Is Sheep Milk Production in Your Future?

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LET'S GROW

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Major Countries for Sheep Milk Cheese Production (average for 2008-2012)

Country	Production, million lb.
Greece	271
China	238
Italy	139
Spain	135
Syria	134
France	123
Turkey	64
Romania	53
Iran	41
Portugal	29

faostat.fao.org

Major Countries for Sheep Milk Cheese Exports (average for 2007-2011)

Country	Exports, million lb.
Italy	40.6
France	17.2
Bulgaria	11.4
Greece	4.1
Spain	1.2
Romania	1.1

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Long-Standing Commercial Sheep Dairy Industries

Portugal, Spain, France, Italy, Greece, Romania, Bulgaria, Turkey, Lebanon, Syria, Israel, Iran

Dairy Ewes in Southern Spain

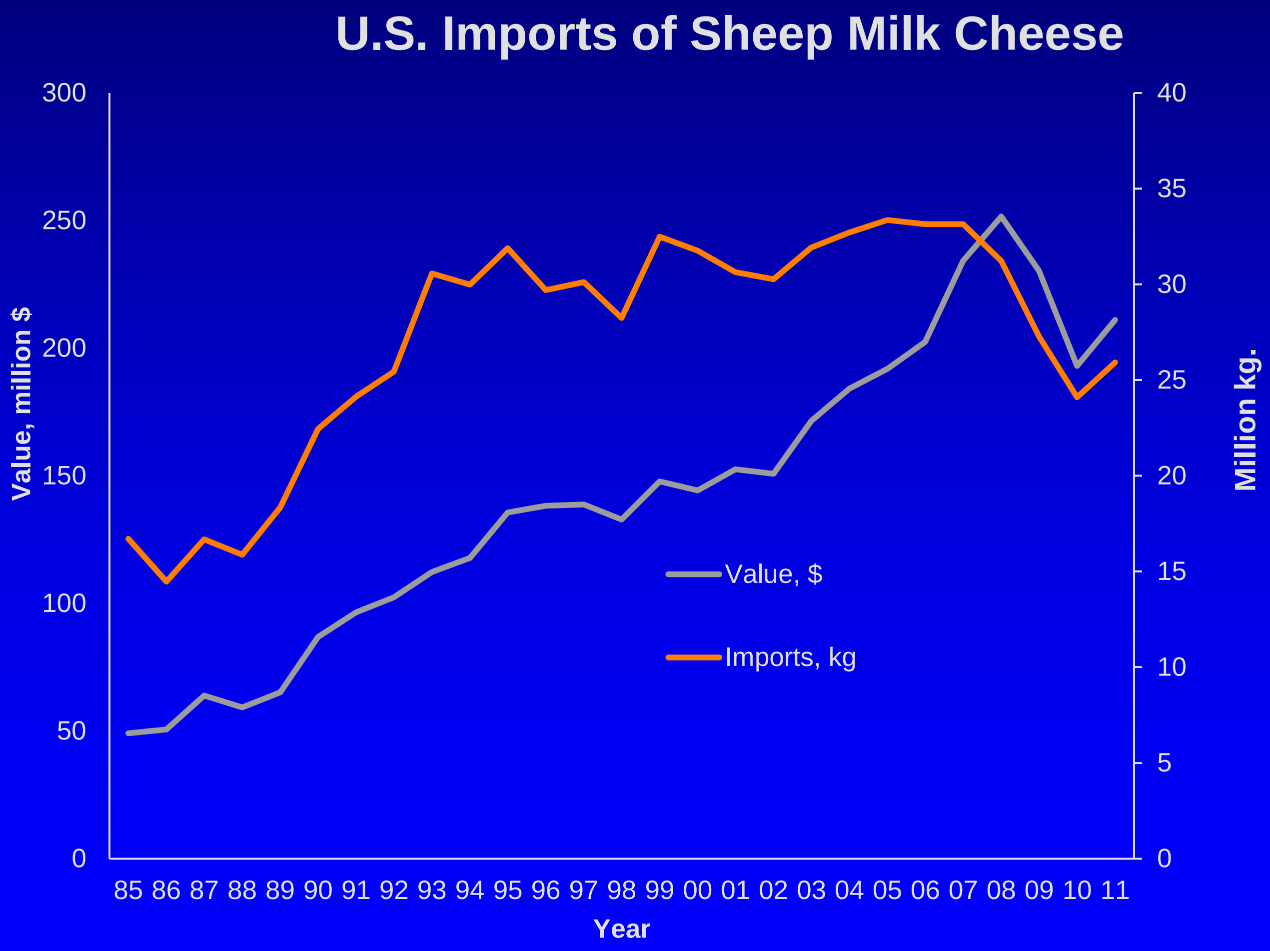
Familiar Imported Sheep Milk Cheeses

France
Roquefort cheese
Lacaune sheep

Italy (Sardinia)
Pecorino-Romano cheese
Sarda sheep

Spain
Manchego cheese
Manchega sheep

In recent years, 53 - 73 million lb. (24 - 33 million kg) of sheep milk cheese is imported into the U.S. each year; 40 - 60% of world exports come to the U.S.



North American Dairy Sheep Industry

No extended history of dairy sheep production in North America

First commercial dairy sheep farms established in mid- to late-1980's with meat-wool sheep

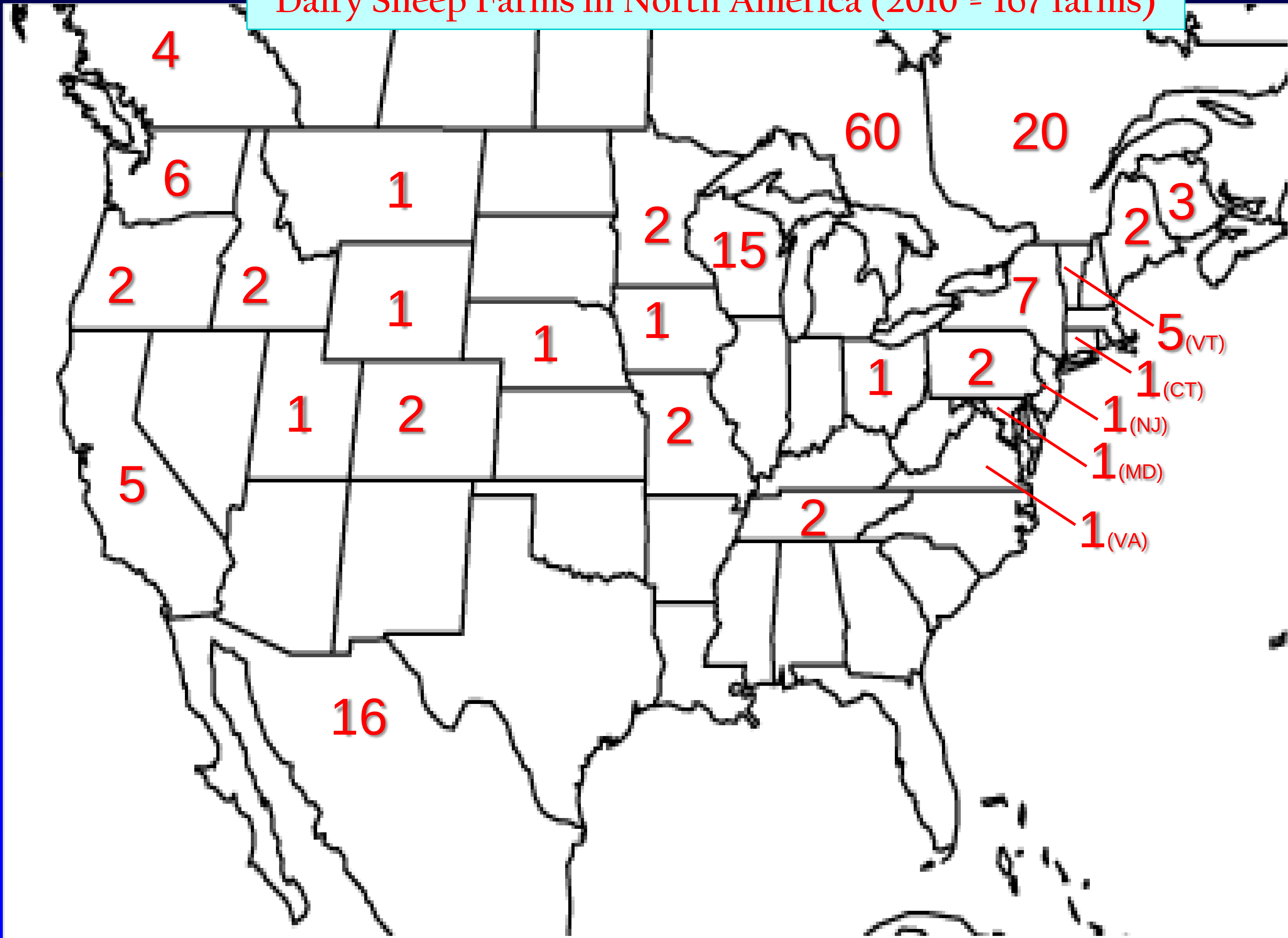
Early pioneers:

Dr. Bill Boylan - First dairy sheep research program, University of Minnesota (1984)

Joan R. Snyder – First licensed dairy sheep farm in U.S., Hollow Road Farm, Stuyvesant, NY (1985)

Roger and Lucy Steinkamp - North American Dairy Sheep Assoc., Hinckley, MN (1987)

Dairy Sheep Farms in North America (2010 = 167 farms)



Composition of Milk from Cows, Goats, and Sheep

	Milk Composition, %				
Species	Protein	Lactose	Fat	Ash	Total Solids
Cow	3.3	5.0	4.0	0.7	13.0
Goat	3.7	4.2	4.1	0.8	12.8
Ewe	5.9	4.8	7.4	0.9	19.0

Crude Estimate of U.S. Sheep Milk and Sheep Milk Cheese Production

125 farms x 150 milking ewes/farm x 500 lb. milk/ewe = 9.4 million lb. of sheep milk

9.4 million pounds of sheep milk / 5 lb. milk/lb. cheese = 1.9 million lb. of domestic cheese

53 - 73 million lb. of imported cheese – 28 to 38 times our domestic production

OPPORTUNITY FOR EXPANSION OF DOMESTIC PRODUCTION!!

First Dairy Sheep Breeds in the U.S.

East Friesian – Two F1 crossbred rams from Canada in 1993

Lacaune – Frozen semen from three rams from the U.K. in 1998

Dairy Sheep Breeds in North American

A few purebred East Friesian and Lacaune sheep and a greater number of East Friesian-Lacaune crossbred sheep are now found in Canada, the U.S., and Mexico.

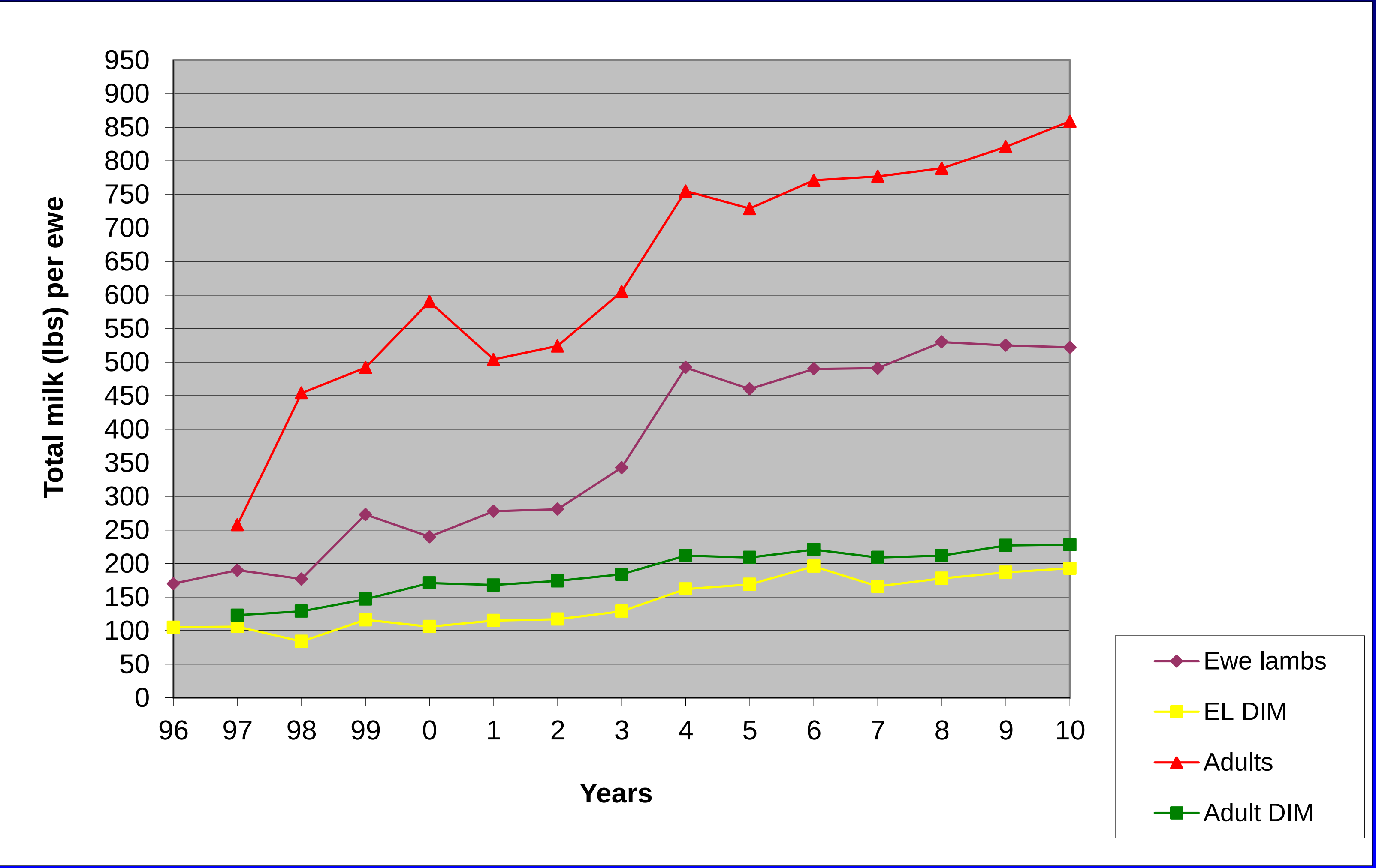
A dairy breed found in Canada is the British Milk Sheep
- a breed developed in the U.K. for lamb production by crossing East Friesian, Blue-Faced Leicester, Polled Dorset and Lleyn sheep.

Artificially Reared Lambs

18 lb. of milk replacer powder/lamb - weaned at 30 days of age onto dry diets.

Automatic Milk Replacer Machines (Approx. $1,100/unit)

Change in Milk Yield/Ewe at the Spooner Ag Research Station by Year



Milking Systems

Elevated platform, cascading yokes, milking into buckets

Double-12, pit parlor, Casse stanchions, high-line pipeline

Milking Systems

Double-24 pit parlor, Casse stanchions, low-line pipeline

Milking Systems

Double-24 pit parlor, rapid exit, high-line pipeline

Milking Systems

36 head rotary parlor

Milking Systems

Small home-made rotary parlor for hand-milking

Milking Machine Settings

Sheep
- 180 pulsations per minute
- 50:50 ratio (milk phase:rest phase)
- vacuum level at the teat end of 36 kPa (kiloPascal) = 11 in. Hg (mercury) = 5.22 psi (lb. per square inch)

Cows
- 45 - 60 pulsations per minute
- 50:50 – 60:40 ratio (milk phase:rest phase)
- vacuum level at the teat end of 11 - 12 in. Hg (mercury)

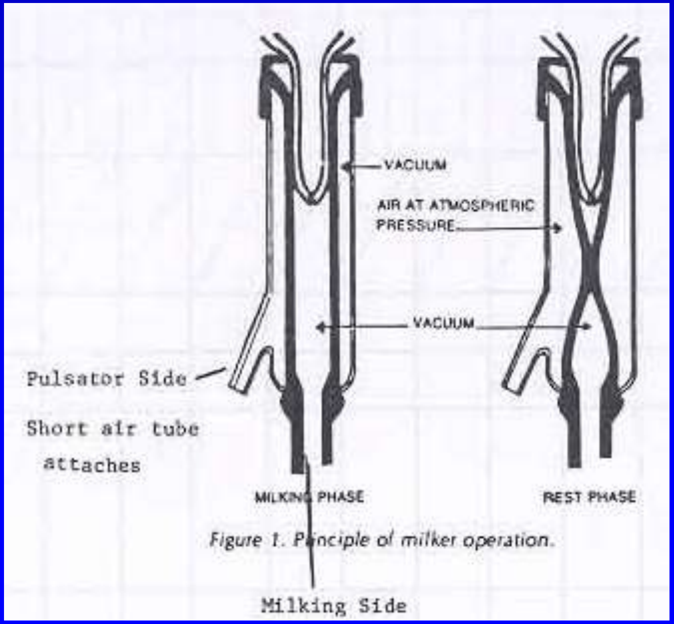


Figure 1. Principle of milker operation.

Milk Quality Standards

Grade A: fluid milk or processing, interstate shipment

- < 100,000 bacteria / ml
- < 750,000 somatic cells (SCC) / ml
- no drug residue

Grade B: milk for processing

- < 300,000 bacteria / ml
- < 750,000 somatic cells (SCC) / ml
- no drug residue

Storage of Milk

If sheep milk is frozen quickly in a commercial walk-in freezer and kept at a temperature of -25 to -27 degrees C (- 13 to -17 degrees F) or colder, it can be stored for up to 1 year and retain good processing properties.

Storage of Milk

Fluid milk is preferred by both the producer and the processor. Most states will allow milk to remain cooled in the bulk tank for up to 4 days between pick-ups.

Farm Price of Milk

$0.80 - $1.10 / lb.

Processor often pays shipping costs

Some marketing of milk with premiums or deductions for milk composition or quality, but much of the milk is sold strictly on weight as long as legal hygiene standards are met.

Milk Marketing Cooperatives

Ontario, Canada

Wisconsin, U.S.

Farmstead Cheesemakers

Hidden Springs Creamery
Brenda & Dean Jensen
Westby, WI

Farmstead Cheesemakers

Shepherds Manor Creamery
Colleen & Michael Histon
New Windsor, MD

Farmstead Cheesemakers

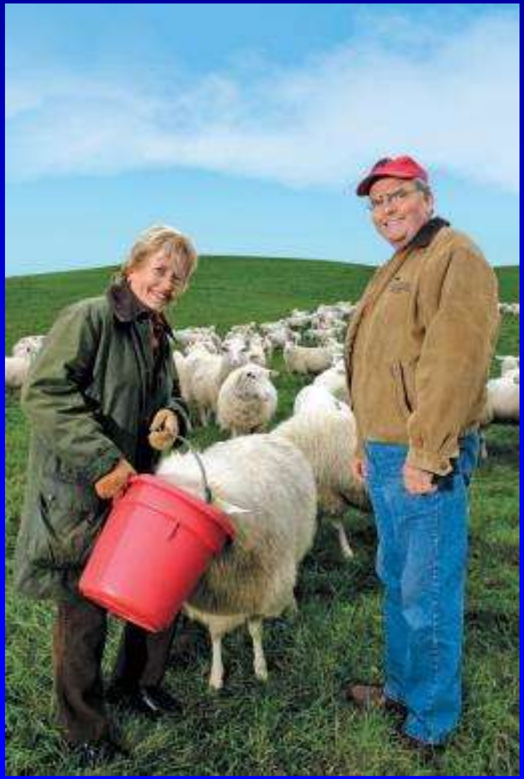
Bellwether Farms
Liam & Cynthia Callahan
Petaluma, CA

Sheep Milk Processors

Carr Valley Cheese Company
Sid Cook
LaValle, WI

Sheep Milk Processors

Old Chatham Sheepherding Company
Tom & Nancy Clark
Old Chatham, NY



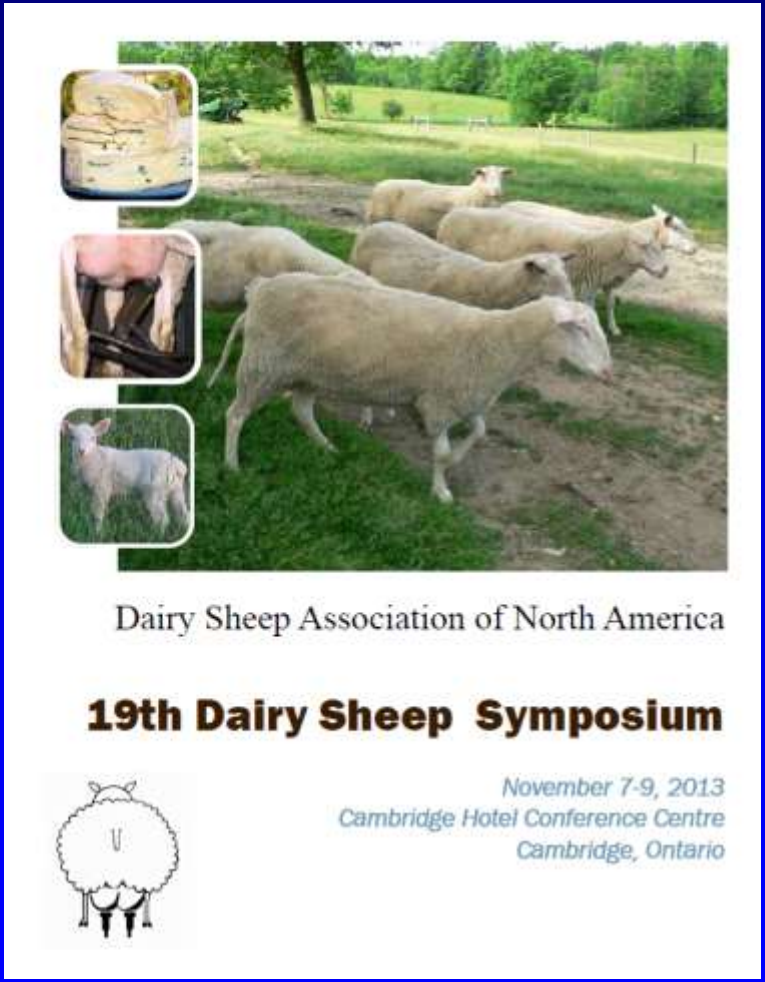
Milk Recording and Genetic Improvement Program

No program in North America for organized milk recording or genetic improvement

A few producers collect individual ewe milk production, % fat, % protein, and SCC each month for within flock selection.

Dairy Sheep Association of North America

- Established in 2002 to foster the industry in North America
- Publish a newsletter – Journal of the DSANA (J-DSANA)
- Sponsors the annual DSANA Symposium with a proceedings



Dorset-Cross vs. EF-Cross (≤ 50%)

Table 1. Lactation performance[1] of one- and two-year-old East Friesian-cross and Dorset-cross ewes

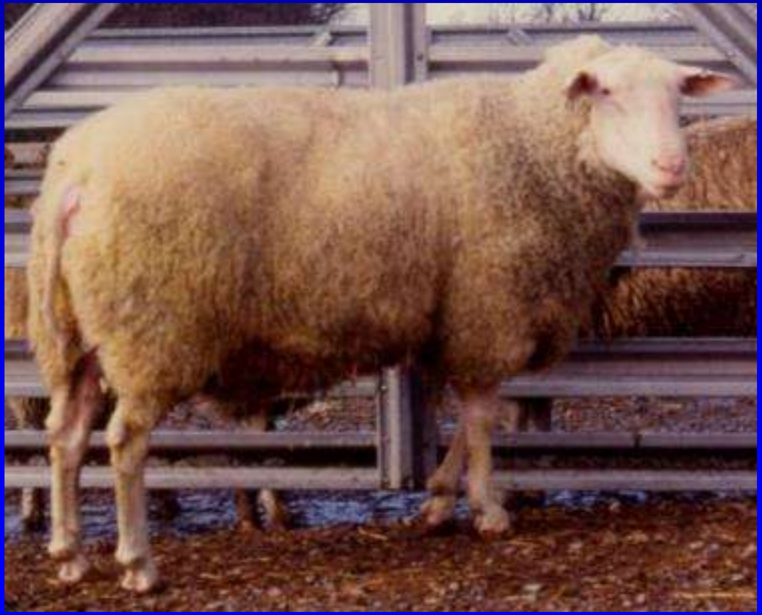
Trait	Breeding of ewe	
	Dorset-cross	East Friesian-cross
Number of lactations	76	246
Lactation length, d	92.7[a]	126.2[b]
Milk yield, kg	56.9[a]	109.1[b]
Fat, %	5.5[a]	5.02[b]
Fat yield, kg	3.3[a]	5.5[b]
Protein, %	5.42[a]	4.97[b]
Protein, kg	3.2[a]	5.4[b]
Somatic cell count, $\log_{10}$	4.99	5.02

[1]Ewes were milked starting approx. 30 days after parturition.

[a,b]$P < 0.05$.

East Friesian vs. Lacaune

- The Spooner Station imported the first Lacaune genetics into the U.S. in 1998.
- Purebred East Friesian genetics also became available after 1995.




East Friesian vs. Lacaune

Expected performance of pure East Friesian and Lacaune 3-year-old ewes.

Trait	Breed	
	East Friesian	Lacaune
Lactation length, d	188.6	180.3
Milk yield, kg	359.3	345.1
Fat yield, kg	20.9	22.1
Fat, %	6.3[a]	6.5[b]
Protein yield, kg	18.0	18.2
Protein, %	5.2[a]	5.3[b]
Litter size, no.	1.97[a]	1.84[b]

[a,b]$P < 0.05$.

Weaning Systems

- 1998 - first dairy sheep production trial
- Three weaning systems compared
  - DY1 – Lambs raised on milk replacer from 24-36 hours to 30 days, ewes milked twice per day for entire lactation, lambs weaned to dry diets at 30 days.
  - MIX – First 30 days: lambs separated from ewes overnight, ewes milked once per day in the morning, ewes returned to their lambs for the day. Lambs weaned to dry diets at 30 days, ewes milked twice per day for remainder of lactation.
  - DY30 – Ewes raised their lambs for 30 days, lambs weaned to dry diets at 30 days, and ewes milked twice per day from 30 days to end of lactation.

Weaning Systems

Ewe lactation traits for three weaning systems.

Trait	Weaning system DY1	MIX	DY30
Machine milking period, d	182.4[a]	178.2[a]	152.3[b]
Commercial milk yield, kg	260.1[a]	235.8[b]	171.7[c]
Fat yield, kg	13.2[a]	10.9[b]	8.4[c]
Fat, %	5.1[a]	4.5[b]	4.8[a,b]
30-d fat, %	4.8[a]	2.8[b]	-
Protein yield, kg	13.7[a]	12.1[b]	9.0[c]
Protein, %	5.3	5.1	5.2

[a,b,c]$P < 0.05$.

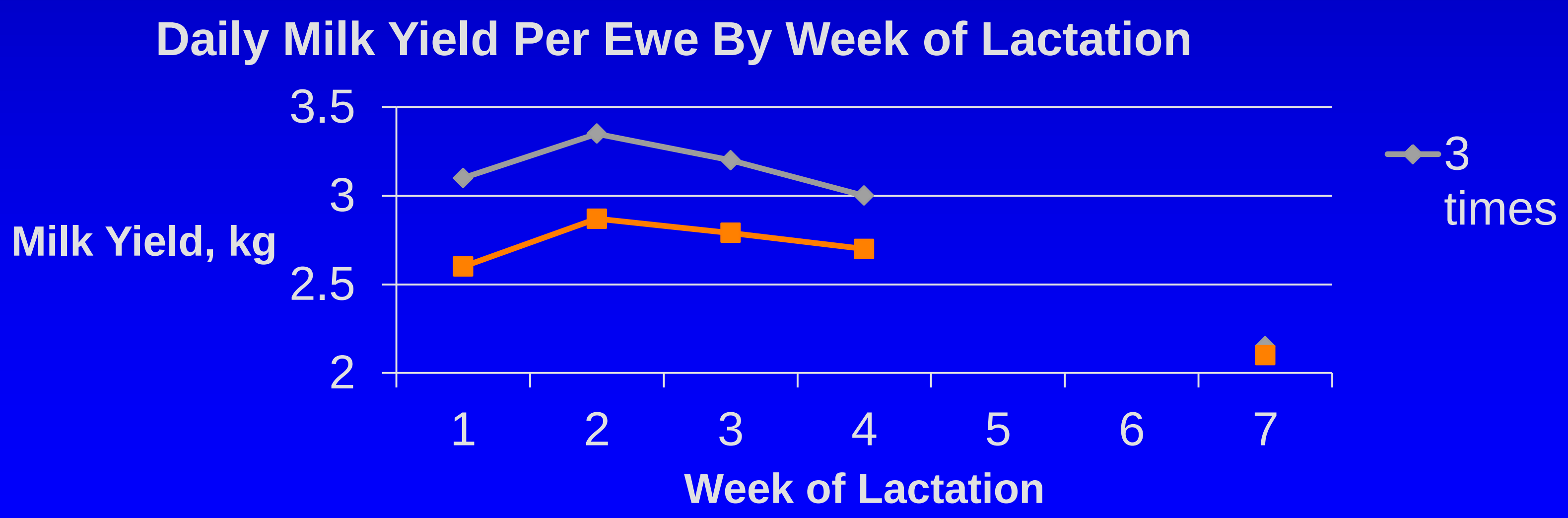
Weaning Systems

- Subsequent detailed studies with MIX and DY1 ewes showed that the low fat of MIX ewes was due to the failure of oxytocin release and milk let down during the milking period.
- During milking of MIX ewes, cisternal milk was captured, but milk in the alveoli, which is higher in fat, was not captured.
- MIX ewes had oxytocin release and milk let down when reunited with their lambs after milking.

- Another study fed 91 g of Megalac/ewe/day to MIX and DY1 ewes
- Milk fat increased by 1.9 percentage units in DY1 ewes but had no effect on MIX ewes

3-Times Per Day Milking

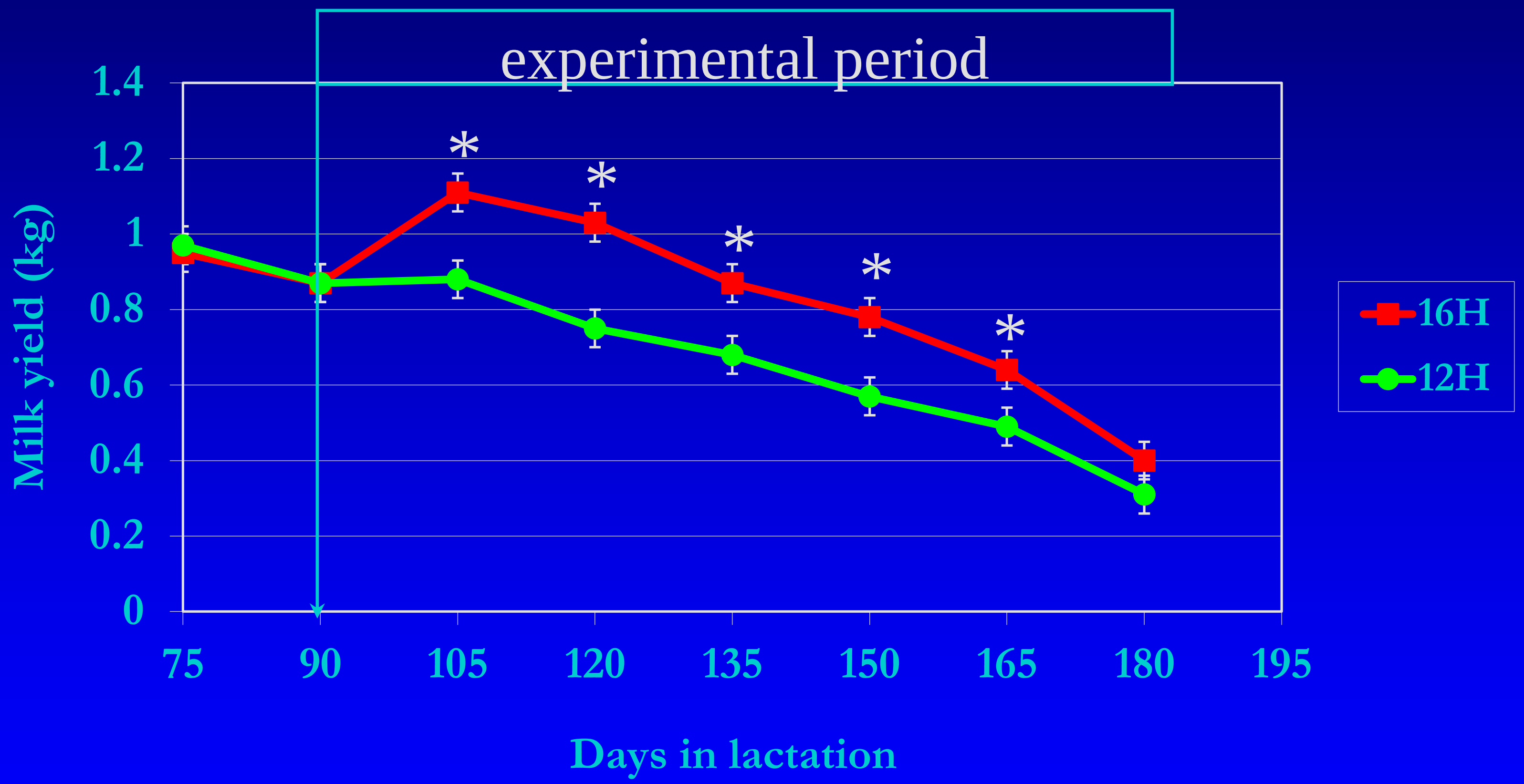
- 125 DY1 ewes, 53-3X (6 am, noon, 6 pm), 72-2X (6:30 am, 5:30 pm)
- Treatments applied for the first 30 days of lactation, 2X daily milking of all ewes from 30 days to end of lactation
- Total yield first 30 days: 3X = 95 kg, 2X = 83 kg, 15% increase for 3X
- No effect after 30 days



12- vs. 16-Hour Milking Interval
(Milking 2 times per day or 3 times in 2 days)

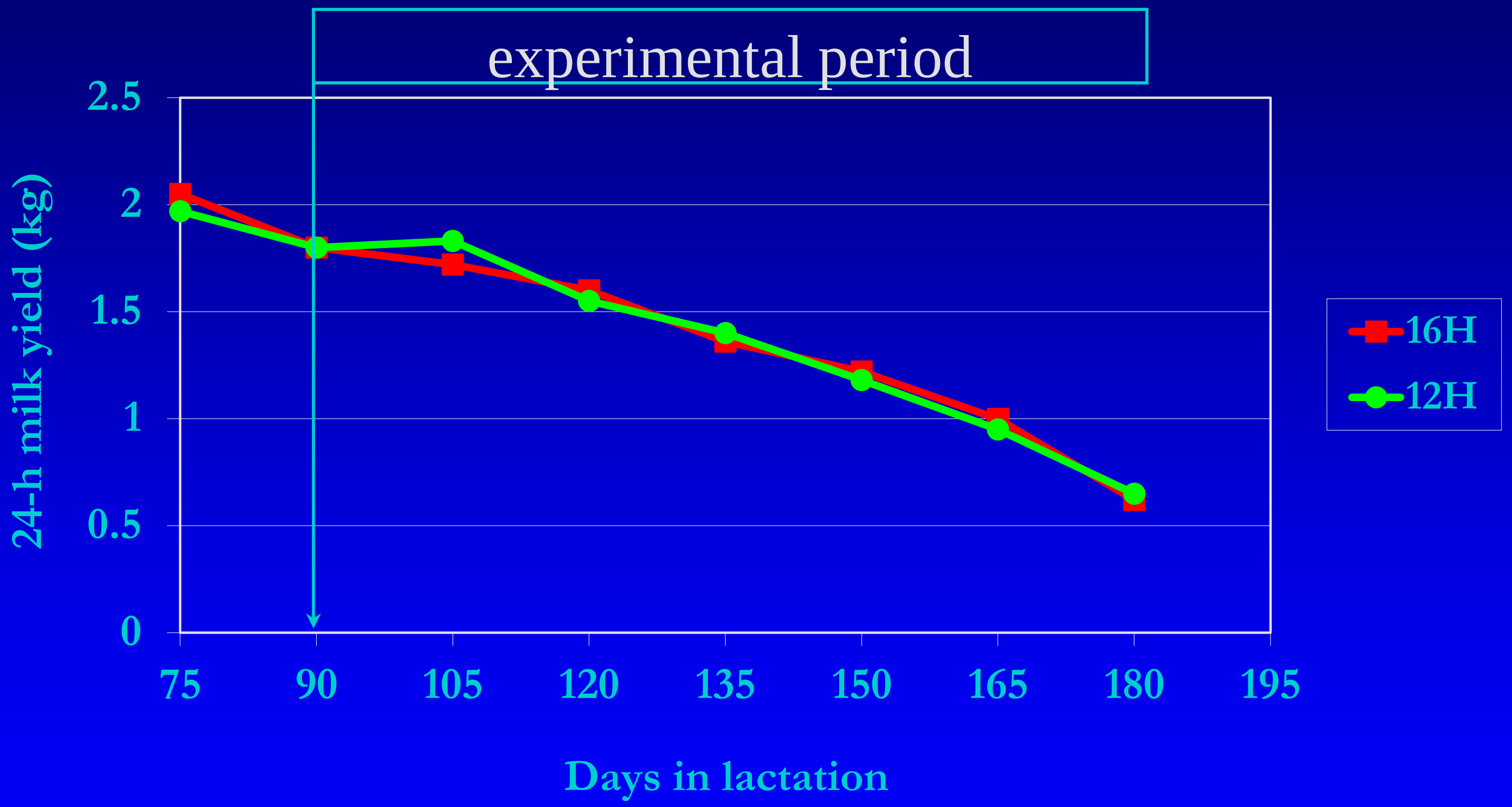
- 3rd parity East Friesian crossbred ewes
- Similar udder morphology, milk yield, and stage of lactation (90 d)
- Milking Treatments
  - 12H:6AM and 6PM (n = 24)
  - 16H:6AM, 10PM, and 2PM (n = 24)
- From day 90 to 180 of lactation
  - 12H = 180 milkings
  - 16H = 135 milkings

Morning Milk Yield (6 AM)



* $P < 0.05$

24-hour Milk Yield



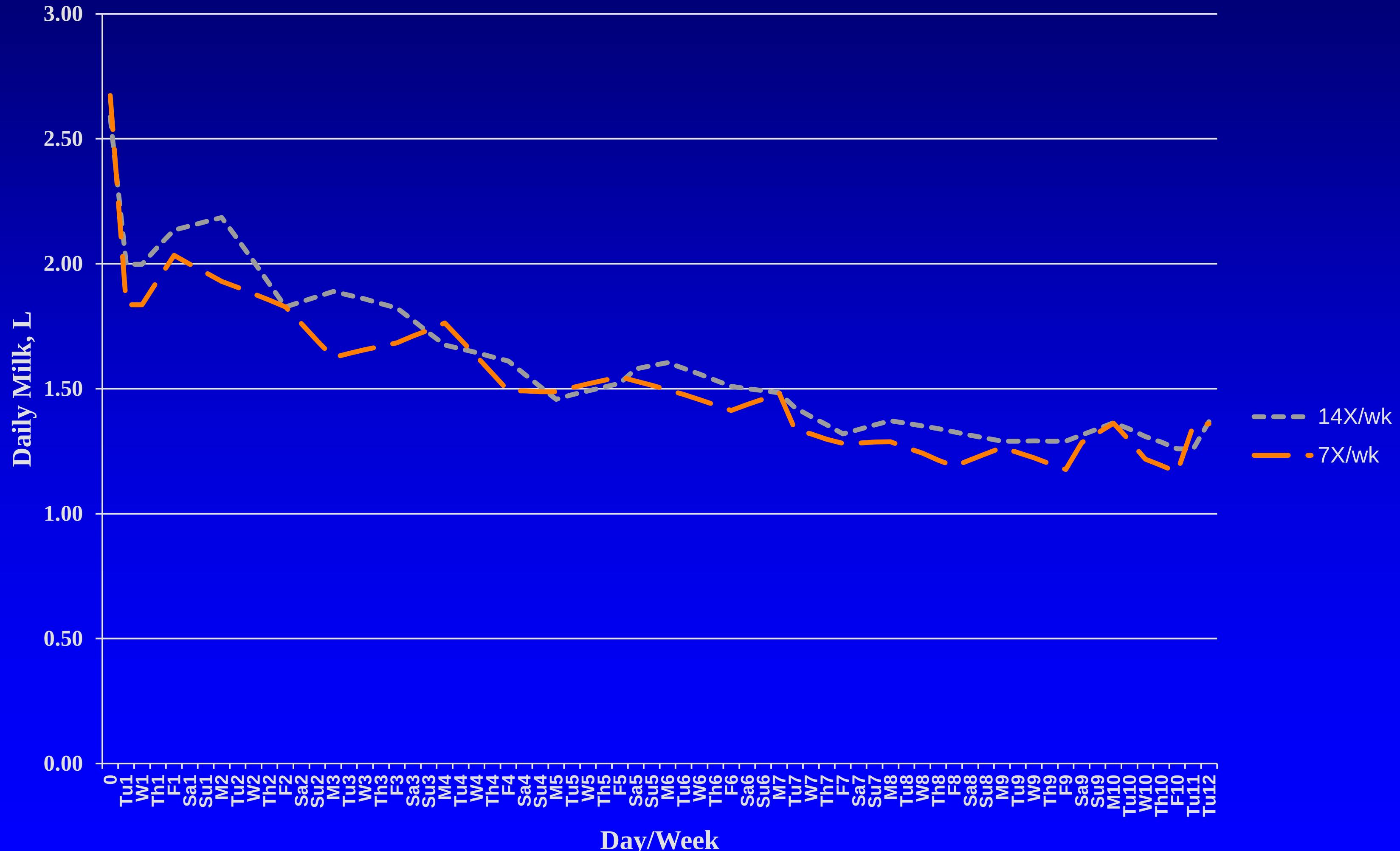
12- vs. 24-Hour Milking Interval

(Milking twice-daily or once-daily)

- 72 multi-parous ewes
- Milking Treatments
  - Twice-daily (14X/wk)
  - Once-daily (7X/wk)
  - Once-daily but not on Sunday (6X/wk)
- From day 100 to 167 of lactation
  - 14X/wk = 134 milkings
  - 7X/wk = 67 milkings
  - 6X/wk = 60 milkings

12- vs. 24-Hour Milking Interval

(Milking twice-daily or once-daily)



12- vs. 24-Hour Milking Interval

(Milking twice-daily or once-daily)

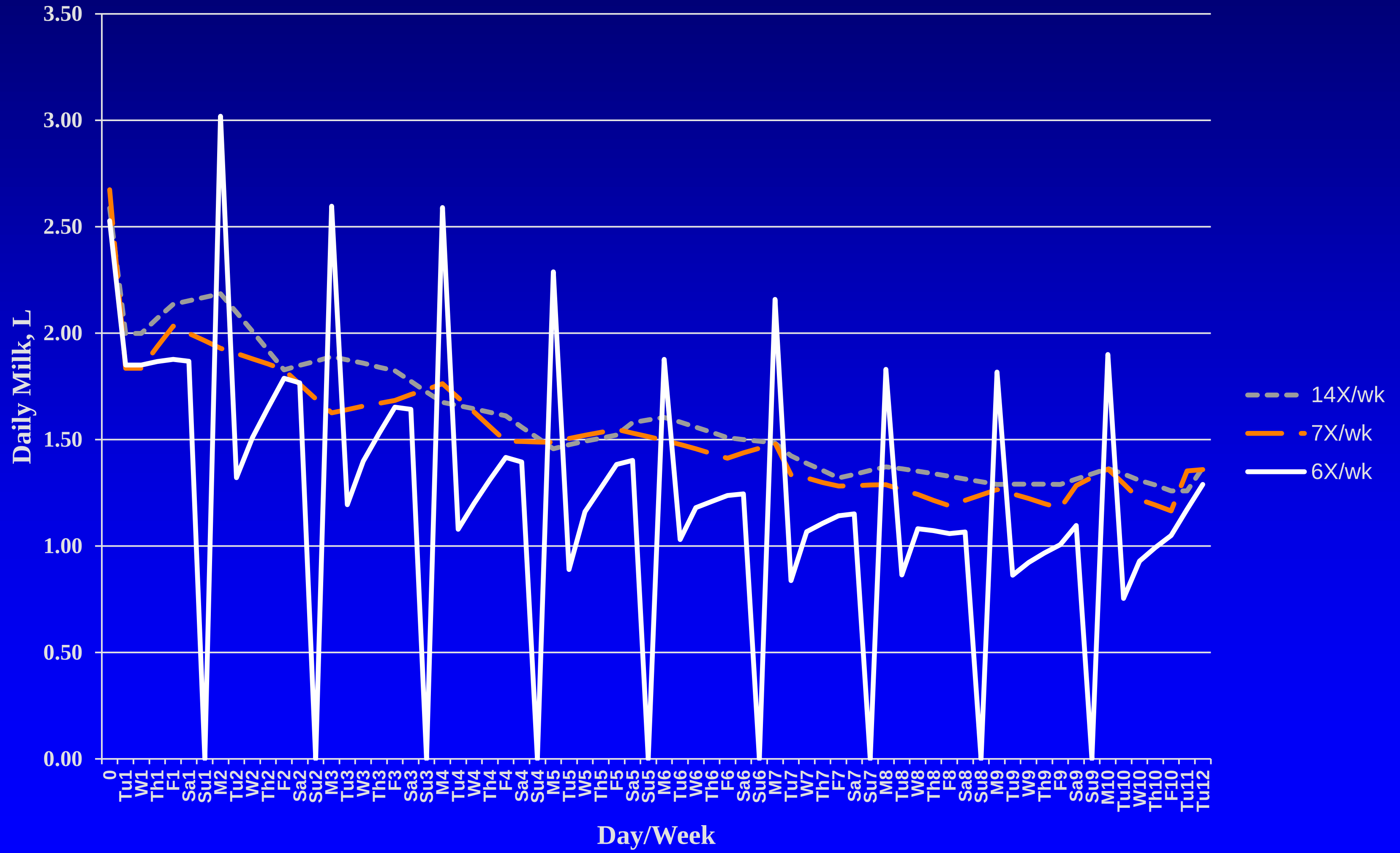
Lactation performance of ewes milked twice-daily (14X/wk) or once-daily (7X/wk) from mid- to late-lactation (67 days).

Treatment	Milk yield, kg	Fat, %	Protein, %	SCC, $\log_{10}$
14X/wk	109.6	5.61[d]	4.98[d]	5.30
7X/wk	105.2	6.37[c]	5.26[c]	5.25

[c,d]$P < 0.01$.

12- vs. 24-Hour Milking Interval

(Milking twice-daily or once-daily)



12- vs. 24-Hour Milking Interval

(Milking twice-daily or once-daily)

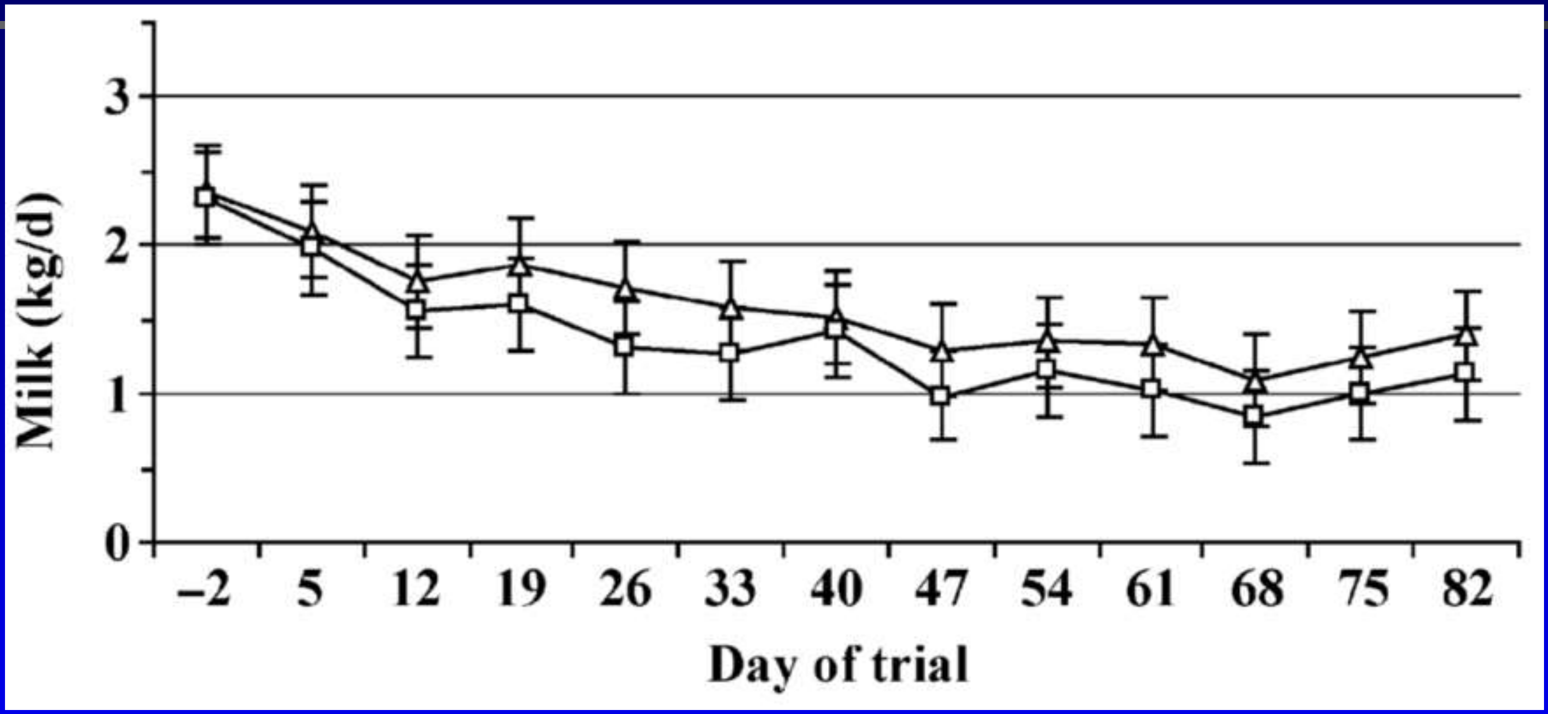
Lactation performance of ewes milked twice-daily (14X/wk), once-daily (7X/wk), or once-daily except not on Sunday (6X/wk) from mid- to late-lactation (67 days).					
Treatment	Milk yield, kg	Fat, %	Protein, %	SCC, $\log_{10}$	Plasma lactose, nmol/µL
14X/wk	109.6[a]	5.61[d]	4.98[d]	5.30	3.40[b]
7X/wk	105.2[a]	6.37[c]	5.26[c]	5.25	2.00[b]
6X/wk	86.0[b]	6.64[c]	5.34[c]	5.28	4.90[a]
[a,b] $P < 0.05$. [c,d] $P < 0.01$.					

Grazing Research

- Starting in mid-lactation in 1998, 49 ewes grazed during the day on kura clover/orchard grass pasture, 48 ewes remained in drylot on alfalfa hay.
- Pastured ewes produced 10.5% more milk.
- Since 1998, all ewes have been pastured.

Pasture Supplementation Research

Milk yield of ewes receiving 0.00 (□) or 0.91 (Δ) kg corn-soybean meal (16% CP) supplement



Supplemented ewes produced an average of 0.23 kg/d more milk than unsupplemented ewes (1.59 vs. 1.36 kg/d, respectively).

Milk urea nitrogen (MUN) mg/dl = 25 for both treatments; indication of poor protein utilization

Pasture Supplementation – Corn Only

Lactation performance of grazing ewes unsupplemented or supplemented with corn.

Trait	Whole corn supplementation, kg/ewe/day			
	0.0	.45	.91	1.36
Test day milk yield, kg	1.30[a]	1.32[a]	1.41[b]	1.44[b]
Milk fat, %	6.26[b]	6.40[b]	6.09[b]	5.89[a]
Milk protein, %	5.29	5.41	5.37	5.39
Milk urea nitrogen, mg/dL	18.9[a]	17.1[b]	13.6[c]	13.6[c]

[a,b,c]($P < 0.05$).

Effect of alfalfa and orchardgrass on performance of dairy ewes

Cut-and-Carry Trial Alfalfa/Orchard grass: 0/100, 25/75, 50/50, 75/25

Grazing Trial – Alfalfa/Orchardgrass: 0/100, 25/75, 50/50

Effect of alfalfa and orchardgrass on performance of dairy ewes

Lactation performance of ewes fed or grazing forage of varying proportions of alfalfa.

Trait	% alfalfa in forage			
	0	25	50	75
Cut-and-carry trial:				
Milk yield, kg/d	1.74[g]	1.85[f]	1.94[e]	1.95[e]
Fat yield, kg/d	0.12	0.12	0.12	0.13
Protein yield, kg/d	0.09[a]	0.09[a]	0.10[b]	0.10[b]
Milk urea nitrogen, mg/dL	10.9[d]	12.7[c]	14.3[b]	16.8[a]
Grazing trial:				
Milk yield, kg/d	1.55[g]	1.78[f]	1.87[e]	
Fat yield, kg/d	0.10	0.11	0.11	
Protein yield, kg/d	0.08[a]	0.09[a,b]	0.10[b]	
Milk urea nitrogen, mg/dL	15.0[b]	19.8[a]	22.1[a]	

[a,b,c,d] ($P < 0.05$), [e,f,g] ($P < 0.10$).

Prepartum Photoperiod Effects on Milk Production of Dairy Ewes

Ewes: 22 four-yr-old dairy ewes

Treatments – Livestock Lab on campus:

long day photoperiod (LDPP) = 16 h light, 8 h darkness, n = 11.

short day photoperiod (SDPP) = 8 h light, 16 h darkness, n = 11.

Treatments started Dec. 20, 2005 and were applied for 44 to 78 days prior to lambing.

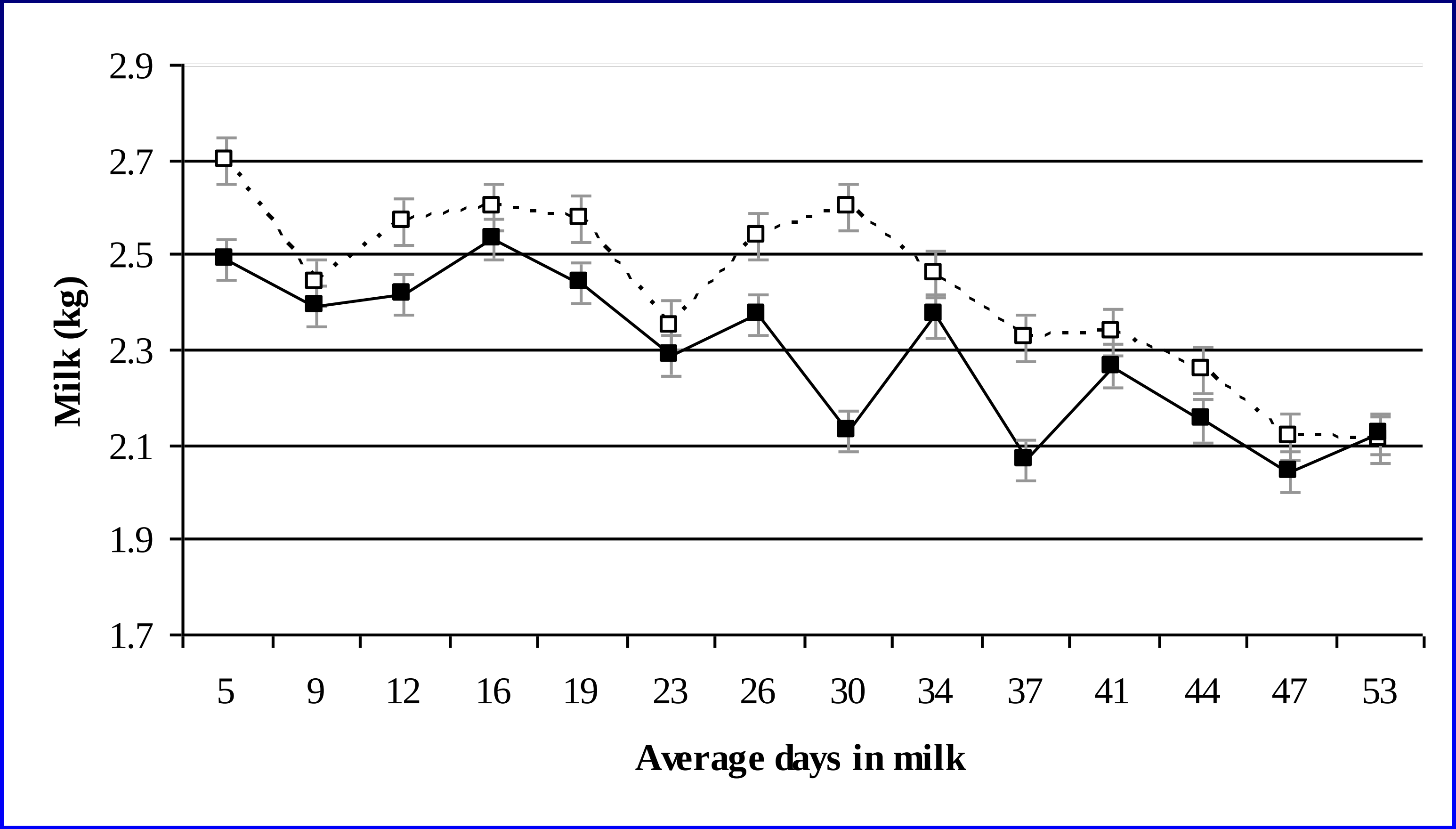
Milking period:

Ewes milked twice per day for approx. 180 days.

After lambing, all ewes exposed to 12 h light for 34 to 63 days in Livestock Lab on Campus.

Moved to Spooner Station April 10, 2006 under ambient light.

Mean test day milk production of SDPP (□) and LDPP (■) treatments during the milking period on campus.



Mean Daily Milk Production and Milk Composition During the Period on Campus, average of 53 d

	SDPP	LDPP	*P* <
Milk, kg/d	2.43	2.29	0.05
Fat, %	6.04	5.51	0.01
Protein, %	4.61	4.54	0.45

Mean Daily Milk Production and Milk Composition During the Period on Campus and At Spooner, average of 180 d

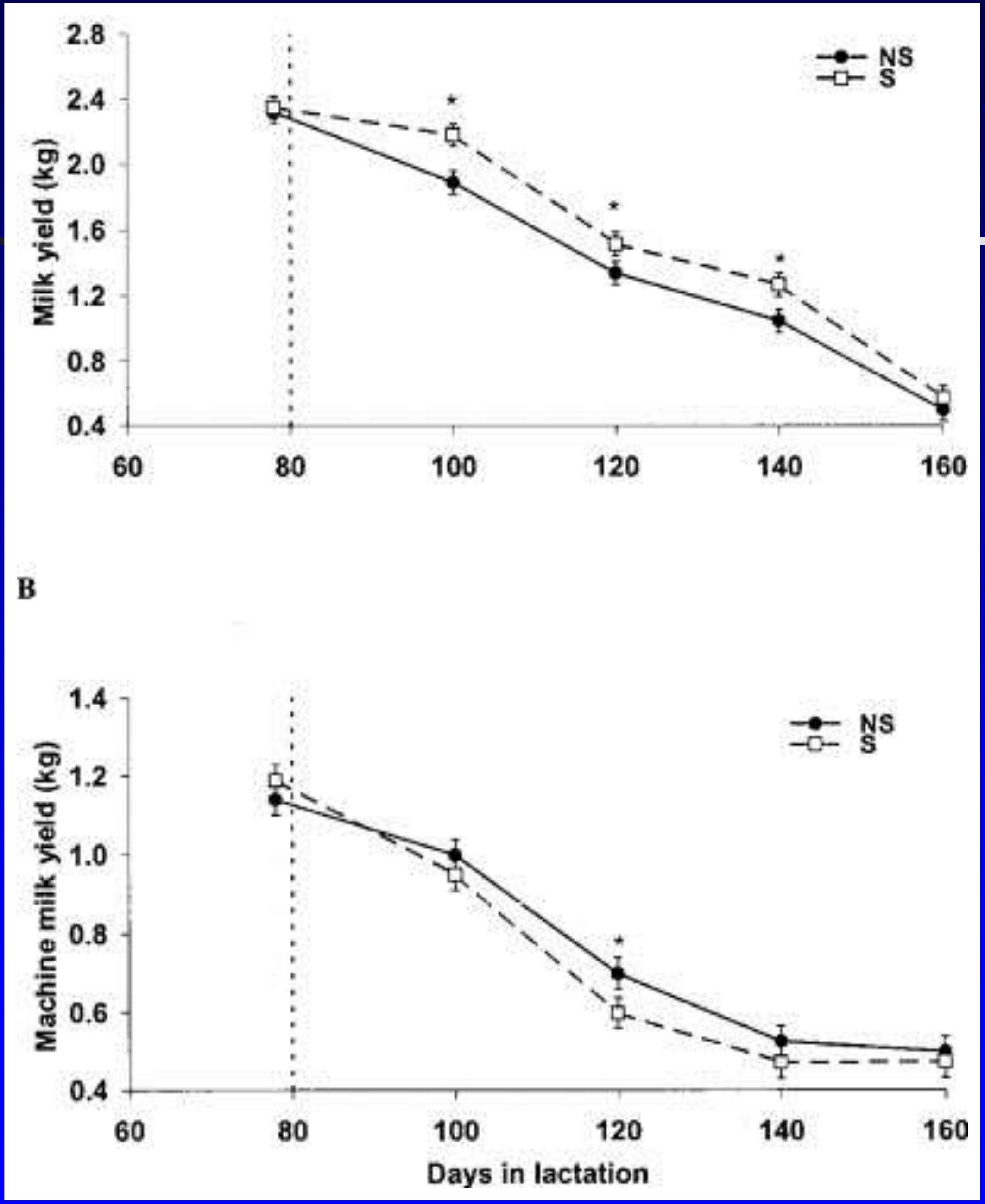
	SDPP	LDPP	*P* <
Milk, kg/d	2.17	2.02	0.01
Fat, %	6.38	6.15	0.04
Protein, %	5.01	4.95	0.30

Economics?

SDPP ewes produced 0.15 kg more milk per day x 180 day lactation x $1.65/kg milk = $44.55 increased milk income per ewe over LDPP ewes

Practical Implications?

Will ewes that have late gestation during short days (December/January for January/February lambing) be expected to produce more milk than ewes that have late gestation in longer days (April/May for May/June lambing)?



Machine Stripping

- 48 East Friesian crossbred ewes: 24 machine stripped, 24 no stripping
- From day 80 to end of lactation
- Stripped ewes produced 14% more milk than non-stripped ewes (+0.44 lb./day)

Machine Stripping Simulation

(Group of 12 ewes in a double-12 parlor)

	Stripping treatment/number of milkers			
Factor	**Stripping/1**	**Stripping/2**	**No-Stripping/1**	**No-Stripping/2**
Parlor entry time, s	**45**	**45**	**45**	**45**
Milking procedure time, s	**344**	**237**	**207**	**186**
Parlor exit time, s	**30**	**30**	**30**	**30**
Parlor time, min	**6.98**	**5.20**	**4.70**	**4.35**
Parlor throughput, ewes/h	**103**	**138**	**153**	**166**
Ewes overmilked, no.	**11/12**	**4/12**	**0/12**	**0/12**

Sheep Research Unit, Spooner Ag Research Station, UW-Madison

Conducted dairy sheep research from 1994 – 2016.

Milking procedure at Spooner

Dairy ewes coming from pasture to the milking parlor

Sheep barn with milking parlor in the foreground

Ewes waiting to enter the milking parlor

Ewes entering the milking parlor

Ewes entering the milking parlor – taking any one of 12 stanchions

When all ewes are stanchioned, the entire stanchion system moves the ewes back to the edge of the milking pit. Ewes are fed grain in the parlor.

The milker's view from the pit.

Milking and the milkers. Data collection on the right side.

Milk in collection jar prior to going into bulk tank

Milk is cooled in a bulk tank.

Ewes exiting the parlor

Ewes returning to pasture

Thank You