

Integrated Nutritional Systems

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Introduction

After reaching a historical low of slightly over 29 million head of beef cows in 2014, the U.S. beef cattle inventory continues to recover, adding an additional 1.5 million heifers and cows in the last two years. While this is a very positive sign of the recovery of the U.S. beef industry, and a testament of the resilience of a mature and consolidated industry, in the short term this has caused a depression in prices that has forced producers to adapt to a new normal. Only a few years ago (taking 2014 as an example), when feeder prices were as high as \$240/cwt, almost any supplementation strategy was sufficient to generate a profit by supplementing cattle a little extra time after weaning, preconditioning or even creep feeding. Grain prices at that time were already depressed (as they continue to be today despite some slight recoveries), which meant that byproducts to use in cattle supplementation were very reasonably priced. It was not uncommon to be able to supplement newly weaned 500 lb calves with a \$180/ton supplement, with a feed cost ranging from \$0.6 to \$0.9/head/day, assuming 10 lb/d feeding. Those same supplemental programs, using conservative estimates, were generating an additional 1 lb of ADG over not supplemented calves, which on a 45 days preconditioning or backgrounding period could lead to \$10/calf in gross income (around \$9/head when feed costs were included). While feed prices have not changed much since 2014, cattle prices have dropped to about half of what they were, and many viable supplementation strategies have changed drastically. In the current scenario of prices, the best strategies are those that aim at maintaining the condition of cows during the winter with the minimal amount of supplementation, without hindering pregnancy rates, and selling calves at weaning. When a drought such as the one currently hitting the southeastern U.S. is added on top of the current market conditions, early weaning of calves becomes more critical than ever to avoid losing body condition in cows as the forage shortage deepens. Strategies that aim at maximizing the impact of supplementation on performance while minimizing the inputs, have been the focus of several research projects conducted at the North Florida Research and Education Center (NFREC) in the past years. *The objective of this work is to review a series of studies aimed at assessing the impact of supplementation on nutrient intake and cattle performance.*

The first great challenge: How much hay are cows eating?

The ability of Florida beef production systems to sustain the growth of cows and calves during the summer with minimal input (almost exclusively pasture and minerals) is contrasted every year with the challenge of the winter months. Depending on where in Florida beef production takes place, the forage shortage in the winter time could result in the need of supplementation for as long as 120 days. The use of stockpiled forages, mainly in central and south Florida reduces the reliance on hay and other forms of conserved forages, which are almost a must in north Florida unless the grazing of winter annual pastures is an option. However the quality of most stockpiled forages in Florida often lead to a shortage of nutrients that need to be provided in the form of supplement such as liquid byproducts, grain byproducts, etc. Any supplementation program relies on the ability of effectively determine how much forage is cattle consuming in order to be able to supply the remaining nutrients (if needed). However, measuring hay or haylage intake in field conditions can be almost as challenging as measuring intake of a grazing pasture. Not being able to accurately predict intake of the basal forage in the diet leads to inaccuracies in the amounts of supplement needed. Because winter feed costs are typically one of the largest expenses in a beef cattle operation, in times of lean markets such as this one, the importance of supplementing the correct amounts in order to prevent losses in body condition that may lead to open cows, is imperative.

Waste can turn hay or haylage into the most expensive feed in an operation. While little research has been conducted to accurately assess hay waste under various feeding systems, an excellent summary of results conducted in the Midwestern U.S. was presented a few years ago in the Florida Ruminant Nutrition Symposium (DiCostanzo and Jaderborg, 2015) and the reader is referred to that reference for further information on hay waste. A link to the actual proceedings paper by DiCostanzo and Jaderborg (2015) is provided in the Literature Cited section.

Waters et al. (2015) conducted a 2-year study at the NFREC to assess the impact of various feeding strategies on heifer development. Waters et al. (2015) fed Tifton-85 bermudagrass hay ad libitum in a pasture, and intake was recorded by weighing the amount of hay offered (weighing an entire bale) and the amount of refusals recovered. Over a period of 140 d each year, the heifers in the study by Waters et al. (2015) gained 0.40 and 1.06 lb/d when fed only bermudagrass hay or supplemented with 80:20 corn:soybean meal, respectively. Table 1 shows the exact amount of hay consumed in each treatment and the intake as % of BW. One of the interesting observations when comparing these data with most studies of hay intake conducted in the Midwestern U.S., is the decreased intake in terms of % of BW observed in Florida. It is quite possible that a lower digestibility of warm season forages fed in the Southeast, along with the more limiting concentrations of protein in these forages, limits rumen digestion, and thus decreases intake capacity. This initial observation in the study by Waters et al. (2015) was later confirmed in other studies conducted. A subsequent study was conducted at the NFREC Feed Efficiency Facility (FEF) in Marianna, to determine hay intake; however, this time using the GrowSafe feed intake system at the FEF. A total of 120 mature cows were enrolled in the study, 60 of them were in mid-to late lactation, with calves of approximately 5 months of age, and the other 60 cows were weaned two weeks prior to the initiation of the study. All cows and calves in the study were fitted with radio frequency identification to assess individual intake in pens of 5 cows (“weaned” treatment) or 5 pairs each (“lactating” treatment) at the FEF. During the 56 days of the study, feed intake of Tifton-85 bermudagrass hay offered ad libitum, was monitored continuously. Data from this study (DiLorenzo and Lamb, unpublished) are summarized in Table 1 and Figure 1. The results from this study showed that hay intake in weaned cows was 1.4% of their BW, while lactating cows consumed 1.7% of their BW (Figure 1). Again these values contrast with those reported in studies conducted feeding better quality hay, typically from cool season forages. A final study conducted at NFREC (Ciriaco et al., 2015) is also summarized in Table 1. In the study by Ciriaco et al. (2015), recently confirmed pregnant heifers were fed Tifton 85 bermudagrass hay and were offered or not 5 lb/d of a mixture of 50:50 molasses:crude glycerol. Results confirmed the observations in previous studies. When no liquid supplement was offered, heifers in Ciriaco et al. (2015) consumed 1.36% of their BW daily. *As an important conclusion from this segment of the review of literature, the voluntary intake of hay of warm season forages observed across various categories of beef cattle, seems much lesser than what has been reported in cool season forages.* The intake of Tifton-85 bermudagrass hay in cattle not supplemented, ranged from 1.36 to 1.72% of their BW, and was decreased by 15% when cows were weaned after 5 months of lactation (Figure 1).

Moving on with the integration: postweaning supplementation

As indicated during the introduction, cattle markets are the great driver of the postweaning management strategies. For example, in current market conditions, it is probably a much better option to sell calves at normal weaning, or even earlier if early weaning may be needed because of drought conditions and forage shortage. Regardless of marketing strategy, it is important to know the expected performance of weaned cattle under various scenarios to be able to re-assess the market conditions every year and decide on whether may be economical or not to feed calves for some time after weaning. While retaining weaned calves may not be typical in many Florida cattle operations, almost all of the cow/calf operations keep a portion of their females as replacement. This heifer development period has several unique characteristics in terms of ideal rates of gain, timing of that weight gain and nutrient profile of the diet. Because nutritional considerations for heifers can be an entire subject on its own, this review will not cover that aspect in detail, but rather summarize the most relevant principles of heifer development providing some local examples from studies conducted at the University of Florida. Waters et al. (2015) fed developing

heifers the following three treatments: 1) ad libitum Tifton-85 bermudagrass hay (BGH); 2) ad libitum BGH plus 2.7 lb/d of an 80:20 corn:soybean meal mix; or 3) ad libitum BGH plus 6 lb/d of perennial peanut hay. After a development period of 140 days during which heifers were supplemented, they were managed as a single group until the beginning of the breeding season. Figure 2 shows the results in terms of the evolution of their BW during the entire study. When growing heifers were fed over two consecutive years either BGH only, or BGH plus *Brassica carinata* meal pellets (43.6% CP, 76% TDN) at 0.3% of their BW/d, growth rates were 0.32 and 0.92 lb/d, respectively (Figure 3; Schulmeister et al., 2017). A study was conducted in collaboration between NFREC and Louisiana State University (Demeterco et al., 2016) to determine the effects of feeding ryegrass conserved as hay or haylage on animal performance in growing Angus and Brangus steers. Steers had an initial BW of 540 lb and were fed ad libitum amounts of ryegrass hay or haylage for 14 days of adaptation and 64 days of experimental period. Steers fed ryegrass haylage had an ADG of 0.99 lb, while those fed ryegrass hay had an ADG of 0.60 (effect of forage conservation method on ADG, $P < 0.05$). In conclusion from this study, and extrapolating to a heifer development situations, if heifers of similar initial BW were to be developed using ryegrass haylage as the sole forage source, supplementation may still be needed to achieve a target ADG of 1.5 to 1.8 lb/d.

Taken together, the studies by Waters et al. (2015), Schulmeister et al. (2017), and Demeterco et al. (2016) suggest that when developing heifers in the southeastern U.S., even the best quality hay or haylage available may not be sufficient to produce the rates of weight gain necessary to achieve the target weight before the breeding season, and supplementation may be needed.

Finishing cattle in Florida?

Finishing cattle in Florida is perhaps the greatest challenge for a full integration of a beef/forage system. While the topic is complex and deserves a much more in depth analysis than the one intended in this review, it is noteworthy that the few operations that are finishing cattle in Florida are doing so in a very competitive manner. Considering the challenges related to weather, which may impact directly on performance, and availability of high-energy grains or byproducts, a few operations have been able to take advantage of some of the state competitive advantages to challenge the conventional wisdom in terms of beef production systems in Florida. Some of those advantages include 1) a very large consumer market and the possibility of creating branded products that add value to Florida calves; 2) availability of some high-energy byproducts (DDGS, gluten feed, molasses, etc.) that can help to partially replace corn and other high-starch grains without much effect on animal performance; 3) a readily available source of heat-adapted calves that for the most part need to be loaded in trucks to leave the state at weaning. While the number of cattle finished in Florida is still small compared to traditional cattle-finishing regions of the U.S., Several interesting initiatives in Florida are worth highlighting and certainly well suited to challenge the conventional wisdom in terms of cattle finishing operations. The marketing component of branded Florida beef that is associated with Florida cattle finishing operations is remarkable and is one of the greatest competitive advantages. However, on the grand scheme of things, still the vast majority of the nearly 900,000 calves produced in Florida every year, leave the state at weaning or shortly after.

Take home message

Florida beef production systems have several competitive advantages that may allow for the expansion of current systems, integration (to a certain degree) or diversification (backgrounding, heifer development, etc.). Despite the abundance of forages, the quality of Florida forage resources can be limiting. Intake of hay from warm season forages seems to be lesser than that reported in cool season forages. This may have implications in nutrient balancing of hay-based diets during the months of forage shortage. Additionally, the quality of warm season forages available, is in part the reason why the majority of the calves leave the state at weaning or shortly after, limiting the opportunities for backgrounding or stocking operations. However, heifer development is an important segment of the Florida beef industry and it can be a challenging enterprise, considering the very specific targets needed in terms of rate of weight gain. When attempting to develop heifers with any form of conserved forage, it may be difficult to obtain rates of weight gain greater than 1 lb/d, unless heifers are supplemented. Fortunately, the availability of

byproducts from the citrus, cotton, sugar cane, and peanut industry provide ample opportunities for cost-effective strategic supplementations. Additionally, the abundance of winter annual pastures in central and north Florida can provide forage of excellent quality, albeit, with great dependence on weather (and this year should be a perfect reminder of that). A series of research-based strategies have been developed by the University of Florida in terms of cattle supplementation and heifer development, and a valuable compilation of those can be found in the University of Florida Beef Extension Research Reports, available at http://animal.ifas.ufl.edu/beef_extension/#beef.

Literature Cited

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Table 1. Summary of experiments conducted at the University of Florida NFREC in Marianna, in which ad libitum intake of Tifton-85 bermudagrass hay was recorded.

	Waters et al. (2015)		Ciriaco et al. (2015)		DiLorenzo and Lamb (unpublished)	
	Number of cattle	40	40	6	6	60
Cattle type	Developing heifers	Developing heifers	1-mo pregnant heifers	1-mo pregnant heifers	Lactating mature cows	Weaned mature cows
Hay DMI, lb/d	7.7	6.6	11.9	10.8	21.2	18.1
Hay DMI, % BW	1.42	1.11	1.36	1.23	1.72	1.43
Supplementation	no	2.7 lb/d of 80:20 corn:soybean meal mix	no	5 lb/d of 50:50 molasses:crude glycerol	no	no

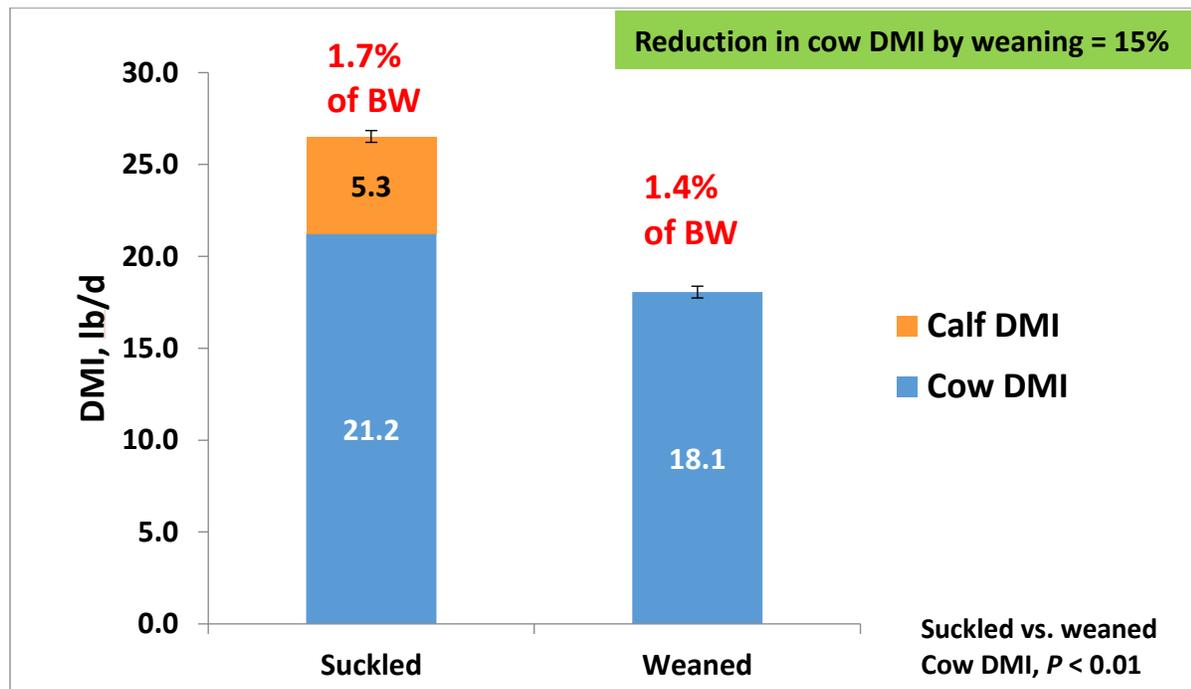


Figure 1. Ad libitum intake of Tifton-85 bermudagrass hay by mature cows at 5 months of lactation or after weaning. Hay intake was recorded for 56 days using the GrowSafe system of the NFREC Feed Efficiency Facility in Marianna, FL (DiLorenzo and Lamb, unpublished).

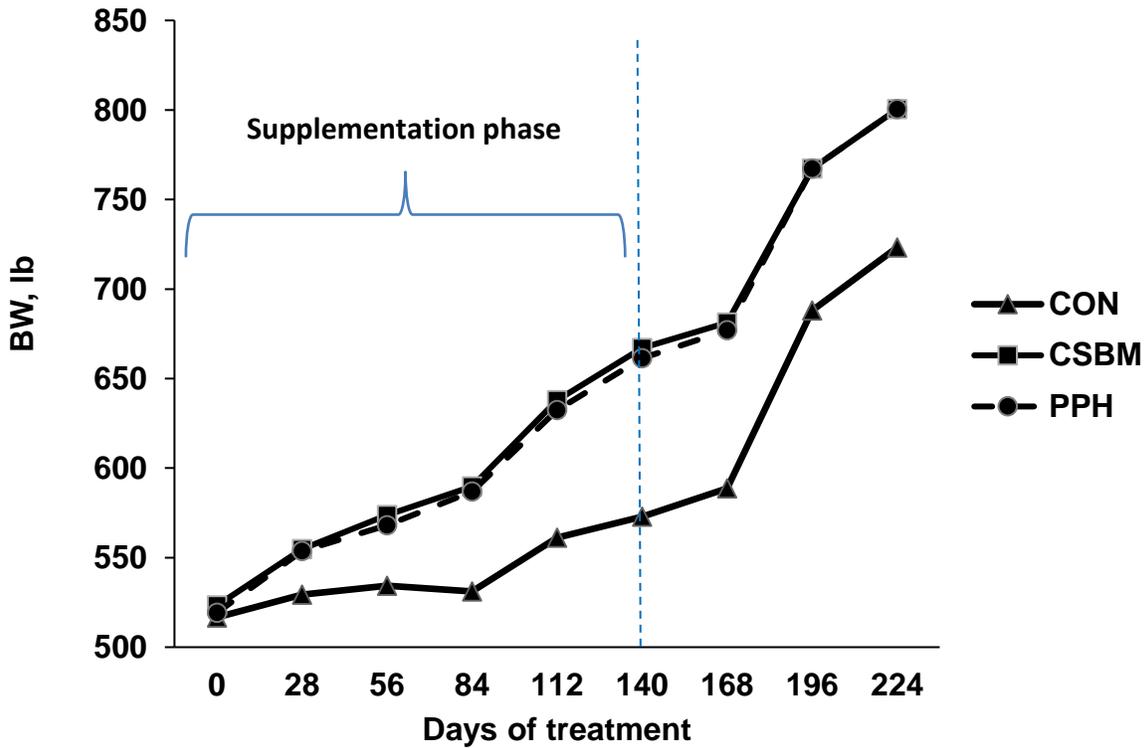


Figure 2. Evolution of BW in heifers fed bermudagrass hay and supplemented or not during the development phase. Treatments: CON) ad libitum Tifton 85 bermudagrass hay (BGH); CSBM) ad libitum BGH plus 2.7 lb/d of an 80:20 corn:soybean meal mix; or PPH) ad libitum BGH plus 6 lb/d of perennial peanut hay.

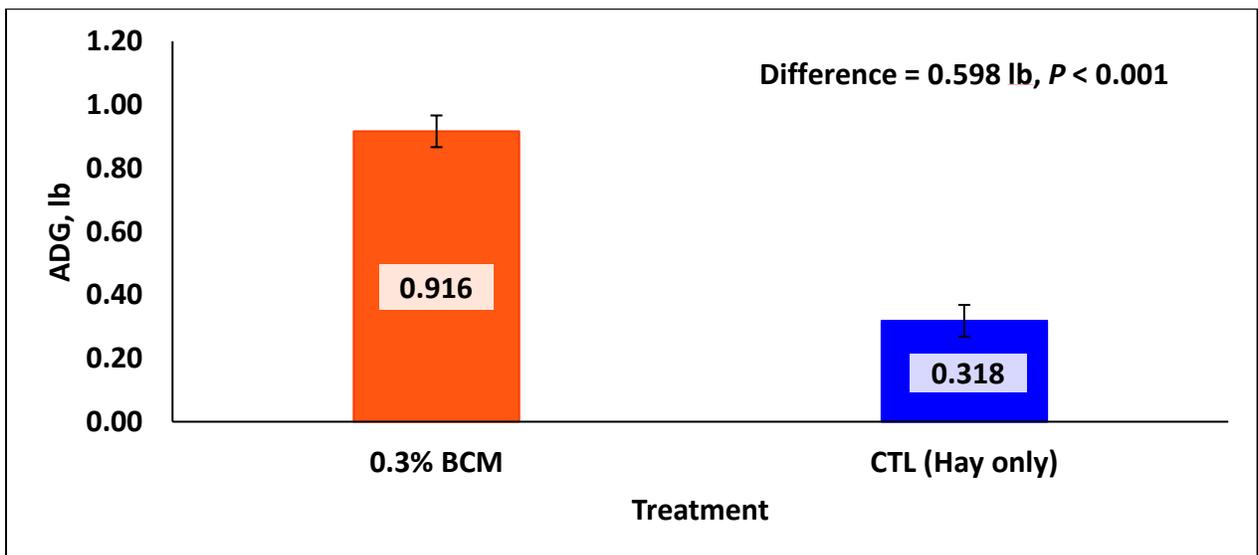


Figure 3. Effect of feeding *Brassica carinata* meal pellets (43.6%CP, 76% TDN) at 0.3% of BW/d on heifer performance (529 lb of initial BW) over 2 consecutive years. Total of 64 heifers used in the study for a total of 70 days each year. All heifers were fed ad libitum amounts of Tifton-85 bermudagrass hay (Schulmeister et al., 2017).