Strategies for Reproductive Success

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Sources of Income for a Dairy Farm

- Milk
- Sale of prepartum cows
- Sale of cows for dairy purposes
- Sale of cows for beef
- Sale of bull calves

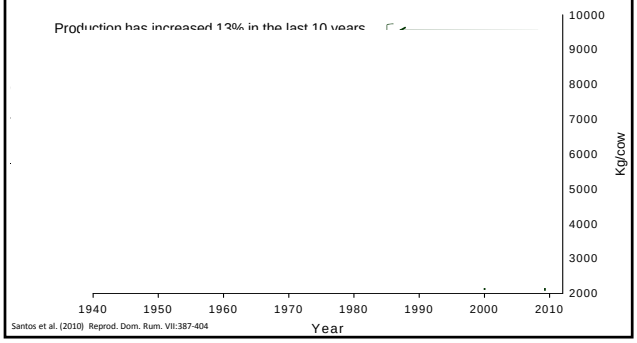
Data used (2 large high-producing dairy herds)
- Production per cow = 12,500 kg/year
- Price of milk = $ 0.30/Kg
- Value of a prepartum heifer = $2,000
- Value of a bull calf = $30
- Value of a cows sold to dairy = $1,600
- Value of cull cow = $600
- Mortality of cows = 5.7%
- Replacement = 28.1%
- Herd turnover = 33.8%
- Number of calvings/year = 132% of lactating herd
- Stillbirth = 8%

Santos et al. (2010) Reprod. Dom. Rum. VII:387-404

Milk Yield

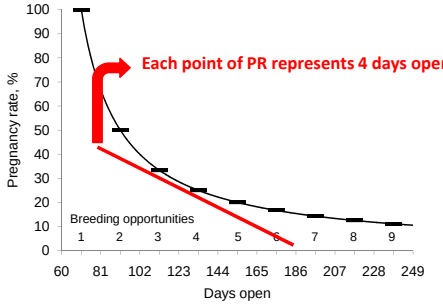
- Main factors influencing milk yield in dairy herds:
  - ✓Nutrition
  - ✓Genetic potential
  - ✓Management (environment, cow comfort, health programs)
  - ✓Bovine somatotropin in countries in which its use is approved
  - ✓Reproductive efficiency

US Milk Production Per Cow



Santos et al. (2010) Reprod. Dom. Rum. VII:387-404

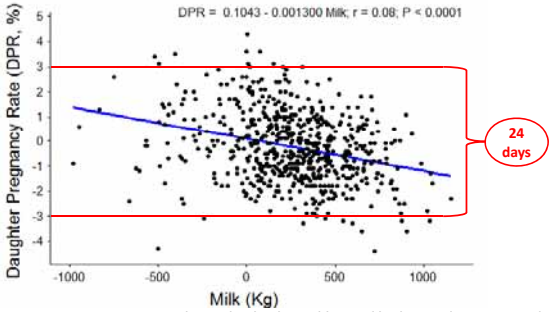
We Can Select for Fertility



Voluntary waiting period is 60 days

Santos et al. (2010) Reprod. Dom. Rum. VII:387-404

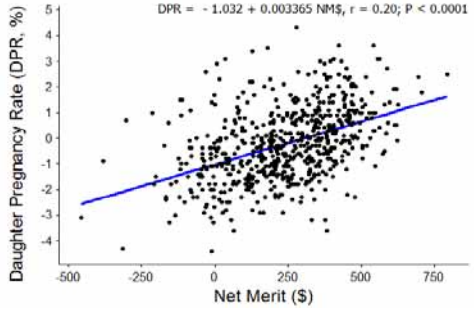
Selection for Milk Yield and Daughter Fertility



626 active Holstein sires with proof in the US (August 2010)

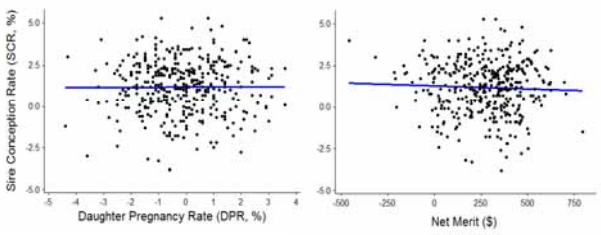
Santos et al. (2010) Reprod. Dom. Rum. VII:387-404

Selection for Net Merit and Daughter Fertility



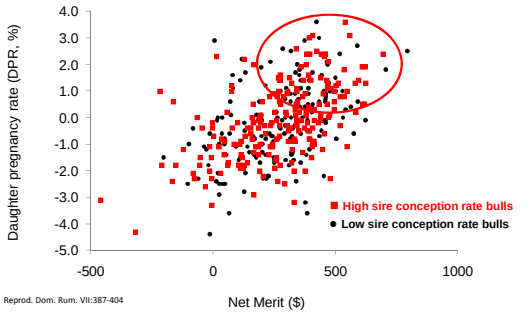
626 active Holstein sires with proof in the US (August 2010)

Sire Fertility is Not Related to Daughter Fertility and Net Merit



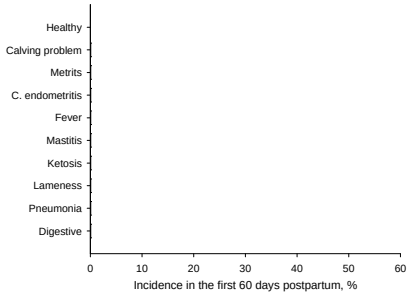
382 active Holstein sires with proof in the US (August 2010) with SCR

We Can Select for High Net Merit, Bull Fertility, and Daughter Fertility



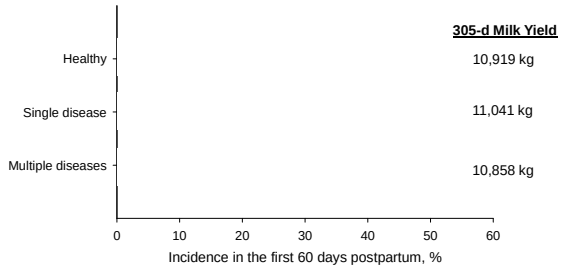
382 active Holstein sires with all 3 proofs in the US (August 2010)

Incidence of Health Disorders in the First 60 d in Milk in High-Producing Holstein Herds



5,719 postpartum dairy cows evaluated daily for health disorders from eight experiments in seven dairy farms in the US.

Incidence of Health Disorders and Milk Yield in High-Producing Holstein Cows



5,719 postpartum dairy cows evaluated daily for health disorders from eight experiments in seven dairy farms in the US.

Health Problems in the First 60 DIM and Resumption of Estrous Cyclicity in Dairy Cows

Category	Cyclic, %	Adjusted OR (95% CI)	*P*
Healthy	84.1	1.00	---
1 case of disease	80.0	0.97 (0.72 – 1.30)	0.83
> 1 case of disease	70.7	0.60 (0.44 – 0.82)	0.001
Type of health problem			
Calving problem	70.5	0.52 (0.40 – 0.68)	< 0.001
Metritis	63.8	0.37 (0.28 – 0.50)	< 0.001
Clinical endometritis	68.9	0.51 (0.37 – 0.71)	< 0.001
Fever postpartum	80.0	0.55 (0.40 – 0.74)	< 0.001
Mastitis	81.5	0.87 (0.55 – 1.36)	0.53
Clinical ketosis	77.7	0.71 (0.47 – 1.07	0.10
Lameness	85.0	0.82 (0.52 – 1.30)	0.40
Pneumonia	88.9	1.78 (0.22 – 14.34)	0.59
Digestive problem	60.7	0.54 (0.25 – 1.17)	0.12

5,719 postpartum dairy cows evaluated daily for health disorders in seven dairy farms in the US.

Health Problems in the First 60 DIM and Pregnancy in Dairy Cows

Category	Pregnant, %	Adjusted OR (95% CI)	*P*
Healthy	51.4	1.00	
1 case of disease	43.3	0.79 (0.69 – 0.91)	0.001
> 1 case of disease	34.7	0.57 (0.48 – 0.69)	< 0.001
Type of health problem			
Calving problem	40.3	0.75 (0.63 – 0.88)	< 0.001
Metritis	37.8	0.66 (0.56 – 0.78)	< 0.001
Clinical endometritis	38.7	0.62 (0.52 – 0.74)	< 0.001
Fever postpartum	39.8	0.60 (0.48 – 0.65)	< 0.001
Mastitis	39.4	0.84 (0.64 – 1.10)	0.20
Clinical ketosis	28.8	0.50 (0.36 – 0.68)	< 0.001
Lameness	33.3	0.57 (0.41 – 0.78)	< 0.001
Pneumonia	32.4	0.63 (0.32 – 1.27)	0.20
Digestive problem	36.7	0.78 (0.46 – 1.34)	0.38

5,719 postpartum dairy cows evaluated daily for health disorders in seven dairy farms in the US

Santos et al. (2010) Reprod. Dom. Rum. VII:387-404

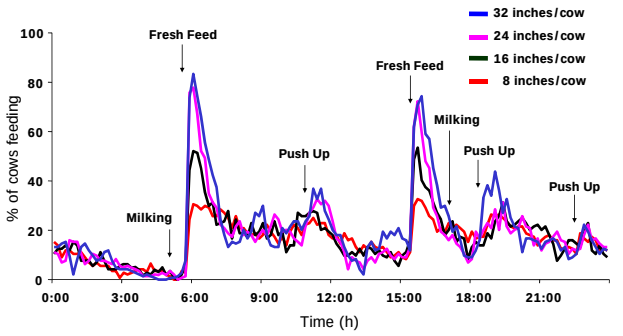
Health Problems and Pregnancy Loss in the First 60 d of Gestation in Dairy Cows

Category	Loss, %	Adjusted OR (95% CI)	*P*
Healthy	8.9	1.00	---
1 case of disease	13.9	1.73 (1.25 – 2.39)	< 0.001
> 1 case of disease	15.8	2.08 (1.36 – 3.17)	< 0.001
Type of health problem			
Calving problem	15.9	1.67 (1.16 – 2.40)	< 0.01
Metritis	11.3	1.01 (0.71 – 1.60)	0.76
Clinical endometritis	15.1	1.55 (1.04 – 2.32)	0.03
Fever postpartum	18.0	2.00 (1.24 – 3.14)	< 0.01
Mastitis	19.8	2.62 (1.48 – 4.64)	< 0.001
Clinical ketosis	14.6	1.64 (0.75 – 3.59)	0.22
Lameness	26.4	2.67 (1.38 – 5.12)	< 0.01
Pneumonia	16.7	1.87 (0.40 – 8.69)	0.42
Digestive problem	15.8	1.81 (0.52 – 6.32)	0.35

5,719 postpartum dairy cows evaluated daily for health disorders in seven dairy farms in the US.

Santos et al. (2010) Reprod. Dom. Rum. VII:387-404

Daily Feeding Pattern in Dairy Cows



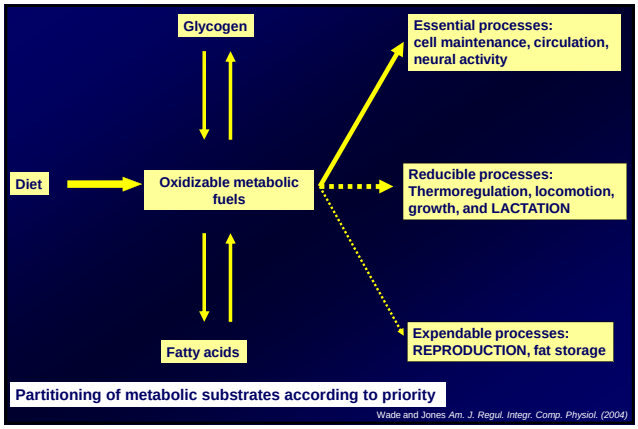
Huzzey et al. (2006) J. Dairy Sci. 89:126-133

What Seems to be Normal to Us May not be Normal to a Cow

Nutrition Programs to Enhance Fertility

Focus:

- ✓ Assure feed available at all times and increased feed delivery
- ✓ Minimize competition in the feedbunk
- ✓ Diets should be designed to prevent postparturient diseases
  - Mineral composition to avoid hypocalcemia
  - Adequate forage fiber content
  - Prepartum cow should consume daily ~ 15 Mcal of NE_L and 2.3 lbs of metabolizable protein
- ✓ Fresh cow programs should be designed for prompt diagnosis and treatment of sick cows



Wade and Jones *Am. J. Regul. Integr. Comp. Physiol. (2004)*

Polar Expedition or Iditarod

- Energy requirements increase to 6 to 8 Mcal/day
- Therefore working at between 2.5 and 3.5 times maintenance

Courtesy J. Huxley, University of Nottingham

Holstein Cows at Peak Production

Average cow at 45 kg/day

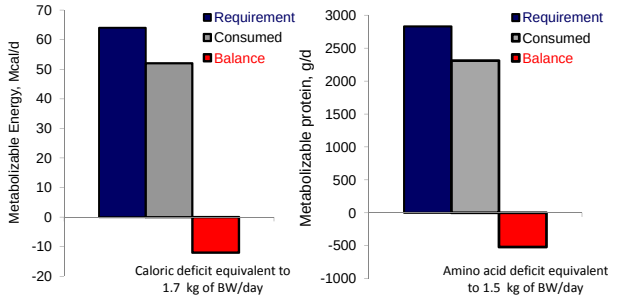
- Maintenance energy required: 15 Mcal/d of ME
- Energy for milk synthesis 55 Mcal of ME/d
- Total energy needed = 70 Mcal of ME/d
- **Therefore, consuming at 4.6 times maintenance**

Lucinda produced 104 kg/day

- Maintenance energy required: 15 Mcal/d of ME
- Energy for milk synthesis 113 Mcal of ME/d
- Total energy needed = 128 Mcal of ME/d
- **Therefore, consuming at 8.5 times maintenance**

Santos et al. (2010) Reprod. Dom. Rum. VII:387-404

Negative Energy Balance is only a Portion of Negative Nutrient Balance



Santos et al. (2010) Reprod. Dom. Rum. VII:387-404

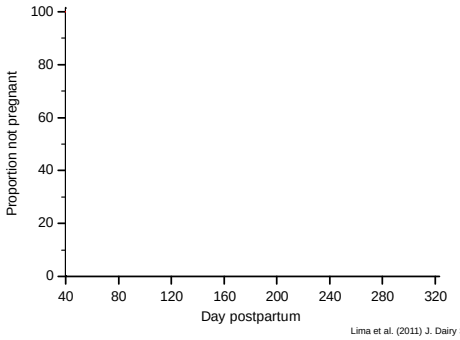
Risk factors for resumption of estrous cycles by 65 days postpartum and pregnancy at 1st AI in lactating dairy cows

Variable	Cyclic, % (n/n)	Adjusted OR (95% CI)	*P* value
BCS change from calving to 65 DIM			
Lost 1 unit or more	58.7 (279/475)	Referent	-------
Lost < 1 unit	74.6 (2,507/3,361)	1.96 (1.52, 2.52)	< 0.001
No change	80.9 (2,071/2,560)	2.39 (1.74, 3.28)	< 0.001
Milk yield in the first 90 DIM			
Q1, 32.1 kg/d	72.7 (1,011/1,390)	Referent	------
Q2, 39.1 kg/d	77.6 (1,204/1,552)	1.34 (1.13, 1.60)	< 0.01
Q3, 43.6 kg/d	77.6 (1,350/1,739)	1.36 (1.15, 1.62)	< 0.001
Q4, 50.0 kg/d	75.3 (1,292/1,715)	1.21 (1.02, 1.43)	0.04

Variable	Pregnant, % (n/n)	Adjusted OR (95% CI)	*P* value
BCS change from calving to 65 DIM			
Lost 1 unit or more	28.9 (132/472)	Referent	------
Lost < 1 unit	37.3 (1204/3230)	1.42 (1.13, 1.79)	< 0.01
No change	41.6 (1008/2422)	1.69 (1.32, 2.17)	< 0.001
Milk yield in the first 90 DIM			
Q1, 32.1 kg/d	37.2 (496/1,334)	Referent	------
Q2, 39.1 kg/d	38.9 (576/1,481)	1.06 (0.91, 1.24)	0.42
Q3, 43.6 kg/d	39.3 (652/1,661)	1.09 (0.93, 1.26)	0.26
Q4, 50.0 kg/d	37.6 (620/1,648)	1.03 (0.88, 1.21)	0.65

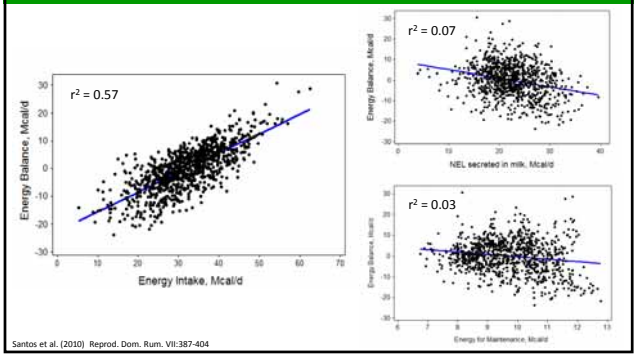
Santos et al. (2009) Anim. Reprod. Sci. 110: 207–221

BCS and Cyclic Status at First AI are Important Predictors of Reproductive Performance in Dairy Cows



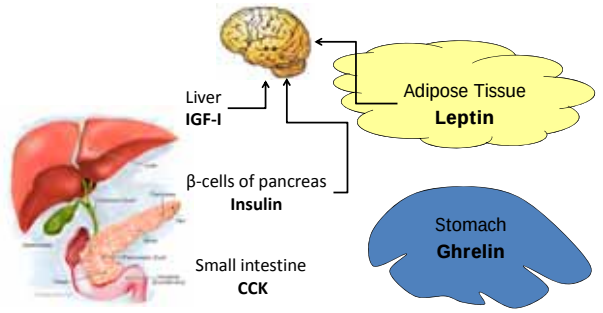
Lima et al. (2011) J. Dairy Sci. 93 (Abstr.)

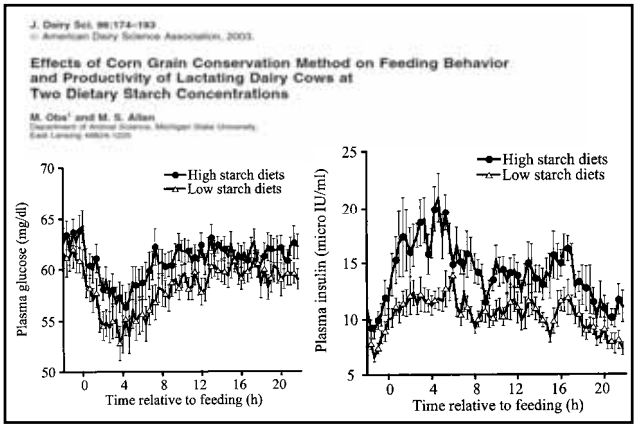
If Energy Balance is a Major Drive of Reproductive Success in the Dairy Cow, then the Focus Should be on Intake and not Milk Yield



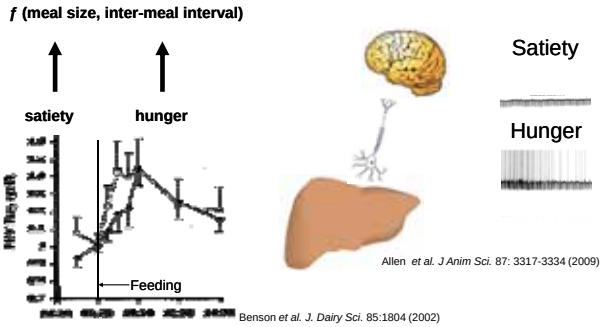
Santos et al. (2010) Reprod. Dom. Rum. VII:387-404

Communication of Energetic Status to the Central Nervous System Through Hormones





Nutrient Absorption Influences Feed Intake



Allen *et al. J Anim Sci.* 87: 3317-3334 (2009)

Benson *et al. J. Dairy Sci.* 85:1804 (2002)

Courtesy of M.S. Allen, Michigan State University

Highly Fermentable Diets Cause Satiety Sooner

	Corn Type	
	High Moisture	Dry ground
DMI, kg/d	20.8[b]	22.5[a]
Rumen fermentable OM, kg/d	11.3	10.3
Meal size, kg	1.9[b]	2.3[a]
Intermeal interval, min	93.9	105.0

Oba and Allen *J. Dairy Sci.* 86: 174-183 (2003)

Effects of Fat Supplementation on Energy Status in Studies Reporting Benefits to Fertility

Reference	DMI, kg/day	FCM, kg/day	BW/Energ Status
Nebraska, 1996	-1.2	+0.7[a]	More neg ES
Israel, 1991	-0.1	+1.7[a]	Loss of BW
Wisconsin, 1995	NR	+1.3[a]	No difference
Florida, 1998	-0.1	+1.6[a]	No difference
Israel, 1988	-1.0	+2.9[a]	No difference
Israel, 1989	NR	+1.4[a]	Loss or gain BW
Penn, 1990	NR	+0.9[a]	Not reported

[a]Significant increase for cows fed supplemental fat.

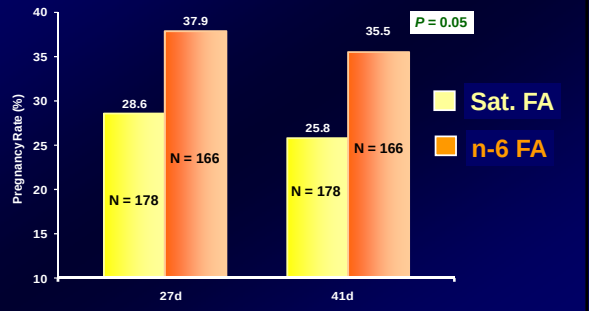
Courtesy of C.R. Staples, University of Florida

Effect of Source of FA on Fertilization and Embryo Development (n = 154 cows)

	Fatty Acid		
	Saturated	n-6 FA	*P* value
Fertilization rate, %	73.3	87.2	0.10
Accessory spermatozoa, n	21	34	0.001
Excellent and good embryos			
% Embryos	51.5	73.5	0.06
% Embryos-ova	37.8	54.1	0.01
Viable blastomeres, %	85.3	94.2	0.09

Cerri *et al.* (2009) J. Dairy Sci. 92:1520–1531

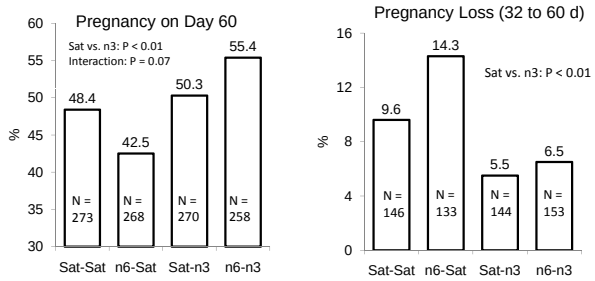
Source of Fatty Acids and Pregnancy at 1st Postpartum AI



Juchem *et al.* Reprod. Dom. Anim. (2010) 45:55-62

Effects of Fatty Acid Supplementation During the Transition and Breeding Periods on Fertility of Dairy Cows

Transition diets = -30 to 30 DIM
Breeding diets = 30 to 160 DIM



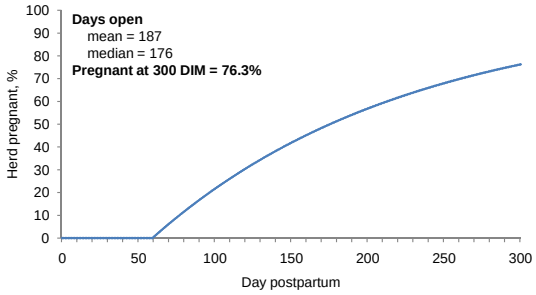
Silvestre *et al.* (2011) J. Dairy Sci. 94:189-204.

Reproductive Indices

- Estrous detection rate = $\frac{\text{Number of cows detected in estrus}}{\text{Number of eligible cows to be in estrus}}$
- Pregnancy per AI = $\frac{\text{Number of pregnant cows}}{\text{Number of inseminated cows}}$
- Pregnancy rate = $\frac{\text{Number of pregnant cows}}{\text{Number of eligible cows to become pregnant}}$

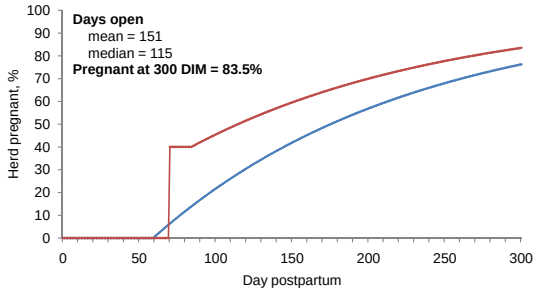
True rate and it is typically evaluated at 21-d intervals, although it changes daily

Current Status of the US Herd (21-d Cycle Pregnancy Rate of 13%)



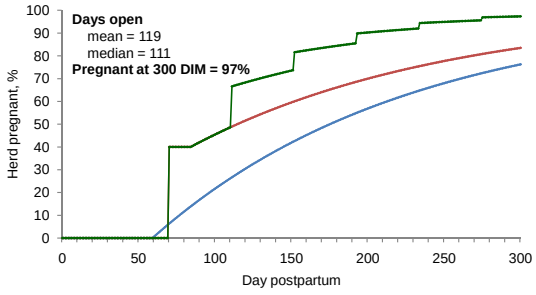
Santos, J.E.P. 2010. Rum. Reprod. Symp. Anchorage, AK

Synchronization for 1st AI Only



Santos, J.E.P. 2010. Rum. Reprod. Symp. Anchorage, AK

Synchronization 1st AI + Resynchronization at Open Diagnosis

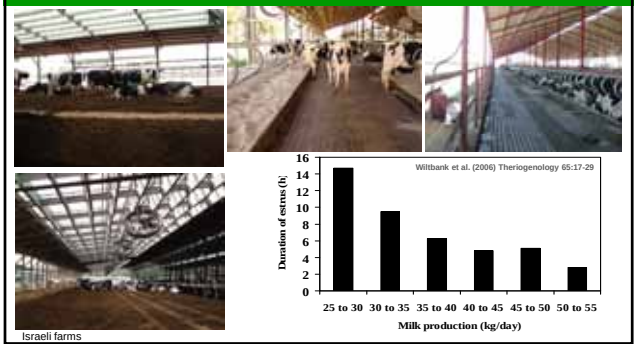


Santos, J.E.P. 2010. Rum. Reprod. Symp. Anchorage, AK

Reproductive Programs

- **Good reasons why controlled reproductive programs have become popular in the US and many other countries**
  - ✓ Overcome reproductive problems that are not solved with other management, nutritional or health manipulations
  - ✓ Deal with anovular cows and cows with clinical and subclinical endometritis
  - ✓ Optimize veterinarian's time to devote more professional expertise to herd health/nutrition/personnel training without neglecting the individual cow
  - ✓ Robust and work under different conditions
  - ✓ Improve insemination rates with consequent impacts on pregnancy rate
  - ✓ The improvement in reproductive performance is typically profitable
  - ✓ Best interest for the welfare of cows → **an open cow is often a dead cow**!

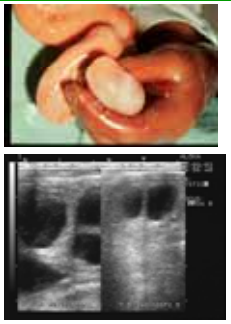
Estrous Detection is a Major Issue in High Producing Dairy Cows in Confinement Housing



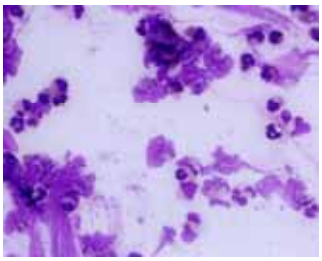
Israeli farms

20 to 50% of the Dairy Cows Are Anovular at 60 d Postpartum

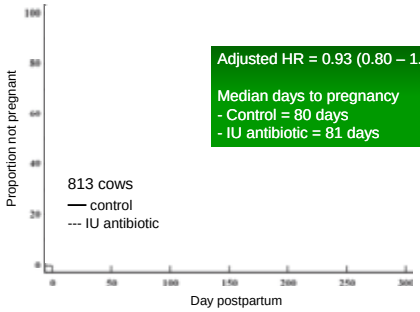
- Multiparous: 10 to 25%
- Primiparous 20 to 50%
- High-producing anovular cows
  - ✓ Do not respond well to progesterone therapy only (50% induction of cyclicity)
  - ✓ GnRH induces ovulation in 70 to 80% of the anovular cows



20 to 50% of the Cows Develop Clinical or Subclinical Endometritis



Uterine Therapy with Antibiotic does not Benefit Fertility when Cows are on $PGF_{2\alpha}$ Programs

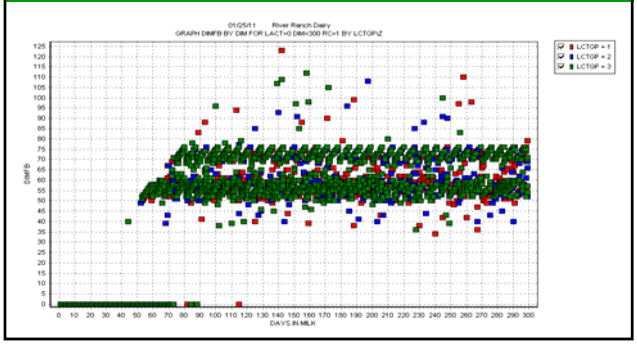


Adjusted HR = 0.93 (0.80 – 1.07), P = 0.31

Median days to pregnancy
- Control = 80 days
- IU antibiotic = 81 days

Galvão et al. (2009) J. Dairy Sci. 92 :1532–1542

Breeding Policy at 1st AI on a Large CA Herd

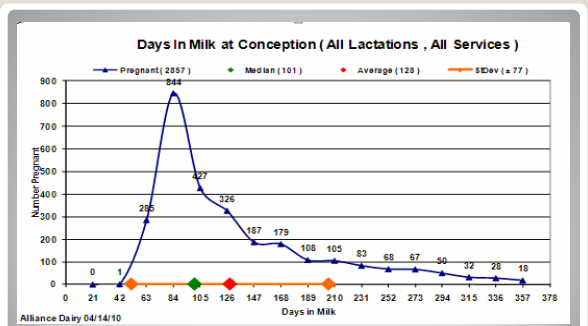


21-d Cycle Reproductive Performance Voluntary Waiting Period of 50 d

Date	Br Elig	Bred	Pct	Pg Elig	Preg	Pct	Aborts	
1/12/10	1106	806	73	1088	394	36	39	
2/02/10	1108	774	70	1086	337	31	30	
2/23/10	1110	786	71	1090	346	32	42	
3/16/10	1132	821	73	1111	355	32	48	
4/06/10	1080	779	72	1055	352	33	46	
4/27/10	1025	733	72	1011	337	33	53	
5/18/10	981	705	72	966	327	34	35	
6/08/10	870	562	65	849	232	27	23	
6/29/10	907	617	68	892	194	22	11	
7/20/10	991	687	69	972	240	25	10	
8/10/10	1059	744	70	1034	219	21	19	
8/31/10	1160	847	73	1118	281	25	20	
9/21/10	1181	802	68	1148	225	20	11	
10/12/10	1291	945	73	1251	354	28	21	
11/02/10	1318	905	69	1285	332	26	5	
11/23/10	1376	985	72	1316	406	31	1	
12/14/10	1333	962	72	0	0	0	0	???? Preg Stat
1/04/11	1049	881	84	0	0	0	0	???? Preg Stat
Total	17695	12498	71	17272	4931	29	414	

Wait Period 50

5,600 cow dairy in CA with RHA 3.5% FCM of 12,100 kg



4,000 cow free-stall dairy in Florida
Production in 2009 of ~ 10,000 kg of milk/cow

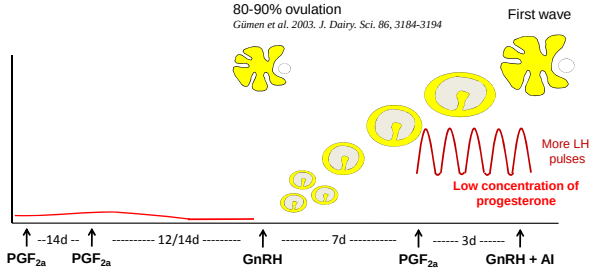
Santos, J.E.P. 2010. Rum. Reprod. Symp. Anchorage, AK

Principles of Ovsynch/Timed AI Programs

- GnRH, $PGF_{2\alpha}$, and intravaginal inserts containing progesterone (CIDR) are the only reproductive hormones labeled for use in dairy cattle in the US
- Pivotal points to high fertility in GnRH/$PGF_{2\alpha}$ based programs
  - ✓ Initiate the program during early diestrus (5 to 8 of the cycle)
  - ✓ 1st GnRH → ovulate a dominant follicle, thereby causing synchronization of ovulation and control follicle dominance
  - ✓ $PGF_{2\alpha}$ → completely regress an active CL (progesterone < 0.3 ng/mL) and allow for proper proestrus time
  - ✓ 2nd GnRH → cause a synchronous ovulation within 24 to 30 h of injection

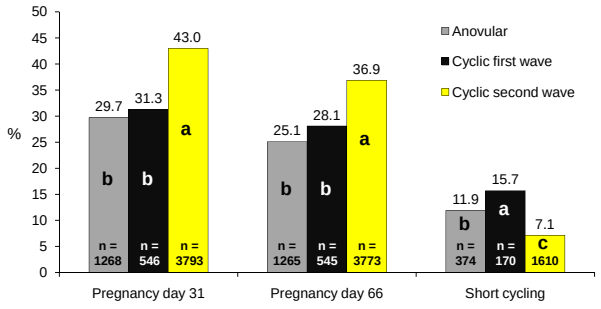
Santos, J.E.P. 2010. Rum. Reprod. Symp. Anchorage, AK

Ovarian Dynamics of Anovular Cows Subjected to Timed AI Protocols



Bisinotto et al. 2010. J. Dairy Sci. 93:3578-3587.

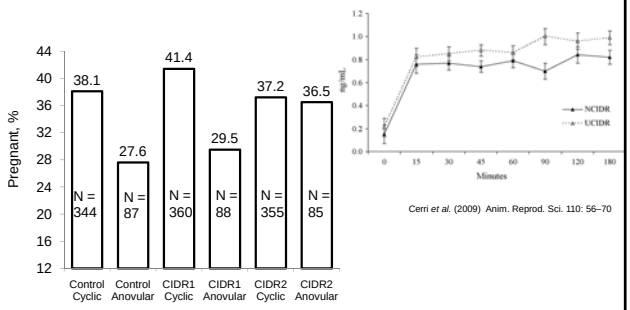
Effect of Follicular Wave and Cyclic Status on Fertility of Dairy Cows



a, b, c differences declared at $P < 0.001$

Bisinotto et al. 2010. J. Dairy Sci. 93:3578-3587.

Effects of Increasing Amounts of Progesterone During the Timed AI Protocol on Fertility of Dairy Cows

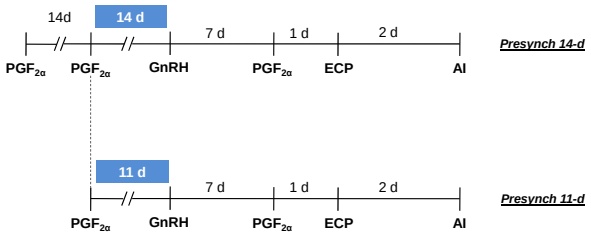


Cerri et al. (2009) Anim. Reprod. Sci. 110: 56–70

Lima et al. (2009) J. Dairy Sci. 92 :5436–5446

Effect of Interval Between Presynchronization and Ovsynch

1,214 lactating Holstein cows assigned



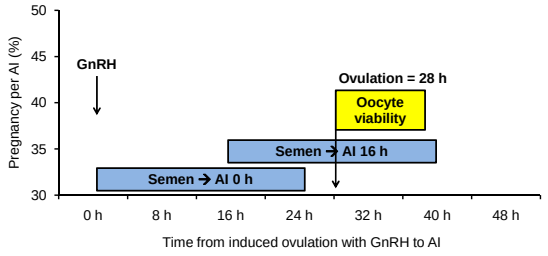
Galvão et al. J. Dairy Sci. (2007) 90:4212-4218

Effect of Interval Between Presynchronization and Ovsynch

	Presynchronization		
	14 Days	11 Days	P
Ovulation to 1st GnRH			
Overall	44.7	61.4	<0.01
Cows with CL at GnRH1	37.2	54.4	<0.01
Cows without CL at GnRH1	75.8	81.6	0.34
Pregnant, %	33.5	40.5	0.02
Pregnancy loss, %	8.8	9.7	0.88

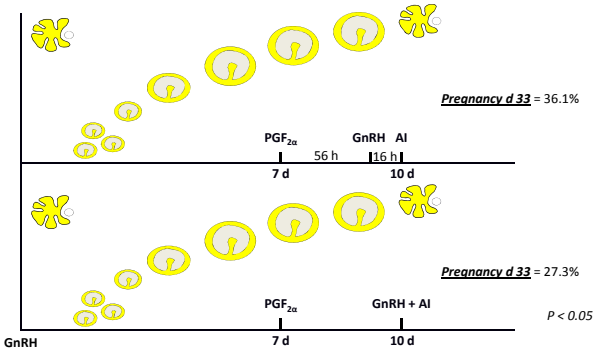
Galvão et al. J. Dairy Sci. (2007) 90:4212-4218

Synchrony Between Semen Availability and Oocyte Viability



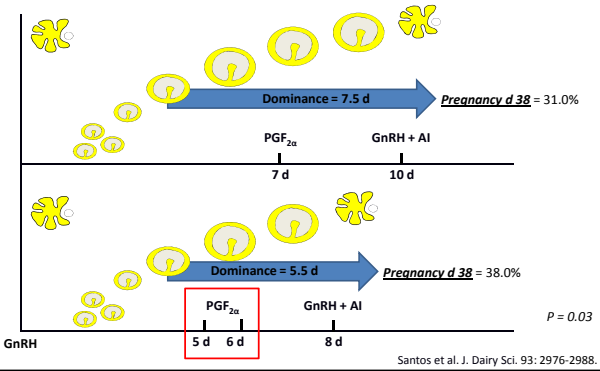
Pursley et al. 1998. J. Dairy Sci. 81:2139-2144.

Timing of AI Relative to Induced Ovulation



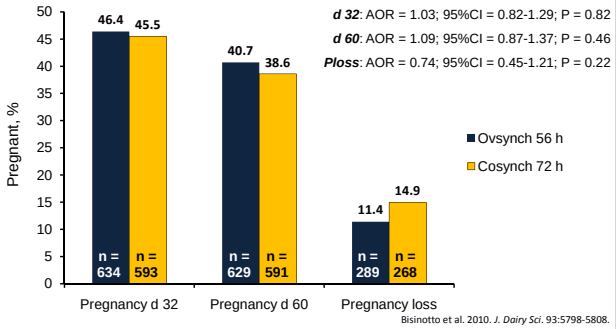
Brusveen et al. 2008. J. Dairy Sci. 91:1044-1052.

Altering Follicle Dominance in Dairy Cows



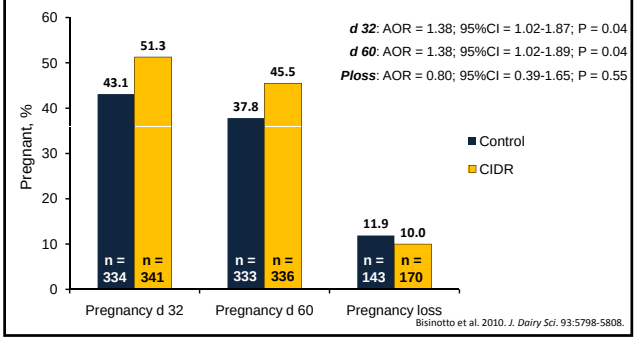
Santos et al. J. Dairy Sci. 93: 2976-2988.

Effect of Timing of Induced Ovulation on Fertility of Dairy Cows in the 5-d Timed AI



Bisinotto et al. 2010. *J. Dairy Sci.* 93:5798-5808.

Effect of Progesterone on Fertility of Dairy Cows During Resynchronization with the 5-d Timed AI



d 32: AOR = 1.38; 95%CI = 1.02-1.87; P = 0.04

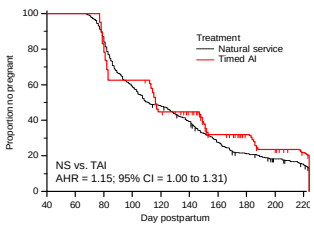
d 60: AOR = 1.38; 95%CI = 1.02-1.89; P = 0.04

Ploss: AOR = 0.80; 95%CI = 0.39-1.65; P = 0.55

Bisinotto et al. 2010. *J. Dairy Sci*. 93:5798-5808.

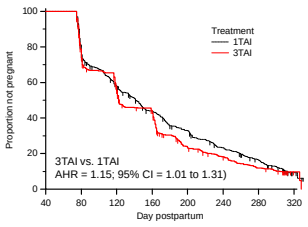
Are Bulls the Solution to Poor Estrous Detection and Pregnancy Rate?

Natural Service vs. Only Timed AI



Lima et al. (2010) J. Dairy Sci. 92:5456–5466

1 vs. 3 TAI Followed by Natural Service



Lima et al. (2011) J. Dairy Sci. 93 (Abstr.)

Good Reproduction Requires a Real Team Effort…..

Dairy Management / Staff

Consulting team (veterinarian, nutritionist)

Focus on what is really important

- ✓ Healthy cows
- ✓ Proper nutrition/health program
- ✓ Sound reproductive program
- ✓ Selection for fertility without neglecting production

THANK YOU

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