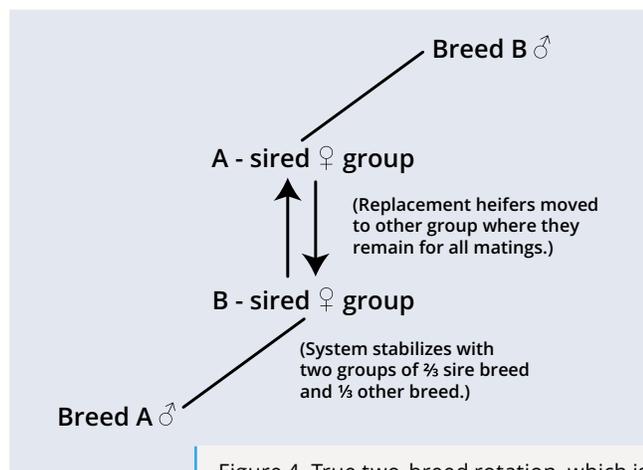


Figure 4. True two-breed rotation, which is sometimes called a “crisscross.”

remain in that breeding group (with the same breed of sire) for all of their lifetime matings.

Because they require multiple breeding groups, true rotations increase the complexity of a breeding program. Artificial insemination (AI) can simplify the mechanics, but not the management of some crossbreeding systems. Also, a compromise must be made between complementary matings and uniformity across groups. Because of these complexities and limitations, true rotations are not as common as some other systems, especially those involving more than two breeds.

### Sire Rotations

The systems just described are true rotations. Sire rotations have similar effects but use only one breeding group or herd. The breed of sire is changed on a planned schedule, usually every 2 or 3 years. Regardless of breeding system, sires should not be bred to their daughters, to avoid reduced production from inbreeding. To maximize hybrid vigor possible in a sire rotation, females should not be bred to the same breed as that of their sire. Hybrid vigor in sire rotations is lower than in true rotations, but is still enough to be beneficial. Sire rotations are easier to conduct than true rotations because there is only one breeding group. This is a common way to crossbreed. Unfortunately, many sire rotations cannot really be called “systems” because they are implemented haphazardly with no logical plan for changing sires.

## TERMINAL CROSSBREEDING SYSTEMS

The simplest terminal cross mates females of one breed to sires of another. Females are straightbred so there is no hybrid vigor for maternal ability (an important shortcoming).

A common terminal system uses two-breed cross (F1) females bred to a third breed (Fig. 5). The same producer could maintain all breeds and crosses needed for the complete system, involving considerable complexity. In most cases, F1 females are purchased or (less commonly) produced in another herd separate from the terminal cross. A terminal system also can use crossbred females other than an F1. Terminal crossing using crossbred females produces the most hybrid vigor of any system because both calves and their mothers are crosses, but a terminal system does **not** produce its replacement females.

### Static Terminal

In a static terminal system, replacement females are either purchased or produced in another herd.

Purchasing females simplifies the operation of this system because the only breeding group needed is for the terminal cross. A straightbred terminal is possible, but there usually is no good reason to do so (unless a producer does not want to save and manage heifers in a continuous straightbred system) because the benefits of crossbreeding are absent. A two-breed static terminal system, using purebred sires and dams of different breeds, produces direct heterosis in crossbred calves. However, this system forfeits the considerable advantages of maternal heterosis from crossbred dams.

A three-breed terminal is more productive and efficient (Fig. 6). Two breeds with desirable maternal traits are crossed to produce adapted and productive F1 dams, which are bred to sires of a third breed in a terminal cross. Figure 5 shows a complete three-breed static terminal cross system. In the complete system, about one-fourth of the dams must be straightbred, about one-fourth are needed to produce the F1, and only about one-half are available for the terminal cross.

Static terminal crossing is the only system that can have maximum heterosis in both cows and calves, favorable breed combinations, and the bonus of complementarity.

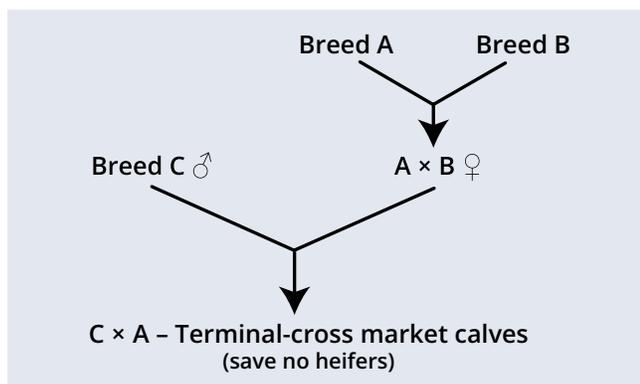


Figure 5. A complete three-breed static terminal cross system.



Figure 6. Example of a three-breed terminal cross, using a Simmental bull on Brahman F1 cows.

However, these advantages are tempered by the necessity of purchasing replacement females or producing them outside the terminal cross.

## Rotation-Terminal

A rotation-terminal combines continuous and terminal systems. It is one way to provide crossbred replacement females for static terminals. A rotation-terminal system, either true rotation or sire rotation, produces replacement females both to keep itself going and to use in a separate terminal herd. Middle-aged dams (4 to 6 years old) are moved out of the rotation to the terminal cross because they are less prone to calving problems if terminal sires are relatively large.

Producers must have multiple breeding groups for rotation-terminal systems: one or more for the rotation (depending on whether it is a true rotation or sire rotation), and one for the terminal cross. About one-half of the dams are needed in the rotation to provide enough replacements for the entire system, leaving about one-half of them for terminal crossing. Approximately two-thirds to three-fourths of sale calves come from the terminal (with most of the rest being male calves from the rotation).

Hybrid vigor is relatively high in rotation-terminals because all progeny and dams are crossbred. However, since a high percentage of females from the rotation must be retained to provide replacements for both the rotation and the terminal, there is little opportunity to select individual females for breeding.

## COMBINATION BREEDS

Existing breeds sometimes are blended to form combination breeds with new packages of traits. Because these breeds are formed by crossbreeding, there is some residual heterosis. How much heterosis depends on how many breeds are included, in what portions they are included, and how much inbreeding occurs as the breed develops. Therefore, with these combination breeds it may be possible to obtain some heterosis using a single-breed in a straightbred system.

The first of these combination breeds in the U.S. was the American Brahman, created by combining several *Bos indicus* (i.e., humped) breeds imported from India or by way of Brazil. Numerous breeds have been created in the Southern U.S. (especially in Texas) by combining different biological types. Most of these contain Brahman and British or, in a few cases, Brahman and Continental European breeds, which generally are called American breeds. More recently, some British and Continental combinations have been made and some British or Continental with American breeds.

TABLE 1. FEATURES OF BREEDING SYSTEMS.

Breeding System	Calf Heterosis	Cow Heterosis	Complementarity	No. Breeds/ Breeding Groups	Calf Uniformity
Straightbred <sup>1</sup>	None	None	None	1 / 1	Very High
Straightbred <sup>2</sup>	Low	Low	None	1 / 1	High
Rotation	Med-High	Med-High	None	2-3 / 1-3 <sup>7</sup>	Low-Med
Terminal Only <sup>3</sup>	Very High	None-Low	High	2 / 1	High
Terminal Only <sup>4</sup>	Very High	Very High	High	3 / 1	Med-High
Complete Terminal <sup>5</sup>	Medium	None-Low	Medium	2 / 2	Low-Med
Complete Terminal <sup>6</sup>	High	Medium	Medium	3 / 3	Low
Rotation + Terminal	High	Med-High	High	3 / 2 or 3 <sup>8</sup>	Medium
Combination Breed	Low-Med	Low-Med	None	1 / 1	Med-High

<sup>1</sup>Breeds with no retained heterosis.

<sup>2</sup>Combination breeds, containing some retained heterosis.

<sup>3</sup>Using straightbred females purchased or produced in another herd (cow heterosis is Low if females are a combination containing some retained heterosis).

<sup>4</sup>Using F1 females purchased or produced in another herd.

<sup>5</sup>Producing straightbred females in one group for terminal cross in another group (cow heterosis is Low if females are a combination breed containing some retained heterosis).

<sup>6</sup>Producing straightbred females in one group to create F1 females in another group for terminal cross in another group.

<sup>7</sup>One group if sire rotation; two or three groups (depending on number of breeds) if true rotation.

<sup>8</sup>Two groups if sire rotation; three groups if true two-breed rotation.

## BREEDING SYSTEMS AND BREEDING GROUPS

The choice of a breeding system depends partly on the number of separate breeding groups a producer can or will maintain. If feasible (regardless of the breeding system), the development, breeding, and calving of heifers should be conducted in a separate management group using easy-calving sires.

### One Breeding Group

One-breeding-group herds, ranging from those needing only one bull to large herds that require multiple bulls, have the following choices of breeding systems:

- ▶ Straightbreeding (with either a traditional or combination breed).
- ▶ Static terminal cross (with purchased straightbred or crossbred females).
- ▶ Sire rotation.

### Two Breeding Groups

Two groups can be used in these systems:

- ▶ True two-breed rotation.
- ▶ Straightbreeding in one group to produce females for a two-breed terminal cross in another group.

- ▶ Sire rotation or combination breed in one group to produce replacement females for a terminal cross in another group.
- ▶ Purchase of straightbred females for creation of F1 replacements in one group to be used in a terminal cross in another group.

### Three Breeding Groups

Three groups can be used in these systems:

- ▶ True three-breed rotation
- ▶ True two-breed rotation in two groups to produce replacement females for a terminal cross in a third group
- ▶ Complete terminal, with straightbred females produced in one group to be used for creating F1 females in a second group to be used for terminal crossing in a third group

Multiple breeding groups are more complex to manage. Each group in a multi-group crossbreeding system has a different breed composition, which can reduce marketing flexibility because fewer like calves are produced. Also, some breed combinations may be less valuable than others. Weigh these possible disadvantages against any expected economic benefit before implementing systems that require multiple breeding groups.

## EFFICIENCIES OF BREEDING SYSTEMS

A standard measure of efficiency of cow-calf production is pounds of calf weaned per bred cow, which combines fertility, livability, and calf weaning weight. Continuous crossbreeding systems requiring only a single breeding group can increase efficiency by 10 to 15 percent.

Crossbreeding systems using multiple breeding groups, or three-breed terminal crossing in one group using introduced females, can increase efficiency by 15 to 30 percent. These estimates are for systems using British and Continental breeds in temperate environments. In harsh tropical or sub-tropical environments, including types that are native to these locales (especially *Bos indicus*), it can be even more efficient because animals have more heterosis and greater adaptability. These are significant advantages.

In choosing a breeding system for commercial beef cow herds, consider the major factors that affect production efficiency and financial return, including:

- ▶ Number and type(s) of animals available to market.
- ▶ Average pounds per animal marketed.
- ▶ Average price per pound.
- ▶ Total cost of production.

Production efficiency and financial return usually are greatest when these factors are balanced, rather than when one factor dominates to the reduction or exclusion of the others.

## SUMMARY

After choosing a breeding system, producers should determine what breeds and individuals within breeds fit their climate, forage, general management practices, and market. For a discussion of breeds, see (ANSC-PU-059): [Texas Adapted Genetic Strategies for Beef Cattle – V: Type and Breed Characteristics and Uses](#); and (ANSC-PU-060): [Texas Adapted Genetic Strategies for Beef Cattle VII: Sire Types for Commercial Herds](#).

Regardless of the size of the cow herd, the use of single breeding groups is by far the most common practice in Texas. Therefore, the prevailing breeding systems are straightbreeding (of both traditional and combination breeds) and purchasing replacement females for a terminal cross, with some implementation of sire rotations.

When choosing a breeding system, give careful thought to the entire process. Do not embark on the first stage of a system without understanding and planning for subsequent stages. A system that works well for one producer, or one set of production and market conditions, might be unsuitable for another producer or different conditions.

# TEXAS ADAPTED GENETIC STRATEGIES FOR BEEF CATTLE V: TYPE AND BREED CHARACTERISTICS AND USES

Stephen P. Hammack<sup>1</sup> and Joe C. Paschal<sup>2</sup>



Figure 1. A 1700s painting of the foundation cow of an early cattle breed.  
 Source: Michigan State University Animal Science Department

The subject of “breeds” intrigues most beef cattle producers. However, breeds are only part of a genetic strategy, which should include:

- ▶ Matching applicable performance or functional levels to environmental, management, and marketing conditions.
- ▶ Choosing a breeding system, either continuous (in which replacement females are produced within the herd) or terminal (in which replacements are introduced externally).
- ▶ Selecting functional types, breeds within types, and individuals within breeds that are compatible with the performance levels needed and breeding system chosen.

## GENETIC CLASSIFICATIONS AND BREEDS

Cattle have been divided into two basic classifications: *Bos taurus* (i.e., non-humped) or *Bos indicus* (i.e., humped, also called Zebu). Because these two types readily interbreed, some authorities now classify them as *Bos taurus*, sub-species *taurus*, and *Bos taurus*, sub-species *indicus* (or, simply call them taurine and indicine).

Cattle are not native to the Western hemisphere. The *Bos taurus* found now in the U.S. originally came from the British Isles and Western Continental Europe. *Bos indicus* originated in South Central Asia, but most in the U.S. came by way of Brazil (Fig. 1).

Although it has no strict biological definition, a “breed” can be described as a group of animals of common origin with certain distinguishing characteristics that are passed from parent-to-offspring. Breed characteristics result from both natural selection and from that imposed by breeders.

Most breeds have registry associations that record ancestry, define and document characteristics, and promote the breed. There are about 75 registry associations in the U.S.

For a discussion of breed backgrounds, see another publication in this series by Texas A&M AgriLife Extension Service: *Texas Adapted Genetic Strategies for Beef Cattle—VI: Breeds: Origins and Development*.

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## FUNCTIONAL TRAITS OR CHARACTERISTICS

The major functional traits that are important in beef production are birth weight and calving ease, body size and growth, milking potential, age at puberty, heat tolerance, fleshing ability, cutability (i.e., lean-to-fat ratio), and marbling. The estimates of functional trait levels listed below are based on breed averages (individuals can vary considerably within breeds).

### Birth Weight

Birth weight is a primary factor involved in calving ease. All breed associations that publish genetic evaluations (Expected Progeny Difference) include birth weight. Some also evaluate calving ease. Birth weight in Brahman differs depending on how the breed is used. In purebreds and crosses on Brahman dams with *Bos taurus* sires, birth weight is relatively low, but use of Brahman sires on *Bos taurus* dams can result in relatively high birth weight.

### Body Size and Growth

Inherent body size is best evaluated as weight at the same level of body condition or fatness. However, growth or rate of gain often is evaluated over time-constant periods or to the same age. This type of comparison can produce differences in fatness among individuals of different functional types or breeds within types.

As a result, evaluations of rate-of-gain and feed efficiency over time (or age-constant periods) often differ from evaluations of cattle to the same level of fatness. Genetically larger, later-maturing animals generally gain faster and more efficiently than do smaller, earlier-maturing animals over time or age-constant periods, but often not when fed to the same level of fatness. Larger animals have higher nutritional requirements for body maintenance.

Cattle that are heavier at birth tend to be heavier throughout life. An important exception is in *Bos indicus*. Calves out of *Bos indicus* dams, even by *Bos taurus* sires, tend to be relatively smaller at birth than later in life, usually resulting in fewer difficulties in calving. However, calves by *Bos indicus* sires out of *Bos taurus* dams often are relatively large at birth, therefore calving can be more difficult.

Size is discussed in: *Texas Adapted Genetic Strategies for Beef Cattle—III: Size and Milk*. Frame score, an objective measure of skeletal dimension used to estimate current and future body size, is discussed in: *Texas Adapted Genetic Strategies for Beef Cattle—X: Frame Score, Frame Size, and Muscling*.

### Milking Potential

Milking potential is the genetic capability to produce milk. It is not the actual volume of milk produced, which also is influenced by the cow's nutrition and the calf's nursing pressure.

Milking potential should be evaluated in relation to body size. Females of higher milking potential need more nutrients for body maintenance and require higher-quality diets, even when not lactating. Again, see: *Texas Adapted Genetic Strategies for Beef Cattle—III: Size and Milk*.

### Age at Puberty

Age at puberty relates to body size, milking potential, and genetic classification. Smaller individuals and higher-milking types usually mature relatively early. *Bos indicus* mature relatively late. Although higher-milking females, even large breeds, often reach puberty and conceive when relatively young, but their subsequent reproductive performance can suffer because they may become thin after beginning lactation and therefore be slow to start cycling. While *Bos indicus* types reach puberty relatively late, their productive life usually is longer.

### Heat Tolerance

Cattle best adapted to hot climates are those with *Bos indicus* inheritance, which also have better resistance to insects. However, to a lesser degree, some *Bos taurus* animals do have some heat tolerance, especially those with dark skin and lighter-colored, shorter, earlier-shedding hair coats.

High humidity intensifies the effects of heat because it decreases the ability to reduce heat load through respiration. Also, hot, humid climates often add the stresses of parasites and low-quality forage. Heat with high humidity will stress cattle that fail to shed long, thick hair coats, particularly those that are dark colored. As might be expected, animals tolerant to hot climates are relatively less adapted to cold.

### Fleshing Ability or Fatness

Inherent fleshing ability is the body's capacity to fatten and retain fat or "condition." Fleshing ability tends to decrease with rises in maintenance requirements relative to body size and milking level. Also, larger animals may be unable to consume enough forage when it is sparse, thus reducing condition. Animals poorly adapted to their environment generally are less able to maintain and increase condition.

Compared to *Bos taurus*, *Bos indicus* often flesh more easily on low-quality forage. Easy-fleshing cattle may better tolerate periods of nutritional energy deficiency and, therefore, may reproduce more consistently. However, they also may over-fatten more readily in the feedyard, unless they are fed for a shorter period than is typical.

### Cutability

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Cutability (ratio of lean-to-fat) usually is evaluated in beef carcasses as U.S. Department of Agriculture (USDA) Yield Grade. Cutability depends on the relative proportions of fat (which varies most), muscle, and bone (which varies least).

Cutability is most commonly evaluated over time-constant feeding periods; in this type of evaluation, animals that grow faster and mature later tend to be higher in cutability. However, feeders can manipulate fatness, and therefore cutability, by varying nutrition and length of feeding. Types and breeds possessing inherent high cutability often are not as functional as brood cows.

### Marbling

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Marbling (or intramuscular fat) is the primary factor determining USDA Quality Grade. Marbling increases with age, up to physiological maturity, and generally is higher in earlier-maturing types. Marbling generally can be increased by feeding high-energy rations for extended periods starting early in life.

*Bos indicus* and most heavy-muscled, later-maturing types tend to have relatively low marbling. Because marbling tends to increase with overall body fatness, comparing types or breeds usually involves a trade-off between Yield Grade and Quality Grade. As one improves, the other tends to decline. Also, as with cutability, marbling can be affected by nutrition, length of feeding, and growth implants.

For a discussion of carcass genetic considerations, see: *Texas Adapted Genetic Strategies for Beef Cattle—IX: Selection for Carcass Merit*.

## FUNCTIONAL TYPES AND THEIR BEST USES

U.S. cattle can logically be categorized into six primary functional types based on their genetic classification and levels of functional traits. Table 1 contains relative trait levels for breeds within functional types, based on research reports from the USDA Meat Animal Research Center and other reports.

Differences among breeds in some functional levels have changed over the years.

This is particularly true when comparing Continental breeds to other types. Compared to the existing breeds, most of the Continental breeds that came to the U.S. in the late 1960s and 1970s were considerably larger. In some cases, they were also notably higher in milk production. Since then, some of these differences have diminished, or even disappeared, as increased weight and milk have been emphasized in selection of breeding stock within previously existing breeds.

There is no “best” type or breed for beef production because of extensive variation in climates, production conditions, and market preferences. These factors often cause differences in optimal functional levels of all traits. For more information, see: *Texas Adapted Genetic Strategies for Beef Cattle—II: Genetic- Environmental Interaction*.

The following is a list of the types and their best uses based on functional characteristics. Keep in mind that individual animals within a “type” can vary considerably.

### British Beef

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The British Beef type consists of British-originated breeds that were developed and used for beef production only. These breeds are the most common in the U.S. beef herd. Commercial producers who use only one breed (i.e., for straightbreeding) often choose a British breed. Breeding them to any other breed or type will produce various levels of hybrid vigor in their crossbred offspring.

British breeds are suitable for general-purpose production, as well as for both the dam and sire sides of a terminal cross (depending on the target market).

### Continental

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These breeds originated in Western Continental Europe. They were developed there for beef or beef-dairy purposes. In the U.S. they are used only for beef production.

The most effective use of Continental breeds has been as sires used in a terminal crossbreeding system. For this purpose, when selecting sires from this group, pay attention to birth weight and calving ease, especially for use on smaller, mature dams. Depending on the breed, Continental breeds increase muscling and leanness in females and may increase milk production.

In general, do not straightbreed this type or cross with other Continental breeds. These breeds vary somewhat in adaptability to hot climates. Also, see *New Intermediate Types* below.

TABLE 1. RANKINGS OF FUNCTIONAL LEVELS OF CATTLE TYPES AND BREEDS.<sup>1</sup>

FUNCTIONAL TYPE BREED	BIRTH WEIGHT	GROWTH AND SIZE	MILKING POTENTIAL	AGE OF PUBERTY <sup>3</sup>	HEAT TOLERANCE	FLESHING ABILITY	CUTABILITY <sup>4</sup>	MARBLING <sup>4</sup>
<b>British Beef</b>								
Angus	2	3	3	4	1	3	1	5
Hereford <sup>5</sup>	3	2	2	3	1	3	2	3
Red Angus	2	2	3	4	2	3	2	4
Shorthorn	3	2	3	3	1	3	2	3
<b>Continental</b>								
Braunvieh	4	2	3	3	2	2	4	3
Charolais	4	3	2	3	2	2	4	3
Gelbvieh	3	2	3	3	1	2	3	3
Limousin	3	2	2	2	1	2	4	2
Maine-Anjou	3	2	2	2	1	2	4	2
Salers	3	2	2	3	1	2	3	3
Simmental	4	3	3	3	1	2	4	3
<b>Dairy</b>								
Holstein	3	3	5	4	1	1	3	4
Jersey	1	1	4	5	3	2	1	5
<b>Bos indicus</b>								
Braham	3 <sup>6</sup>	2	3	1	5	3	3	1
<b>American</b>								
Beefmaster	3	2	3	3	4	3	2	2
Brangus	3	2	3	3	4	3	2	3
Santa Gertrudis	4	2	3	3	4	3	2	2

<sup>1</sup>Rankings are estimates of purebred breed-wide averages (see text for explanation of productive functions). Higher numbers = greater expression of the trait. Range exists within these levels. Also, considerable individual variation exists within breeds. Levels for cattle of multi-breed background can be estimated from proportions of the constituent breeds.

<sup>2</sup>Rate of gain and mature weight.

<sup>3</sup>Higher numbers = earlier expression of puberty.

<sup>4</sup>Time-constant feeding (see text for explanation).

<sup>5</sup>Horned and polled.

<sup>6</sup>Differs whether appears on sire or dam side (see text).

## Dairy

These breeds originated in Western Continental Europe (or the British Isles) and are used primarily for dairy purposes. Beef is produced secondarily from a dairy enterprise. In some dairies, females are bred by artificial insemination (AI) to beef sires to produce surplus progeny that is better suited for beef production.

Though uncommon, the dairy type could be used to create crossbred early-maturing, high-milking, moderate-musled females for beef production. Smaller cattle of this group also may be used to maintain or possibly increase fertility if the body condition is maintained. However, it may be difficult to keep dairy crosses in good flesh on typical rangeland or coarse pasture, especially those of larger body size. Potential significant price discounts are common for stocker and feeder animals of visible dairy breeding, especially at local auctions.

## Bos indicus

This group contains straight *Bos indicus* and are used only for beef production. They are used primarily to create crossbred females that are adapted to hot climates and have highest longevity, hybrid vigor, and calving ease.

Generally, these females are best used in terminal crossing systems. Do not straightbreed or cross them with other cattle containing *Bos indicus*, unless persistently hot and humid climatic conditions preclude any other logical choice.

## American

This type includes beef breeds that were created in the U.S. from combinations of about  $\frac{3}{8}$  to  $\frac{1}{2}$  Brahman, with the remainder usually consisting of a British Beef breed(s) or a Continental breed.

American breeds are widely applicable, especially for (but not limited to) hot climates. They can logically be straightbred, crossed with other American breeds, or crossed with other types, except for purebred or high-percentage *Bos indicus*. American breeds can be used effectively in general-purpose production and in terminal systems. They often are the most logical choice for sires used in natural service in hotter climates. Also, see “New” *Intermediate Types* below.

## Specialty

These breeds cannot easily be placed in any of the types above. They often are characterized by a strong emphasis on certain traits. Specialty breeds vary considerably in their level of functional traits.

## “New” Intermediate Types

Just as *Bos taurus* and *Bos indicus* were combined years ago to form intermediates now known as American breeds, “newer” intermediates have been formed. One group involves combining Continental and British breeds. The more numerous of those combinations (and their registry associations) include Beef Builder (Braunvieh), ChiAngus (Chianina), Balancer (Gelbvieh), Lim-Flex (Limousin), MaineTainer (Maine Anjou), Optimizer (Salers), and SimAngus (Simmental).

Also, some American or *Bos indicus* have been combined with British or Continental breeds to reduce the proportion of *Bos indicus* to  $\frac{1}{4}$  or less. The more numerous of these breeds are Advancer (Beefmaster), UltraBlack and UltraRed (Brangus), Southern Balancer (Gelbvieh), SimAngus HT (Simmental), and American Red (Santa Gertrudis). For their best uses in commercial herds, use the proportions of their constituent breeds to estimate the functional characteristics of intermediate types.

## MATCHING FUNCTIONAL LEVELS TO PRODUCTION CRITERIA

Climate and nutrition are key variables affecting where differing groups and breeds can be used efficiently and profitably. Production suffers when cattle are not adapted to climatic conditions. In hot, humid climates, cattle benefit from some *Bos indicus*, or other tropically-adapted genetics.

Table 2 shows the effects of nutrition on optimum levels of the three primary production functions in cow herds. In general, as nutrition declines, the smaller, lower-milking and easier-fleshing cattle are better adapted and more efficient. This is discussed in detail in: *Texas Adapted Genetic Strategies for Beef Cattle—III: Size and Milk*.

TABLE 2. MATCHING COWHERD FUNCTIONAL LEVELS TO NUTRITION (SOURCE: BEEF IMPROVEMENT FEDERATION).

NUTRITIONAL AVAILABILITY <sup>1</sup>	MATURE SIZE	MILKING POTENTIAL	FLESHING ABILITY
Low	Low to Medium	Low to Medium	High
Medium	Medium	Medium	Medium to High
High	Medium to High	Medium to High	Medium

<sup>1</sup>Quantity, quality, and consistency of nutrition; whether from grazing, harvested forage, or supplemental concentrates.

APPENDIX A. ADDITIONAL CATTLE BREEDS THAT HAVE REGISTRY ASSOCIATIONS.

BRITISH BEEF	CONTINENTAL BEEF	DUAL-PURPOSE	DAIRY	BOS INDICUS	AMERICAN	SPECIALTY
American Aberdeen	Blonde d'Aquitaine	Devon	Ayrshire	Gyr	Barzona	Akaushi
Belted Galloway	Marchigiana	Dutch Belted	Brown	Indu-Brazil	Brahmousin	Ankole-Watusi
Black Hereford	Piedmontese	Kerry	Swiss	Nelore	Charbray	Beefalo Belgian
British White	Romangola	Normande	Guernsey		South Poll	Blue Corriente
BueLingo		Norwegian Red	Milking Shorthorn			Dexter
Galloway		Pinzgauer				Florida Cracker
Highland		Red Poll				Texas Longhorn
Irish Black		South Devon				Wagyu
Irish Red		Sussex				
Lincoln Red		Tarentaise				
Lowline						
Murray Grey						
Welsh Black						
White Park						

Appropriate functional levels can differ depending on the breeding system implemented.

Cattle for general-purpose, continuous systems should contain a balanced blend of important production traits in both sires and dams without extremes in any production characteristic.

Conversely, dissimilar types of sires and dams may be effectively used in terminal systems. To reduce cow herd nutritional needs, or increase stocking rate, use relatively small terminal dams complemented by high-growth sires. Maternal ability is irrelevant in terminal sires because their heifers are not kept for replacements.

For more discussion on breeding systems, see: *Texas Adapted Genetic Strategies for Beef Cattle—IV: Breeding Systems*.



## SUMMARY

Genetics vary widely within functional types and breeds. However, in creating specific production levels, it is usually more effective to exploit breed averages of applicable functional types than to look for genetic outliers in other types.

A fundamental challenge in commercial beef production is to match genetic capability with climatic, nutritional, management, and market conditions. Knowing the functional levels of types and breeds can help optimize animal performance to achieve the highest profit.

## FURTHER READING

Sire choice is greatly influenced by types represented in a cow herd. This subject is discussed in the AgriLife Extension publication: *Texas Adapted Genetic Strategies for Beef Cattle—VII: Sire Types for Commercial Herds*.

To obtain other publications in this *Texas Adapted Genetics Strategies for Beef Cattle* series, visit AgriLife Learn: <https://agrilifelearn.tamu.edu/s/>; and the Texas A&M Animal Science Extension website: <http://animalscience.tamu.edu>.

# TEXAS ADAPTED GENETIC STRATEGIES FOR BEEF CATTLE VII: SIRE TYPES FOR COMMERCIAL HERDS

Stephen Paul Hammack<sup>1</sup> and Joe C. Paschal<sup>2</sup>



Choosing functional types of sires is one of the most important decisions for beef producers. That choice should depend on:

- ▶ Climatic, management, and market conditions.
- ▶ Number of production phases.
- ▶ Breeding systems.
- ▶ Types and breeds of cows in the herd.
- ▶ Characteristics of sire types and breeds (that complement the factors above).

Producers need to assess production conditions accurately to make sure they are compatible with genetic potential for production. Genetic considerations for herds marketing at weaning should differ from those marketing on a value-based carcass grid. Breeding systems are crucial factors in choosing types, breeds within types, and individuals within breeds.

There are two basic commercial breeding systems:

- ▶ **Continuous systems**, in which females from the herd are retained for breeding. These systems should use types and breeds that are similar and, in general, have moderate levels of production for primary characteristics.
- ▶ **Terminal systems**, which do not retain females that must be brought in from outside. Terminal systems can use different sire and maternal types, and should for maximum efficiency.

For more information, see: [Texas Adapted Genetic Strategies for Beef Cattle IV: Breeding Systems](#).

To produce efficiently, types, breeds, and individuals must be compatible with production conditions and breeding systems. Most cattle can be categorized by genetic classification, as *Bos taurus* (i.e., non-humped) or *Bos indicus* (i.e., humped; also called Zebu) and by breed averages for body size (weight) and composition, milking potential, and carcass merit.

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Until recently, it was relatively easy to group the major breeds based on differences in these characteristics. But body size and milking potential are now more similar among many of the major breeds than previously, especially when the Continental European breeds were first introduced in the late 1960s, and the British breeds had not started genetic selection to increase size and milk.

Even so, the traditional functional types are still a logical starting point for designing an adapted breeding program. Below are the types (and most numerous breeds) listed alphabetically within type:

- ▶ **British Beef:** Angus, Hereford, Red Angus, Shorthorn.
- ▶ **Continental:** Braunvieh, Charolais, Chianina, Gelbvieh, Limousin, Maine-Anjou, Salers, Simmental.
- ▶ **Dairy:** Holstein, Jersey.
- ▶ **Bos Indicus:** Brahman.
- ▶ **American (3/8 to 1/2 Brahman base):** Beefmaster, Braford, Brangus, Red Brangus, Santa Gertrudis, Simbrah.
- ▶ **Specialty:** Breeds varying widely in characteristics, therefore they cannot logically be placed in any of the above groups.
- ▶ **New Intermediates**

Bos taurus and Bos indicus were combined to create an intermediate type: American breeds. Recently, some of the Continental and British breeds listed above have been combined to create intermediates. The more numerous of those combinations (and their registry association) include: Balancer (Gelbvieh), Beef Builder (Braunvieh), ChiAngus (Chianina), LimFlex (Limousin), MaineTainer (Maine Anjou), Optimizer (Salers), and SimAngus (Simmental).

Also, some American breeds have been combined with British or Continental to decrease the percentage of Bos indicus. Of these, the more numerous include: Advancer (Beefmaster), American Red (Santa Gertrudis), Angus Plus (Red Angus), SimAngus HT (Simmental), Southern Balancer (Gelbvieh), and UltraBlack/UltraRed (Brangus).

Producers should estimate, from the proportions of their constituent breeds, the functional characteristics and therefore best uses in commercial herds, of these newer, intermediate combinations.

For a more complete discussion of breeds, see: [Texas Adapted Genetic Strategies for Beef Cattle V: Types and Breeds, Characteristics, and Uses](#); and: [Texas Adapted Genetic Strategies for Beef Cattle VI: Breed Origins and Development](#).

Producers who market at weaning (via traditional methods) often are subject to biases and visual perceptions that may reduce prices unjustifiably, especially for new breeds, unusual breeds, and their crosses. Factors such as hair color and estimates of breed composition often affect price offered by buyers. In Texas, traditional producers can avoid or minimize price discounts, while maximizing production efficiency in their environments, by producing medium to large-frame calves that are at least 1/4 British, no more than 1/2 Continental, and no more than 1/4 Bos indicus. For markets rewarding high United States Department of Agriculture (USDA) Quality Grade, use greater percentages of higher-marbling breeds (typically from the British group). Where USDA Yield Grade is more important, use higher percentages of breeds known for leanness, especially from the Continental group.

Prices differ somewhat even within these ranges. These differences change over time in the percentages favored, and the variations usually are smaller and shorter term than for cattle outside of these ranges.

Some combinations not preferred as stocker-feeders may be a logical choice for replacement females, particularly 3/8 to 1/2 Bos indicus. In Texas, and much of the Southern U.S., part-Bos indicus cows have advantages too important to ignore, including longevity, calving ease, maximum hybrid vigor, and adaptability to prevailing climatic conditions and forage characteristics. Also, bulls with some Bos indicus genetics are better adapted to tropical or sub-tropical environments.

Traditional cow/calf producers marketing at weaning should heed the preferences of their marketing systems while emphasizing biological and economic efficiency to weaning. To increase revenue, be sure to document genetic merit and market it to the buyer. Or, better yet: Retain ownership through finishing and marketing on value-based carcass grids.

Otherwise, the performance of market calves beyond weaning and their eventual carcass merit are of no economic importance to these traditional producers and should not influence decisions on the selection of sires.

The following are the most applicable sires for commercial cow herds:

**British cows:** Although straightbred British cows can be bred to the same breed of sire to produce straightbred calves, these calves lack hybrid vigor. Also, some straightbreds incur price discounts.

To produce progeny such as Angus-Hereford “black baldies,” cross them within the British breeds. If saving heifers and limited amounts of Continental genetics in the cowherd are desired, use Continental-British

intermediate sires. Continental sires can improve USDA Yield Grade (and in some cases, weight gain).

American sires add a “touch of ear” for either stocker-feeder marketing or some replacement female buyers. American-British intermediate sires would create even less “ear.”

Brahman sires (not recommended on heifers) produce the highly regarded Brahman F1 female. To fully capture their market potential, develop Brahman F1 females to at least breeding age. Prices for half-Brahman steers probably will be discounted.

The main cautions with British cows are 1) avoid low-calving-ease, high-birth-weight sires, and 2) do not produce straightbreds that are price-discounted in a producer/rancher’s specific area.

**Straight Bos indicus cows:** For commercial production, straight Bos indicus cows should be used most logically to produce F1 replacements. For this purpose, Hereford sires most often are used or, less frequently, Angus.

Do not use Bos indicus or American sires on straight Bos indicus commercial cows, because the calves will be significantly discounted for being over half-blood. It is possible to use Bos indicus sires to create straightbred commercial Bos indicus females for crossing to produce F1 females. However, the price of straightbred Bos indicus stockers or feeders will be severely discounted.

Part Bos indicus cows: This includes true F1 or other part Bos indicus, including cows of the American type. Terminal crossing can apply using Continental, Continental-British intermediate, or British sires, which also would reduce the Bos indicus percentage in any females retained for replacements (if the producer so desires).

American sires are appropriate (i.e., straightbreeding) to maintain 3/8 to 1/2 Bos indicus replacements, especially for hot and humid conditions, unless the cows are more than 1/2 Bos indicus. However, stocker/feeder progeny usually are price-discounted. Using intermediate sires containing American with British or Continental, or British with Continental, reduces the percentage of Bos indicus more than it does using American sires. To avoid significant price discounts in stocker/feeders: Do not use pure Bos indicus sires on part Bos indicus cows for commercial production.

**Part Continental cows:** British sires produce desirable slaughter offspring and also can be used for female replacements. American sires add some Bos indicus background for hot-climate adaptability, as would (to a lesser degree) using sires from the new intermediates containing American and British or Continental.

Continental-British intermediate sires will maintain levels of Continental in progeny if desired.

In general, avoid using Continental sires on part Continental cows, except when targeting lean-beef markets, as visibly high-percentage Continental calves may be price-discounted. Also, high-percentage Continentals may not be as useful for brood cows, as they may milk excessively and/or be too muscular (leading to a low body condition and reduced reproduction) for some Texas pasture and range conditions.

**First-calf heifers:** The most applicable sires are documented individuals of known calving ease, which is most influenced by birth weight. Such sires are most easily found in smaller individuals from British, small dairy, and dual-purpose breeds (developed for moderate levels of both milk and beef), and some specialty breeds such as the Texas Longhorn. Also, an unsupported claim of “calving-ease bull” often is worthless.

Do not reduce birth weight to extremes below that needed for calving ease because it may unnecessarily reduce calf sale weight and (with some easy-calving breeds) market price.

## SUMMARY

When choosing a commercial beef sire, avoid:

- ▶ Calving difficulty
- ▶ Body size and muscling that are too low or too high for production efficiency and market desirability
- ▶ Milk production that is too low or too high for production efficiency
- ▶ Levels of Bos indicus that are too high for acceptable market calf value
- ▶ Numerous genetic combinations will avoid these problems and result in an optimum, most profitable production.

## FURTHER READING

To obtain other publications in this *Texas Adapted Genetic Strategies for Beef Cattle* series, visit AgriLife Learn (<https://agrilifelearn.tamu.edu>) or the Texas A&M Animal Science Extension website (<http://beef.tamu.edu>).



# Texas Bovine Trichomoniasis Control Program: FACTS FOR CATTLE OWNERS

Rick Machen<sup>1</sup>, Ron Gill<sup>1</sup>, Floron Faries<sup>2</sup>, and Tom Hairgrove<sup>3</sup>

Bovine trichomoniasis (trich) is a **venereal disease** caused by the protozoan *Tritrichomonas foetus*. Because trich has no visible symptoms in bulls and few if any symptoms in cows and heifers, it is best to prevent exposure rather than try to control or eradicate the disease.

The primary production and economic impact of trich is on cows because it causes infertility and abortions and often extends the breeding/calving season. The infection can be transmitted only by sexual intercourse and not by the environment. Bovine trichomoniasis is not transmitted to people.

## BULLS

Bulls become infected by breeding infected cows. The protozoa live in microscopic folds, or crypts, on the surface of the bull's penis and internal prepuce.

**Infected bulls must be moved to slaughter because there is no effective treatment for them.** The remaining bulls in the herd must be held and isolated from female cattle until tested negative.

Two laboratory tests can determine whether a bull is infected:

- ▶ RT-PCR test (two tests at least 7 days apart) or
- ▶ Culture test (three cultures at least 7 days apart)

Only certified, accredited veterinarians can collect samples and submit them to certified laboratories.

## COWS AND HEIFERS

Cows and heifers become infected when they are bred to infected bulls. The protozoa live in the vagina, cervix, uterus, placenta, and fetus. Most infected cows will rid

themselves of the infection if they receive an extended period of sexual rest (120 to 150 days). However, the immunity is short-lived—a cow can become reinfected. A vaccine can help reduce the severity of the disease in an infected herd.

## CONTROL PROGRAM

Texas is implementing measures to control the spread of trichomoniasis. The program is being implemented in two phases (Tables 1 and 2). Under these regulations, bovine trichomoniasis becomes a reportable disease.

Bovine trichomoniasis enters a herd or ranch **only** via infected bulls, cows, or heifers. Again, an infected bull can transmit the disease to a cow or an infected cow can transmit the disease to a bull.

## PREVENTION

To avoid this disease, practice sound biosecurity principles:

- ▶ Maintain good fences to control the movement and commingling of cattle.
- ▶ Buy only virgin bulls and heifers, preferably from the original breeder.
- ▶ Keep the bull battery as young as possible. Older bulls harbor the protozoa more easily.
- ▶ Consider artificial insemination as a way to avoid introducing trich. Reputable semen companies repeatedly test bulls for many diseases, including trich, to ensure that the semen is not contaminated.
- ▶ Implement a defined breeding season. Trich may go undetected in a continuous mating system.
- ▶ Identify herd sires and record the breeding group to which each bull is exposed.
- ▶ Consider keeping bulls in the same breeding groups for several breeding seasons. Should a false negative (infected) bull be in the battery, the infection would not be spread to uninfected groups.

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- ▶ To avoid infecting many bulls in one season, consider maintaining small—but not necessarily single—sire groups instead of large, multiple-sire herds.
- ▶ Avoid buying open or short-bred (less than 120 days) cows.
- ▶ If you buy replacement cows, do not commingle them with the existing herd during the first breeding season.

## ANNUAL REVIEW

The Texas Bovine Trichomoniasis Control Program is subject to annual review and adjustment by the Texas Animal Health Commission. The commission solicits industry input for changes in the program to review, analyze, and consider for adoption.

Several recommendations for change to the program were considered and adopted by the commission at the fall 2010 meeting. They are listed below. The changes have been incorporated into the summary of regulations previously addressed in this document.

## REVISIONS APPROVED IN 2010

- ▶ A negative cattle trichomoniasis test will now be valid for 60 days if the bull is kept separate from female cattle during that time. The test may also be transferred within that period with the original signature of the consignor.
- ▶ A virgin certificate is now valid for 60 days if the bull is kept separate from female cattle. A virgin certificate may now also be transferred within that period with the original signature of the consignor.
- ▶ Revised entry requirements now exempt out-of-state breeding bulls from an entry trichomoniasis test if they come from a Certified Semen Service (CSS) artificial insemination facility where they were isolated from female cattle. The bulls must be accompanied by documents with an original signature by the veterinarian or manager of the facility.
- ▶ Revised regulations now allow untested, non-virgin Texas bulls to be sold and moved to a trichomoniasis-certified feedlot before slaughter. Under previous regulations, untested, non-virgin bulls were allowed to be sold only for direct movement to slaughter. This change does not apply to bulls not of Texas origin. Producers may also still buy untested bulls for movement under a TAHC-issued hold order/permit to a location away from female cattle, where the bull is to be tested for trich.
- ▶ Commission veterinarians will now notify producers by letter when an infected bull is identified on an adjacent premise. Neighbors will be only informed of the situation, not required to test.

Table 1. Phase I of the Texas bovine trichomoniasis control program, which became effective April 1, 2009. This phase applies to breeding bulls entering the state.

Requirements for breeding bulls entering Texas	
Age and experience of bull	Protocol
Virgin bulls 24 months old or younger  Age determined by: <ul style="list-style-type: none"> <li>▶ Birth date recorded on breed registration papers</li> <li><b>or</b></li> <li>▶ Not more than two central permanent incisors in wear</li> </ul>	<ol style="list-style-type: none"> <li>1. Must be officially identified with <b>at least one</b> of the following:               <ul style="list-style-type: none"> <li>▶ a breed registry tattoo or brand</li> <li>▶ a USDA metal ear tag (Bang's tag)</li> <li>▶ official 840 bangle or RFID ear tag</li> <li>▶ official trichomoniasis ear tag from the state of origin</li> </ul> </li> <li>2. Can be certified as a virgin bull <b>ONLY IF</b> it has <b>not been commingled with female cattle</b> and is accompanied by a breeder's certificate, signed by the breeder, and has this information included on the veterinary inspection certificate</li> </ol>
Non-virgin breeding bulls and all bulls more than 24 months old  Negative tests are valid for 60 days provided bulls remain separated from female cattle.	<ol style="list-style-type: none"> <li>1. Must be officially identified with <b>at least one</b> of the following:               <ul style="list-style-type: none"> <li>▶ a breed registry tattoo or brand</li> <li>▶ a USDA metal ear tag (Bang's tag)</li> <li>▶ official 840 bangle or RFID ear tag</li> <li>▶ official trichomoniasis ear tag from the state of origin</li> </ul> </li> <li>2. Must have <b>no contact with female cattle</b> during the test period and before shipment and have negative test results for trichomoniasis within 60 days prior to entry:               <ul style="list-style-type: none"> <li>▶ one negative RT-PCR test <b>or</b></li> <li>▶ three consecutive negative culture tests not less than 7 days apart</li> </ul> </li> <li>3. Must be accompanied by an official trichomoniasis test document, certificate of veterinary inspection, and other required health documents</li> </ol>

# RANGE DETECT SERIES: USING BODY CONDITION SCORES TO MANAGE RANGE COWS AND RANGELAND

Robert K. Lyons<sup>1</sup> and Richard V. Machen<sup>2</sup>

Body condition scoring is a valuable tool for managing beef cattle nutrition. Because body condition score is directly related to reproductive ability, ranchers can improve reproductive performance by monitoring the scores of their cattle and taking action when needed.

Body condition scores can be used at critical times to:

- ▶ Determine whether supplemental feed is needed
- ▶ Identify the cows needing special attention
- ▶ Gain insight into the causes of nutritional problems

Body condition scoring is an estimation of the relative fatness or body composition of cows. Scores range from 1, for a very thin body condition, to 9, indicating extreme fatness. A cow that is average—neither thin nor fat—would have a score of 5. For information on how to estimate body condition in beef cattle, see Extension publication ANSC-PU-079, *Body Condition, Nutrition and Reproduction of Beef Cows*.

As an evaluation tool, body condition scoring offers several advantages over weighing cows:

- ▶ Cow weights are affected by variations in digestive tract fill, which has little effect on condition score.
- ▶ Defecation and urination near weighing time can reduce cow weights by as much as 20 pounds or more, but have little effect on condition scoring.
- ▶ Body condition scoring does not require scales, can be done without putting animals through a chute, and can be done when working cows for other routine management practices.
- ▶ Most importantly, weight is a poor indicator of condition. A small-frame, fleshy cow and a large-frame, thin cow may weigh the same but differ greatly in body condition.

By using body condition scores, producers can glean important information about the nutritional status of their cattle. Nutritional status is primarily affected by two major factors: forage quantity and forage quality. These factors vary by season, causing periodic nutrient deficiencies in cattle.

To overcome or at least reduce these seasonal nutritional deficiencies, ranchers can match the cow's periods of highest forage requirements—breeding and calving—to the range's periods of highest forage supply.

Problems with forage quantity are often related to stocking rates and stock densities. Because body condition scores indicate the amount and quality of forage that a grazing animal harvests from a specific area during a specific period, the scores can be used to determine whether stocking rates and stock densities are correct. That is, they can indicate whether the cow's nutritional needs are being met and whether the range resource can be sustained at those stocking rates and stock densities.

At calving, body condition affects milk production, calf health and vigor, potential calving problems in extremely fat heifers, and the length of time between calving and the first estrous cycle. Body condition scores at calving should be at least 5 and maybe even 6, depending on individual situations. Reproductive efficiency is reduced at condition scores below 5; scores above 6 at calving do not appear to be of any additional benefit.

Higher scores at calving and during breeding are related to fewer services per conception, shorter calving intervals, and fewer open cows. During the breeding season, condition scores should be maintained at or above 5 to avoid the low conception rates associated with scores below 5.

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## HERDS COMPARED

To learn more about trends in body condition scores for beef cattle, the Texas A&M AgriLife Extension Service monitored the scores of four herds on three ranches over a 2- to 3-year period.

The scores were monitored monthly in:

- ▶ Two herds on the same ranch and same range sites, but in different management units in the eastern part of the Edwards Plateau. One was a fall-calving herd, the other, spring-calving
- ▶ One herd in the central Edwards Plateau
- ▶ One herd in the northern Rio Grande Plain

Additional body condition scores were obtained from a Texas A&M AgriLife Research project conducted in the Post Oak Savannah. These scores are presented from August through July of each year. During the first year, cows were on a summer-calving schedule (June-July). For experimental purposes, these cows were then shifted to a spring-calving schedule for the next 2 years.

Key management information for these five herds is shown in Table 1.

The quality of the forage selected by the cows in these herds was estimated using near infrared reflectance spectroscopy (NIRS) fecal analysis. The Nutritional Balance Analyzer (NutBal) computer software was used to calculate the apparent forage intake of the cows in each herd by adjusting forage intake estimations when necessary to match observed body condition scores.

### Yearly trends

The yearly average body condition score was near 5 or better for all herds (Table 2), with the Post Oak Savannah herd having the highest yearlong averages. Within the Post Oak Savannah herd, the average condition scores varied among years by as much as 0.7. Average yearlong scores were lower and more variable in the eastern Edwards Plateau spring-calving herd than in the fall-calving herd on the same ranch.

Table 2. Average yearly body condition scores for case study ranches during 2 to 3 years of observation.

Ranch/Herd Location	Year		
	1	2	3
Eastern Edwards Plateau Fall-Calving	5.2	5.4	5.4
Eastern Edwards Plateau Spring-Calving	4.7	5.2	4.9
Central Edwards Plateau	5.5	5.2	
Rio Grande Plain	4.9	5.0	
Post Oak Savannah	6.1	7.0	6.5

However, body condition scores at the critical stages of weaning (or 90 to 100 day before calving), calving and breeding are more important to management decisions than yearly averages.

### Weaning to calving

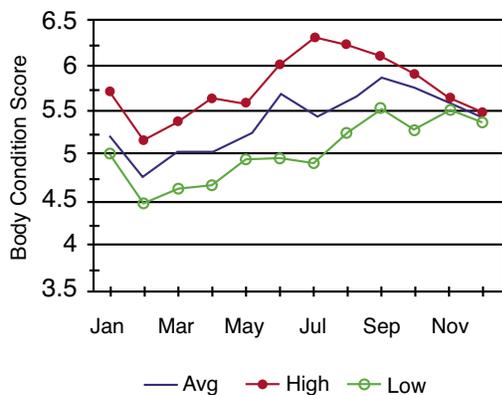
On all the ranches studied, cattle body condition scores exceeded 5 between weaning and calving (Fig. 1-6; Table 1). In fact, in all but the eastern Edwards Plateau spring-calving herd, cow condition scores exceeded 5.5 at calving. Although the eastern Edwards Plateau spring-calving herd reached an average score of almost 5.5 in December (Fig. 2), the cows were unable to hold this condition until calving because of low forage availability.

From February through August, condition score trends were generally positive for cows in the eastern Edwards Plateau fall-calving herd (Fig. 1). They were also positive from August through November for the eastern Edwards Plateau spring-calving herd (Fig. 2). The scores of cows in the central Edwards Plateau herds increased slowly and steadily from January through April (Fig. 3).

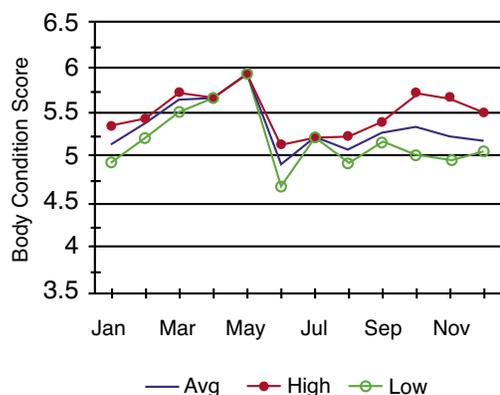
Trends for cows in the Rio Grande Plain herd were generally positive to neutral from April through January. The largest monthly increases were in May and August (Fig. 4). These condition scores rose because rainfall increased the amount of forage available.

Table 1. Weaning periods and major calving and breeding months.

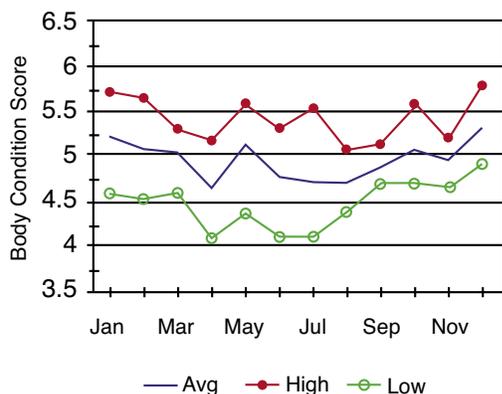
Ranch/Herd Location	Wean	Calve	Breed
Eastern Edwards Plateau Fall-Calving	May	October	December 22-January 21
Eastern Edwards Plateau Spring-Calving	October	March	May 22-June 21
Central Edwards Plateau	December	May	July 22-August 21
Rio Grande Plain	August	January	March 24-April 23
Post Oak Savannah Summer-Calving	January	June	August 22-September 20
Post Oak Savannah Spring-Calving	October	March	May 22-June 21



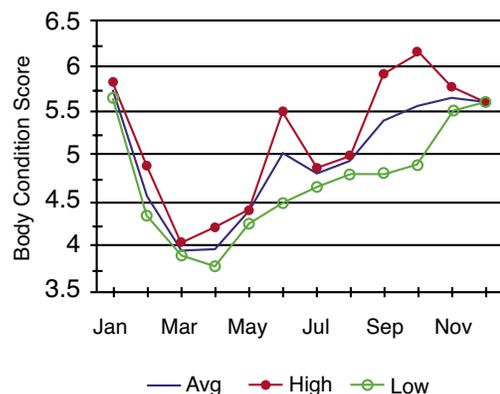
**Figure 1.** The body condition score profile for a fall-calving herd in the eastern Edwards Plateau showing the herd 3-year monthly average and the highest and lowest monthly herd averages during the 3-year period.



**Figure 3.** The body condition score profile for a May-calving herd in the central Edwards Plateau showing the herd 2-year average and the highest and lowest monthly herd averages during the 2-year period.



**Figure 2.** The body condition score profile for a spring-calving herd in the eastern Edwards Plateau showing the herd 3-year monthly average and the highest and lowest monthly herd averages during the 3-year period.



**Figure 4.** The body condition score profile for a winter-calving herd in the northern Rio Grande Plain showing the herd 2-year average and the highest and lowest monthly herd averages during the 2-year period.

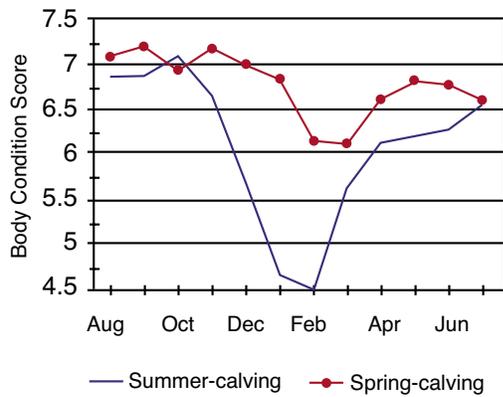
For the summer-calving schedule, condition scores in the Post Oak Savannah herd rose after weaning in January (Table 1; Fig. 5). Cows lost condition after weaning from November through February under the spring-calving schedule because forage quality declined. However, this loss was less than that during the same season with the summer-calving schedule.

### Calving to breeding

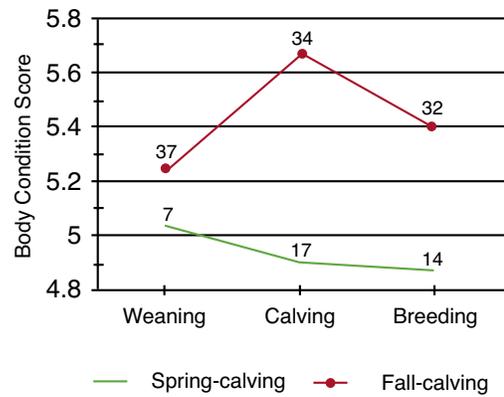
Changes in condition score varied among herds after calving. The eastern Edwards Plateau fall-calving herd lost an average of 0.3 condition score from calving to breeding (Fig. 6) because forage quality declined. In comparison, the eastern Edwards Plateau spring-calving herd lost only about 0.1 condition score during this period because forage quality and quantity improved.

The central Edwards Plateau herd lost a full condition score immediately after calving in May (Fig. 3). The Rio Grande Plain herd lost almost 2 condition scores in the 2 months immediately after calving in January (Fig. 4). The condition scores dropped in both herds because forage availability decreased.

Under the summer-calving schedule, body condition dropped steadily in the Post Oak Savannah herd after the breeding season, from about 7 in September to 4.5 in February (Fig. 5). This drop was related to declining forage quality. For the 2 years this herd was observed under the spring-calving schedule, cows gained condition immediately after calving in March.



**Figure 5.** The body condition score profile for a cattle herd in the Post Oak Savannah. The summer-calving profile is for 1 year. The spring-calving profile represents the average of 2 years.



**Figure 6.** The relationship between stock density (acres per animal at a given time) and a 3-year average for body condition scores at weaning, during the calving season, and during the breeding season for the Eastern Edwards Plateau (EEP) herds. Numbers above the lines indicate the average stock density for the period in acres per cow.

## MANAGEMENT IMPLICATIONS

The eastern Edwards Plateau fall-calving herd demonstrated that a fall-calving herd needs to reach a body condition score of better than 5 at calving to compensate for the loss from calving to breeding and to keep cows above a 5 condition score during breeding.

The eastern Edwards Plateau spring-calving herd was able to maintain nearly a 5 condition score from weaning to calving to breeding. This herd actually increased to more than a 5 condition score in December after weaning, but was unable to hold this condition.

Comparisons of apparent forage intake for these two herds suggests that the spring herd did not have enough forage from December through February. In December, for example, apparent forage intake (27 pounds per day) for the fall herd was almost as much as the expected forage intake (29 pounds per day) and almost twice as much as the apparent forage intake (16 pounds per day) for the spring herd.

This comparison suggests that more forage was available for the fall herd. This difference in forage availability appears to have been related to stocking rate and stock density (acres per animal at a point in time). The stock density was two to five times higher (fewer acres per animal) for the spring herd than for the fall herd (Fig. 6) at weaning, calving and breeding.

Although the spring herd maintained a condition score of about 5, there was no room for error. To provide more forage to improve body condition and reduce risk in these kinds of circumstances, producers can reduce stock density during the weaning-to-calving period. In addition, to avoid damage to forages and soils, the

range resource should be monitored closely when it has high stock densities, such as those in the spring herd.

The central Edwards Plateau herd was in satisfactory condition for most of the year. This ranch was moderately stocked. Based on total acres, the stocking rate was about 40 acres per cow. Based on estimated grazeable acres, accounting for brush areas with little to no forage production to support cattle, the stocking rate was about 25 acres per cow.

However, the drastic condition score loss immediately after calving appeared to be related to forage availability, because in May, forage quality is usually relatively high. In such situations, the cows should be provided more access to forage to reduce this condition score loss and to create an additional buffer against unpredictable circumstances such as drought.

Loss of condition score after calving in the Rio Grande Plain herd also appeared to be related to forage availability. The stocking rate on this ranch was about 65 acres per cow, based on total acres. However, the ranch was heavily covered with South Texas brush, which reduced grazeable acres, making the effective stocking rate about 16 acres per cow.

One approach to this problem for this ranch would be to open some of the brushy areas to increase forage production and availability. Supplemental feeding during this period should be used to slow the condition score loss rather than to try to eliminate it, because elimination would not be economically feasible.

The Post Oak Savannah herd demonstrates the effect of timing the calving season to match forage quality and quantity. In the summer-calving schedule, extreme

condition score loss occurred from fall to winter. The loss should not have affected reproduction because cows would have been bred in August and September. However, this kind of loss in condition could reduce milk production and thus calf performance.

Under the spring-calving schedule, fall condition loss was much less than under the summer schedule. Those cows even gained condition immediately after calving. The high condition scores observed with the spring-calving schedule suggests that the stocking rate for this herd could be increased if key forage species are not being overused.

## RECOMMENDATIONS

Keeping condition score records over a period of years can provide a basis for understanding what is happening and what can be expected on an individual ranch.

- ▶ Use body condition scoring routinely.
- ▶ At a minimum, condition score at weaning (or at 90 to 100 days before calving), at calving, and during the breeding season.

Make the best use of the ranch's forage resources. Remember that forage is the most economical source of nutrients for a grazing animal.

- ▶ Schedule calving and breeding seasons to match the periods when forage quality and quantity from the range can best provide nutritional requirements and achieve desired condition scores.
- ▶ Matching cattle requirements with nutrient supplies from forage is the most economical management approach.

Use body condition scoring to make the best use of supplemental feeding. Because forage conditions can change rapidly in range situations, condition scores at weaning and calving provide a guide for managing cows to maintain good condition through subsequent calving and breeding seasons.

- ▶ Before calving, sort and feed cows according to condition score.
- ▶ At weaning (or 90 to 100 days before calving), condition scores can be used to determine the gain required to attain the target body condition score of 5 to 6 at calving.
- ▶ Using supplemental feeding to promote gains in condition score is economically feasible only from weaning to calving.
- ▶ At other times, supplemental feeding should be used only to maintain condition or to reduce condition score loss.

Many ranches use a fall-calving season in addition to spring calving to reduce the number of bulls needed and to provide an additional marketing period for calves. However, fall-calving requires special management.

- ▶ Fall-lactating cows are at risk of nutritional stress from declining forage quality.
- ▶ Fall-calving requires lighter stocking rates/densities so that cows will be in condition score above 5 at calving and then at least condition score 5 during breeding.

Condition scores before calving, at calving and at breeding also provide insight into problems with forage quality and quantity. Understanding whether the source of a nutritional problem is forage quality or forage quantity can help producers determine the appropriate management approach to solve the problem.

Condition scores can also provide insight into resource management. For example, if cows cannot achieve and maintain target condition scores without excessive feed inputs, the stocking rate or stock density needs to be lowered. If this situation exists, the preferred, productive forage species or preferred range sites are probably being overused, or general overuse is occurring. In either case, adjustments in stocking rate or stock density are needed to protect the resource from long-term damage.

### For more information on body condition scoring and related topics

- Herd, D.B. and L.R. Sprott. 1996. *Body Condition, Nutrition and Reproduction of Beef Cows*. ANSC-PU-079, Texas A&M AgriLife Extension Service.
- Lyons, R.K. and R.V. Machen. 2000. *Interpreting Grazing Behavior*. RWF-PU-058, Texas A&M AgriLife Extension Service.
- Lyons, R.K., R.V. Machen, and J.W. Stuth. 2000. *Forage Quality Photo Guide: Evaluating Diet Quality Selected by Grazing Beef Cattle Using Photographic Guidelines*. RWF-PU-027, Texas A&M AgriLife Extension Service.
- McCullum, T. III. 1997. *Supplemental Strategies for Beef Cattle*. ANSC-PU-085, Texas A&M AgriLife Extension Service.

Table 2. Phase II of the Texas Bovine Trichomoniasis Control Program, effective January 1, 2010, applies to any bull offered for sale, lease, exchange, or otherwise change of possession for breeding. No test or certification is required for bulls marketed as “slaughter only.”

Requirements for breeding bulls in Texas	
Age and experience of bull	Protocol
<p>Virgin bulls 24 months old or younger</p> <p>Age determined by:</p> <ul style="list-style-type: none"> <li>▶ Birth date recorded on breed registration papers</li> <li><b>or</b></li> <li>▶ Not more than two central permanent incisors that show wear</li> </ul> <p><i>Virgin status can be extended to 30 months if the breeder <b>and</b> an accredited veterinarian certify on the breeder’s certificate that the facility in which the bull is raised and held allowed no contact with female cattle.</i></p>	<ol style="list-style-type: none"> <li>1. Must be officially identified with <b>at least one</b> of the following: <ul style="list-style-type: none"> <li>▶ a breed registry tattoo or brand</li> <li>▶ a USDA metal ear tag (Bang’s tag)</li> <li>▶ official 840 bangle or RFID ear tag</li> </ul> </li> <li>2. Can be certified as a virgin bull <b>ONLY</b> if it has <b>not been commingled</b> with female cattle and is accompanied by a breeder’s certificate signed by the breeder.</li> </ol>
<p>Non-virgin breeding bulls and all bulls more than 24 months old</p> <p>Negative tests are valid for 60 days provided bulls remain separated from female cattle.</p>	<ol style="list-style-type: none"> <li>1. Must be officially identified with <b>at least one</b> of the following: <ul style="list-style-type: none"> <li>▶ a breed registry tattoo or brand</li> <li>▶ a USDA metal ear tag (Bang’s tag)</li> <li>▶ official 840 bangle or RFID ear tag</li> </ul> </li> <li>2. Must have <b>no contact with female cattle</b> during the test period and have negative test results for trichomoniasis within 60 days of change of possession. Test options are: <ul style="list-style-type: none"> <li>▶ one negative RT-PCR test <b>or</b></li> <li>▶ three consecutive negative culture tests not less than 7 days apart</li> </ul> </li> <li>3. Must be accompanied by an official trichomoniasis test document and a certificate of veterinary inspection.</li> <li>4. <b>Infected bulls will be reported and restricted to movement to slaughter only.</b> Remaining bulls in the herd will be held and isolated from female cattle until tested negative. Test options are: <ul style="list-style-type: none"> <li>▶ two negative RT-PCR tests not less than 7 days apart <b>or</b></li> <li>▶ three consecutive negative culture tests not less than 7 days apart</li> </ul> </li> </ol>

# INFECTIOUS BOVINE RHINOTRACHEITIS

Edited by L.R. Sprott<sup>1</sup> and Steve Wikse<sup>2</sup>

Infectious bovine rhino tracheitis (IBR) was originally recognized as a respiratory disease of feeder cattle in the western United States. Later, IBR became recognized as a complex of disease syndromes occurring throughout the United States and over the other major cattle-producing areas of the world.

Cattle and some wild ruminants (cud-chewing animals) are the only known hosts. IBR is also known as red nose and IPV (infectious pustular vulvovaginitis).

Knowing symptoms and prevention measures can help producers minimize losses from IBR.

## SYMPTOMS

Several symptoms are associated with IBR, including a respiratory syndrome, infectious pustular vulvovaginitis, abortion, pinkeye and postmortem lesions.

### Respiratory syndrome

Respiratory symptoms were the first signs reported for this disease. The animal has difficulty inhaling, breathes rapidly, has a profuse, watery nasal discharge becoming thicker and darker as the infection progresses, and stands with its head and neck extended. Depression, higher body temperature (104 to 108 degrees F) and decreased appetite accompany the respiratory signs.

As the infection progresses, the animal's nostrils become encrusted, it loses weight rapidly and may have diarrhea. If the crusts on the nostrils are rubbed off, the underlying tissue appears very red and inflamed, hence the term "red nose."

The respiratory form of the disease usually affects concentrated groups of cattle, such as in feedlots. The IBR virus is one of the most common agents involved in shipping fever pneumonia of feedlot calves. Keeping

many cattle in close contact provides an ideal situation for the virus to spread rapidly. As the virus passes from animal to animal, its ability to produce disease increases.

The first signs of the disease appear about a week after infection. Usually, several animals become sick about a week before a large number of animals show signs of illness. Fifteen to 100 percent of the herd may become ill, with a death rate of 0 to 5 percent of those affected. The respiratory form of this disease is the most frequently observed form under feedlot conditions.

### Infectious pustular vulvovaginitis (IPV)

Cattle exhibiting the vulvovaginitis form of the IBR complex are sexually mature females that do not appear ill. Signs of IPV include a thick yellow to brown vulvar discharge that attaches to the vulvar tuft of hair. The vulva is swollen and the vulvar and vaginal lining is reddened, dying and/or contains small whitish-colored pustules. The vaginal-vulvar infection causes irritation, exhibited by frequent tail-switching and urination. Temporary infertility accompanies this infection.

Lesions similar to those from IPV may appear on the bull's penis and prepuce (foreskin). This infection is believed to result from coitus with an IPV infected female. The libido of infected males is usually decreased temporarily. The condition is known as *balanoposthitis*.

### Abortion

The IBR virus is one of the most common causes of bovine abortion. Possible sources of the virus include new additions (shedders) to the herd, vaccines, birds or wild ruminants. Often this abortion is preceded by a mild respiratory and/or eye infection (pinkeye), although abortion occurs without observed signs of illness. The aborted fetus has no consistent gross characteristic lesions.

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Abortion may occur at any stage of the gestation period, but is usually noticed in the second half of gestation. Death and absorption of the fetus may occur in early pregnancy and may be assumed to be an infertility problem.

Beef and dairy cattle may be affected, with up to 75 percent of the herd aborting. Abortion has been reported in herds two successive years, possibly indicating that recovery does not produce complete immunity. Abortions have also been reported occasionally in herds where a program of IBR vaccination has been practiced for up to several years before the onset of abortions. After aborting, the animal apparently has no injury to its reproductive tract; normal pregnancy may follow.

Abortions may also be produced by vaccinating pregnant cattle with certain types of modified live IBR virus vaccine. Other types are labeled for use in pregnant cows or in calves nursing pregnant cows. Be sure to read label directions.

Calves may be born infected with the IBR virus. Infection is exhibited as enteritis, weak calves that have difficulty nursing, or as a respiratory problem.

### Pinkeye (keratoconjunctivitis)

The pinkeye form of IBR may accompany or precede the respiratory or abortion form of this disease. The signs are reddened, swollen mucous around the eyes and a clear, watery secretion draining over the hair below the eye. The secretions cause the hair to mat and collect dirt and other debris. As the condition progresses, the secretions become thicker and darker. This condition is sometimes called "winter pinkeye" and is differentiated from classic pink eye caused by the bacterium *Moraxella bovis* by lack of a central corneal ulcer.

Another condition observed in young cattle with the IBR virus is encephalitis. This nervous system infection may look like the nervous form of listeriosis.

### Postmortem lesions

Diseased cattle that have died usually have hemorrhages or a mucofibrinous exudate over the sinuses. A tracheitis is usually present with hemorrhages and a hyperemia. These lesions may extend into the bronchi.

Because cattle often have dual infections, typical lesions are seldom observed, and differentiating between shipping fever, mucosal disease or malignant catarrhal fever requires laboratory examination for confirmation.

### PREVENTING IBR AND IPV

Producers should take measures to prevent IBR and IPV:

- ▶ Have a veterinarian examine all new additions to an established herd and obtain a health certificate indicating that they were disease-free at purchase.
- ▶ Isolate all new additions for at least 30 days and have a veterinarian reexamine them before having contact with the established herd.
- ▶ Isolate all diseased animals immediately upon detection. This helps prevent contact and spread of the infection.
- ▶ Vaccinate cattle. Numerous IBR vaccines are readily available. Use them only as the instructions on the label indicate.

### TREATMENT

No medicines are available to treat the IBR viral infection. Secondary infections may be controlled by using antibiotics and sulfonamides through veterinary prescription.

This information was prepared for the Great Plains Beef Cattle Handbook by I.A. Schipper, D.V.M., Professor of Veterinary Science, North Dakota State University. Appreciation for editorial comments is extended to Dr. Steve Wikse, College of Veterinary Medicine, Texas A&M University.

## CALF PERFORMANCE AS AFFECTED BY MONTH OF BIRTH

Table 6 shows the effect of month of birth on calf performance. These data were taken from more than 8,000 calves born in the central, southern and Gulf Coast regions of Texas. In general, the information can be applied to herds in the eastern, southeastern, south central and southern regions of Texas.

The data show that growth performance drops in calves born in May through September. Calves born in those months had adjusted weaning weights (to remove age bias) below that of calves born in cooler months.

Peak performance occurred in calves born in March (Trails 1 and 2) or April (Trial 3) and declined for all calves born from May through September by as much as 56 (Trial 1), 79 (Trial 2), and 124 (Trial 3) pounds. The information presented in Table 6 should not be used to target a specific month to calve because there is some variation in the data between locations.

It can be concluded that high temperatures are very stressful on summer-born calves and will reduce their growth. Unless a producer retains ownership of summer-born calves to feed through the winter, the calves are unlikely to generate acceptable income. Even then, data from a fourth Gulf Coast herd with summer calves (not shown) revealed that growth rate in summer calves was low, which forced them to be kept until 12 months of age to reach an acceptable sale weight that their herd mates reached at 7 months of age.

If calves born in cooler months perform better than those born in summer, then what effect is there on performance of calves born in the cold of December, January and February? Table 6 shows that calves born in those months also suffer, but not to the same degree as those born in hot months. Cold may negatively affect calf performance, but the degree of cold stress in central, southern and the Gulf Coast regions of Texas is not high enough to eliminate calving in the fall and winter.

This is completely contrary to the effects of cold on performance in winter-born calves in northern states where temperatures are more severe and high death loss and the potential for low growth rate in calves are major concerns. Perhaps the most important thing to conclude from data in Table 6 is that stressful temperatures of both cold and heat will affect calf performance, and summer calving is not recommended in the eastern, central, southern and Gulf Coast regions of Texas.

## EFFECTS OF COW SIZE ON CHOOSING WHEN TO CALF

Cow size is an important consideration in choosing when to calve. Data from an Arkansas trial show that calf performance and profits are best in small to medium frame cows that calve in the fall compared to spring months. Even though feed costs increased for these fall-calving cows compared to those calving in spring, the value of higher performance in their calves justified the higher feed costs and resulted in higher profits.

To the contrary, large frame cows that calved in the spring had higher profits than when calved in the fall. The reason was that supplemental feed requirements for the fall-calving cows were so high that the value of performance in their calves did not justify the high feed costs. These data suggest that unless alternative nutritional management steps can be taken to reduce feed costs in large frame, fall calving cows, it is best to calve such cows in the spring.

## CONCLUSIONS

The data presented do not clearly identify a specific month to calve and breed cows in Texas, but there is no question that summer calving (May through September) in the eastern, central, southern and the Gulf Coast regions of Texas will result in significantly reduced calf performance. A drop in calf performance ranging

Table 6. Effect of month of birth on adjusted weaning weight in calves.

Trial	Month of Birth											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	388	427	430	417	416	—	—	374	424	—	478	465
2	477	491	477	467	432	424	434	414	398	432	447	474
3	361	394	415	438	396	—	341	314	320	349	359	357

Trail 1 - Burleson County, 1976  
 Trail 2 - Webb County, circa 1969  
 Trail 3 - Calhoun County, 1976-1979