Country   Canada

Trait category: *Individual trait(s):*

Reproduction-calving   **Calving performance (direct, maternal)**
Health   **Somatic cell count**
Workability   **Milking speed**
Conformation   **Udder**
        Locomotion
        Other
Longevity   **Herd life**

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Somatic cell count and herd life in collaboration with:
Centre for Genetic Improvement of Livestock, University of Guelph

Conformation traits in collaboration with:
Centre for Genetic Improvement of Livestock, University of Guelph
Canadian Dairy Breeds

Reproduction calving traits	Calving performance (direct, maternal)
Breed(s)	Holstein, Ayrshire, Brown Swiss, Canadienne, Guernsey, Jersey
Trait definition and unit(s) of measuring	Scored in 5 categories; unassisted/unobserved (1), easy pull (2), hard pull (3), surgery (4), abnormal presentation (5, not included in analysis)
Method of measuring and collecting data	Scored by herd owner in early lactation and collected by milk recording
Time period for data inclusion	All available data
Age groups	All
Genetic parameters	$h^2_{\text{calving performance (direct)}} = 0.11$ $h^2_{\text{calving performance (maternal)}} = 0.12$ $r_{g(\text{calving performance (direct, maternal)})} = -0.27$
Sire categories	All bulls
Environmental effects pre-adjustment evaluation model	None Herd x year x season of calving, parity x sex of calf, permanent environment
Base for age adjustment	No
Use of genetic groups and/or relationships	All relationships and phantom parent groups
Method (model) of genetic evaluation	Maternal effects ST BLUP AM for repeated records
System validation	Data quality control, ongoing research into genetic parameters and evaluation models
Expression of proof	Normalized 1-9 scale, higher values indicate easier calving
Genetic (reference) base	All bulls with an official proof
Criteria for official publication of sire proofs	REL $\geq$ 55% and daughters in $\geq$ 10 herds
Number of evaluations/ publications per year	One; July
Use in total merit index	No
Key reference on methodology applied	Internal documentation

Health traits	Somatic cell count
Breed(s)	Holstein
Trait definition and unit(s) of measuring	Test-day somatic cell count is log 2 transformed to linear somatic cell score
Method of measuring and collecting data	Collected by milk recording
Time period for data inclusion	Since 1988
Age groups	1st to 3rd lactation
Genetic parameters	$h^2_{somatic\ cell\ score\ (lactation\ 1)} = 0.09$ $h^2_{somatic\ cell\ score\ (lactation\ 2)} = 0.09$ $h^2_{somatic\ cell\ score\ (lactation\ 3)} = 0.11$ $r_{g(somatic\ cell\ score\ (lactation\ 1,\ lactation\ 2))} = 0.79$ $r_{g(somatic\ cell\ score\ (lactation\ 1,\ lactation\ 3))} = 0.75$ $r_{g(somatic\ cell\ score\ (lactation\ 2,\ lactation\ 3))} = 0.95$
Sire categories	All bulls

Environmental effects
    pre-adjustment
    evaluation model
	None
	Herd x test-day, age x season of calving, days in milk, permanent environment within lactation

Base for age adjustment	No
Use of genetic groups and/or relationships	All relationships and phantom parent groups
Method (model) of genetic evaluation	MT BLUP AM for test-day records. Lactations 1, 2 and 3 are considered as separate traits
System validation	Data quality control, ongoing research into genetic parameters and evaluation models
Expression of proof	ETA on somatic cell score scale with M = 3. Higher values indicate higher somatic cell count
Genetic (reference) base	All bulls with at least 1 daughter calving in the past 5 years
Criteria for official publication of sire proofs	REL $\geq$ 55% and daughters in $\geq$ 10 herds
Number of evaluations/ publications per year	Two; January, July
Use in total merit index	Total Economic Value : 26 x (10 x production + 4 x herd life - 1.5 x somatic cell score) Production = [9 x (protein - 13)/ SD + 2 x (fat - 15) / SD]/11 Herd life = (herdlife proof - 3) / SD Somatic cell score = (somatic cell score proof - 3) / SD
Key reference on methodology applied	Reents, R., J.C.M. Dekkers & L.R. Schaeffer, 1996. Genetic evaluation for somatic cell score with a test-day model for multiple lactations. J. Dairy Sci. 78: 2847-2857

Workability traits	Milking speed
Breed(s)	Holstein, Ayrshire, Brown Swiss, Canadienne, Guernsey, Jersey
Trait definition and unit(s) of measuring	Scored from very fast (1) to very slow (5), relative to herd average
Method of measuring and collecting data	Scores assigned by herd owner and collected by milk recording during second test after calving
Time period for data inclusion	All available data
Age groups	1st lactation
Genetic parameters	$h^2_{milking\ speed} = 0.21$
Sire categories	All bulls

Environmental effects
  pre-adjustment
  evaluation model
	None
	Herd x year x season of calving, age at calving, stage of lactation at scoring

Base for age adjustment	No
Use of genetic groups and/or relationships	All relationships and phantom parent groups
Method (model) of genetic evaluation	ST BLUP AM
System validation	Data quality control, ongoing research into genetic parameters and evaluation models
Expression of proof	Normalized 1-9 scale, higher values indicate faster milking
Genetic (reference) base	All bulls with an official proof
Criteria for official publication of sire proofs	≥ 55% REL and daughters in ≥ 10 herds
Number of evaluations/ publications per year	Two; January, July
Use in total merit index	No
Key reference on methodology applied	Banos, G. & E.B. Burnside, 1992. Genetic evaluation of Canadian dairy bulls for milking speed with an animal model. Can. J. Anim. Sci. 72: 169-172

Conformation traits	Udder:	udder texture, fore attachment, rear attachment height, rear attachment width, median suspensory ligament, fore teat placement, mammary system, fore udder, rear udder, fore teat placement
	Locomotion:	foot angle, bone quality, set rear legs, feet & legs
	Other:	size, stature, chest floor, loin strength, pin setting, pin width, dairy character, capacity, rump, conformation (overall score)

Breed(s)	Holstein, Jersey, Canadienne, Guernsey, Brown Swiss, Ayrshire
Trait definition and unit(s) of measuring	Most traits are scored on a linear 1-9 point scale, following recommendation of the European and World-wide group for harmonization of linear type classification, except for mammary system, fore udder, rear udder, fore teat placement, feet & legs, dairy character, capacity and rump, which are scored on a 1-18 point scale, and conformation (overall score), which is scored on a 50-100 point scale
Method of measuring and collecting data	Scored by Breed Association classifiers
Time period for data inclusion	Since 1982
Age groups	1st lactation
Genetic parameters	$h^2_{udder\ traits} = 0.08$ to 0.24 $h^2_{locomotion\ traits} = 0.07$ to 0.20 $h^2_{other\ traits} = 0.18$ to 0.40
Sire categories	All bulls
Environmental effects pre-adjustment evaluation model	None Herd x round x classifier, age at calving, stage of lactation at classification
Base for age adjustment	No
Use of genetic groups and/or relationships	All relationships and phantom parent groups
Method (model) of genetic evaluation	ST BLUP AM
System validation	Data quality control, ongoing research into genetic parameters and evaluation models
Expression of proof	Standardized scale with M = 0 and SD = 5
Genetic (reference) base	All bulls with an official proof
Criteria for official publication of sire proofs	REL $\geq$ 60% and daughters in $\geq$ 10 herds

Conformation traits *continued*	Udder Locomotion Other
Number of evaluations/ publications per year	Two; January, July Monthly unofficial evaluations
Use in total merit index	Lifetime Profit Index: 7 x [6 x (9 x protein / SD + 2 x fat / SD) + 4 x (5 x mammary / SD + 4 x feet & legs / SD + 1 x conformation / SD + 1 x capacity / SD)] NB: All weights are standardized based on genetic standard deviations
Key reference on methodology applied	Meyer, K. & E.B. Burnside, 1988. Joint sire and cow evaluation for conformation traits using an individual animal model. J. Dairy Sci. 71: 134-1049

Longevity traits	Herd life
Breed(s)	Holstein
Trait definition and unit(s) of measuring	Functional (adjusted for production) survival (yes/no) within lactations 1, 2 and 3, considered as separate traits, and combined with information from conformation traits
Method of measuring and collecting data	Survival data obtained from milk recording records
Time period for data inclusion	Since 1970
Age groups	1st to 3rd lactation
Genetic parameters	$h^2_{\text{functional survival (lactation 1)}} = 0.03$ $h^2_{\text{functional survival (lactation 2)}} = 0.03$ $h^2_{\text{functional survival (lactation 3)}} = 0.03$ $r_{g(\text{functional survival (lactation 1, lactation 2))}} = 0.62$ $r_{g(\text{functional survival (lactation 1, lactation 3))}} = 0.57$ $r_{g(\text{functional survival (lactation 2, lactation 3))}} = 0.75$ $r_{g(\text{functional survival, type)}} = 0.60$
Sire categories	All bulls
Environmental effects pre-adjustment evaluation model	None Herd x year x season of calving, age at first calving, registry status, fat and protein production in first lactation (rank within herd) x change in herd size from previous year
Base for age adjustment	No
Use of genetic groups and/or relationships	All relationships and phantom parent groups
Method (model) of genetic evaluation	MT BLUP AM on survival data. Sire evaluations for survival and conformation are combined with SM
System validation	Data quality control, ongoing research into genetic parameters and evaluation models
Expression of proof	ETA in number of lactations with M = 3. Units reflect expected differences in number of lactations. Higher values indicate higher expected functional herdlife
Genetic (reference) base	All bulls with $\geq$ 1 daughter calving in the past 5 years
Criteria for official publication of sire proofs	Official evaluation for conformation
Number of evaluations/ publications per year	Two; January, July
Use in total merit index	Included, see page 23
Key reference on methodology applied	Jairath, L. & J.C.M. Dekkers, 1995. Operational model for genetic evaluation of functional herd life of Canadian Holsteins. J. Dairy Sci. 78 (Suppl. 1): 157(Abstract). (Manuscript in preparation)