Florida Cattle Enhancement Grant Application

Title: *Does year-round supplementation of cows pay off?*

FCEB No: 6 **UF Project No: AGR7486**

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Project Overview

Our proposal will address the FCA Priorities **#3 (Calf loss)**, **#7 (Animal herd nutrition – mineral** and **winter supplementation)**, and **#8 (Animal health).** We will evaluate if year-round supplementation of cows will enhance their reproductive success and impact the long-term growth and health of their calves compared to the traditional Fall/Winter supplementation program. Our objectives include using year-round supplementation of beef cows to: **(1)** better manage the body condition score and increase pregnancy rates of cows; **(2)** improve calf development during gestation and impact their subsequent health and growth, and consequently, cowherd profitability; **(3)** improve our understanding of the differences on the metabolism of mature cows (and their calves) under different supplementation strategies, which will assist on designing future studies and harvest greater performance levels; and **(4)** generate novel information for local educational programs to further assist producers and county agents on cowherd supplementation strategies.

Significance

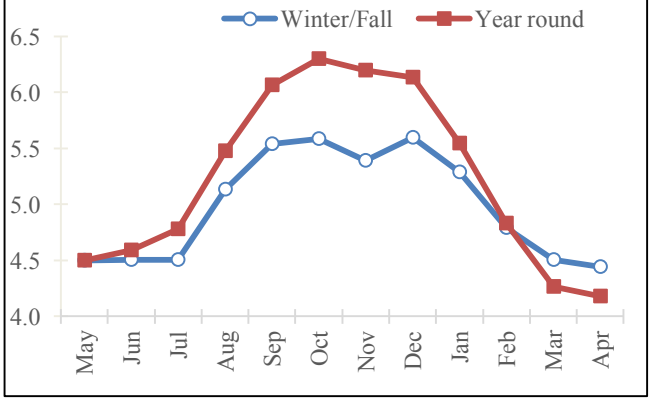
Fall/Winter seasons in Florida correspond with critical events that determine the economic success of a cow-calf operation, and those are the **late gestation**, **breeding season,** and **first trimester of the subsequent gestation** of beef females. These events occur during periods of low forage quality and availability, but highest nutrient demand for the growing fetus and cow milk production. Unfortunately, reproduction has the lowest nutrient priority, and consequently, it is often impaired by the mismatch between nutrient demand and availability. Increased reproductive success can be achieved by increasing body condition score at calving (5 or 6, according to a 1 to 9 scale) and trace mineral status of mineral-deficient beef cows. In fact, body condition score at calving is the most important factor that influences the interval from parturition to first ovulation, overall pregnancy rate, and calving distribution of beef cows. Most of FL cow-calf operations provide year-round supplementation of trace minerals, but provide protein and energy supplementation to alleviate cow weight loss only during early-lactation. However, inadequate dietary energy/protein during late pregnancy lowers reproduction even if the amount of energy and protein consumed during early-lactation are sufficient.

Until recently, the decisions about cow-herd supplementation considered only the cost of supplements and its impact on pregnancy rates. However, recent studies have shown that nutritional insults during gestation can also modify placental development, fetal organ formation, and offspring growth and health (a process called ***fetal-programming***). For instance, calves born to cows that experienced energy deficiency during the last 40 days of gestation (which often occurs in cows grazing warm-season grasses) experienced poor vaccine response and antibody production, which might compromise calf health and increase calf loss. Additional studies also indicated that providing beef cows sufficient nutrition during late-gestation can compensate for many of the negative consequences of nutrient restriction that occur in early- to mid-gestation, and

improve calf survivability, weaning performance, and economic returns. Thus, the decisions about cowherd supplementation should also include the impact on future offspring performance. Identifying nutritional strategies that can improve reproductive performance of cows, decrease calf loss, and optimize future calf growth and health is crucial and the primary goal of this proposal.

One strategy that can improve cow reproductive success and offspring performance following birth is the use of year-round supplementation. Figure 1 simulates a scenario of body condition score change of two Brangus cows calving in November. Both cows received **similar total annual amount of sugarcane molasses** (600 lb of dry matter/cow) that was provided during the Fall/Winter season only or distributed throughout the entire year (see Table 1 also). Cows supplemented year-round might achieve a greater body condition score at calving without increasing the annual supplement amount. Another advantage is that the trace mineral salt can be mixed into the supplement, reducing annual fluctuations in voluntary intake and wastage of free choice trace mineral formulations, and improving cow trace mineral status. Our hypothesis is that year-round supplementation of molasses or range cubes will increase body condition score at calving and trace mineral status of cows throughout the year, which will enable cows to experience greater body condition loss during early-lactation without reducing their reproductive performance compared to cows supplemented with molasses during Winter/Fall season only. In addition, year-round supplementation of molasses and range cubes will improve calf development during pregnancy, and then, improve calf health, survivability, and growth following birth.

Figure 1. Body condition score simulation (NRC, 2016)



Approach

The 3-year experiment will be conducted at the IFAS-Range Cattle Research and Education Center (RCREC; Ona, FL). The study at RCREC will be repeated twice (**Cow group 1** = March 2017 to March 2019; **Cow group 2** = March 2018 to March 2020) in order to have stronger data and powerful statistical analyses.

Pastures and feed facilities were prepared in March 2017. In June (day 0 of the study), mature Brangus cows were allocated into 1 of 6 bahiagrass pastures (14 cow-calf pairs/pasture; 84 pairs/year). Treatments consist of control cows supplemented with molasses from calving until end of breeding season (November to April; **CON**), or cows receiving year-round supplementation of molasses (**YMOL**) or range cubes-based (**YRAN**) formulations (2 pastures/treatment). Total annual amount of supplement will be similar among all treatments (approximately 600 lb of supplement dry matter/cow annually; Table 1). Supplements are being offered twice weekly (Mondays and Thursdays) at 8 am. Trace mineral/vitamin supplementation is being provided during the entire year in a loose meal form for control cows, or mixed into the molasses or range cubes for cows assigned to year-round supplementation.

Table 1. Supplement dry matter intake (lb/cow daily) of cows offered molasses during Fall/Winter only (Control) or year-round supplementation of molasses or range cubes.

Treatments [a]	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
	lb of dry matter/cow daily											
Year-round Molasses	0.5	0.5	1.5	1.5	1.5	1.5	2.5	2.5	2.5	2.5	2.5	0.5
Year-round Range cubes	0.5	0.5	1.5	1.5	1.5	1.5	2.5	2.5	2.5	2.5	2.5	0.5
Fall/Winter Molasses						3.3	3.3	3.3	3.3	3.3	3.3	

[a] *Total annual supplement dry matter offered will be approximately 600 lb/cow.*

Cow body weight and condition score have been collected every 60 days. Also on these days, blood samples from jugular vein have been collected from 6 cows/pasture to determine the plasma concentrations of hormones and metabolites correlated with reproductive performance and energy metabolism (glucose, insulin growth factor-1, and non-esterified fatty acids). Also, 6 cows/pasture were assigned to liver tissue collections on days 0, 120, and 240 to determine the liver trace mineral status. Pregnancy rates will be determined in April 2018 and 2019.

Offspring evaluation: Calving season will occur from October to December of 2017 (cow group 1) and 2018 (cow group 2). Body weight of calves will be collected every 60 days from birth to weaning at 7-8 months of age. All calves will be vaccinated against bovine respiratory disease pathogens in March and July. After weaning, 45 steers will be randomly assigned to a post-weaning evaluation of growth and immune response, whereas 48 heifers will be selected for a 150-day development program (July to November) and a 60-day breeding season (December to February). Steers will be fed ground hay and concentrate for 45 days in drylot. Blood samples of steers will be collected from jugular vein on days 0, 1, 3, 7, 14, and 45, relative to weaning, to determine the plasma concentrations of haptoglobin and cortisol (indicators of innate immunity), and serum antibody titers against bovine viral diarrhea virus 1a and infectious bovine rhinotracheitis virus (indicators of vaccine response). Heifers will graze on bahiagrass pastures and receive concentrate supplementation to achieve 1.25 lb/day of weight gain until the end of breeding season. Blood samples of heifers will be collected every 7 days from September to February to assess the plasma progesterone concentrations (indicator of puberty assessment).

General comments to sponsors

By design, cow supplementation began during the second trimester of gestation, and thus, animal feeding phase began on June 5^{th,} 2017 and will end on April 2018. However, all reagents for laboratory analyses of samples to be collected in 2017 were successfully purchased between July to August (the late purchase date of these reagents was intentionally used due to the short shelf life of commercial laboratory kits). Collection of blood and liver samples (Year 1) began on June 5th, and will be completed on October 5th. Laboratory analyses of these blood and liver samples will be performed before November 15th. An article summarizing the available data will be prepared and submitted to The Florida Cattlemen and Livestock journal in December 2017. Due to conflict of dates, the educational program for producers was postponed to October 2017. This program will be delivered in a 3-day format training in collaboration with livestock agents. The program will cover multiple topics related to body condition score and nutritional management of beef females. At the end of the program, producers will be exposed to an interactive body

condition score training to improve the accuracy of body condition scoring. Due to the educational program being postponed, the **project completion percentage by September 1st, 2017 was 83%, but will reach 100% by November 2017.**

Data Summary (data collected from May to September 2017).

In this 3-year study, treatments consist of control cows supplemented with molasses from calving until end of breeding season (November to April; **CON**), or cows receiving year-round supplementation of molasses (**YMOL**) or range cubes-based (**YCUB**) formulations (2 pastures/treatment). From June to August 2017, cows assigned to YMOL and YCUB treatments were supplemented with 0.62 lb/day of molasses (and 0.13 lb/day of trace mineral salt mixed into the molasses) or 0.72 lb/day of range cubes (trace mineral salt included in the cubes), respectively. Supplement amount differed in order to equalize the daily intake of energy (total digestible nutrients; TDN) and protein (crude protein; CP). Supplements were offered twice weekly (Mondays and Thursdays) at 8 am. Calves were weaned on August 9th.

Table 1. Growth performance of cows receiving no molasses supplementation until calving (CON), or year-round supplementation of molasses (YMOL) or range cubes-based (YCUB).

	Treatments				*P*-value
Item	**CON**	**YCUB**	**YMOL**	**SEM**	**Treatment**
Cow Body Condition Score [1,2]					
Start of study (day 0; June)	4.70	4.40	4.60	0.097	-
Weaning (day 56; August)	5.04	5.14	5.10	0.053	0.42
Cow Body Condition Score change [1,2]					
June to August	0.52	0.60	0.57	0.054	0.65
Cow Body Weight [1]**, lb**					
Start of study (day 0; June)	957	907	954	10.5	-
Weaning (day 56; August)	941	966	936	13.9	0.39
Cow Average Daily Gain, lb/day					
June to August	0.09	0.57	0.00	0.249	0.34
Suckling calf Body Weight [1,2]**, lb**					
Weaning (day 56; August)	490	498	496	5.5	0.61
Calf Average Daily Gain, lb/day					
June to August [2], lb/d	1.87	2.02	1.99	0.100	0.52

[1] Covariate-adjusted to cow or calf body weight on day 0 ($P \leq 0.05$).
[2] Covariate-adjusted to calf age on day 0 ($P \leq 0.05$).

Data shown in Table 1 demonstrated that molasses or range cubes supplementation was not sufficient to impact body weight and body condition score change of cows during the first 56 days of the study compared to cows receiving no supplementation (CON cows). Starting in August 15th, supplement dry matter amount offered to YCUB and YMOL cows increased to 1.5 lb/day (approximately 2 lb of molasses and 1.74 lb of cubes) and will be provided until calving (November 2017). Consequently, it is expected that such increase in supplement amount will make YCUB and YMOL cows achieve greater body condition score at calving compared to CON cows.

However, data shown in Tables 2 demonstrated that despite the lack of differences on cow growth performance, range cubes supplementation tended to increase plasma concentrations of IGF-1 and glucose compared to cows receiving no supplementation (CON cows). Insulin-like growth factor 1 (IGF-1) and glucose are highly correlated with nutrient intake, and crucial metabolites and hormones for proper growth performance and calf development. For instance, glucose is the primary energy fuel for the growing fetus. Hence, the greater plasma concentrations of IGF-1 and glucose indicate that the energy status of YCUB cows were improved compared to CON cows, which could benefit calf growth during pregnancy and growth performance after birth. Calves will be born in November. Blood samples will be collected from calves immediately after birth to evaluate their immune status at birth. Calf body weight will be collected every 60 days from birth to weaning (August 2018) to evaluate their growth performance.

Table 2. Plasma indicators of energy metabolism of cows receiving no molasses supplementation until calving (CON), or year-round supplementation of molasses (YMOL) or range cubes (YCUB).

	Treatments				*P*-value
	CON	**YCUB**	**YMOL**	**SEM**	**Treatment**
Cow plasma concentrations in August (day 56)					
IGF-1 [1], ng/mL	40.6[a]	48.2[b]	38.7[a]	2.46	0.11
NEFA, mEq/L	0.259[a]	0.307[b]	0.166[a]	0.029	0.008
Glucose, mmol/L	3.80[a]	4.79[b]	4.71[b]	0.307	0.06

[a-b] Within a row, means without a common superscript differed ($P \leq 0.05$).
[1] Covariate-adjusted the concentrations of respective plasma measurement obtained on day 0 ($P \leq 0.05$).

Liver samples were collected from cows at the start of the study (baseline trace mineral levels shown in Table 3). The next liver sample collection is scheduled for Oct 5^{th,} 2017, and will be used to determine the trace mineral status of all cows after 120 days of receiving no supplementation, or supplementation with molasses or range cubes from June to October.

Table 3. Average liver concentrations of trace minerals of samples collected on day 0 (start of the study).

Trace mineral	**Average concentration of liver trace minerals on day 0, ug/g of dry tissue**
Copper	142.5
Iron	308.3
Cobalt	0.34
Selenium	1.12
Zinc	135.3
Molybdenum	3.33
Manganese	11.3

In summary, a relatively small amount of molasses and range cubes supplementation (approximately 0.5 lb of dry matter daily) from June to August was not sufficient to increase cow growth performance compared to cows receiving no supplementation. However, physiological parameters crucial for fetal growth were increased by providing range cubes, which might positively affect calf development during gestation. We expect that due to an increase in supplement amount offered to cows from August to November, cow BCS at calving will be

increased. We also expect that the physiological parameters related to energy metabolism and calf fetal growth will be further increased by providing molasses or range cubes during late-gestation.

BUDGET FOR FLORIDA CATTLE ENHANCEMENT FUND- BUDGET JUSTIFICATION

PROJECT TITLE: Does year-round supplementation of cows pay off? (FCEB# 6)

DETAILED LINE ITEM DESCRIPTION	QTY	% Complete	TOTAL	EXPLANATION/JUSTIFICATION OF DELIVERABLE	COMPLETION DATE
Materials and supplies	Various	100%	$ 3,483.47	Laboratory consumables used for collection of first set of liver biopsy samples (needles, RNA preservative, storage vials) and fencing supplies.	6/1/2017
Laboratory analyses - Liver trace minerals	Various	100%	$ 1,147.50	Collection and analyses of DNA samples from hair follicles for Year of the project	6/19/2017
Laboratory analyses - Plasma hormones and metabolites, and gene expression	Various	100%	$ 6,613.35	Estrus synchronization and artificial insemination supplies for Year 1 of the project	8/1/2017
Research Animals (per diem)	Various		$ 3,868.04	Research animals housed at the Feed Efficiency Facility to measure feed intake individually	6/9/2017
Data and sample collection, and feed sample analyses	N/A		$ 2,583.64	Data analyses for Year 1 to assess the relationship between feed efficiency and fertility and preparation of final report	6/19/2017
IDC	N/A		$ 2,123.54		N/A
GRAND TOTAL: (equal to percentage of completion)			**$ 19,819.54**		