Early Weaning Beef Calves at 70 to 90 Days of Age
An overview of recent research[1]

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Summary
The benefits of early weaning during instances of environmental strain, usually witnessed by a shortage of summer forage, has been understood and practiced for many years. However, the use of early weaning as a normal, annual management practice for beef cows is not common. Our interest in the topic originated from the common production practice in the Southeast, which allowed heifers to develop for two years before being bred the first time. Calving heifers for the first time at three years of age is quite common across production regions that utilize a high percentage of *Bos indicus* lineage (i.e. Brahman). Compared to heifers of traditional English lineage (*Bos taurus*), Brahman-crossbred heifers have been shown to have lower calving rates when developed to calve at 24 months of age (DeRouen and Franke, 1989). The reason relates to the slow rate of maturity common to *Bos indicus* cattle, witnessed by both delayed onset of puberty (Rodrigues et al., 2002) and increased time required to achieve mature body size (Martin et al., 1992). Nevertheless, heifers that calve for the first time at three years of age have reduced lifetime economic efficiency than those managed to calve at two years of age. Although, calving at three years of age may increase repeatability of pregnancy, forcing all two year olds to remain non-productive an entire year decreases the overall economic efficiency of the cowherd (Nunez-Dominguez et al., 1991).

Introduction
In beef production systems, early weaning lacks an appropriate definition. In most regions of the US, beef calves are weaned from their dams at approximately six to eight months of age. Therefore, any calves weaned prior to six months of age may be considered, "early weaned". For our purposes, early weaning refers to the permanent separation of the calf from its mother at 70 to 90 days of age. This target age is used to ensure that the process of early weaning has an opportunity to impact the reproductive performance of the cow. Calves weaned at four and five months of age may be mistakenly referred to as "early weaned", but this is truly a misnomer, as the cow will benefit little reproductively within a fixed breeding season. By this age, the breeding season has likely ended or almost over once the calf is weaned. To harvest the most efficiency from the effort, early weaning should always occur at the start, or very near the start, of the normal breeding season. It has been our experience that beef calves should not be weaned when they are less than 50 days of age. When weaning at ages less than 50 days, we have found that calves perform poorly and appear to be stunted, never recovering their normal body weight even many months later. This age threshold is supported by the common age at which dairy calves begin consuming significant amounts of dry feed. Dairy producers begin the transition process from liquid milk to complete dry feeds when calves reach 45 to 50 days of age. Therefore, the target age for early weaning beef calves should be > than 50 days with a target range of 70 to 90 days of age.

The Cow
Body Condition
Assuming the beef herd is otherwise healthy, nothing impacts cowherd reproductive performance more than prolonged post-partum anestrus – and nothing impacts post-partum anestrus more than cow body condition. Low cow body condition is the primary reason for reduced conception rates and overall poor cowherd productivity. Cow body condition is a subjective estimate of the amount of fat on a cow and is the most reliable method for evaluating a nutritional program. Body condition typically declines after calving, when the nutritional demands of the cow are at a maximum. It is during this time that

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supplemental nutrition is most needed. Research from the University of Florida (Rae et al., 1993) has shown that cows with low body condition scores (≤ 4.0) have a 30% reduction in pregnancy rate compared to cows in optimum body condition (5.0 to 6.0). The low body condition score cows that do conceive often do so late in the breeding season. This increase in post-partum interval results in later calves the following year. This is most pronounced in young cows, which possess higher nutritional demands to support both lactation as well as their own continued growth. When managing these young cows, producers are faced with a limited number of options, including, 1) provide adequate nutrient-dense supplementation, 2) early weaning, therefore removing the nutritional demands associated with lactation, or 3) breed heifers at 3 years of age when their own growth demands are lessened. We examined the influence of early weaning on first-calf cow body weight and body condition score change over two consecutive years (Arthington and Kalmbacher, 2003). In our study, early weaning resulted in a 2-point increase in cow body condition score compared to contemporary cows nursing their calves up to the time of normal weaning. (Table 1). This difference in body condition score allows the cows to calve in the following year with greater condition, which optimizes their chances to rebreed early resulting in older, heavier calves at weaning the next year.

Table 1. Effect of early- versus normal-weaning on first-calf heifer BW and body condition (average of two consecutive years).

	Treatment		
Item	EW	NW	SEM
Heifer BW, lb [a]			
January	922 [c]	955 [d]	11.2
April	988 [d]	946 [c]	9.7
August	1,083 [d]	997 [c]	11.0
Change	161 [d]	42 [c]	7.1
Heifer BCS [b]			
January	4.28	4.28	0.10
April	5.42 [d]	4.46 [c]	0.11
August	6.34 [d]	4.75 [c]	0.07

[a] Individual heifer BW collected at the time of early weaning (EW; January), when calves came off ryegrass (April), and at the time of normal calf weaning (NW; August) (n = 50 and 58 for EW and NW, respectively).
[b] Heifer body condition score (BCS) recorded as an average of two technicians at each collection date using a 1 to 9 scale (1 = emaciated and 9 = obese).
[c,d] Treatment means within a row without a common superscript letter differ ($P < 0.05$).

Feed Intake

As early-weaned cows begin to stop lactating, their dry matter intake decreases by as much as 30%. Results from our research (Arthington and Minton, 2004) have shown that early-weaned, first-calf cows require approximately 50% less TDN to achieve and maintain a body condition score of 5.0 compared to lactating heifers of the same age and body condition (Figure 1). The intake values represented by these data show the amount of TDN consumed by a lactating first-calf cow, plus her calf, compared to an early-weaned first-calf cow without her calf. These data suggest greater than a 40% improvement in converting TDN into calf gain as a result of early weaning**.**

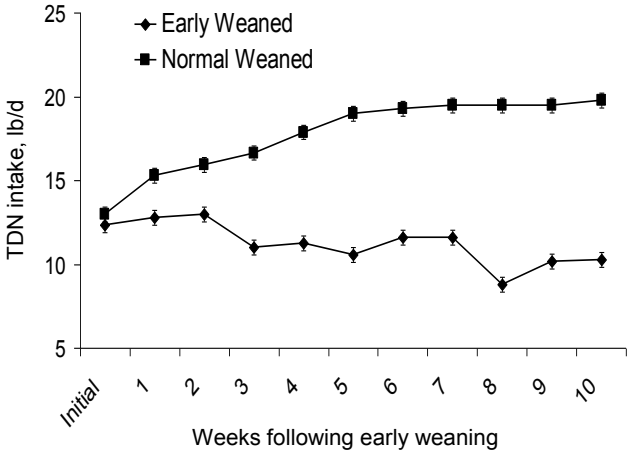

Figure 1. Effect of early calf weaning on voluntary dry matter intake of TDN in first-calf cows. Early-weaned calves were removed on the first d of wk 1.

This voluntary decrease in dry matter intake has important practical implications for the cow/calf producer, whereas the cow can maintain or gain body weight with almost 30% less forage. In one study (Galindo-Gonzalez et al., 2007), the effect of cow parity (primi- versus multiparous) and early weaning on hay intake, cow body weight and condition change, and pregnancy rate was investigated. In that study, there was very little difference in the effect of parity when measuring cow response to early weaning. Our original hypothesis stated that young, primiparous cows would realize a greater production response to early weaning versus mature, multiparous cows when each were compared to normal-weaned contemporaries of a similar parity. This was not the case, as mature cows also experienced a considerable decrease in hay dry matter intake concurrent with an increase in body condition and pregnancy rate. In this study, cows with their calves consumed approximately 18% more hay than early-weaned cows. This value differs from the 30% decrease suggested earlier due to the presence of winter perennial pasture. The hay was a supplement to pasture and pasture forage intake was not measured. The pooled response summary over two yeas (n = 96 cows) for both primi- and multiparous cows is provided in Table 2. Considering a 100 day winter hay supplementation period and hay valued at $100/ton, early weaning can save nearly $12 per cow in hay costs alone. This production efficiency estimate does not take into account the value of increased pregnancy rate and decreased post-partum interval, which are the primary benefits realized by early weaning.

Table 2. Effect of early weaning on supplemental hay intake and performance of beef cows wintered on perennial bahiagrass pasture (average of two years; n = 96 cows).

Item	Early-weaned	Normal-weaned	SEM	P =
Hay intake, lb/cow/d [a]	14.2	16.7	0.5	< 0.01
Body condition change [a,b]	+ 0.5	- 0.5	0.08	< 0.01
Pregnancy rate, %	80.4	69.6	-----	0.23

[a] Calves early weaned at an average age of 85 days. Hay intake and body condition change calculated for 75 days after early weaning, after which all cows were exposed to mature bulls as a single group for 45 days.

[b] Body condition scored on a 1 to 9 scale (1 = emaciated and 9 = obese).

Reproductive Performance

The removal of a calf from a post-partum, anestrous cow results in an endocrine response initiating estrus. The common management system involving a 48-hour calf removal is targeted at initiating this response by removing the suckling stimuli. Early calf weaning creates the same scenario, but in this case the calf is not returned to the dam. In one study, we evaluated the post-partum interval of thin, first-calf heifers which were early-weaned or allowed to remain with their calf (Arthington and Minton, 2004). We fed each heifer individually to ensure similar amounts of body weight gain over 70 days. By the end of the feeding period, cows from both treatments gained a similar amount of body weight and body condition; however, more early-weaned cows were cycling compared to normal-weaned contemporaries (Figure 2). These data suggest that the calf-removal response is an important factor affecting post-partum anestrus, independent of nutrition.

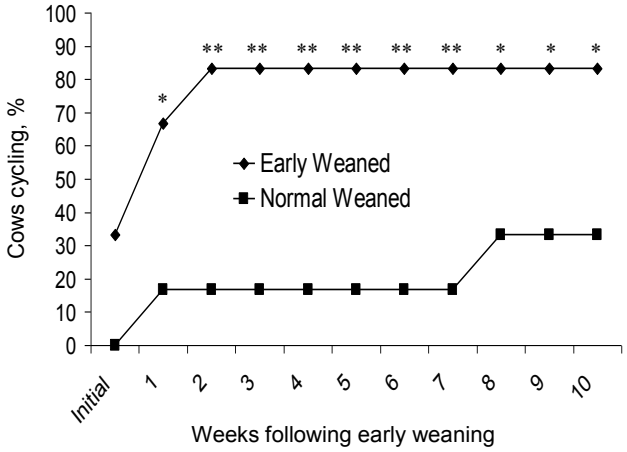

Figure 2. Effect of early calf weaning on post-partum cyclicity of first-calf heifers. Early-weaned calves were removed on the first d of wk 1. Date of return to estrus was determined as the first wk when progesterone concentrations were greater than 1 ng/mL for two consecutive weekly samples. * and **; $P < 0.10$ and 0.05, respectively.

In some situations, producers may be unable or unwilling to permanently separate beef calves at these early ages. To address this, we compared the reproductive effects of 5 consecutive 48-h calf withdrawals (20 d apart) to permanent calf withdrawal (early weaning) and a traditional single 48-h calf withdrawal (Martins et al., 2012). In that study, first-calf cows that were exposed to multiple calf withdrawals attained post-partum cyclicity at the same rate as early-weaned cows and sooner than first-calf cows that were submitted to a single 48-h calf withdrawal (Figure 3). Although, the multiple calf withdrawals mimicked permanent separation in terms of hastened post-partum anestrus, cows with unweaned calves had lesser body weight gain and a greater body condition decline compared to early-weaned cows throughout the breeding season.

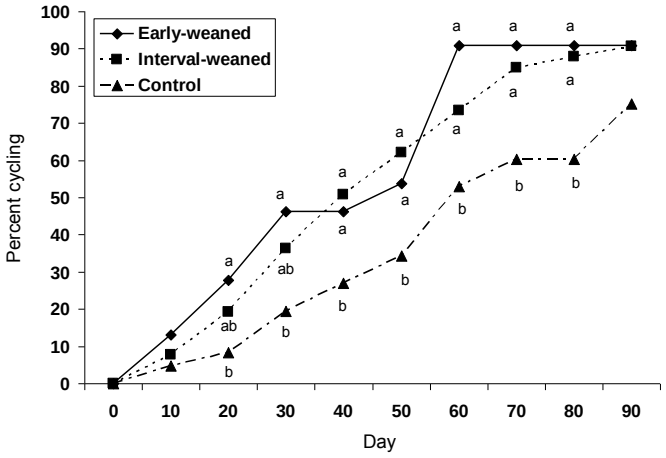

Figure 3. Percentage of cows cycling during the 90-d breeding season. Early-weaned cows had their calves permanently removed at the start fo the breeding season (day 0); control cows had their calves removed for 48 h once at the start of the breeding season; interval-weaned cows had their calves removed for 48 h five times, 20 d apart throughout the breeding season. a,b; $P < 0.05$.

In any given year, the majority of cows in a producer's non-pregnant category are young cows (i.e. first and second calf cows). The use of early weaning will allow these females to regain their lost body condition, and do so with less forage and supplemental feed. As well, the decrease in post-partum interval means these females will become pregnant earlier in the breeding season and produce calves that will be older and heavier at next year's weaning. In a two-year study, investigating two-year old first calf heifers, we reported a greater pregnancy rate and a 21-day shorter calving interval in early-weaned versus normal-weaned cows of a similar age (89.5 versus 50.0 % pregnant for early- and normal-weaned cows, respectively; Arthington and Kalmbacher, 2003). The greatest economic advantage of early calf weaning is realized through hastened post-partum cyclicity and increased pregnancy attainment of otherwise anestrous cows. Although our data suggests that early weaning also improves the performance of mature cows, the major advantage to the system is allowing heifers to be bred as yearlings, calve at two-years of age without suffering losses in body weight and poor subsequent fertility as a lactating two-year old.

Early Weaning Mature Cows

The data presented henceforth was collected primarily from first calf cows. In our one study including both primiparous and multiparous cows, we realized similar reductions in voluntary forage dry matter intake and improved cow body condition change among both parity groups as a result of early weaning. Therefore, we designed a systems-approach study to evaluate the effects of early weaning among mature beef cows in optimal body condition. Based on our previous findings, we sought to capitalize on the observed 30% reduction in voluntary forage dry matter intake among early-weaned cows by increasing stocking density in pastures containing early-weaned cows. The study was conducted over three consecutive years. Cows were originally stocked at 2 acres of bahiagrass/cow (8 pastures; 40 acres/pasture; 20 cows per pasture). The study began in January of year 1 at the time of the first early weaning. Stocking rates remained the same from January to July (normal weaning) and available forage was estimated monthly. As expected, available forage was approximately 30% greater within pastures containing early-weaned cows. Therefore, in July stocking rates were increased by 25% for herds assigned to the early-weaned management treatment. These herds were maintained over three continuous

production cycles with early weaning occurring in January at the start of the breeding season and normal weaning occurring in mid-July (Figure 4). Amounts of supplemental forage, molasses+urea, and free-choice mineral offered to the pastures were held similar among both management systems.

Within 2 months following the 25% increase in stocking rate among pastures of early-weaned cows, there were no longer differences in available forage between treatments. However, throughout the remainder of the 3-year study, this response was variable. For example, in the following summer, pastures with early-weaned cows once again had greater available forage compared to normal-weaned cows, with no differences observed in the Fall or Spring months of the final year (Figure 4). Throughout the entire 3-year study, measurements of available forage were either the same or greater for pastures with early-weaned cows. At no time was available forage greater for pastures containing normal-weaned cows, despite a lesser stocking rate, which suggests that our 25% increase in stocking rate for pastures with early-weaned cows may have not been great enough.

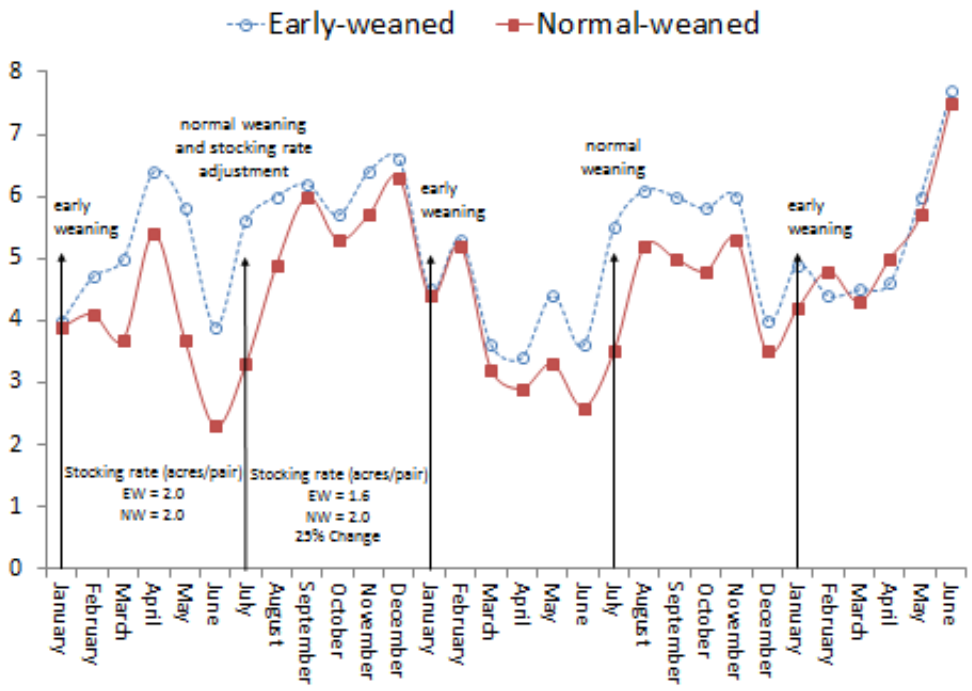

Figure 4. Effects of early calf weaning and stocking rate on available forage (1000 kg DM/ha).

Cow body condition score did not differ (P = 0.47) in January at the time of early weaning for the first production cycle; however, approximately 90 days later at the end of the breeding season, early-weaned cows had increased body condition while normal-weaned cows remained unchanged (Table 3). These differences in cow body condition continued in the subsequent two production cycles with early-weaned cows retaining greater body condition scores and at all months of measurement. At times, particularly at normal weaning (July), cows assigned to the early-weaning treatment were considered obese (BCS > 7.5). These results further support the supposition that pastures assigned to the early-weaned cows may have supported a greater stocking density than used in this experiment. Further, our experimental design focused on using differences in stocking density to account for the expected reduction in forage intake due to early weaning. All other factors were held similar among treatments, such as the amount of winter

supplementation offered to the herds. Reducing winter supplement offered to early-weaned cows may have reduced over conditioning and better equalized herbage allowance among treatments.

Table 3. Effect of early weaning mature cows on subsequent cow body condition over 3 complete production cycles.[a]

Year	Month[b]	Early-weaned	Normal-weaned	Largest SEM	P =
1	January	4.8	5.0	0.11	0.47
	April	6.3	4.7	0.18	< 0.001
	July	7.7	6.1	0.16	0.001
2	January	5.3	4.9	0.15	0.07
	April	6.7	5.1	0.19	0.001
	July	8.2	6.6	0.23	0.002

Pregnancy rates among early- and normal-weaned cow groups were high and were not impacted by early weaning (3-year average = 92 and 93% for early- and normal-weaned cows, respectively). This result is not necessarily surprising since pregnancy rates among mature cows in optimal body condition are expected to be high; however, we anticipated the early-weaned cows to become pregnant sooner, as revealed by previous studies evaluating early weaning in first-calf cows. This was not the case. Mature cows in optimal body condition became pregnant later in the breeding season when early-weaned (Figure 5), which shifted the calving distribution to a later date in the following year. Day of the calving season corresponding to the birth of half of the season's calf crop was sooner ($P < 0.05$) in years 1 and 2 for normal- vs. early-weaned cow (Figure 6).

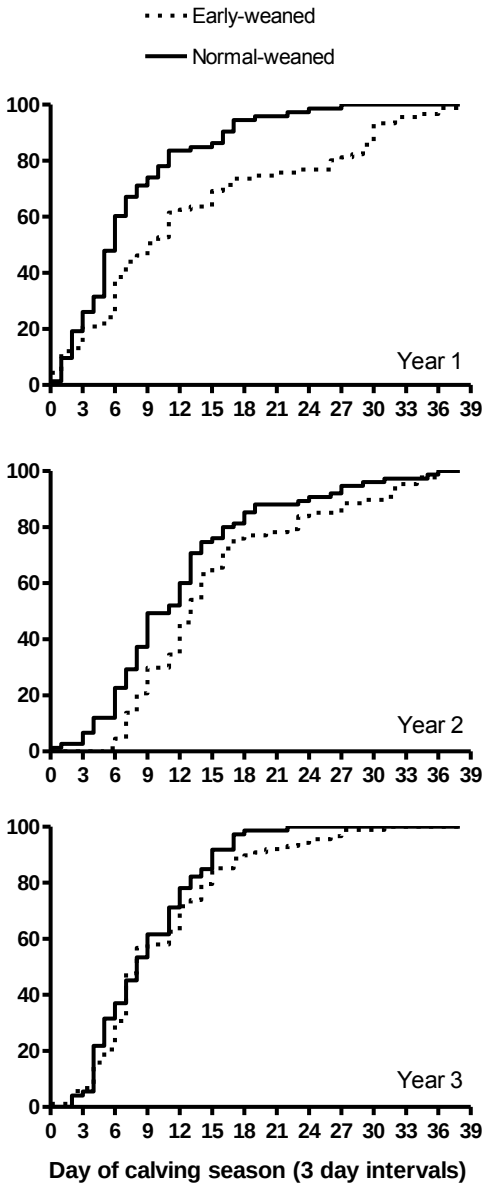

Figure 5. Effect of early weaning on subsequent calving distribution (% of total calves born) over 3 consecutive production cycles.

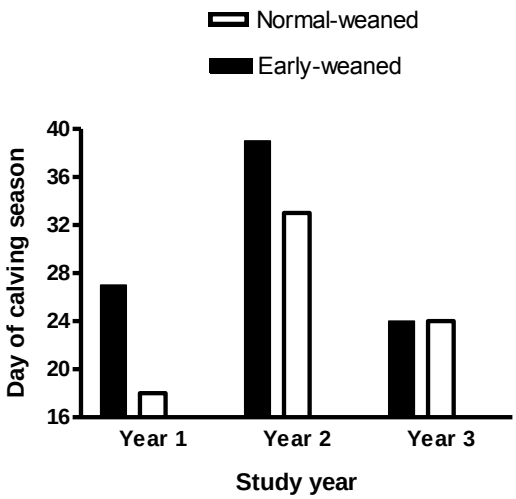

Figure 6. Effect of early weaning on subsequent calving distribution; day calving season corresponding to the birth of 50% of total calves born that year. Date of calving season corresponding to the birth of > 50% of the calf crop was sooner ($P < 0.05$) in Years 1 and 2 for normal- vs. early-weaned cows.

This reproductive response was most pronounced in the first year diminishing in year 2 with very little difference in year 3. We attribute this response to a delay in the attainment of pregnancy in cows that were early-weaned, which is likely explained by the stress-impacts of cow and calf separation. Although the stress may be similar in first-calf cows, the vast majority of these females are anestrus at the time of early weaning. In contrast, in the current study, nearly 2/3 of the cows were already cycling at the time of early weaning. We surmise that the stress of early weaning delayed attainment of pregnancy among cows that were already cycling and prepared to become pregnant at the start of the breeding season. This delay pushed their average calving date back in year 1 and again in year 2, therefore shortening the period between calving and the start of the breeding season. Thus, by year 3, a larger percentage of early-weaned cows were likely acyclic at the start of the breeding season when compared to the same cows in years 1 and 2. Our results were unexpected and create additional questions regarding the suitability of adopting early calf weaning as a management option for mature beef cows in adequate body condition.

The Early-Weaned Calf

Nutritional Management

Depending on the region of production, producers may or may not have forage resources to graze early-weaned calves. Some of the research studying the effects of early weaning on calf productivity in the Midwest and High-plains regions of the US have focused on drylot feeding of the early-weaned calves. In warmer climates, producers may be able to graze calves on perennial or annual pastures throughout the year. In our experiences, opportunities to rear early-weaned calves on high-quality pasture forage provide an important value toward the costs of maintaining an early-weaned calf.

Early-weaned calves respond favorably to supplemental concentrate, even when they are grazing highly nutritious pastures, such as annual winter ryegrass. In a study investigating the performance of early-weaned calves grazing winter ryegrass pastures (Vendramini et al., 2006), voluntary forage intake

decreased and calf ADG increased as the rate of supplementation increased from 1.0, 1.5, and 2.0% of body weight (Table 4).

Table 4. Performance of early-weaned calves grazing winter rye-ryegrass pastures and supplemented with different levels of concentrate. [a]

Item	Concentrate, % BW			SEM	Response	P =
	1.0	1.5	2.0			
Average daily gain, lb/d	1.63	1.79	1.96	0.07	Linear	< 0.05
Forage OM intake, % BW [a]	1.8	1.3	1.1	0.01	Linear	< 0.01

[a] Forage organic matter intake determined on grazing calves by the use of a sustained release bolus containing an indigestible residue.

Recently, we evaluated the effects of 3 different early-weaned calf management systems on measures of calf performance and economic return. In this study (unpublished data), calves were early weaned at approximately 70 days of age and reared in 1 of 3 management systems for 84 days. The systems included; 1) grazing dormant winter perennial grass pasture (Bahiagrass) with 2% body weight concentrate supplementation, 2) drylot with concentrate limit-fed at 3.5% body weight, or 3) annual pasture grazing (Ryegrass) with 1% body weight supplementation. Our findings show that greater body weight gain can be achieved with drylot rearing on concentrate diets, however the efficiency and value of this gain is dependent upon the cost of feed and price/lb of calf gain (Table 5). Despite the method of calf management system adopted, each of these systems produced profitable performance results. Beef producers adopting early weaning systems with their young cows should consider harvesting the value of efficient feed conversions of these young calves by designing a 3 to 4 month rearing system that best fits their local resources.

Table 5. Evaluation of management systems for the rearing of early-weaned calves.[1]

	Treatment[1]			
Item	Bahiagrass	Drylot	Ryegrass	SEM
BW, lb				
d 0	197 [a]	215 [b]	225 [b]	7.4
d 28	245 [a]	276 [b]	270 [b]	8.9
d 56	269 [a]	342 [b]	322 [b]	10.1
d 84	336 [a]	417 [b]	367 [c]	10.9
ADG, lb/d				
d 0 – d 28	1.94 [a]	2.27 [b]	1.66 [a]	0.125
d 28 – d 56	0.87 [a]	2.36 [c]	1.89 [b]	0.141
d 56 – d 84	2.29 [a]	2.58 [c]	1.56 [d]	0.136
d 0 – d 84	1.69 [a]	2.40 [b]	1.70 [a]	0.080
Feed Intake, lb/calf daily				
d 0 – d 28	4.4 [a]	8.8 [b]	2.8 [c]	0.13
d 28 – d 56	5.0 [a]	12.6 [b]	3.5 [c]	0.22
d 56 – d 84	6.0 [a]	12.4 [b]	4.2 [c]	0.19
d 0 – d 84	5.1 [a]	11.3 [b]	3.5 [c]	0.15
Economics				
Feed cost, $/ lb BW gain [2]	0.60	0.94	0.41	.
Value of BW gain, $/calf [3]	481	565	525	.
Return, $/calf [4]	269	315	299	.

[1]Calves ealy-weaned at approximately 70 days of age. Bahiagrass = calves grazing bahiagrass pastures and supplemented with concentrate at 2% of BW (n = 5 calves/pasture; 4 pastures); Drylot = calves in drylot and limit-fed concentrate at 3.5% of BW (n = 5 calves/pen; 4 pens); Ryegrass = calves grazing ryegrass pastures and supplemented with concentrate at 1.0% of BW (n = 4 calves/pasture; 4 pastures).
[2]Feed cost ($/lb BW gain). Feed estimated at $0.20/lb or $400/ton.
[3]$2.50 per lb of calf BW gain (April/May market).
[4] Return = Value of BW gain ($/calf) - feed cost ($/calf).

In Florida, our fall-born, early-weaned calf management systems often involve the establishment of winter annual ryegrass. Over the past 13 years, we have grazed early-weaned calves at an average stocking rate of four to six calves/acre with concentrate supplement provided at a rate of 1% of body weight. Despite both dry and wet winters this stocking rate has proven acceptable. Optimal stocking rate should be defined as the rate which best utilizes the available forage for maximum animal body weight gain. On non-irrigated land, this target rate is highly dependent upon the amount of effective precipitation received during pasture establishment. Over six consecutive years, we have found a great deal of variability among ryegrass yield and calf performance (Table 6); however, a stocking rate of four to six calves per acre has proven to be acceptable to achieve rates of body weight gain similar to or greater than the gain achieved by non-weaned calves of a similar age. In each of the studies reported in Table 6, early-weaned calves were provided supplemental concentrate feed at a rate of 1% of body weight. Although we utilize annual ryegrass or rye-ryegrass blends in our Florida early-weaned calf studies, this system will not be practical for all regions of the country. For temperate regions of the US, other grass varieties should be considered. It is important to note that high-quality forage varieties that may not be tolerant to

cow grazing may work well in an early-weaned calf grazing system. Young calves are much gentler on the pasture, consuming forage much like a deer or goat. As well, because the calves are smaller their dry matter intake is much less than a mature cow; therefore, moderate yielding, high-quality forages may be good candidates for use in an early-weaned calf rearing system.

Table 6. Performance of early weaned calves in both winter and summer grazing seasons over six consecutive years (average daily body weight gain ± stnd. dev.).[a]

Year	Winter grazing[b]	Summer grazing[b]	Stocking rate, calves/acre	
			Winter	Summer
2000	1.89 ± 0.04	1.21 ± 0.07	3.3	3.3
2001	2.08 ± 0.06	-------	3.3	-------
2002	1.35 ± 0.07	1.31 ± 0.18	4.4	2.4
2003	1.60 ± 0.06	1.34 ± 0.06	4.0	1.2
2004	1.73 ± 0.11	1.48 ± 0.05	6.7	2.0
2005	2.15 ± 0.10	-------	5.3	-------
Average	1.80 ± 0.07	1.34 ± 0.09	4.7	2.2

[a] Calves are approximately 60 to 90 days of age at the time of early weaning. All calves are provided supplemental feed at a target rate of 1.0% of body weight during both grazing seasons. A commercial feed (14 and 65 % CP and TDN, respectively) was utilized in 2000, 2001, 2002, and 2003 and a commodity blend of soybean hulls and cottonseed meal (85:15) was used in 2004 and 2005.
[b] Winter and summer grazing periods each are approximately 100 days. Winter grazing always occurred on annual ryegrass. Ryegrass was typically fertilized twice using a complete fertilizer, once upon emergence and again approximately 50 days into grazing. Summer grazing consisted of established limpograss in 2000 (Arthington and Kalmbacher, 2001) and established stargrass in all other years.

In our system, a major shortcoming of the management of an early-weaned calf occurs once the winter annual ryegrass dies out in the spring. Once early-weaned calves are moved onto perennial, summer pastures their performance declines rapidly. Our annual ryegrass is grazed out by early to mid-May, leaving a 100 day deficit period until the time of normal weaning (late July). In our studies, performance of early-weaned calves drops by an average of 25% in the summer versus winter periods. Although performance in the winter is similar among early-and normal-weaned calves, performance in the summer period is usually inferior for the early-weaned calf compared to those left with their dams. This decline in performance often results in a greater overall ADG for normal-weaned compared to early-weaned calves when calculated from January (time of early weaning) to August (time of normal weaning). We attribute this decline in summer performance to the lesser digestibility of our summer perennial pastures compared to the winter annual ryegrass (Figure 7). For Florida producers, these data would support the marketing of early weaned calves in late April or early May. Historically, calf markets are at their greatest at this time of the year. Consideration of regional variation in forage quality, quantity, and annual trends in market value should be considered when determining the optimal marketing time for early-weaned calves.

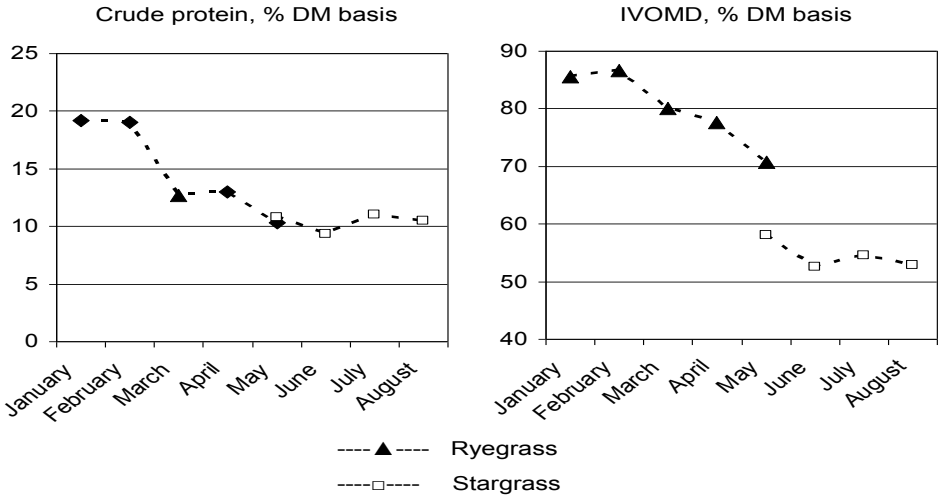

Figure 7. Average ryegrass and stargrass quality over two consecutive seasons (2003 and 2004). Average stocking rate = 1.6 calves/acre. Average SEM = 0.65 and 0.29, and 1.37 and 1.27 for ryegrass and stargrass crude protein and in vitro organic matter digestibility (IVOMD), respectively.

Feedlot Performance of Early-Weaned Calves

Early weaning also has positive implications on the value of calves post-weaning. Researchers from the University of Illinois (Myers et al., 1999) investigated the effect of early weaning on carcass merit. In their studies, they reported that early weaning improved the percentage of calves grading USDA Choice or higher by over 30% compared to normal-weaned calves. In a comparison of weaning age (90, 150, or 210 days), they found that calves weaned at 90 days tended to produce higher quality carcasses.

In many ranch settings, normal-weaned calves are shipped immediately after separation from the cow. When shipped as a complete group (not commingled) these calves typically perform well, nevertheless, buyers often discount fresh-weaned calves due to the potential for stress-related disease. The use of early weaning, followed by a growing period of 60 to 90 days, produces calves that have recovered from the stress of weaning and understand how to eat. Once received into the feed yard, these calves are likely to have fewer incidences of illness. In a study conducted in collaboration with North Carolina State University, we examined the productivity of early- versus normal-weaned calves in the feedlot (Arthington et al., 2005). In that study, early-weaned calves were lighter at the time of normal weaning (492 versus 611 lb), but gained body weight at a faster rate during the feedlot receiving period (Figure 8). By day 28, body weight was similar (538 versus 617 lb for early- and normal-weaned calves, respectively). Overall, early-weaned calves gained over 1 lb/d more than normal-weaned calves (Figure 8), despite no differences in daily feed dry matter intake (Table 7).

Table 7. Effects of early- versus normal weaning age on calf feedlot performance[a]

Period[b]	Early-weaned	Normal-weaned	SEM [c]	*P* =
Receiving				
ADG, lb/d	1.92	0.88	0.22	0.03
DMI, lb/d[d]	12.5	11.6	0.62	0.36
G:F[e]	0.154	0.076	0.010	0.01
Growing				
ADG, lb/d	3.04	2.60	0.11	0.05
DMI, lb/d	19.4	19.6	0.77	0.84
G:F	0.157	0.133	0.006	0.06
Finishing				
ADG, lb/d	3.02	2.91	0.12	0.77
DMI, lb/d	19.2	20.2	0.64	0.33
G:F	0.157	0.144	0.007	0.35
Overall				
ADG, lb/d	2.71	2.76	0.24	0.82
Total BW gain, lb	650	589	20.5	0.10
Total DMI, lb	4,231	4,357	165.2	0.62
G:F	0.154	0.135	0.004	0.02

[a] Early-weaned calves were removed from their dams at 85 d of age. Normal-weaned calves remained with their dams until the day of normal weaning (average age = 300 d).
[b]Receiving diet = d 0 to 28; Growing diet = d 28 to 112; and Finishing diet = d 112 to harvest. Table values are least square means. ADG = average daily body weight gain.
[c]Largest SEM of least square means (n = four pens/treatment).
[d]dry matter intake
[e]gain:feed

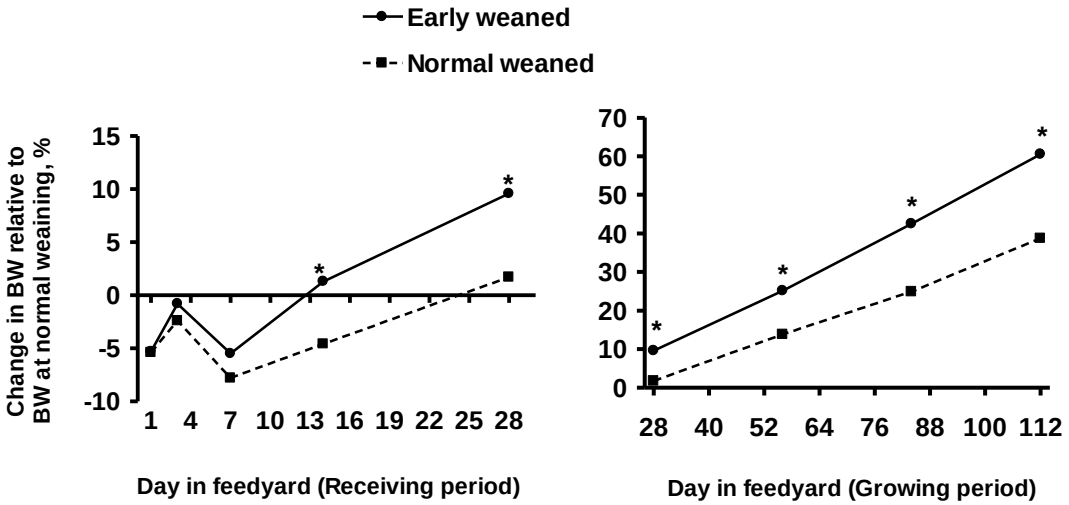

Figure 8. Percent change in body weight relative to weaning weight for early- and normal-weaned calves. Calves were shipped during the first week in August. Early-weaned calves were weaned (early January) and retained on the ranch of origin until the time of normal weaning. Normal weaned calves were shipped the day of weaning. (Arthington et al., 2005).

The most striking response to early weaning in our feedlot study was the significant improvement in feed efficiency (Table 7). We have attributed this response to a lesser inflammatory reaction in early- versus normal-weaned calves in response to the stressors associated with weaning and transport. During normal stress events the early inflammatory reaction results in the production of acute phase proteins. In our study, early-weaned calves had a lesser acute phase protein response following transport and entry into the feedlot. Further, a relationship between plasma acute phase protein concentrations and daily body weight gain was observed in normal-weaned steers during the feedyard receiving period, whereas average ceruloplasmin concentrations were negatively associated with body weight gain in normal-weaned ($P < 0.01$; $R^2 = 0.59$), but not early-weaned ($P > 0.05$; $R^2 = 0.21$) calves. Similarly, average haptoglobin concentrations were negatively associated with body weight gain in normal-weaned ($P < 0.01$; $R^2 = 0.40$), but not early-weaned ($P > 0.05$; $R^2 = 0.10$) calves. Other researchers have shown that feeder calf plasma haptoglobin concentrations, upon entry into the feedlot, are positively associated with the incidence of morbidity and subsequent number of medical treatments required (Berry et al., 2004; Carter et al., 2002).

General Healthcare of the Early-Weaned Calf

One common question related to weaning calves at this young age is health status. It is understandable that producers may be concerned with the viability of calves of this age. In fact, ranch-derived calves early-weaned at 70 to 90 days of age have a very high health status. This is related to the passive immunity that they obtained from their mothers through colostrum at birth. This colostrum provides important immunity to calves of this age. In comparison, calves of normal weaning age (6 to 8 months) have little to no remaining passive immune protection. If normal-weaned calves are not properly vaccinated they will be more susceptible to succumbing to disease at the time of weaning compared to 70 to 90 day old early-weaned calves. We do not recommend vaccinating calves at the time of early weaning, as the vaccine will likely be neutralized by the calf's own passive immunity. Early-weaned calves should be vaccinated according to the same schedule used for the normal-weaned calves in the herd. One exception to this rule relates to producers that may "gather" early-weaned calves from multiple sources. In this situation, the producer often does not know the health status of the herds from which the calves are sourced. Further, the stress of transport and commingling may elicit the onset of disease. In these situations the producer should work with their veterinarian to develop a health-care plan that will take into consideration the balance between disease pressure and immune protection.

One important difference that we have noticed in early-weaned calves is their susceptibility to internal parasites. We typically treat our early-weaned calves for internal parasites two to three times during the 200-day grazing period – depending on the product being used. By following this management schedule, we have noticed significant improvements in calf body weight gain following anthelmetic treatment.

Summary

1. Early weaning must occur prior to the start of the breeding season to gain the full reproduction benefits associated with this management practice.

    a. Calves should *not be less than 50 days of age* at the time of early weaning.

    b. Attempt to breed yearling heifers 30 days before the mature cowherd so that the calves will be old enough to early wean at the start of the regular breeding season in the following year.

2. Early-weaned cows will voluntarily consume approximately 30% less dry matter following early weaning. Their decrease in dry matter intake coupled with their concurrent decrease in nutrient demands translates into a > 40% increase in nutrient efficiency of calf gain following early weaning.

3. Early weaning management systems should be focused on young cows (first- and second-calf cows). Having a longer post-partum interval, a larger percentage of these cows are typically acyclic at the start of the breeding season. Thus, the reproductive benefits of early weaning (i.e. eliciting post-partum estrus) are more apt to impact these young cows. In our study, early weaning mature cows in optimal body condition resulted in a delay in the attainment of pregnancy causing an extended calving distribution the following year.

4. Early-weaned calves grow well on high quality annual pastures such as ryegrass, when provided supplemental grain at a rate of 1% of body weight. When high-quality pastures are not available, early-weaned calves will grow well when provided access to a high-quality concentrate feed at a target rate of 3.5% of body weight along with supplemental hay. At the time of early weaning (70 to 90 days of age), the crude protein requirement of the early-weaned calf diet may be as high as 20% on a dry matter basis. We generally recommend starting calves on a 20% crude protein diet, reducing to 18% crude protein 60 days later.

5. If planning to ship early- and normal-weaned calves at the same time, vaccinate the early-weaned calves on the same schedule as the normal-weaned calves. Calves should not be vaccinated at the time of early weaning, as the vaccine will be neutralized by the calf's own passive immunity. Early-weaned calves are highly susceptible to internal parasites. Consider anthelmetic treatment at the time of early weaning and again every 50 to 60 days, depending on the product being used.

6. In our experiences in Florida, we have been unable to maintain the high growth rate of the early-weaned calf into the summer. Depending on the region of the country, producers should carefully examine their pasture forage options and consider the efficiency of moving the calf to regions closer to feeding and finishing.

7. When received into the feedlot at the time of normal weaning, early-weaned calves have greater feed efficiency compared to normal-weaned contemporaries. This is an important production response for producers to consider when evaluating retained calf ownership opportunities.

8. Early-weaned calves have been shown to have carcasses of greater USDA quality score compared to normal-weaned contemporaries. This response is likely the result of being placed onto concentrate diets at an earlier age. Our early-weaned calves have similar USDA carcass quality scores as normal-weaned calves when grazed on pasture until the time of normal weaning,

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