MANAGEMENT OF BEEF PRODUCTION IN ADVERSE ENVIRONMENTS

Jim Gerrish
Grazing Lands Consultant
21451 Ivy Drive, Brookfield MO 64628

Introduction:

Environmental adversity can affect beef production on many fronts. Climatic conditions that limit forage availability or place stress on livestock are only two of the more common aspects of environmental adversity. Extremes in either heat or cold and drought or flood affect many other aspects of the animal's environment including presence or absence of parasites and pests, forage composition and nutritional quality, and occurrence of toxic plants. Topography that demands athletic cattle or soils containing excessive or deficient minerals are other forms of environmental adversity. The Upper South and Lower Midwest may look like a very favorable environment to arid-country ranchers from the West, but the presence of endophyte-infected tall fescue in the majority of pastures throughout the region places tremendous stress on cattle grazing in this region. While a serious health and production challenge, fescue toxicosis is rarely ever fatal to cattle. Western ranchers on the other hand face the challenges of many species of toxic plants in their native rangeland that can be highly lethal and act very quickly leaving dead animals strewn over the range. The bottom line is beef production in almost every environment faces challenges on the bio-physical front.

Within any given set of challenges, we can make alternative choices for addressing those challenges. Historically, BIF has focused on genetic adaptation to meet production challenges. The positive benefits of selecting animals of an appropriate genetic makeup to meet the unique challenges of a particular environment cannot be overemphasized. In the long term, genetic adaptation is the first line of defense. Our second line of defense is management of the production system within the context of our environment. While fescue toxicity causes significant economic loss for cattle producers, there are fairly simple management strategies that can help offset the effects of the endophyte. By the same token, consumption of toxic plants on native range can be minimized through well-planned grazing management.

At this point, it is important to note the production environment includes not only the bio-physical characteristics of the environment but the economic and social climate as well. While this paper deals primarily with bio-physical issues of production management, we cannot overlook other challenges. The current trend among beef researchers and producers to identify economically relevant traits and establish criteria for comparisons clearly shows the need for economic relevance in our efforts. There are certain genetic traits that will likely always have economic relevance such as maintenance requirements and overall reproductive efficiency. Other traits may have only transitory economic relevance. It is important to focus our efforts on long term economic relevance. Social issues are becoming an increasing part of the production environment. Questions of animal well-being, multiple use of public lands, and wildlife interface will continue to increase in importance in our decision making over the foreseeable future. How we interact with our bio-physical environment will be tempered by these social issues.

Understanding the challenge:

The first step in dealing with beef production in an adverse environment is understanding what the challenges are and what resources are at your disposal to assist you in meeting those challenges. It is easy to say that your farm is all infected fescue or that you ranch in dry country, but those are not the challenges. They are simply environmental conditions. Those same environmental conditions you view as challenges also provide advantages and opportunities. The production challenge is getting cows bred in a timely manner or keeping winter feed costs within some defined level of profitability. Growing yearling cattle on pasture is a similar situation. The challenge is maintaining acceptable rate of gain, not that you live in Arizona or Arkansas. For both the cow and the yearling in any environment, the challenge is maintaining adequate dietary intake while avoiding toxicity.

Getting cows bred in a timely manner is largely a nutritional issue and, in a grazing-based operation, depends on balancing nutritional demands with seasonal variation in forage availability and quality. The nutrient demand of a beef cow is very cyclic and seasonal in nature. Timing of the cycle is driven by when calving occurs and degree of fluctuation in nutrient demand is closely tied to the lactation potential of the cow. Prevailing weather conditions alter nutrient demands on a daily and seasonal basis, but weather-induced demands are also largely predictable based on historic weather patterns. Providing adequate energy cost effectively to support lactation and breeding efficiency is the challenge most cow-calf producers face.

From 1986 through 1993, we collected lactation data from the cow herd at the University of Missouri - Forage Systems Research Center. Lactation curves were determined for one group of cows calving between Feb 15 and March 15 with a mean calving date of March 1 and a second group calving from March 16 through April 15 with a mean calving date of March 26. Later calving cows reached peak lactation more quickly and achieved a higher peak lactation. We believe this response was due to fresh pasture becoming a part of the cow's diet earlier in the lactation period. Depending on milking ability of the cow, net energy demand increases from 30 to 100% over maintenance with the onset of lactation. This is equivalent to increasing stocking rate by those same percentages during the lactation period, placing increased demand on available feed and forage resources. In a cow-calf operation, timing of calving and control of forage supply are our primary means of bringing nutritional demand and forage supply into balance. This basic concept is fundamental to successful beef production in any environment. The more challenging the environment, the more critical establishing balance becomes.

Figure 1 illustrates the lactation curve for beef cows calving on March 1. The daily growth rate of pasture under typical management in north Missouri is also shown. Nutrient demand increases rapidly due to lactation and occurs well before pastures begin growing. Nutrients for the period from March 1 calving until mid-April are typically supplied from harvested forage or feedstuffs. The relative cost of providing energy from hay is generally two to four times greater than supplying energy from standing pasture. Calving March 1 or earlier places the animals highest nutrient demand occurring at the time when feed resources are most costly and quality is frequently the lowest. Pasture production later in the summer is fairly minimal on unimproved pastures resulting in cows losing weight until weaning. Body condition must then be returned to the cows following weaning, again relying on harvested forage.

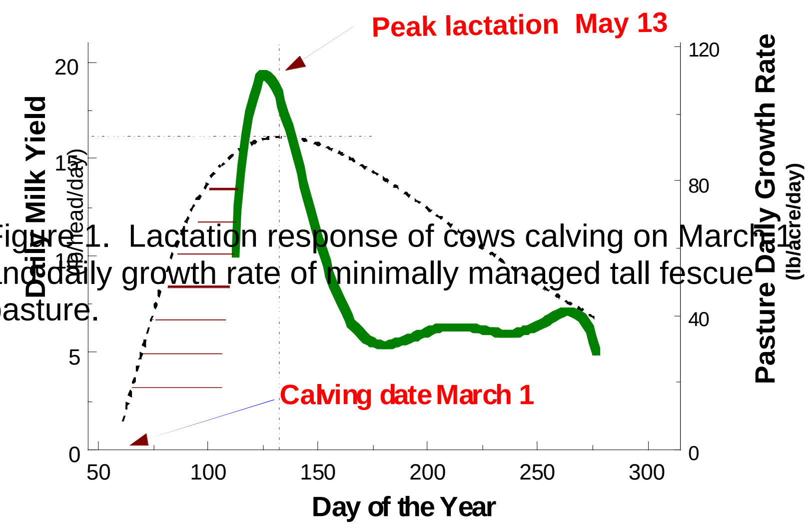


Figure 1. Lactation response of cows calving on March 1 and daily growth rate of minimally managed tall fescue pasture.

The pasture growth curve in Figure 1 describes a tall fescue dominant pasture receiving 40 lb N/acre in spring and managed with a minimal 3-paddock rotation. This is the classic perception of cool-season grass growth, excess growth in the spring followed by pasture deficiency from mid-summer on. With late winter calving , the peaks in lactation and forage growth rate do come fairly close together but both before and after the lactation peak forage supply is poor. This same scenario is repeated across many environments all around the world. While pasture daily growth rate is much lower in arid rangeland than shown in this figure, the same pattern of a short season of rapid growth followed by little growth applies.

What can we do to bring animal demand and forage supply into better balance just through improved pasture management? The growth curve in Figure 2 illustrates a tall fescue-legume pasture managed with flexible rotational stocking with target grazing height of eight inches and post-grazing residual of three to four inches. Using a legume in the pasture provides greater summer forage production. Rotational grazing allows grazing to be initiated earlier in the spring and extend later into the fall, thus reducing the need for as many days of supplemental feed. By keeping calving date at March 1, the gap between increasing lactation demand and forage supply is reduced, but the requirement for supplemental feed is still there.

Delaying calving until mid-April minimizes the requirement for nutrients supplied through harvested forages or feedstuffs (Figure 3). While nutrient demand by the cow increases through the last several weeks of gestation, it is at a much slower rate than the lactation demand. Calving in mid-Spring should allow cows to both gain weight prior to calving as well as adequately meet their nutritional needs just from pasture. Research conducted by Adams et al (1996) in Nebraska has shown both economic and reproductive benefit for delaying calving even later.

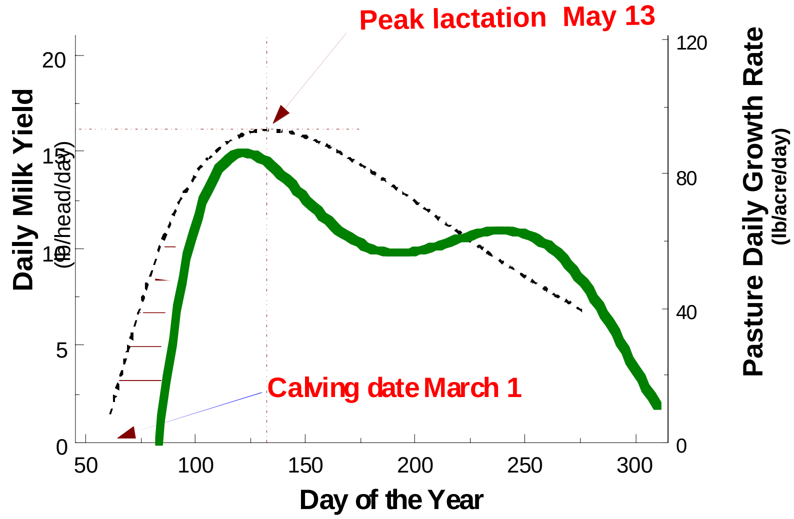
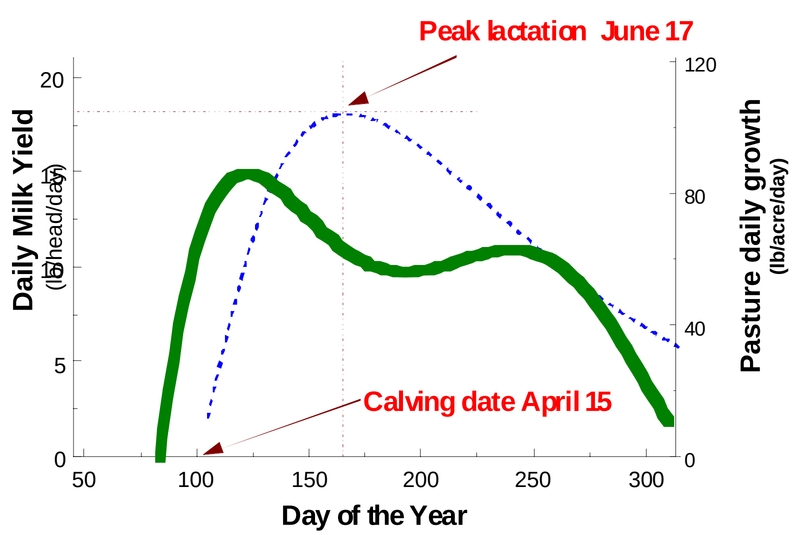


Figure 2. Improved pasture management including interseeded legumes and rotational grazing can reduce need for harvested forage even with early calving.

Another consideration is that early calving requires the breeding season to begin while cows are either still on hay or have been only a few weeks on pasture. Cows are often slow to regain body condition prior to the breeding season in these situations resulting in extended anestrous and a strung out calving season. Cows calving in April or later can be on good quality pasture for two months prior to breeding season and can regain body condition and breed back in a much tighter season.



One major drawback of late spring calving in many parts of the country is that the corresponding breeding season occurs in the hottest part of the summer. Compound potential heat stress with fescue toxicity and the forage utilization benefits from later calving quickly evaporate.

Figure 3. Delaying calving to April 15 eliminates the gap

With fescue in the picture, animal type becomes increasingly important if considering spring calving with breeding occurring in mid-summer. Cattle with *Bos indicus* influence are more heat tolerant and may be less affected by fescue toxicity (Aiken & Brown, 1994;Brown et al 1997). Animals coming from a fescue-free, low humidity Western environment are much less tolerant of endophyte-infected fescue. Buying what are otherwise high quality bulls from large Western ranches and bringing them to the fescue environment is generally disastrous. By the same token, taking a well adapted fescue-developed bull to the Western range can be equally disastrous as the bull may not have the conformation and endurance to cope with 40-acre per cow rangeland.

The greatest challenge infected tall fescue places on the beef herd is getting cows bred for spring calving (Porter and Thompson, 1992). The main endophyte induced toxin in tall fescue is ergovaline which occurs primarily in seedheads, stems, and leaf sheaths. Some toxicity is present in leaf tissue but is at a much lower concentration than in other plant parts. As seedhead production occurs almost entirely in late spring, this is when fescue is most toxic. With increasing ambient temperature and ergovaline concentration, grazing animals become heat stressed and forage intake is depressed just when nutrient demand is greatest. The first production function to fail when nutritional stress occurs is reproduction. One of the quickest ways to overcome fescue toxicity in a breeding herd is to switch to fall calving. Fall pasture tends to be mostly leaf material so ergovaline content is lower and ambient temperatures are cooler resulting in much less stress on the animal. Breeding occurs mainly in December so heat stress is rarely a problem.

While fall calving significantly reduces the effects of fescue toxicity on breeding, it completely misses the traditional grass growth curve for much of the US (Figure 4). Fall calving is considered by many producers to be far too expensive a program due to the need to provide peak lactation nutrition through harvested forage and concentrate feed. An important concept for cattle producers to understand is that the growing season and the grazing season are two completely different things. The more challenging the production environment or the shorter the growing season, the more important this concept becomes for breeding operations. Stockpiling perennial forages for grazing in the dormant

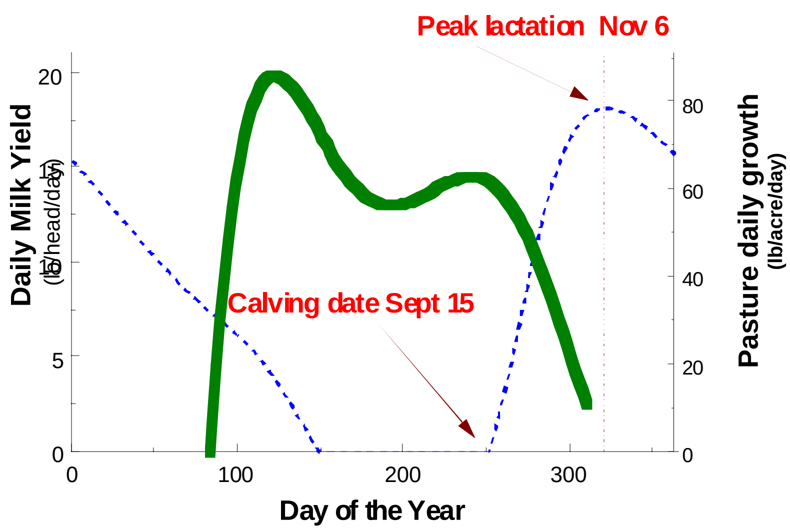


Figure 4. While fall calving reduces effects of fescue

season is a proven management practice for both rangeland and tame pasture environments (Allen et al, 1992). In warm-season rangeland environments, protein supplementation is essential for ruminant livestock to be able to utilize low protein, high fiber range grasses even for maintenance (Lardy et al, 1999). For dry cows, daily cost of standing range even with protein supplement is still considerably cheaper than feeding harvested forage but is unlikely to meet the needs of lactating fall-calving cows. In the cool-season forage environment, especially with tall fescue, protein content rarely drops below the required level for even lactating cows. Energy content is more likely to become limiting, but with proper stockpiling procedures and appropriate grazing management, adequate net energy levels can be maintained throughout the winter to support both lactation and rebreeding. If energy supplementation is required, it usually comes at much lower cost than protein supplementation.

This discussion illustrates the importance of considering the total production system when planning herd structure and the management calendar. Altering the genetic base of the herd, timing of calving, and forage base all affect one another both bio-physically and economically. Fall calving is an economically viable solution for fescue-induced breeding problems only when combined with a low-cost winter forage system. Fortunately, tall fescue is the grass species best adapted to fall stockpiling and winter grazing. It grows more rapidly than any other cool-season species in late summer and autumn, it increases in energy content in response to shorter day length and cooler nights, and it withstands freezing damage better than any other cool-season grass species. So, even though we may first consider getting cows bred on endophyte infected tall fescue to be a challenge, it also provides the best opportunity for a low-cost winter grazing system that allows us to effectively breed cows at a time of year when fescue toxicity is a minimal problem. Similarly, the very aridity of the Western range which seems to be a challenge also virtually eliminates internal parasites as a management problem in mature cows.

Practical management for reducing fescue toxicity:

Management of fescue pastures to reduce endophyte effects can be categorized as dilution, supplementation, avoidance, and replacement techniques. Most fescue graziers use a combination of these factors to deal with the fescue problem.

Interseeding red clover into endophyte-infected tall fescue has already been mentioned as a means of improving forage supply and distribution. This practice is beneficial for all cool-season grasses but is especially applicable with tall clover because of the toxin dilution that occurs when the animal is provided with a more diverse diet. Each bite of red clover effectively replaces a bite of toxic fescue thus reducing the daily ergovaline intake. Any other forage species, grass or legume, warm-season or cool-season, that can be grown in association with fescue is beneficial for reducing toxicity potential. Crabgrass oversown on fescue pastures is proving to be a very good combination for improving summer forage supply and reducing fescue toxicity.

Supplementation is actually another dilution technique but has the additional benefit of providing dietary energy in a form that results in lower rumen temperature and reduces some of the heat stress potential. Because dietary intake reduction is a main effect of fescue toxicosis, providing additional energy in a concentrated form offsets some of the intake reduction. Supplementation at 0.3 to 0.8 % of bodyweight is generally recommended for cattle on infected fescue pastures.

Establishment of alternative pastures to use at the times of greatest fescue toxicity potential is the avoidance process. Often referred to as complementary grazing systems, use of warm-season species from May through August removes livestock from fescue pastures during their most toxic period. In the Midwest, native tall grasses such as big bluestem. Indiangrass, switchgrass, and eastern gama grass are the most common alternatives. In the Upper South, bermudagrass, Old World bluestems, as well as the native species are commonly used. Summer annuals such as crabgrass, millets, and sudangrass can also be used as complementary forages. Summer annuals are especially useful for alternative forage if infected pastures are being renovated.

The final pasture management strategy for dealing with endophyte-infected tall fescue is to eradicate it and replace it with some other pasture species. The feasibility of renovating many fields that are predominantly infected tall fescue may be challenged by topography, soil conditions, or location. These fields are best managed through the options described above. Fields that can be legitimately tilled and cropped or be accessed by sprayer and no-till drill should be given serious consideration for pasture conversion. Endophyte-free fescue varieties have been available for many years but have had disappointing performance in many parts of the country. The endophyte exists in tall fescue for a reason and that reason is improved plant persistence. Chemical compounds generated by or in response to the presence of the endophyte provide the host plant with enhanced insect, disease, and drought resistance. Removal of the endophyte from tall fescue removed these beneficial attributes as well as animal toxicity. Endophyte-free cultivars have performed acceptably north of a line approximated by Interstate Highway 70. They have performed reasonably well south of this line on soils with higher organic matter content and with rotational grazing management. In recent years a new class of tall fescue cultivars has entered the arena: novel or friendly endophyte varieties. These cultivars have an endophytic fungus reintroduced that will provide the protective benefits without animal toxicity. South of the I-70 line, novel endophyte cultivars are probably the better choice. While some producers may have such ill feelings toward fescue that they wish only to plant something entirely different, tall fescue has so many desirable attributes as a pasture species it should be included in most pasture programs throughout the region.

Many producers are intimidated by the cost of complete pasture conversion, especially in light of the current high price of novel endophyte cultivars. The lost production and performance attributable to endophyte toxicity is far more costly than pasture renovation. In the mid-1980's, Dr. Vic Jacobs, University of Missouri economist, clearly showed the cost effectiveness of converting infected fescue to endophyte-free cultivar even with persistence as short as three years.

In addition to pasture management to deal with the fescue problem, animal selection for tolerance to fescue is extremely important. Within any beef cow herd on toxic fescue, we see varying levels of toxicosis. While some animals are completely debilitated on fescue pastures, there will be herd mates who show very little effect. Over time, simply culling the most susceptible animals and keeping replacements only out of those least affected will increase the fescue tolerance of the herd. This is especially true for those herds that do not use supplemental feed to overcome toxicosis as it tends to mask genetic traits. Many cow-calf producers end up with a six month breeding season on infected fescue because they are afraid of having open cows. To create a cow herd with fescue tolerance it is essential to maintain a tightly controlled breeding season of 45 to 60 days. Yes, you will have open cows the first several years but you will also rapidly eliminate the genetics most susceptible to fescue toxicity.

Summary:

Successful beef production in adverse environments comes first from understanding the challenges. For cow-calf production the most critical issue is maintaining dietary intake to ensure reproductive success. Fescue toxicosis places tremendous physiological stress on the animal resulting in reduced intake. Ruthless selection against fescue toxicity and maintaining a tight breeding season can significantly improve genetic adaptation for fescue tolerance. Sound pasture management to reduce the amount of fescue in the pasture and provide alternative grazing choices can greatly reduce the impact of endophyte infection of animal performance and herd profitability.

References:

Adams, D.C., R.T. Clark, T.J. Klopfenstein. And J.D. Volesky. 1996. Matching the cow with forage resources. Rangelands 18:2:

Aiken, G.E. and M.A. Brown, 1994. Potential of cattle genetics for improving production on endophyte-infected tall fescue. Proc. Amer. Forage Grassl. Council vol 3. pp 294-298.

Allen, V.G., J.P. Fontenot, D.R. Notter, and R.C. Hammes. 1992. Forage systems for beef production from conception to slaughter. I. Cow-calf production. J. Anim. Sci. 70:2:576-587.

Brown, M.A., A.H. Brown, W.G. Jackson, and J.R. Meisner. 1997. Genotype x environment interactions in Angus, Brahman, and reciprocal cross cows and their calves grazing common bermudagrass and endophyte-infected tall fescue pastures. J. Anim. Sci. 75:4:920-925.

Lardy, G.P., D.C. Adams, Klopfenstein, T.J., and R.T. Clark. 1999. First limiting nutrient for summer calving cows grazing autumn-winter range. J. Range. Mgmt. 52:4:317-326.

Porter, J.K. and F.N. Thompson. 1992. Effects of fescue toxicosis on reproduction in livestock. J. Anim. Sci. 70:5:1594-1603.