4th Annual NUTRITION FOR BEEF FEMALES

Friday - August 13th, 2021 – 10 AM to 1PM

Register at
https://rcrec-nbf.eventbrite.com/
or scan the QR code below

Registration options:
Join us in person at Range Cattle REC, 3401 Experiment station, Ona FL 33865
Preregistration required by August 10th
or
Join us online a link to attend the webinar will be provided after preregistration

Questions?
Contact Philipe Moriel
(352) 682-2904 or pmoriel@ufl.edu

10:00-10:30 am – ***Precalving supplementation of protein and energy: impacts on cow and calf performance***
Dr. Philipe Moriel, University of Florida - Range Cattle Research & Education Center

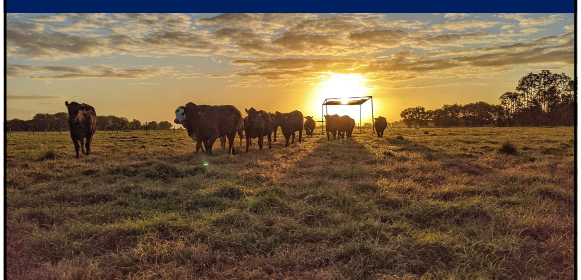
10:30-11:00 am – ***Precalving supplementation of trace minerals and fat: impacts on cow and calf performance***
Dr. Reinaldo Cooke, Texas A&M University

11:00-11:30 am - ***Pregnancy loss in beef cattle***
Dr. Ky Pohler, Texas A&M University

11:30-12:30 pm – ***Producer Round-Table***

12:30 to 1:30 pm – Lunch

Precalving supplementation of protein and energy: Impacts on cow and calf performance



Philipe Moriel, Ph.D.
Associate Professor - Department of Animal Science
University of Florida – Range Cattle Research & Education Center

Overview

Precalving supplementation of protein and energy

- *Traditional vs. recent perspective*
  - *Enhance progeny performance*
- *Supplementation strategies*
  - *Timing, frequency, feed additive*
  - *Preweaning growth, immune response*
  - *Heifer progeny*

Body condition score (BCS) vs. Pregnancy rate (%)

First calf cows

BCS at calving	# Cows	% pregnant 1st AI	BCS change	% pregnant 1st AI
High BCS ≥ 6.00	142	47.4 [a]	**Maintained**	54.9[a]
			Lost	43.0 [ab]
			Gained	54.5 [a]
Moderate BCS 5.00 - 5.50	358	44.3 [a]	**Maintained**	53.9 [a]
			Lost	35.7 [b]
Low BCS ≤ 4.50	93	25.9 [b]	**Gained**	33.2 [bc]
			Maintained	19.4 [c]
SEM		*4.4*		*6*
P-value		*0.002*		*0.0001*

[ab]$P < 0.05$

Vasconcelos et al. (2017) Proceedings of the 31st Annual Meeting of the Brazilian Embryo Technology Society (SBTE); Cabo de Santo Agostinho, PE, Brazil, August 17th to 19th, 2017.

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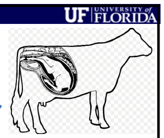
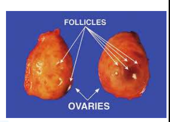
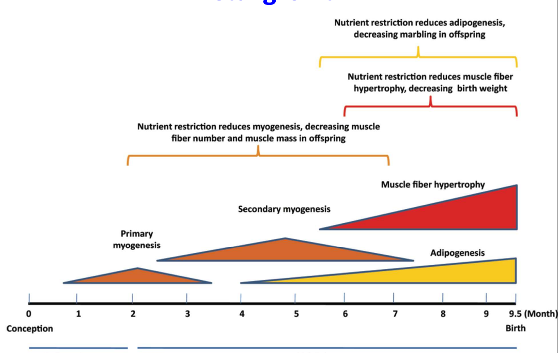
Prenatal strategies

Fetal-Programming





Fetal growth



Adapted from Du et al. (2010) JAS 88:E51–E6

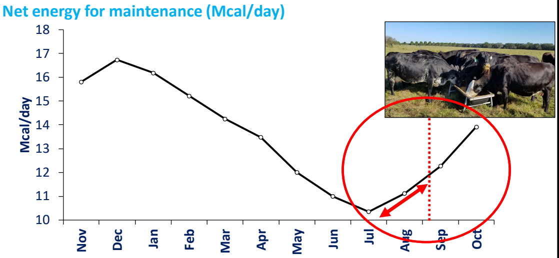
Study	Gestation trimester	Birth body weight	Preweaning growth	Post-weaning growth
Corah et al., 1975 (Exp. 1)	Third	+	+	Not reported
Corah et al., 1975 (Exp. 2)	Third	+	+	Not reported
Hough et al., 1990	Third	ND	ND	Not reported
Greenwood et al., 2005	Second + third	+	+	+
Banta et al., 2006	Third	ND	ND	ND
Stalker et al., 2006	Third	ND	+	ND
Stalker et al., 2007	Third	+	+	+
Martin et al., 2007	Third	ND	+	+
Larson et al., 2009	Third	+	+	+
Micke et al., 2010	First and/or second	+	Not reported	Not reported
Long et al., 2010	Early	ND	ND	-
Funston et al., 2010	Third	ND	+	ND
Underwood et al., 2010	Second	ND	+	+
Long et al., 2012	Early	ND	ND	ND
Mulliniks et al., 2012	Third	Not reported	ND	ND
Winterholler et al., 2012	Third	+	+	Not reported
Radunz et al., 2012	Second + third	+	+	ND
Bohnert et al., 2013	Third	+	+	ND
Shoup et al., 2015a	Third	ND	+	Not reported
Shoup et al., 2015b	Third	Not reported	Not reported	ND
Wilson et al., 2015	Third	ND	ND	ND
Summers et al. 2015a	Third	ND	Not reported	Not reported
Summers et al. 2015b	Third	Not reported	ND	+
Wilson et al., 2016a	Third	ND	ND	ND
Wilson et al., 2016b	Third	+	ND	ND
Kennedy et al., 2016	Third	+	Not reported	Not reported
Moriel et al., 2016	Third	ND	ND	ND
Marquez et al., 2017	Second or third	ND	ND	Not reported
Nepomuceno et al., 2017	Third	ND	ND	ND
McLean et al., 2018	First	ND	+	+/-
Maresca et al., 2018	Second + third	Not reported	Not reported	Not detected
Kennedy et al., 2019	Third	+	+	Not reported
Maresca et al., 2019	Second + third	+	ND	Not reported
Tanner et al., 2020	Second + third	ND	+	Not reported
Moriel et al., 2020	Third	ND	ND	+
Palmer et al., 2020	Third	ND	+	Not reported
Rodrigues et al., 2021	Second + third	+	ND	Not reported
ND = no statistical difference		14 of 33 studies	17 of 32 studies	8 of 22 studies

Beef Enhancement Funds
Florida Cattlemen's Association

Fetal Programming

Timing of precalving supplementation

Net energy for maintenance (Mcal/day)



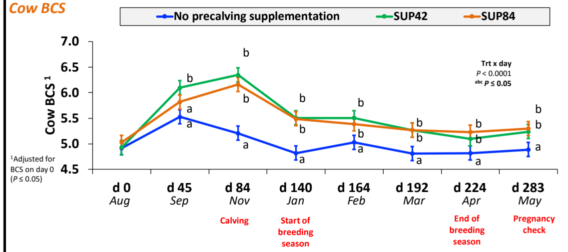
Supplementation offered:
Day 0 to 84 = dried distillers grains (DDG)
Day 84 end of breeding season = Molasses + urea

Day 0 = Start of study
Day 84 = start of calving
Day 140 to 224 = Breeding season

Treatments	Day of the study: Day 0 to 42	Day 42 to 84 (*Calving*)	Day 84 until end of breeding season
NO precalving supplementation	0	0	4 lb/day
Supplement day 0 to 84 – SUP84	2.2 lb/day	2.2 lb/day	4 lb/day
Supplement day 0 to 42 – SUP45	4.4 lb/day	0	4 lb/day

Results

Cow BCS



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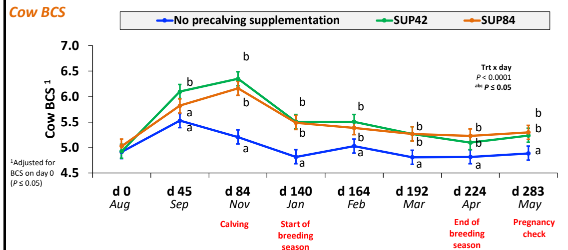
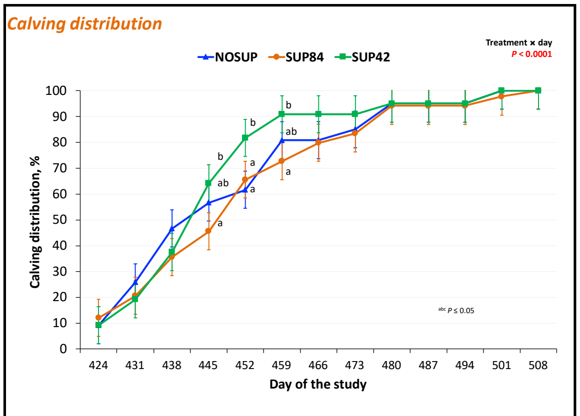
Results

Cow BCS



	Treatment: NO Sup	SUP84	SUP42	SEM	*P* - value: Treatment
Calving date, day of the study	82	83	86	4.7	0.76
Pregnancy rate (day 283), % of total	96.3	96.2	88.0	4.81	0.39

Calving distribution



Results – Preweaning calf body weight

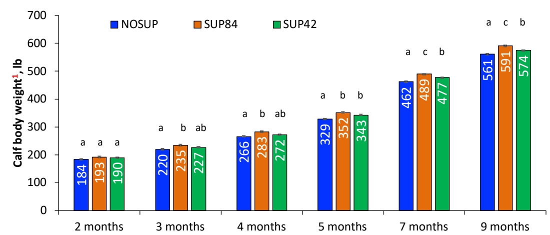
Item	Treatment			SEM	P
	NO SUP	SUP84	SUP42		Treat.
% calves born alive	98.1	94.3	96.4	2.55	0.58
Birth body weight, lb	79.3 [a]	82.4 [b]	81.9 [b]	3.70	0.08

Treatments	Day of the study		
	Day 0 to 42	Day 42 to 84 (*Calving*)	Day 84 until end of breeding season
NO precalving supplementation	0	0	4 lb/day
Supplement day 0 to 84 – SUP84	2.2 lb/day	2.2 lb/day	4 lb/day
Supplement day 0 to 42 – SUP45	4.4 lb/day	0	4 lb/day

Results – Preweaning calf body weight

[1]Adjusted for calf sex and age ($P < 0.01$)

Trt x day $P = 0.03$



Treatments	Day of the study		
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Supplement day 0 to 42 – SUP45	4.4 lb/day	0	4 lb/day

Results – Post-weaning phase

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Steer innate and humoral immune response

Item	Treatment			SEM	P - value	
	CON	SUP42	SUP84		Trt	Trt × Day
Plasma cortisol, µg/dL	2.13	2.29	2.15	0.16	0.76	0.79
Plasma haptoglobin, mg/mL	0.25	0.30	0.28	0.02	0.40	0.78
Serum BVDV-1						
Titers, log_2	3.46	4.41	3.91	0.38	0.21	0.87
Seroconversion, % total	78	85	88	7.2	0.64	0.27
Serum PI3						
Titers, log2	2.53[a]	4.30[b]	3.73[ab]	0.44	0.07	0.51
Seroconversion, % total						
day 347	21[a]	63[b]	54[b]	11	0.32	0.01
day 389	80	82	83			

[ab]$P \leq 0.05$

Results – Post-weaning immune response of steers

Item	CON	SUP42	SUP84	SEM	Trt	Trt × Day
	Treatment				*P* - value	
Plasma cortisol, μg/dL	2.13	2.29	2.15	0.16	0.76	0.79
Plasma haptoglobin, mg/mL	0.25	0.30	0.28	0.02	0.40	0.78
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Seroconversion, % total						
day 347	21[a]	63[b]	54[b]	11	0.32	0.01
day 389	80	82	83			

[ab]$P \leq 0.05$

Results – Steer carcass characteristics

Item	CON	SUP42	SUP84	SEM	*P* - value
	Treatment				
Hot Carcass Weight, kg	337	338	338	5.5	0.98
Dressing Percent, %	59.7	60.5	59.8	0.30	0.12
12th rib fat thickness, cm	1.77	1.69	1.62	0.089	0.49
Longissimus muscle area, cm^2	79.2	80.8	80.7	1.58	0.74
KPH, %	2.92	2.62	2.67	0.13	0.20
Yield Grade	3.8	3.6	3.5	0.14	0.33
Marbling	521[a]	570[b]	545[ab]	15	0.07
Average choice, %	5[a]	36[b]	17[ab]	9.3	0.10
Low choice, %	72	46	58	10	0.17
Select, %	23	19	25	8	0.87

[ab]$P \leq 0.05$

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[ab]$P \leq 0.05$

Beef Enhancement Funds
Florida Cattlemen's Association

Fetal Programming

Frequency of precalving supplementation

Frequency of precalving supplementation

80 days before calving:
120 Brangus cows (20 bahiagrass pastures; 6 cows/pasture)

NOSUP *= no precalving supplementation*
1X *= 14 lb of DDG offered on Monday (14 lb of DDG/cow/week)*
3X *= 4.66 lb of DDG offered on Monday, Wednesday and Friday (14 lb of DDG/cow/week)*
7X *= 2 lb of DDG offered daily (14 lb of DDG/cow/week)*

Calving to weaning:
All cows and calves managed similarly

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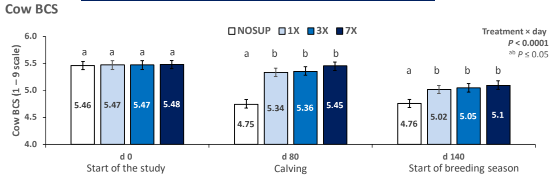
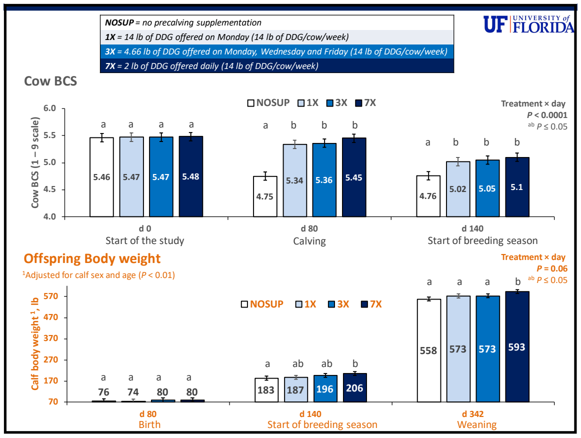
Cow BCS



	NOSUP	1X	3X	7X	SEM	*P*-value
Pregnant cow, % of total	**93.3**	**81.5**	**85.7**	**93.3**	5.71	0.39
Calved a live calf, % of total	**80.0**	**79.3**	**79.3**	**80.0**	7.47	0.99



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FETAL PROGRAMMING

Additives: Monensin

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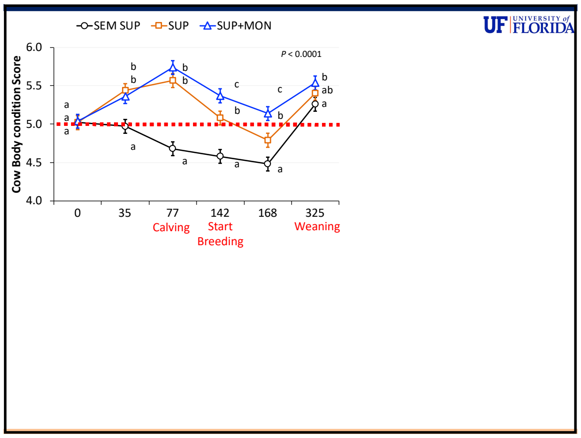
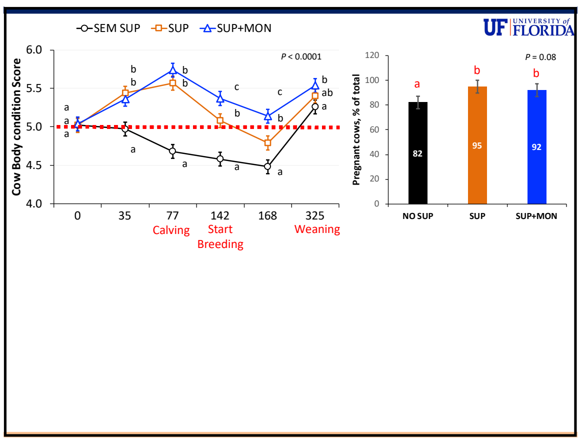
Inclusion of monensin into precalving supplementation

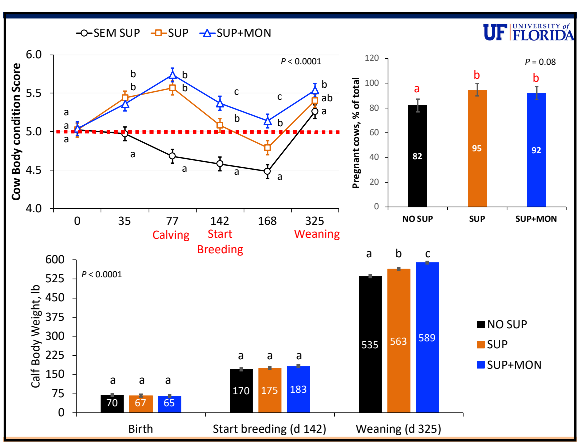
70 days before calving:
160 Brangus cows (16 bahiagrass pastures; 10 cows/pasture)

Treatments :
NO SUP = No precalving supplementation
SUP = 2 lb of DDG daily
SUP + MON = 2 lb of DDG daily + 200 mg de monensin daily

Calving to weaning:
All cows and calves managed similarly!


SEM SUP
SUP
SUP+MON
Cow Body condition Score
P < 0.0001
6.0
5.5
5.0
4.5
4.0
0
35
77
142
168
325
Calving
Start Breeding
Weaning


SEM SUP
SUP
SUP+MON
Cow Body condition Score
P < 0.0001
6.0
5.5
5.0
4.5
4.0
0
35
77
142
168
325
Calving
Start Breeding
Weaning
Pregnant cows, % of total
P = 0.08
82
95
92
NO SUP
SUP
SUP+MON


SEM SUP
SUP
SUP+MON
Cow Body condition Score
P < 0.0001
0
35
77
142
168
325
Calving
Start Breeding
Weaning
Pregnant cows, % of total
P = 0.08
82
95
92
NO SUP
SUP
SUP+MON
Calf Body Weight, lb
P < 0.0001
70
67
65
170
175
183
535
563
589
Birth
Start breeding (d 142)
Weaning (d 325)
NO SUP
SUP
SUP+MON

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Impacts of maternal precalving nutrition (*No Supp.* vs. *Supp.*) on body condition score (BCS) and reproduction of cows and growth and immune response of their calves (studies[1] at the Range Cattle REC; Ona, FL)

	Study 1		Study 2		Study 3		Study 4	
	No Supp.	Supp.	No Supp.	Supp.	No Supp.	Supp.	No Supp.	Supp.
Cow BCS start of the study	5.7	5.7	5.5	5.5	5.3	5.4	5.0	5.0
Cow BCS at calving								
Pregnancy rate, %								
Calf weaning weight, lb								
Response to vaccination, %								

[ab] Means without a common superscript differed (*P* < 0.05).

[1] Study 1 = 0 or 2.2 lb/day of molasses + urea for 57 days before calving (*Moriel et al., 2020*).
Study 2 = 0 or 2.2 lb/day of molasses + urea for 47 days before calving (*Palmer et al., 2020*).
Study 3 = 0 or 2.2 lb/day of dried distillers grains for 90 days before calving (*Palmer et al., in preparation*).
Study 4 = 0 or 2.2 lb/day dried distillers grains for 70 days before calving (*Moriel et al., in preparation*).
In all studies, cows and their calves were managed similarly from calving until calf weaning. Calves were early weaned at 2 to 3 months of age in Study 1 and normally weaned at 8 to 9 months of age in Studies 2, 3, and 4.

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Cow BCS at calving	5.8^{a}	6.1^{b}	5.0^{a}	5.4^{b}	5.2^{a}	5.8^{b}	4.7^{a}	5.6^{b}
Pregnancy rate, %								
Calf weaning weight, lb								
Response to vaccination, %								

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Calf weaning weight, lb								
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Pregnancy rate, %	91.7	94.4	78.5	75.8	96.2	96.3	82[a]	95[b]
Calf weaning weight, lb	275[a]	295[b]	579[a]	597[b]	561[a]	591[b]	535[a]	563[b]
Response to vaccination, %	56.1[a]	81.5[b]	-	-	21[a]	54[b]	-	-

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Prenatal supplementation
Heifer progeny

Table 1
Time course of ovarian development for cattle, sheep, and pigs

	Age in Days Postconception		
	Cattle[4]	Sheep[6]	Pigs[7,8]
Conception			
Mesonephros present		20	
Genital ridge present and being colonized by germ cells	35–36	23	18
Gonadal sex differentiation	39	32	27
Germ cell meiosis initiated	75–80	55	40
Maximum number of germ cells in gonad	110	75	50
First follicles formed	90–170	75	60–70
Most germ cells lost by atresia	150	90	100
First growing follicles observed	90–170	100	70
Most germ cells have completed meiosis	150	120	110
First antral follicles observed	250	135	60[a]
Birth	—	—	—

[a] Indicates days postpartum.
Data from Refs.[4,6–8]

Cushman and Perry (2019) Vet Clin Food Anim 35:321–330

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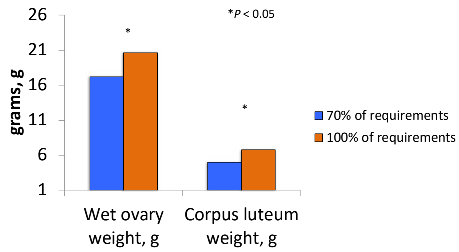
Ovary and *Corpus Luteum* weight of heifers born to cows fed 70 or 100% of their nutrient requirements from day 45 to 185 of gestation



Long et al. (2012) J. Anim. Sci. 90:197-206 https://doi.org/10.2527/jas.2011-4237

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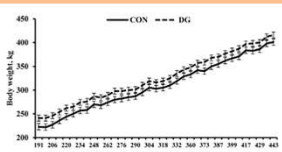
Heifers born from cows that received or not protein supplementation (1 lb/day) during last trimester of gestation

	Martin et al. (2007)		Funston et al. (2010)	
Item	NO Suppl	Suppl.	NO Suppl.	Suppl.
Weaning weight, lb	456	467	496*	511*
Adjusted 205-day BW, lb	480*	498*	469	478
Age at puberty, days	334	339	366*	352*
Pregnancy %	80*	93*	80	90
Calving during the first 21 days, %	49*	77*	-	-

Martin et al. (2007) JAS 85:841-847
Funston et al. (2010) JAS 88:4094-4101

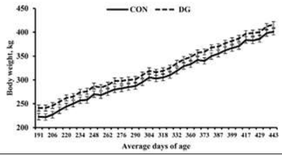
*P < 0.05

Heifers born to Angus-Simmental cows fed a control diet or a diet with DDG from 192 days of gestation through 118 ± 4 days in lactation (Gunn et al., 2015; J. Anim. Sci. 93:746-757)



DDG = ~30lb heavier

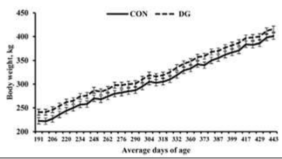
Heifers born to Angus-Simmental cows fed a control diet or a diet with DDG from 192 days of gestation through 118 ± 4 days in lactation (Gunn et al., 2015; J. Anim. Sci. 93:746-757)



DDG = ~30lb heavier

	CON	DDG	SEM	*P*-value
ADG, lb/day	1.54	1.52	0.044	0.64
Age at puberty, days	303	315	10	0.39
Pubertal by 1 year of age, %	100	88.2	-	0.97

Heifers born to Angus-Simmental cows fed a control diet or a diet with DDG from 192 days of gestation through 118 ± 4 days in lactation (Gunn et al., 2015; J. Anim. Sci. 93:746-757)



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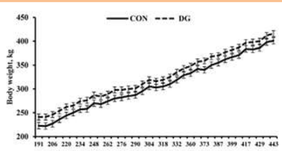
	CON	DDG	SEM	*P*-value
ADG, lb/day	1.54	1.52	0.044	0.64
Age at puberty, days	303	315	10	0.39
Pubertal by 1 year of age, %	100	88.2	-	0.97
Total antral follicles	30.6	27.1	2.25	0.28
Low, %	7.1	6.3	-	0.96
Intermediate, %	38.6	37.5	-	0.53
High, %	64.3	56.2	-	0.83
Estrous response, %	66.7	61.1	-	0.74

Heifers born to Angus-Simmental cows fed a control diet or a diet with DDG from 192 days of gestation through 118 ± 4 days in lactation (Gunn et al., 2015; J. Anim. Sci. 93:746-757)



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Intermediate, %	38.6	37.5	-	0.53
High, %	64.3	56.2	-	0.83
Estrous response, %	66.7	61.1	-	0.74
AI pregnancy rate, %	**33.3**	**70.6**	-	**0.05**
Overall pregnancy rate, %	86.7	100	-	0.97

Multiparous beef cows (MARC III 1⁄4 Angus, 1⁄4 Hereford, 1⁄4 Pinzgauer, and 1⁄4 Red Poll)

Second and third trimester:
- **Low diet** = 75% of maintenance
- **Moderate diet** = 100% of maintenance
- **High diet** = 125% of maintenance

	Diet 2nd trimester / Diet 3rd trimester					
Item	Low/High	Low/Low	Mod/High	Mod/Mod	SEM	P-value

Cushman et al. (2014) Livestock 162:252-258 https://doi.org/10.1016/j.livsci.2014.01.033

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- **High diet** = 125% of maintenance

	Diet 2nd trimester / Diet 3rd trimester					
Item	Low/High	Low/Low	Mod/High	Mod/Mod	SEM	P-value
Birth weight, lb	80.6	82.2	80.4	83.7	1.5	0.40
Preweaning ADG, lb/day	2.07	2.09	2.11	2.11	0.022	0.70
Weaning weight, lb	419	421	423	428	5.9	0.74
Post-weaning ADG, lb/day	1.70	1.67	1.67	1.67	0.022	0.89
Breeding weight, lb	825	826	824	832	10.1	0.95

Cushman et al. (2014) Livestock 162:252-258 https://doi.org/10.1016/j.livsci.2014.01.033

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	Diet 2nd trimester / Diet 3rd trimester					
Item	Low/High	Low/Low	Mod/High	Mod/Mod	SEM	P-value
Percent pubertal	96.4	95.1	92.0	96.6	3.2	0.73
Age at puberty, days	316.5	312.4	315.6	320.5	4.1	0.60
Antral follicle count	22.8	22.0	22.6	21.4	0.7	0.50
Percent pregnant	85.5	89.9	92.0	88.5	2.1	0.23

Cushman et al. (2014) Livestock 162:252-258 https://doi.org/10.1016/j.livsci.2014.01.033

Multiparous beef cows (MARC III 1⁄4 Angus, 1⁄4 Hereford, 1⁄4 Pinzgauer, and 1⁄4 Red Poll)

Maternal BCS	Low/High	Low/Low	Mod/High	Mod/Mod	SEM	P-value
Initial BCS	5.8	5.9	5.9	5.9	0.1	0.93
3rd Trimester BCS	5.6 [a]	5.7 [a]	6.0 [b]	6.1 [b]	0.1	0.04
Calving BCS	6.0 [b]	5.5 [a]	6.2 [b]	6.0 [b]	0.2	0.04

	Diet 2nd trimester / Diet 3rd trimester					
Item	Low/High	Low/Low	Mod/High	Mod/Mod	SEM	P-value
Percent pubertal	96.4	95.1	92.0	96.6	3.2	0.73
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Percent pregnant	85.5	89.9	92.0	88.5	2.1	0.23

[ab] $P < 0.05$

Cushman et al. (2014) Livestock 162:252-258 https://doi.org/10.1016/j.livsci.2014.01.033

Multiparous beef cows (MARC III 1⁄4 Angus, 1⁄4 Hereford, 1⁄4 Pinzgauer, and 1⁄4 Red Poll)

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- **Moderate diet** = 100% of maintenance
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Item	Low/High	Low/Low	Mod/High	Mod/Mod	SEM	P-value
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Antral follicle count	22.8	22.0	22.6	21.4	0.7	0.50
Percent pregnant	85.5	89.9	92.0	88.5	2.1	0.23
Calving percentage	81.5 [a]	82.5 [a]	90.0 [b]	82.0 [a]	2.1	**0.06**
Calved first 21 days, %	51.5 [b]	42.0 [a]	55.1 [b]	40.3 [a]	2.6	**0.004**
Calf birth weight, lb	68.9	70.9	69.6	68.7	1.32	0.71

[ab] $P < 0.05$

Cushman et al. (2014) Livestock 162:252-258 https://doi.org/10.1016/j.livsci.2014.01.033

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Current challenges

Inconsistent results
- Multiple possible explanations

Study	Gestation trimester	Birth body weight	Preweaning growth	Post-weaning growth
Corah et al., 1975 (Exp. 1)	Third	+		
Corah et al., 1975 (Exp. 2)	Third	+		
Hough et al., 1990	Third	ND		
Greenwood et al., 2005	Second + third	+		
Banta et al., 2006	Third	ND		
Stalker et al., 2006	Third	ND		
Stalker et al., 2007	Third	+		
Martin et al., 2007	Third	ND		
Larson et al., 2009	Third	+		
Micke et al., 2010	First and/or second	+		
Long et al., 2010	Early	ND		
Funston et al., 2010	Third	ND		
Underwood et al., 2010	Second	ND		
Long et al., 2012	Early	ND		
Mulliniks et al., 2012	Third	Not reported		
Winterholler et al., 2012	Third	+		
Radunz et al., 2012	Second + third	+		
Bohnert et al., 2013	Third	+		
Shoup et al., 2015a	Third	ND		
Shoup et al., 2015b	Third	Not reported		
Wilson et al., 2015	Third	ND		
Summers et al. 2015a	Third	ND		
Summers et al. 2015b	Third	Not reported		
Wilson et al., 2016a	Third	ND		
Wilson et al., 2016b	Third	+		
Kennedy et al., 2016	Third	+		
Moriel et al., 2016	Third	ND		
Marquez et al., 2017	Second or third	ND		
Nepomuceno et al., 2017	Third	ND		
McLean et al., 2018	First	ND		
Maresca et al., 2018	Second + third	Not reported		
Kennedy et al., 2019	Third	+		
Maresca et al., 2019	Second + third	+		
Tanner et al., 2020	Second + third	ND		
Moriel et al., 2020	Third	ND		
Palmer et al., 2020	Third	ND		
Rodrigues et al., 2021	Second + third	+		

ND = no statistical difference

Study	Gestation trimester	Birth body weight	Preweaning growth	Post-weaning growth
Corah et al., 1975 (Exp. 1)	Third	+		
Corah et al., 1975 (Exp. 2)	Third	+		
Hough et al., 1990	Third	ND		
Greenwood et al., 2005	Second + third	+		
Banta et al., 2006	Third	ND		
Stalker et al., 2006	Third	ND		
Stalker et al., 2007	Third	+		
Martin et al., 2007	Third	ND		
Larson et al., 2009	Third	+		
Micke et al., 2010	First and/or second	+		
Long et al., 2010	Early	ND		
Funston et al., 2010	Third	ND		
Underwood et al., 2010	Second	ND		
Long et al., 2012	Early	ND		
Mulliniks et al., 2012	Third	Not reported		
Winterholler et al., 2012	Third	+		
Radunz et al., 2012	Second + third	+		
Bohnert et al., 2013	Third	+		
Shoup et al., 2015a	Third	ND		
Shoup et al., 2015b	Third	Not reported		
Wilson et al., 2015	Third	ND		
Summers et al. 2015a	Third	ND		
Summers et al. 2015b	Third	Not reported		
Wilson et al., 2016a	Third	ND		
Wilson et al., 2016b	Third	+		
Kennedy et al., 2016	Third	+		
Moriel et al., 2016	Third	ND		
Marquez et al., 2017	Second or third	ND		
Nepomuceno et al., 2017	Third	ND		
McLean et al., 2018	First	ND		
Maresca et al., 2018	Second + third	Not reported		
Kennedy et al., 2019	Third	+		
Maresca et al., 2019	Second + third	+		
Tanner et al., 2020	Second + third	ND		
Moriel et al., 2020	Third	ND		
Palmer et al., 2020	Third	ND		
Rodrigues et al., 2021	Second + third	+		
ND = no statistical difference		14 of 33 studies		

Study	Gestation trimester	Birth body weight	Preweaning growth	Post-weaning growth
Corah et al., 1975 (Exp. 1)	Third	+	+	
Corah et al., 1975 (Exp. 2)	Third	+	+	
Hough et al., 1990	Third	ND	ND	
Greenwood et al., 2005	Second + third	+	+	
Banta et al., 2006	Third	ND	ND	
Stalker et al., 2006	Third	ND	+	
Stalker et al., 2007	Third	+	+	
Martin et al., 2007	Third	ND	+	
Larson et al., 2009	Third	+	+	
Micke et al., 2010	First and/or second	+	Not reported	
Long et al., 2010	Early	ND	ND	
Funston et al., 2010	Third	ND	+	
Underwood et al., 2010	Second	ND	+	
Long et al., 2012	Early	ND	ND	
Mulliniks et al., 2012	Third	Not reported	ND	
Winterholler et al., 2012	Third	+	+	
Radunz et al., 2012	Second + third	+	+	
Bohnert et al., 2013	Third	+	+	
Shoup et al., 2015a	Third	ND	+	
Shoup et al., 2015b	Third	Not reported	Not reported	
Wilson et al., 2015	Third	ND	ND	
Summers et al. 2015a	Third	ND	Not reported	
Summers et al. 2015b	Third	Not reported	ND	
Wilson et al., 2016a	Third	ND	ND	
Wilson et al., 2016b	Third	+	ND	
Kennedy et al., 2016	Third	+	Not reported	
Moriel et al., 2016	Third	ND	ND	
Marquez et al., 2017	Second or third	ND	ND	
Nepomuceno et al., 2017	Third	ND	ND	
McLean et al., 2018	First	ND	+	
Maresca et al., 2018	Second + third	Not reported	Not reported	
Kennedy et al., 2019	Third	+	+	
Maresca et al., 2019	Second + third	+	ND	
Tanner et al., 2020	Second + third	ND	+	
Moriel et al., 2020	Third	ND	ND	
Palmer et al., 2020	Third	ND	+	
Rodrigues et al., 2021	Second + third	+	ND	
ND = no statistical difference		14 of 33 studies	17 of 32 studies	

Study	Gestation trimester	Birth body weight	Preweaning growth	Post-weaning growth
Corah et al., 1975 (Exp. 1)	Third	+	+	Not reported
Corah et al., 1975 (Exp. 2)	Third	+	+	Not reported
Hough et al., 1990	Third	ND	ND	Not reported
Greenwood et al., 2005	Second + third	+	+	+
Banta et al., 2006	Third	ND	ND	ND
Stalker et al., 2006	Third	ND	+	ND
Stalker et al., 2007	Third	+	+	+
Martin et al., 2007	Third	ND	+	+
Larson et al., 2009	Third	+	+	+
Micke et al., 2010	First and/or second	+	Not reported	Not reported
Long et al., 2010	Early	ND	ND	-
Funston et al., 2010	Third	ND	+	ND
Underwood et al., 2010	Second	ND	+	+
Long et al., 2012	Early	ND	ND	ND
Mulliniks et al., 2012	Third	Not reported	ND	ND
Winterholler et al., 2012	Third	+	+	Not reported
Radunz et al., 2012	Second + third	+	+	ND
Bohnert et al., 2013	Third	+	+	ND
Shoup et al., 2015a	Third	ND	+	Not reported
Shoup et al., 2015b	Third	Not reported	Not reported	ND
Wilson et al., 2015	Third	ND	ND	ND
Summers et al. 2015a	Third	ND	Not reported	Not reported
Summers et al. 2015b	Third	Not reported	ND	+
Wilson et al., 2016a	Third	ND	ND	ND
Wilson et al., 2016b	Third	+	ND	ND
Kennedy et al., 2016	Third	+	Not reported	Not reported
Moriel et al., 2016	Third	ND	ND	ND
Marquez et al., 2017	Second or third	ND	ND	Not reported
Nepomuceno et al., 2017	Third	ND	ND	ND
McLean et al., 2018	First	ND	+	+/-
Maresca et al., 2018	Second + third	Not reported	Not reported	Not detected
Kennedy et al., 2019	Third	+	+	Not reported
Maresca et al., 2019	Second + third	+	ND	Not reported
Tanner et al., 2020	Second + third	ND	+	Not reported
Moriel et al., 2020	Third	ND	ND	+
Palmer et al., 2020	Third	ND	+	Not reported
Rodrigues et al., 2021	Second + third	+	ND	Not reported
ND = no statistical difference		14 of 33 studies	17 of 32 studies	8 of 22 studies

Carcass quality

Study	Gestation trimester	Carcass weight	Marbling score	Choice %	Dressing %	Backfat thickness	Longissimus muscle area	Yield grade
Greenwood et al., 2005	Second + third	+	ND	Not reported	+	ND	ND	Not reported
Banta et al., 2006	Third	ND	ND	ND	Not reported	ND	ND	ND
Stalker et al., 2006	Third	ND	ND	ND	ND	ND	ND	ND
Stalker et al., 2007	Third	+	ND	Not reported	Not reported	ND	ND	ND
Larson et al., 2009	Third	+	+	+	Not reported	ND	ND	ND
Long et al., 2010	First	ND	ND	Not reported	ND	ND	ND	ND
Underwood et al., 2010	Second	+	ND	Not reported	Not reported	+	Not reported	ND
Long et al., 2012	First	ND	Not reported	Not reported	ND	ND	ND	-
Radunz et al., 2012	Second + third	ND	-	ND	-	ND	ND	ND
Mulliniks et al., 2012	Third	ND	ND	ND	ND	ND	ND	ND
Bohnert et al., 2013	Third	ND	ND	ND	Not reported	ND	ND	ND
Mohrhauser et al., 2015	Second	ND	ND	Not reported	ND	+	ND	+
Wilson et al., 2015	Third	ND	ND	ND	Not reported	-	ND	ND
Shoup et al., 2015	Third	ND	ND	+	Not reported	ND	ND	ND
Summers et al., 2015	Third	ND	-	ND	Not reported	ND/-	ND	ND/-
Wilson et al., 2016	Third	ND	ND	Not reported	Not reported	ND	ND	ND
McLean et al., 2018	First	ND	ND	Not reported	ND	ND	ND	ND
Luebbe et al., 2019	Third	+	ND	Not reported	Not reported	+	ND	ND
Maresca et al., 2019	Second + third	ND	ND	Not reported	+	ND	+	Not reported

ND = no statistical difference

Carcass quality

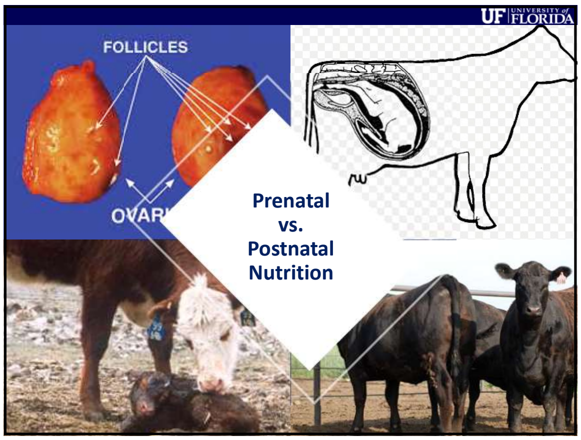
Study	Gestation trimester	Carcass weight	Marbling score	Choice %	Dressing %	Backfat thickness	Longissimus muscle area	Yield grade
Greenwood et al., 2005	Second + third	+	ND	Not reported	+	ND	ND	Not reported
Banta et al., 2006	Third	ND	ND	ND	Not reported	ND	ND	ND
Stalker et al., 2006	Third	ND	ND	ND	ND	ND	ND	ND
Stalker et al., 2007	Third	+	ND	Not reported	Not reported	ND	ND	ND
Larson et al., 2009	Third	+	+	+	Not reported	ND	ND	ND
Long et al., 2010	First	ND	ND	Not reported	ND	ND	ND	ND
Underwood et al., 2010	Second	+	ND	Not reported	Not reported	+	Not reported	ND
Long et al., 2012	First	ND	Not reported	Not reported	ND	ND	ND	-
Radunz et al., 2012	Second + third	ND	-	ND	-	ND	ND	ND
Mulliniks et al., 2012	Third	ND	ND	ND	ND	ND	ND	ND
Bohnert et al., 2013	Third	ND	ND	ND	Not reported	ND	ND	ND
Mohrhauser et al., 2015	Second	ND	ND	Not reported	ND	+	ND	+
Wilson et al., 2015	Third	ND	ND	ND	Not reported	-	ND	ND
Shoup et al., 2015	Third	ND	ND	+	Not reported	ND	ND	ND
Summers et al., 2015	Third	ND	-	ND	Not reported	ND/-	ND	ND/-
Wilson et al., 2016	Third	ND	ND	Not reported	Not reported	ND	ND	ND
McLean et al., 2018	First	ND	ND	Not reported	ND	ND	ND	ND
Luebbe et al., 2019	Third	+	ND	Not reported	Not reported	+	ND	ND
Maresca et al., 2019	Second + third	ND	ND	Not reported	+	ND	+	Not reported

ND = no statistical difference

Current challenges

Inconsistent results

- Multiple possible explanations
  - I. Cow milk production
  - II. Epigenetics
  - III. Pre- vs. postnatal nutrition
  - IV. Breed
  - V. Sex-specific responses
  - VI. Immunological challenges
  - VII. Longer periods of evaluation
  - VIII. Multigeneration studies



Immunological challenge in the feedlot

Effects of maternal supplementation of protein and energy during late gestation were detected for calf ADG immediately after a vaccination challenge against BRD pathogens but not during pre-vaccination period.

Treatments (starting 56 days precalving):

- **NOSUP =** No Molasses + urea supplementation
- **MOL** = 2.2 lb/d of Molasses + urea (DM)
- **MOLMET =** 2.2 lb/d of **MOL** + **18 g/d of methionine hydroxy analog** (Alimet, Novus)

Item	Treatment			SEM	P-value
	No Supplement	Molasses	Molasses Methionine		
ADG[1], lb/day					
Birth to early weaning	1.28	1.26	1.37	0.064	0.48
Postweaning drylot	1.85 [a]	2.00 [b]	2.18 [b]	0.068	0.02
Birth to day 201	1.41 [a]	1.59 [b]	1.65 [b]	0.081	0.10

[1]Adjusted for calf sex ($P \leq 0.05$)

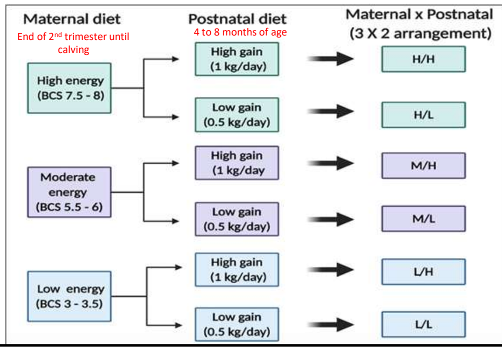
[ab] $P \leq 0.05$

Moriel et al. (2020) J. Anim. Sci. 98(5):1–12 **doi:10.1093/jas/skaa123**

Texas A&M University

Cardoso & Williams (unpublished data)

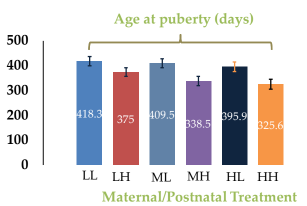
Brangus and Braford beef cows



Results: Age at puberty

Postnatal Treatment ($P < 0.0001$)	Age at Puberty (days)
Low-Gain (0.5 kg/day)	411.0 ± 10.5 days
High-Gain (1.0 kg/day)	348.9 ± 10.7 days

High-Gain heifers reached puberty 62 days earlier than Low-Gain



HH heifers reached puberty 92 days earlier than LL ($P = 0.0037$)

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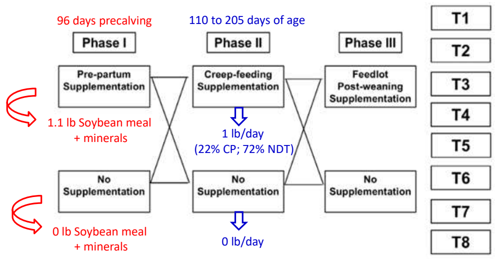
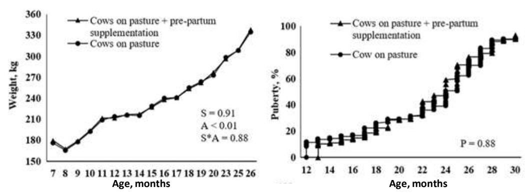
Bos indicus

498 multiparous Nelore cows (950 lb; BCS = 5.5) Factorial = 2 x 2 x 2



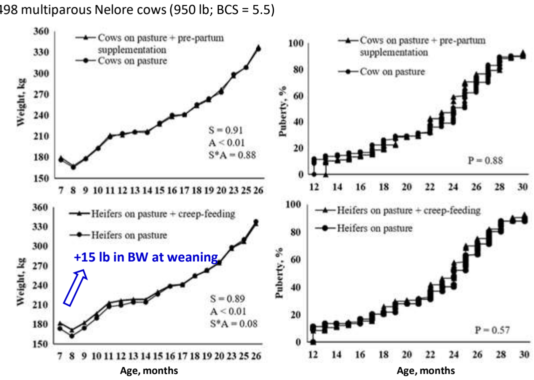
Nepomuceno et al. (2017) Livestock Sci. 195:58–62

498 multiparous Nelore cows (950 lb; BCS = 5.5)

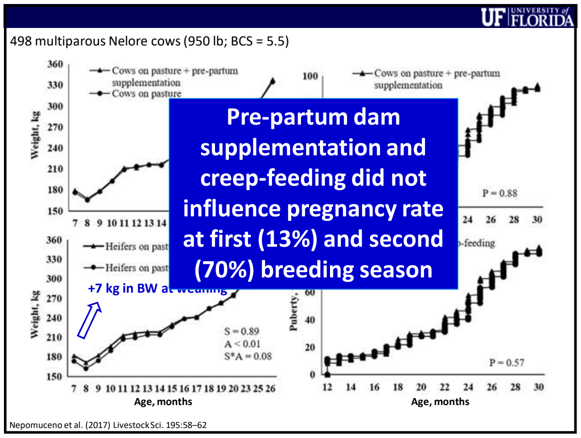


Nepomuceno et al. (2017) Livestock Sci. 195:58–62

498 multiparous Nelore cows (950 lb; BCS = 5.5)

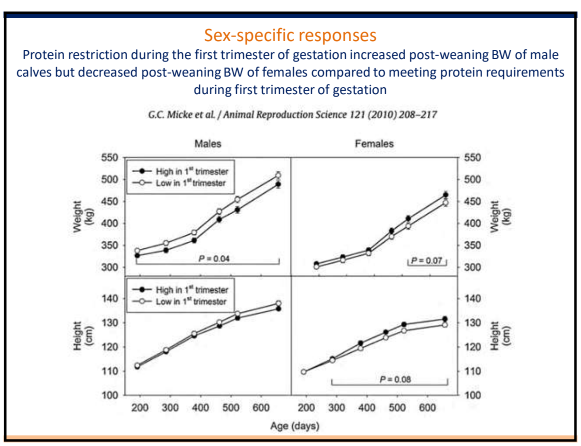


Nepomuceno et al. (2017) Livestock Sci. 195:58–62



498 multiparous Nelore cows (950 lb; BCS = 5.5)
Pre-partum dam supplementation and creep-feeding did not influence pregnancy rate at first (13%) and second (70%) breeding season
+7 kg in BW at weaning
Age, months
Nepomuceno et al. (2017) Livestock Sci. 195:58–62

Sex-specific responses



Sex-specific responses
Protein restriction during the first trimester of gestation increased post-weaning BW of male calves but decreased post-weaning BW of females compared to meeting protein requirements during first trimester of gestation
G.C. Micke et al. / Animal Reproduction Science 121 (2010) 208–217
Males
Females
High in 1st trimester
Low in 1st trimester
Weight (kg)
Height (cm)
P = 0.04
P = 0.07
P = 0.08
Age (days)

Longer evaluations periods

Longer evaluation periods

- Opposite outcomes to offspring performance during shorter vs. longer periods of evaluation.
- Low precipitation vs. high precipitation during gestation
  - Decreased birth and weaning BW of calves
  - Increased longevity and percentage of females calving after 8 years of age (Beard et al., 2019)
- Multiple generations (F1 daughter and F2 granddaughters)
  - Laporta et al. (2020)
    - 10 years of consecutive data collection
    - Maternal heat stress during late gestation decreased milk production
    - Daughters during first, second and third lactations,
    - Granddaughters during their first lactation

Final messages

Maternal precalving supplementation

- Opportunity for beef producers to enhance offspring growth, immune function and reproduction
- Current research opportunities:
  - Less data on *Bos indicus*
  - Pre- vs. postnatal calf nutrition, sex-specific outcomes, and multiple generations beyond F1 offspring.

Thank you

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