Supplementation Strategies in Forage-Based Beef Operations: Sense and Cents

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Beef cattle producers differ in their production goals depending on the nature of their operation. It is safe to say that a seedstock breeder will not have the same management goals as the cow-calf producer, and the stocker operator will not operate the same as the producer focused on heifer development. What these producers do have in common, however, is a desire to identify grazing management systems that enhance productivity while maintaining economic (and environmental) sustainability. Supplementation, the providing of feedstuffs other than forage, is a technique that may be employed to accomplish that goal. In this review, we will provide an overview of the scenarios in which supplemental feed may be offered, the goals of each of these systems, and some rules of thumb for their application.

Keywords: supplement, grazing management, nutrition

Supplementation Strategies

Supplementation is a small word with quite a large connotation in the world of beef cattle nutrition. According to Huston et al. [(1)], there are four strategies for supplementation of beef cattle, depending on the needs of the herd: supplemental feeding, substitution feeding, enhancement feeding, or supply feeding. The choice of supplementation strategy is primarily linked to two factors: the forage base on which the cattle are grazing, and the nutrient

requirements of each class of animal. Forage nutrient provision can be generally related to the class of forage provided (Figure 1), but it is also highly dependent on time of year as growing seasons differ by species (Figure 2).

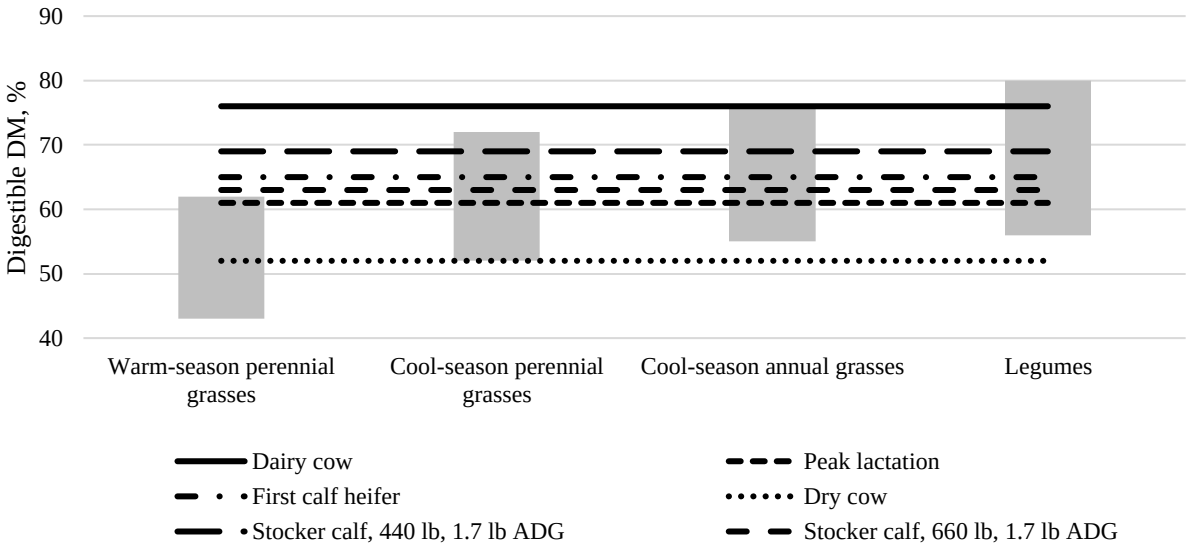

Figure 1 Nutrient requirements of selected classes of cattle and digestible dry matter of selected classes of forages (adapted from Riewe [(2)] and Ball et al. [(3)])

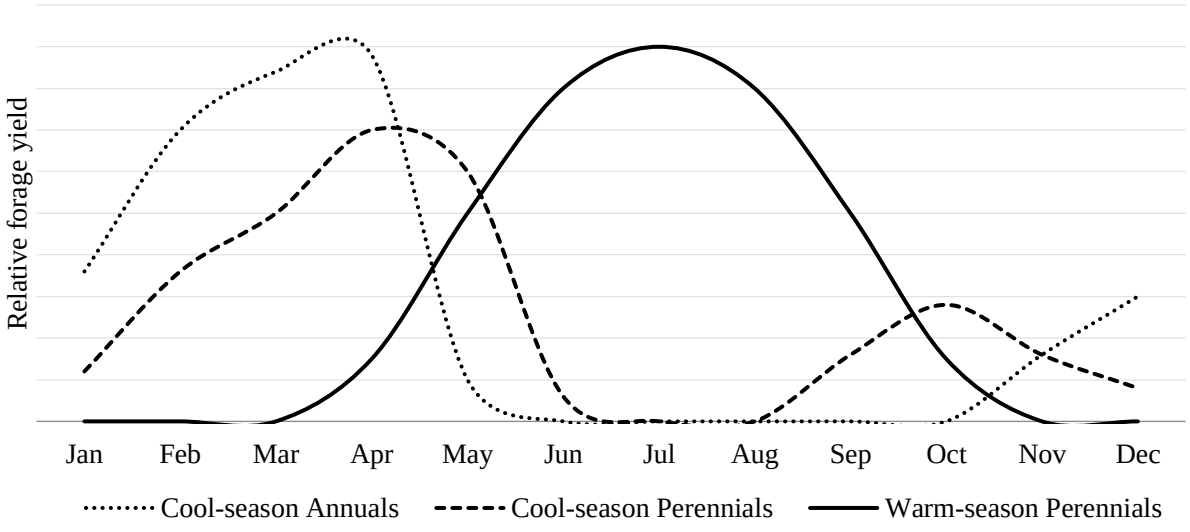

Figure 2 Forage growth distribution for Alabama (adapted from Ball et al. [(3)])

Supplemental Feeding

Supplemental feeding is a scenario in which the limiting nutrient(s) is supplied to stimulate intake and/or digestion of the available forage.[1] In this case, we would typically expect to observe an additive effect of supplementation as illustrated in **Error! Reference source not found.**.

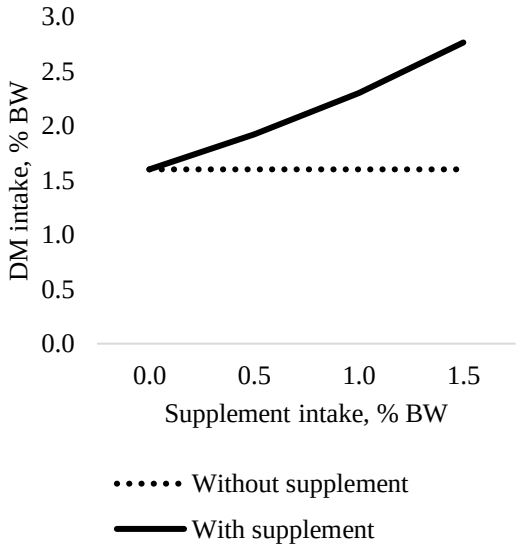

Figure 3 Additive effect of supplementation (adapted from Huston et al. [1])

Supplemental feeding is the typical scenario that we picture when we envision supplementing the beef herd; from a veterinary perspective, this will likely be the second most common scenario in which supplementation is recommended. The general idea behind supplemental feeding is that something in the forage provided to the animal is a limit to their production potential. In many Alabama pastures under "typical" or low-intensity management, this is the case. We are able to develop some general rules of thumb, then, to address the potential problems that might arise. In the warm-season (late spring through mid-autumn in most of the state), the perennial grasses tend to provide plenty of energy (not limited in dry matter production), but crude protein is marginal or deficient for most growing animals. Thus, the typical supplement to be offered in the warm season would be one that offers additional crude protein (e.g., corn gluten feed, dried distillers grains, soybean hulls). Conversely, in the cool season (late autumn through early spring), crude protein and non-structural carbohydrates are abundant, but energy is generally limiting due to the low dry matter

concentration (i.e., lush) of cool-season grasses. During this time of year, we commonly opt for energy-type feedstuffs (e.g., corn, dried distillers grains).

Enhancement Feeding

Enhancement feeding is a scenario in which supplemental feed is offered to increase intake (and quality) of the overall diet, either to satisfy higher nutrient requirements or to make more efficient use of resources.[1] Enhancement feeding differs from supplemental feeding in that there is no single nutrient that represents a limitation to production. Rather, it is the combination of nutrient interactions in the digestive system that causes an increase in efficiency that alters the overall nutrient requirements of the animal itself. Thus, enhancement feeding most likely represents the best opportunity for increased production under intensive management scenarios.

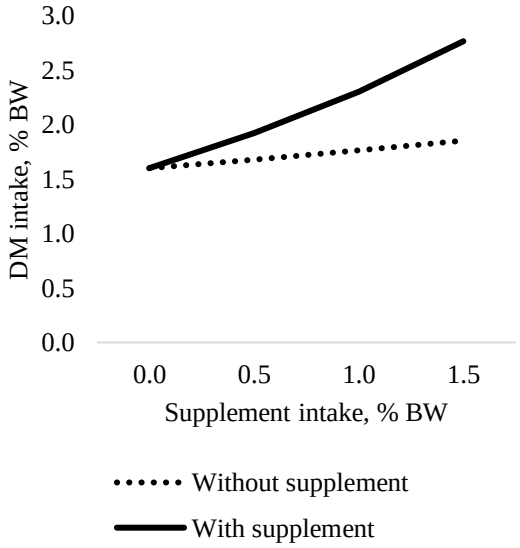

Figure 4 Positive associative effect of supplementation (adapted from Huston et al. [1])

There are some great examples in the literature where enhancement feeding has resulted in increased efficiency, both financially and from the perspective of resource management. Smith et al. [4] supplemented yearling stocker steers grazing Tifton 85 bermudagrass (a highly productive variety that is seldom limiting in nutrients) with dried distillers grains throughout a summer grazing period. In this experiment, the most efficient supplementation strategy was 0.25% BW (approximately 2.25 lb/d); this resulted in a supplement-to-gain ratio of 4.1:1 at a cost of approximately $0.40/lb of additional gain.[4] Increasing daily supplement to 0.05% BW

(approximately 5 lb/d) resulted in a supplement-to-gain ratio of 6.0:1 at a cost of $0.58/lb of additional gain.[4] This effect will vary from forage-to-forage and variety-to-variety, though. For instance, Smith et al. [5] found that 1% BW supplementation (approximately 8 lb/d) was necessary to achieve an added benefit (11.5:1 supplement-to-gain ratio) when steers were grazing Coastal bermudagrass, and this came at a cost of $1.07/lb of additional gain.

Substitution Feeding

Substitution feeding occurs when supplemental feed is offered in replacement of forages that would have otherwise met the nutrient requirements of the animal.[1] In this case, we often observe a substitution effect (Figure 5) in which there is decrease in forage intake with each incremental increase in supplement offered. There is seldom a scenario in which this type of supplementation is targeted. Rather, this is generally observed when supplemental feed is offered in excess of that necessary to obtain the positive associative effect. For example, the incremental increase in supplement-to-gain ratios observed in Smith et al. [4] illustrate a substitution effect (essentially, diminishing returns).

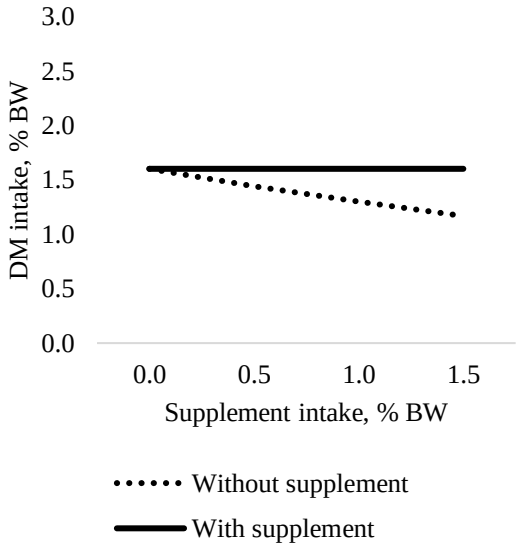

Figure 5 Substitution effect of supplementation (adapted from Huston et al. [1])

Supply Feeding

Supply feeding is a scenario in which the forage supply is limited, and supplemental feed is being used to maintain intake and nutrient requirements (think feedlot on pasture).[1] From a veterinary perspective, this is likely the most common scenario in which supplementation will be

recommended. Forage supply is most often limited when the pasture is overgrazed. Signs that supply feeding may be warranted include short stubble on pasture and thin animals.

Downstream Benefits of Supplementation

Thus far, we have discussed the scenarios under which supplementation may be used and how that benefits the animal in terms of nutrient provision and performance. However, there are also potential downstream benefits to introducing a supplementation program.

Land Use Efficiency

There is evidence to suggest that seasonal supplementation of beef cattle can improve land use efficiency in pasture-based systems by increasing carrying capacity [4, 5]. Land use efficiency is a key component to sustainability in agricultural systems. From 1945 to 2012, urban land in the southern United States increased from 3.5 million ac to 25.7 million ac (653% increase) while pasture and rangeland remained relatively stable (113.9 million ac vs. 134.2 million ac; 18% increase) [6]. Thus, it is imperative that sustainable beef production systems increase outputs while using the same or less land base.

Pasture Fertility

Research has shown that providing supplemental feed may have a benefit on pasture and soil fertility. Previous work has shown that increasing supplemental feed of grazing steers increases stocking density of pastures by up to 21% [4, 5], and steers excreted up to 0.5% N, 0.2% P, and 0.2% K through feces [7]. These strategies could result in excretions of 32 lb N, 15 lb P, and 15 lb K from each animal annually [4, 8]. This can also result in increased dry matter yield of subsequent forages to which the manure is applied [7]. This is especially important when fertilizer prices rise as they have in recent years.

Environmental Impact

Finally, use of supplemental feedstuffs in beef production systems has been demonstrated to reduce enteric methane production [8-10]. Methane has a global warming potential of 23 CO_2-eq [11]. Enteric fermentation from grazing livestock is implicated in the production of 27% of all methane emissions in the United States [12]. The predominant source of enteric methane production in beef cattle is the consumption of feedstocks dense in cell wall material (e.g., when cattle are grazing) [13]. Inclusion of non-forage feedstuffs (i.e., supplemental feedstuffs) dilutes the cell wall concentration of the dry matter while also increasing soluble carbohydrates. Smith et al. [8] found that as supplemental feed (e.g., dried distillers grains) is added to bermudagrass pasture, enteric methane production decreases linearly.

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