US perspective: The importance of functional traits and crossbreeding in dairy cattle

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US Dairy Industry

- 9 million dairy cows
- 66,000 dairy herds
- 85-90% Holstein
- About 50% recorded for mill yield, less for most other tra
- About 75% exposed to artificial insemination at least one time

Major Concerns in US

- Increased frequency of transition diseases
- Decline in reproductive efficiency
- Inability of cows to handle any type of stress
- Dramatic increase in cow death rates
- Calf losses

Reasons for Increased Disease Frequency

- Successful genetic improvement in yield (genetic antagonism between production and diseases)
- Selection for thinner cows
- Inbreeding

- Environmental reasons
  - Management focus on milk per cow per day
  - Overcrowding and cow comfort concerns
  - Increased confinement and concrete
  - Dry cow and transition cow management
  - Others

Selected US Diseases and Lactation Incidence Rates (%)

Disease	Range in herd incidence rate	Rate from Zwald et al. 2004
Clinical mastitis	15-40	20
Lameness	3-25	10
Clinical ketosis & related	4-20	10
Displaced abomasums	1-10	3
Milk fever	1-10	---
Reproductive diseases (all)	10-30	21 (metritis) 8 (cystic ovaries)
Stillbirths	7-15	---

April 2005 Tennessee DHIA
(187 Herds, 124 cows/herd, 30% culling/yr)

Reason	Percent of total cows
Dairy purposes	4
Low production	2
Reproduction	5
Mastitis & udder	3
Feet & legs	2
Disease & injury	7
Died	7

April 2005 Tennessee DHIA
(annual cow death rates)

Reason left herd	Percent by lactation	
Died on the farm	1st	5*
	2nd	6
	3rd or >	10

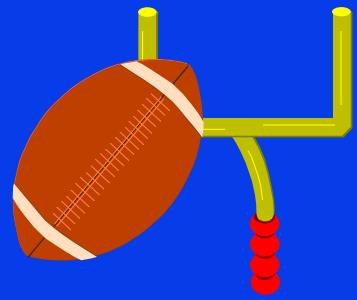
* Does not include deaths before first DHIA test

April 2005 Florida DHIA
(71 Herds, 780 cows/herd, annual death rates)

Reason left herd	Percent by lactation	
Died on the farm	1st	7*
	2nd	8
	3rd or >	14

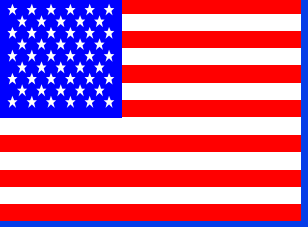
* Does not include deaths before first DHIA test

Breeding Goal Considerations



- Production traits
- Feed efficiency
- Functional traits
  - Udder health
  - Metabolic & digestive health
  - Repro. performance & health
  - Foot & leg health
  - Husbandry traits
  - Calf health & survival

Lead to cow death or culling



Lifetime Net Merit in Holsteins (since 2003)

- Relative emphasis:

  33% protein +

  22% fat +

  11% productive life +

  9% somatic cell score (to reduce) +

  7% udder composite +

  7% daughter pregnancy rate +

  4% feet and legs composite +

  3% body size composite (to reduce) +

  2% daughter calving difficulty (to reduce) +

  2% service sire calving difficulty (to reduce)

Expected annual genetic trend in US (Van Raden 2004)

Protein	3.5 kg
Fat	4.4 kg
Milk	108 kg
Productive life	0.48 mo
Somatic cell score	-0.44
Udder composite	0.14
Feet & leg composite	0.10
Size composite	-0.06
Daughter pregnancy rate	0.10 %
Service sire calving difficulty	-0.13 %
Daughter calving difficulty	-0.16 %

Daughter Pregnancy Rate (DPR – since 2003)

- Positive response from industry
- Percentage of open cows that get pregnant in each 21 d period
- Linear function of days open .25*(233-days open)
- 1% change in DPR = change of 4 days open
- h^2 = .04
- Actual days open
- Predicted days open (in cows 130 to 250 days in milk)

Daughter Pregnancy Rate

- Predicted days open increases reliability by 5% in 4 & 5 year old bulls
  - Weighted less than actual days open
  - Within days in milk group and considers
    - Lactation number
    - Calving ease
    - Age at calving (L & Q)
    - Days open at last breeding

Calving Difficulty

- Holstein and Brown Swiss
- Direct and maternal grandsire evaluations
- All parities
- Model similar to other countries (Sire–MGS threshold model)
- Direct h^2 = .07
- Maternal h^2 = .04
- Sire-MGS correlation .48
- Reported as % difficult births in first parity (4 or 5 scores)
  - %DBH (8 is mode)

US Producer-Recorded Diseases (Zwald et al. 2004)

Disease	No. cows	No. records	heritability 1st lact.	heritability all lacts.
Clinical mastitis	105,029	199,827	0.10	0.09
Lameness	50,611	92,318	0.07	0.06
Ketosis	52,898	100,342	0.11	0.06
Dis. abomasums	75,252	134,871	0.18	0.15
Metritis	97,316	181,322	0.08	0.07
Cystic ovaries	65,080	117,170	0.08	0.05
All diseases 1st 50d lact.			0.12	0.10

US Producer-Recorded Diseases
(Mean Sire PTAs, Zwald et al. 2004)

Disease	Best 10 sires	Worst 10 sires
Clinical mastitis	0.129	0.259
Lameness	0.077	0.131
Ketosis	0.063	0.132
Dis. abomasums	0.017	0.061
Metritis	0.151	0.271
Cystic ovaries	0.052	0.091

Crossbreeding

- Gaining popularity in US
- > 25% of Tennessee herds are using some crossbreeding
- Poor disease resistance, fertility and survival of modern purebreds
- Capitalize on hybrid vigor
- Relieve inbreeding
- Need 3 breeds (or 4) ?
- Selection still important

Results from 7 California herds
(L.B. Hansen, U. Minnesota)
(kg 305d 2X, no adj. days open)

Trait	Holstein	Normande X Holstein	Montbeliarde X Holstein	Scandinavian Red X Holstein
#/group	380*	245*	494*	328*
Milk	9757[a]	8530[c]	9161[b]	9281[b]
Fat	346[a]	319[c]	334[b]	340[a, b]
Protein	305[a]	277[c]	293[b]	297[b]

[a,b,c] different letters indicate significant differences (P<.05)

Results from 7 California herds

(L.B. Hansen, U. Minnesota)

(1st calving Holstein dams - stillbirths & dystocia)

Sire Breed	Holstein	Montebeliarde	Brown Swiss	Scandinavian Red
No. calvings	371	158	224	1,016
Dystocia (%)	16.0[a]	12.0[a]	11.9[a,b]	5.5[b]
Stillbirth (%)	15.7[a]	13.2[a,b]	12.0[a,b]	7.9[b]

[a,b] different letters indicate significant differences (P<.05)

Results from 7 California herds

(L.B. Hansen, U. Minnesota)

(1st calving - stillbirths & dystocia)

Breed of Dam	Holstein	Normande X Holstein	Montbeliarde X Holstein	Scandinavian Red X Holstein
No. calvings	1,398	269	370	264
Dystocia (%)	9.3[a]	9.2[a, b]	8.1[a,b]	4.7[b]
Stillbirth (%)	11.8[a]	7.8[a,b]	7.1[a,b]	4.9[b]

[a,b] different letters indicate significant differences (P<.05)

Results from 7 California herds

(L.B. Hansen, U. Minnesota)

(cow survival in 1st lactation)

Breed	Holstein	Normande X Holstein	Montbeliarde X Holstein	Scandinavian Red X Holstein
No. cows	692	465	655	434
30 days (%)	95[a]	98[b]	98[b]	98[b]
150 days (%)	91[a]	96[b]	96[b]	96[b]
305 days (%)	86[a]	93[b]	92[b]	93[b]

[a,b] different letters indicate significant differences (P<.05)

Results from 7 California herds

(L.B. Hansen, U. Minnesota)

(reproduction in 1st lactation)

Breed	Holstein	Normande X Holstein	Montbeliarde X Holstein	Scandinavian Red X Holstein
No. cows	692	465	655	434
Days open	150[a]	123[b]	131[b]	129[b]
1st service conc. rate (%)	22[a]	35[b]	31[b]	30[b]

[a,b] different letters indicate significant differences (P<.05)

Summary

- Performance for functional traits is important in US - declined in recent years for some traits
- Cow health problems and high death rates are costly and create welfare concerns
- Recently increased focus on functional traits in US selection indexes
- US disease data – some good possibilities on the horizon
- Dramatic increase in crossbreeding
- Improved selection practices and crossbreeding will enhance functional aspects of US dairy cattle