Reproductive Performance in a Commercial Herd

Evaluating Response to a Chromium Supplement

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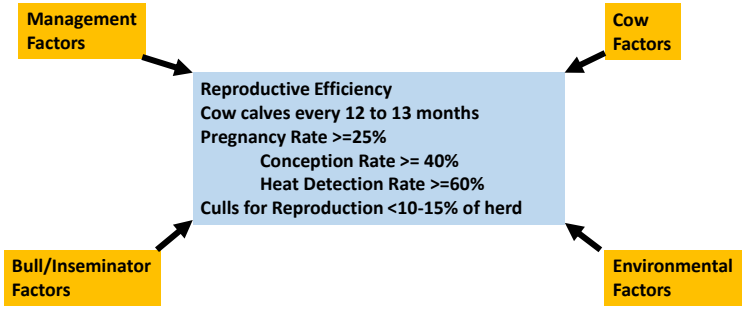
Reproductive Management – Multiple Influences



Need to tease out factors from data and history in herd

Data Analysis - RepMon

- Convert DHIA prevalence data to incidence data to estimate risk factors

Run reports monthly
Store estimates in a spreadsheet
Track trends over time

Age Effects (Parity)
Seasonal Effects
Time postcalving effects
Conception rate
Insemination rate
Pregnancy rate
Culling
Economic Value

What is RepMon

- Program to analyze reproductive data
- Use insemination patterns and reproductive outcomes to evaluate
  - Insemination efficiency (heat detection)
  - Conception Rate
    - Age, season, days in milk, service number
  - Pregnancy Rate
  - Economic opportunities relative to a goal

DHIA Data – a problem

- Pattern of calving biases analysis of PR and CR
  - RepMon corrects for this bias
    - Using insemination data from previous lactatior
- Proportion of active herd pregnant
  - >40% to have a valid calculation

Change in FSTCR with RepMon

	DHIA Estimate	RepMon	Change
Number herds	144	144	144
Mean CR	31.7	36.0	+4.3

Only 21 of the 144 herds had a lower RepMon estimate than DHIA

This is the bias in DHIA estimates due to pattern of calving – first service cows re-calve at a greater frequency than cows with multiple services, thus are underrepresented in prevalence estimates

DHIA estimate is a prevalence estimate based on active cows in herd
Due to calving patterns, cows pregnant at first service recalve at a faster rate than cows with higher service numbers, therefore they are under represented in the data

RepMon estimate is a lactation adjusted incidence rate;
adjusted for animals calving to estimate over a 12 month period
Includes cull cows

Case Report in a SE PA Holstein Herd
Demographics: 819 Active Cows; 28,386 lbs RHA
Free stall barns; double 12 parallel parlor, 3x milking
Problem: Low CR at repeat services

RepMon CR by Service Number: Dec., 2011

X-SYS:Current Calving Interval: 08/13/2010 to 12/13/2011

Conception Rate by service number

All Lactations

Service	# Bred	# Preg	# Open	% Preg	--- CR % --- Preg	All
1	396	304	92	76.8%	59.6%	44.8%
2	139	88	51	63.3%	42.7%	27.2%
3	96	52	44	54.2%	44.1%	27.2%
4	60	36	24	60.0%	54.5%	31.3%
5	31	17	14	54.8%	56.7%	26.2%
6	13	5	8	38.5%	38.5%	12.5%
7	35	8	27	22.9%	100.0%	100.0%
Total bred:	770	510	260	66.2%		
Total services:	1680	951	729			

Significant reduction in CR by service number Through 4th service

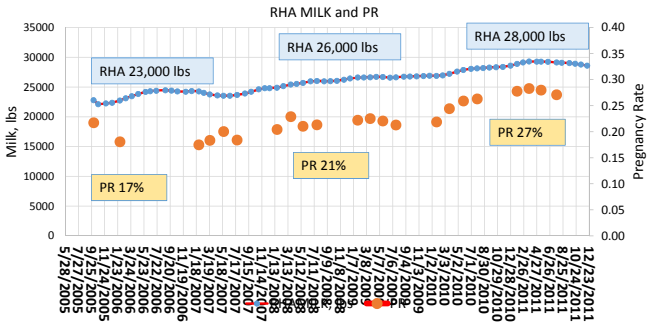
A -66.5282 X-sq 15.0414

B 294.255 p < 0.000105

Cattle groups on the farm

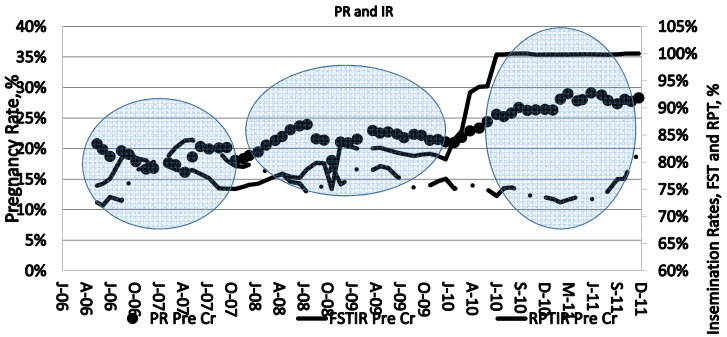
Groups		Num	DIM	Production----------		
		n	days	Milk,lb	Fat,%	Protein,%
Far-off dry cows	dry off to 21 days					
Close-up dry cows	21 days to calving					
Postfresh group		42	14	55	4.4	3.4
First lactation group		144	129	84	3.5	2.8
Two high groups parity >=2 cows		108	126	115	3.4	2.8
		111	139	107	3.6	2.8
Midlactation group		109	266	91	3.7	3.1
Late/Mid lactation groups		81	281	69	4.0	3.2
		103	343	62	3.9	3.2
		77	343	50	4.4	3.5
		34	348	54	4.1	3.3
Hospital group		15	123	92	3.7	3.0

Change in RHA and PR over time

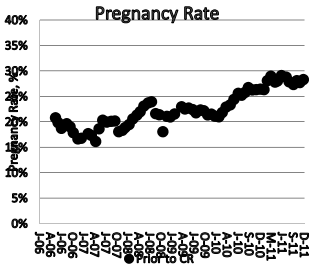


Reproductive Management

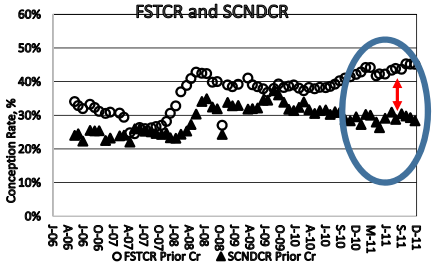
2007 – PreSynch with "cherry picking" + PostSynch Program – VWP 50 days
2010 – PreSynch no cherry picking + PostSynch Program – VWP 70 days



The Issue – fertility in repeat service cows



PR had improved from 17% in 2006 to 29% in 2011



FSTCR had increased to from 30% to about 45% in 2011
SCDCR had improved to 32% but was typically less than 30% from 2010; this was true for third and fourth service

Signalment in December 2011

- First service CR was good
  - Lactation 1 **51.2%** Lactation 2 **41.3%** Lactation 3+ **41.3%**
- Repeat Service Rates were significantly lower
- Second Service CR
  - Lactation 1 **35.9%** Lactation 2 **18.8%** Lactation 3+ **26.6%**
- Third Service CR
  - Lactation 1 **31.6%** Lactation 2 **27.1%** Lactation 3+ **24.0%**
- Fourth Service CR
  - Lactation 1 **43.8%** Lactation 2 **28.6%** Lactation 3+ **25.0%**
- Binomial Trend Analysis : Negative Trend overall $P<0.0001$
  - Lactation 1 0.09 Lactation 2 0.06 Lactation 3+ 0.003

December 2011 – RepMon Analysis

PR at first service 38.5%
PR at repeat services 16.5%

Significant changes in slope due to lower CR at repeat services and the change in frequency of insemination with PostSynch program

Pregnancy Rate by Lactation Group

Mean Pregnancy Rate

Lactation	All	95% CL	First	95% CL	Repeat	95% CL	<=150D O	Mean DO	PR from DO
All Lactations	21.2%	3.2%	38.5%	3.9%	16.5%	3.7%	74.0%	119	0.268
1st Lactation	27.2%	5.7%	46.5%	5.1%	20.3%	5.5%	81.6%	108	0.339
2nd Lactation	18.8%	5.8%	37.4%	5.6%	14.8%	5.0%	73.8%	118	0.274
3rd+ Lactations	18.5%	5.0%	31.3%	6.2%	15.0%	5.8%	64.0%	132	0.217
Lact. # unknown	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0	0.000

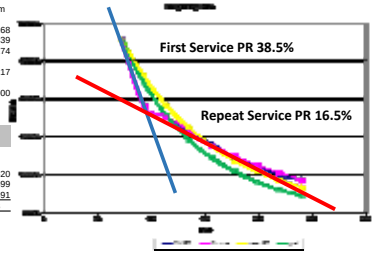
First HDR	Post HDR	Mean HDR	PR Calc
100.0%	57.1%	65.0%	72.3%

Interval Analysis: Distribution of Days between Breedings - All Lactations
Services Sum of 1 - 2, 2 - 3 and 3 - 4

Interval	< 10	10 - 17	18 - 24	25 - 35	36 - 48	>= 49	N
# Cows:	8	25	87	43	436	21	
% Cows:	1.3%	4.0%	14.0%	6.9%	70.3%	3.4%	620
% < 49:	1.3%	4.2%	14.5%	7.2%	72.8%		599
% 10-48:		4.2%	14.7%	7.3%	73.8%		591

Long: 3.4% Abnormal: 11.4% Ratio: 0.20 PostHDR: 7.8

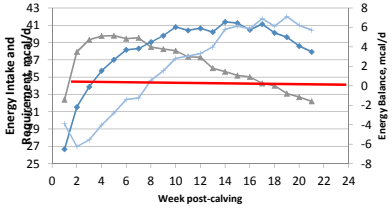
Avg days between: 1-2: 40.1 2-3: 36.1 3-4: 36.5



Data Analysis for CR in Repeat Service Cows

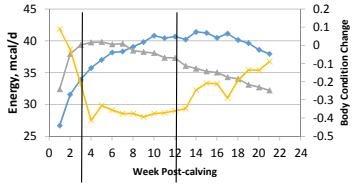
- Fertility for repeat services was examined in logistic models for association with age (parity), milk production, metritis, ketosis, other post-calving problems
  - RP – 2.5%, Ketosis – 8.2%, LDA – 2.7%, Metritis – 5.7%, Antibiotic – 17.7%
  - MF – 1.1%; overall animals with a problem postcalving – 35.8%
- No association with lower fertility in these cows
- Cows did not appear thinner or to apparently have lost more BC

Body Condition and Energy Balance



Body score change – cumulative change
Nadir – week 4 postpartum
½ unit loss on average
1 unit = 400 mcal NEB (-300 to -500)
65 kg of live weight change/unit (40 to 80 kg)

Energy Balance:
Nadir week two postpartum - 6 mcal on average
Positive balance by week 8 (3 to 12 weeks)



Consistent changes -3 weeks to 3 weeks around calving

- Blood glucose is lower postcalving than precalving
- NEFA peaks at calving
  - Fairly acute rise late in gestation prior to calving
  - Decline over first two to three weeks
- Betahydroxy butyrate increases slightly prior to calving and is highest two to three weeks post calving
- Insulin and IGF-1 decrease post calving
- Liver lipid increases day 1 through day 20 post calving
- Plasma total protein declines slightly over dry period and within the first two weeks post-calving
- Plasma Ca declines on day of calving and rises over the next four days

Insulin Resistance – adaptation to support milk production

- Decrease sensitivity to insulin in late pregnancy and early lactation
  - Less glucose uptake by muscle and adipose tissue
  - Less glycogen production in liver
  - More glucose available to conceptus (pre) and mammary gland (post)
- Increases fatty acid mobilization and gluconeogenesis
- Decreased protein synthesis, lipid synthesis, glycogen synthesis
- "Directs" glucose to the conceptus and mammary gland
- Fatty acids source of energy for muscle

Dampening of Reproductive Axis

- More negative energy balance
  - Reduction in insulin, Insulin Growth Factor System
  - Reduced production of LH – amplitude and frequency which dampens the reproductive axis reducing follicular growth and steroid hormone output
  - Delayed ovulation can be up to 60 days or more post calving
- Reduced growth of granulosa cells and reduced steroid hormone production
  - Reduced estrogen and progesterone which result in failure to induce an LH surge and ovulation

FIRST OVULATION – Ovarian Cycling Resumes

- Follicular Waves Resume About 5 Days Postcalving and a dominant follicle will emerge by 10 days and ovulate by 15 to 21 days post calving
- But this only occurs in 42% to 75% of cows (very variable across herds)
  - Regresses or develops into a cyst
  - Metabolic and hormonal signals determine fate of first follicle
- Related to Energy Balance, Age, Breed, Milk Production, Season, Health…

Fertility in cows with delayed ovulation: Ovulatory vs Anovulatory Cows on OvSynch

Literature Studies	CR, %
Ovulatory cows	32, 32, 34, 35, 35, 40
Anovulatory cows	24, 9, 21, 21, 22, 27

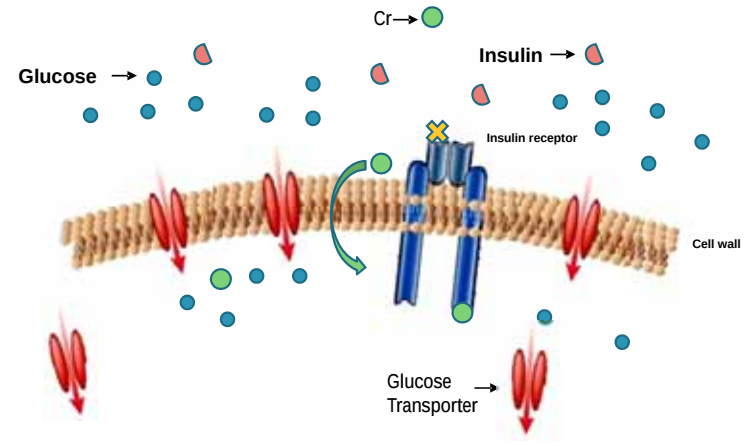
(no ovulation prior to OvSynch)

Cows that have ovulated prior to a TAI program are 2.0 times more likely to become pregnant at insemination

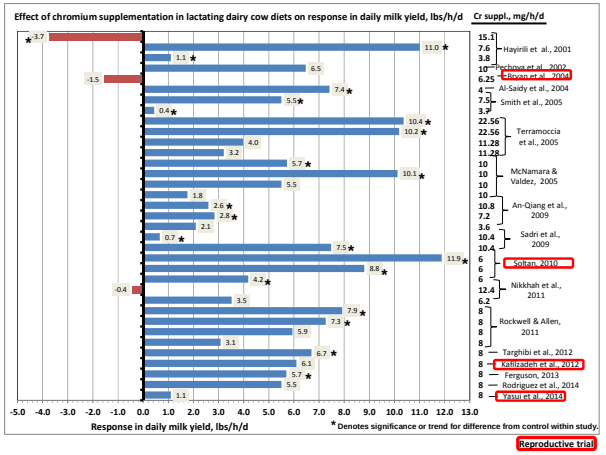
Considered supplementing with Chromium

- Periparturient Effects in Literature
  - Increased DMI postcalving
  - Increased milk yield in early lactation
  - Reduced NEFA in postpartum cows
  - Increased insulin sensitivity
    - Facilitates insulin receptor binding or insulin internalization or both
    - Glucose more available to reproductive tissues in ovary
  - Immunomodulatory effects
  - Reduced BCS loss and improved BC in periparturient cows
  - Suggested Chromium may improved energy metabolism
- Several studies demonstrated improved reproduction

Effect of Cr on Glucose Metabolism



Insulin signaling and the regulation of glucose and lipid metabolism . Saltiel & Kahn *Nature* 414, 799-806 (13 December 2001) | doi:10.1038/414799a.



Possible benefits of Chromium

- Reduced NEFA
  - Improved reproductive performance with reduced fat mobilization
  - Earlier first ovulation
  - Improved progesterone production from CL
    - Benefit oocyte maturation prior to breeding
    - Benefit embryo development and uterine environment postbreeding
- Reduced negative energy balance
  - Increased DMI in early lactation
  - Similar benefits as above to reduced NEFA
- Increased insulin sensitivity and glucose utilization
  - Improved oocyte quality and granulosa cell function

Added Chromium to Lactating TMR's

- 0.4% Chromium Propionate (CrPr, KemTRACE® Chromium, Kemin Industries Inc., Des Moines, IA)
  - Estimated to deliver 8 mg/head in the fresh, first lactation, and high groups at intakes of 55 lb DM
  - Added to a protein supplement mixed into the group TMR's
  - Began in January, 2012
- Herd had never been on a Chromium supplement

Protein Supplement with Chromium Added

Ingredient	% DM	Nutrient	% DM
Amino Plus®[1]	50.08	CP	35.80
Distillers Dried Grains & Solubles	19.46	SP, % of CP	8.48
Limestone, ground	10.70	NDF	15.94
Blood meal, ring dried	5.02	ADF	6.89
SQ-810[1]	7.86	Lignin	1.63
Salt, white	3.89	Starch	2.54
Magnesium oxide	0.78	Sugar	9.46
MFP[2]	0.58	Ether extract	3.07
Vitamin ADE premix	0.41	Ash	31.74
Vitamin E-20	0.41	Ca	4.61
PSU #4[1]	0.33	P	0.51
Se Premix 0.06%	0.31	K	1.37
Rumensin 90	0.078	Mg	0.94
KemTRACE® Chromium 0.4%	**0.086**	S	0.50

-

KemTRACE Chromium is a registered trademark of Kemin Industries, Inc.

Ingredients and composition of TMR fed to lactating groups (%DM).

	Lactating Group				
Ingredient	Post-fresh	High	Mid	Early	Late
Comp. % DM	Fresh cows	2+ Lact.	2+ Lact.	1st Calf	1st Calf
CP	**17.74**	**17.56**	**17.57**	**17.41**	**17.84**
SP, % of CP	33.58	33.75	36.08	34.97	37.90
NDF	**31.53**	**31.36**	**31.65**	**31.31**	**33.01**
Starch	**25.96**	**27.51**	**26.83**	**27.71**	**24.73**
Sugar	4.55	4.36	4.46	4.47	4.24
Ether Extract	**4.95**	**4.16**	**3.82**	**3.91**	**3.65**
Ash	7.27	7.06	7.16	7.08	7.20
Ca	0.80	0.77	0.80	0.78	0.81
P	0.40	0.42	0.44	0.43	0.45
Mg	0.30	0.31	0.32	0.31	0.32
S	0.25	0.25	0.25	0.25	0.25
Vitamin A, KIU/lb	1.55	1.60	1.58	1.61	1.54
Vitamin D, KIU/lb	0.39	0.40	0.40	0.40	0.38
Vitamin E, IU/lb	11.60	11.97	11.88	12.09	11.53
DCAD[6]	26.20	24.80	24.30	24.00	24.70

Nutrient content of high group rations from 2010 to 2012 (2012 the study began)

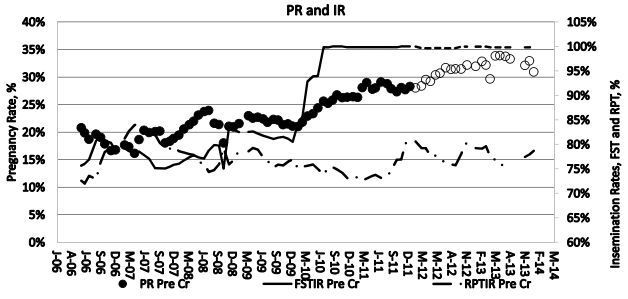
Item[2]	Date----------				
% DM	Spring 2010	Fall 2010	Spring 2011	Fall 2011	Winter 2012
DM	48.2	57.2	56.6	49.6	49.1
Forage	48.9	46.9	51.7	47.5	49.4
CP	17.3	17.5	17.5	17.5	17.6
SP, %CP	30.2	32.9	27.6	30.9	33.8
RDP[3]	9.9	10.2	10.0	10.6	10.5
NDF	30.9	29.8	30.3	31.0	31.3
NFC	42.4	43.3	43.5	42.4	42.2
Starch	30.1	29.4	29.4	28.4	27.5
Sugar	4.6	4.5	3.4	4.4	4.4
Fat	5.0	4.9	4.7	4.9	4.2

Reproductive performance

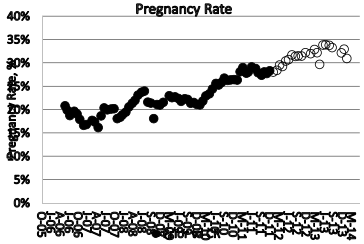
- Monitored monthly using RepMon
- No change in reproductive program on the dairy
- Same inseminators and semen handling
  - Inseminators yearly retraining was policy on farm

Reproductive Management

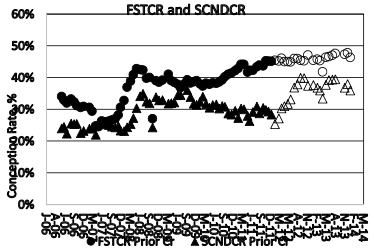
2007 – PreSynch with "cherry picking" + PostSynch Program
2010 – PreSynch no cherry picking + PostSynch Program
2012 – Chromium added to Lactating TMR



The Issue – fertility in repeat service cows



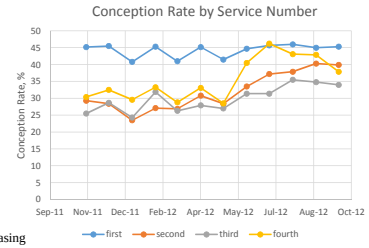
PR had improved from 17% in 2006 to 29% in 2011
PR improved to over 30% in 2012



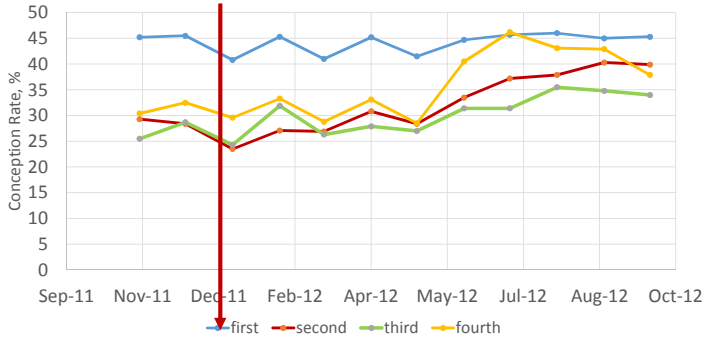
FSTCR had little change in 2012 through 2013
SCDCR improved to close to 40% in 2012 into 2013
TRD and FRTHCR both increased also

Table 3. Binomial trends across service number (first to fourth) from November, 2011 through October, 2012

Month	Service Number CR, % First	Second	Third	Fourth
Mean Num.	749	334	182	107
Nov. 2011	45.2	29.3	25.5	30.4
Dec. 2011	45.5	28.4	28.7	32.5
Jan. 2012	40.8	23.5	24.3	29.6
Feb. 2012	45.3	27.1	31.9	33.3
Mar. 2012	41.0	26.9	26.3	28.8
Apr. 2012	45.2	30.8	27.9	33.1
May 2012	41.5	28.4	27.0	28.5
Jun. 2012	44.7	33.5	31.4	40.5
Jul. 2012	45.7	37.2	31.4	40.5
Aug. 2012	46.0	37.9	35.5	43.1
Sep. 2012	45.0	40.3	34.8	42.9
Oct. 2012	45.3	39.9	34.0	37.9
Trend	increasing	increasing	increasing	increasing
X^2	0.928	41.36	8.65	10.91
P<	0.335	0.0001	0.003	0.0009



First, Second, Third and Fourth Service CR from November, 2011 through October 2012



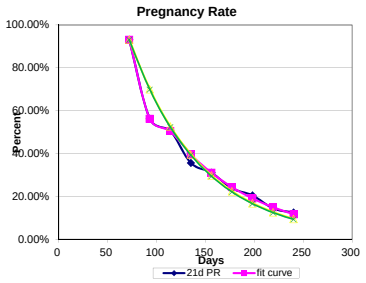
Body Condition Score

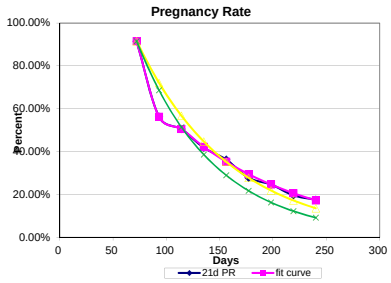
January and May: Body condition score post-fresh group and high group

Mean BCS for post-fresh cows was similar (P = 0.22) from January to May (3.5 vs. 3.5, ±0.02 SEM),

Mean BCS in high group cows significantly increased (P = 0.023) over the same period (2.5 vs. 2.8, ±0.03 SEM)

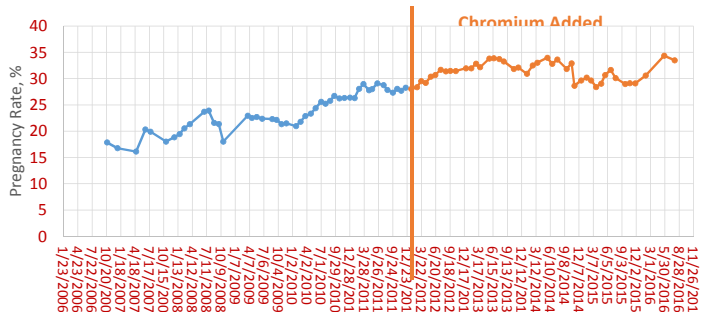
PR: December, 2012 December, 2011



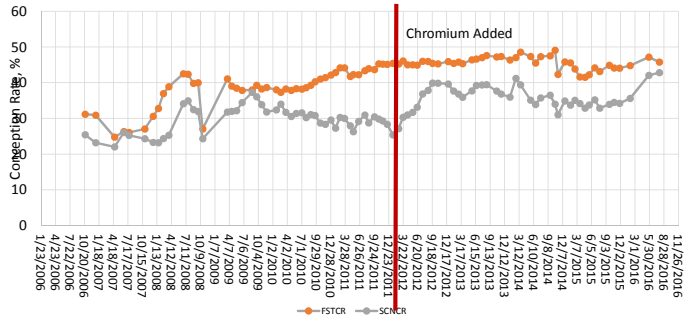


Front end not different, but repeat PR "faster" in 2012 than in 2011 – overlaps the "green" curve and the "yellow" mean PR curve also overlaps the "green" goal curve of 25% PR

Pregnancy Rate



Conception Rate for First and Second Service

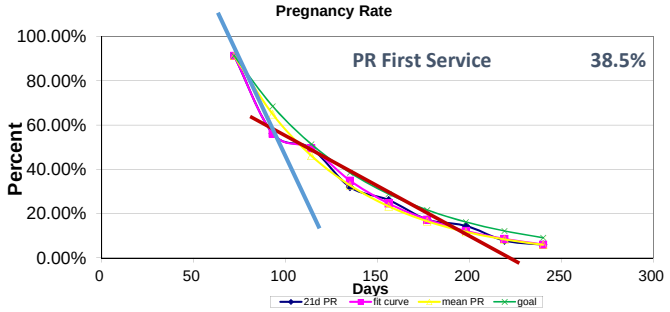


CR by Service Number July 2016

Farm:	**Walmore July 2016**					NRR:	10.0%
Test date:	07/30/2016					Rpt date:	08/09/2016
X-SYS: Current Calving Interval:		03/31/2015	to	07/30/2016			
Conception Rate by service number							
All Lactations							
					--- CR % ---		
Service	# Bred	# Preg	# Open	% Preg	Preg	All	
1	413	341	72	82.6%	53.5%	45.6%	
2	199	155	44	77.9%	52.4%	42.7%	
3	111	82	29	73.9%	58.2%	45.8%	
4	57	35	22	61.4%	59.3%	46.7%	
5	22	14	8	63.6%	58.3%	43.8%	
6	12	6	6	50.0%	60.0%	50.0%	
7	6	4	2	66.7%	100.0%	100.0%	
Total bred:	820	637	183	77.7%			
Total services:	1596	1171	425				

No significant trend

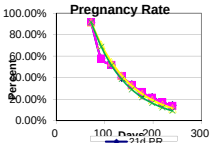
PR Curve July, 2016

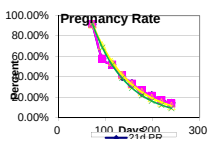


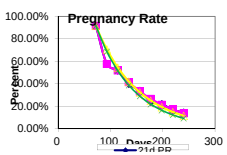
Goals for Reproduction Nov. 2015

- PR >= 25% ; CR >= 40% across all breedings and all age groups

	Herd 1	Herd 2	Herd 3
RHA	33,029	30,919	24,648
CRALL	**45.6**	**39.3**	**42.2**
PRAVG*	**27.9**	**22.9**	**22.3**
PRFST	42.3	37.0	37.1
PRRPT	24.5	19.9	19.5







Conclusions

- Adding Chromium was associated with an improvement in CR primarily at repeat services improving PR in cows after first insemination
- Some improvement in FSTCR through 2013 to 2014
- Cost was about $0.04/cow/day (250 days - $10 total)
- Return was conservatively $66/cow/year
  - Considering low milk price and replacement value
- Chromium won't compensate for poor insemination technique or significant health issues effecting fertility