Breeding values for beef sires based on beef × dairy crossbred offspring

Synopsis

Starting December 2018, NAV routinely estimates breeding values for beef sires, on the basis of data for beef × dairy crossbred offspring. Data included in the evaluation were extracted from the national databases September 2018. The evaluation considers for the time being two trait groups: calving traits and carcass growth traits. Breeding values will be estimated four times per year, in conjunction with the NAV routine genetic evaluation for dairy breeds, and published on https://www.nordicebv.info.

Introduction

The use of beef semen in dairy herds has increased greatly within the last five years. Therefore, the necessity for reliable breeding values for beef breed sires used on dairy cows has also increased. Hence, NAV and its owner organizations developed a NAV genetic evaluation for beef breed sires that solely utilizes data for beef × dairy crossbred animals. An important prerequisite for the evaluation was that breeding values should be comparable across beef breeds. This document provides a brief description of the genetic evaluation.

Data

Data for beef × dairy crossbreds born since 2000 are included in the evaluation. More historic data exists in some countries, but those data were not considered to be representative. Crossbred calves born before 2000 may have been kept and raised under different production circumstances. For similar reasons, data were limited to beef × dairy crossbreds born at milk producing herds. This edit was implemented by requiring that all beef × dairy crossbred have at least five purebred herd-year contemporaries for their record to be included in the evaluation.

Crossbred offspring of beef sires from all beef breeds are included, except for breeds with very few (<50) beef × dairy crossbreds. Only beef AI sires are considered; this edit is implemented by requiring a beef sire to have beef × dairy offspring in at least 10 herds. Table 1 indicates that Danish blue is the largest breed for beef × dairy offspring in Denmark. Angus and Blonde d'Aquitaine are the largest breeds in Finland, and in Sweden the use of beef breeds is somewhat more spread.

Table 1. Country-wise distribution of beef breed of beef × dairy offspring with calving records and born after 2000.

Sire breed	Abbreviation	Denmark	Finland	Sweden
Angus	AAN	2.0	17.1	12.3
Blonde	BAQ	3.2	30.2	2.2
Danish Blue	BBL	72.1	-	-
Beef Shorthorn	BSH	0.1	-	-
Simmental (beef)	BSM	5.2	8.2	27.1
Charolais	CHA	4.5	8.0	24.9
Hereford	HER	0.6	3.6	18.7
Highland	HLA	0.0	0.0	0.2
INRA	INR	1.3	-	-
Limousin	LIM	10.7	32.8	14.6
Piemontese	PIE	0.2	0.0	-
Wagya	WAG	0.1	-	-

Trait definitions

Calving traits

The evaluation includes three biological traits: calf survival, calving ease and calf size. For each of these, calvings by first parity cows are treated as genetically different traits than calvings by later parity cows, as is done in calving traits evaluation for the dairy breeds. Thus, the model includes six traits in total.

Carcass traits

The evaluation includes three traits: daily gain, EUROP form score and EUROP fat score. Daily gain for an animal is calculated by subtracting half of tabulated birth weight from the slaughter weight, and divide this by the age at slaughter. Daily gain is subdivided into two traits, depending on the length of the fattening period (< 550 days or ≥ 550 days). For each of the traits, records for males are treated as genetically different traits than records for females. Thus, the model includes eight traits in total.

Genetic evaluation model

Calving traits

A sire model with a random sire effect has been used for all traits. A fixed effect of sire breed is included to accommodate for systematic differences between beef breeds. Maternal genetic effect are important for calving traits, but are – in the context of this evaluation – only expressed by dairy dams and not by beef sires. Hence, these maternal effects were modelled by a fixed effect of dam breed – dam year of birth to adjust for the genetic trend for maternal genetic effects in the dairy population.

The model for genetic evaluation includes fixed effects of herd-year of calving, year-month of calving, sex of calf-year of calving, dam age at calving, dam breed – dam year of birth and sire breed. Observations are adjusted for heterogeneous variance.

Heritabilities for the calving traits are generally low, ranging from 0.01 to 0.11 (Table 2). Genetic correlations between the same trait in first *vs* later parities were high, around 0.9. Genetic correlations between calf survival and calving ease was estimated to be around 0.6 – 0.7.

Table 2. Genetic parameters (heritabilities on the diagonal, genetic correlations on the off-diagonal) used in the evaluation of the calving traits.

	CSu1	CSu2	CE1	CE2	CSi1	CSi2
Calf survival, first parity (CSu1)	**0.05**	0.88	0.70	0.67	-0.80	-0.50
Calf survival, later parities (CSu2)		**0.01**	0.61	0.62	-0.53	-0.43
Calving ease, first parity (CE1)			**0.11**	0.97	-0.89	-0.93
Calving ease, later parities (CE2)				**0.05**	-0.80	-0.84
Calf size, first parity (CSi1) [1]					**0.17**	0.83
Calf size, later parities (CSi2)						**0.09**

[1] Calf size is only registered in Denmark

Carcass traits

A sire model with a random sire effect has been used for all traits. A fixed effect of sire breed is included to accommodate for systematic differences between beef breeds. A fixed effect of dam breed – dam year of birth is included to adjust for the genetic trends for these traits in the dairy population.

The model for genetic evaluation includes fixed effects of herd-year of birth, year-month of birth, dam age at slaughter, dam breed – dam year of birth and sire breed. Observations are adjusted for heterogeneous variance.

Heritabilities for carcass traits are moderately high, ranging from 0.2 to 0.4 (Table 3). The genetic correlation between male and female traits ranges between 0.8 – 0.9, indicating that the traits are genetically not the same.

Table 3. Genetic parameters (heritabilities on the diagonal, genetic correlations on the off-diagonal) used in the evaluation of the carcass traits.

	dgs,♂	dgl,♂	ccs,♂	cfs,♂	dgs,♀	dgl,♀	ccs,♀	cfs,♀
dgs, ♂	**0.19**	0.97	0.30	-0.21	0.83	0.86	0.22	-0.27
dgl, ♂		**0.21**	0.34	-0.10	0.85	0.86	0.25	-0.21
bcs, ♂			**0.32**	-0.17	0.31	0.24	0.92	-0.12
fats, ♂				**0.23**	-0.20	-0.13	-0.19	0.88
dgs, ♀					**0.33**	0.97	0.35	-0.30
dgl, ♀						**0.33**	0.25	-0.22
bcs, ♀							**0.36**	-0.18
fats, ♀								**0.25**

dgs: daily carcass gain, short fattening period; dgl = daily carcass gain, long fattening period; ccs = carcass conformation score; cfs = carcass fat score; ♂ = bull trait, ♀ = heifer trait

Breeding values

Breeding values are published for seven traits/combination of traits; see Table 4. The four calving trait EBVs are published for beef sires with 50% or higher reliability for calf survival, later parities or if the beef sire has more than 500 beef × dairy crossbred offspring. The three combined indexes for carcass traits are published for bulls with 50% or higher reliability for carcass score or more than 500

beef × dairy crossbred offspring.

Table 4. Calculated and published breeding values for the beef × dairy evaluation.

Calculated EBV	Published EBV
Calf survival, first parity	Calf survival, first parity
Calf survival, later parities	Calf survival, later parities
Calving ease, first parity	Calving ease, first parity
Calving ease, later parity	Calving ease, later parity
Calf size, first parity	
Calf size, later parities	
Daily carcass gain, short fattening period, bulls	Combined daily carcass gain, 25% weight on all four calculated daily carcass gain EBVs
Daily carcass gain, long fattening period, bulls	
Daily carcass gain, short fattening period, heifers	
Daily carcass gain, long fattening period, heifers	
Carcass conformation score, bulls	Combined carcass conformation score, 50% weight on both calculated carcass conformation score EBVs
Carcass conformation score, heifers	
Carcass fat score, bulls	Combined carcass fat score, 50% weight on both calculated carcass fat score EBVs
Carcass fat score, heifers	

Breeding values are expressed as relative breeding values with a mean of 100 and standard deviation of 10. The mean is updated every evaluation run such that crossbreds born 2-5 years prior to the evaluation date have a mean breeding value of 100. Interpretation of the base for the standard deviation is that a group of sires with near perfect reliability would have a standard deviation of breeding values equal to 10.

Table 5. Mean (of published) breeding values by sire beef breed.

	Calving traits [1]					Carcass traits [1]			
	N	CSu1	CSu2	CE1	CE2	N	DG	CCS	CFS
Angus	39	108	105	115	117	66	90	70	137
Simmental	48	100	101	99	98	143	106	77	103
Blonde	31	105	103	100	103	50	100	94	84
Danish Blue	69	91	97	95	97	92	107	120	83
Limousin	71	105	102	100	101	113	94	98	108
Charolais	49	95	97	102	96	81	113	89	105
INRA	1	104	107	131	114	4	84	118	108
Hereford	27	109	104	109	105	43	86	67	141

[1] CSu1 = calf survival, first parity; CSu2 = calf survival, later parities; CE1 = calving ease, first parity; CE2 = calving ease, later parities; DG = daily carcass gain; CCS = carcass conformation score; CFS = carcass fat score.

You can get more information about the joint Nordic evaluation:
General about Nordic Cattle Genetic Evaluation: www.nordicebv.info
Contact person: Gert Pedersen Aamand, Ph.: +45 87405288 gap@seges.dk.

Denmark: https://www.landbrugsinfo.dk
Contact person: Ulrik Sander Nielsen, Seges Cattle, Ph. +45 87405289. usn@seges.dk

Sweden: www.sweebv.info. www.vxa.se
Contact person: Emma Carlén, Växa Sverige, Ph +46 10 4710614. Genetic.Evaluation@vxa.se

Finland: www.faba.fi
Contact person: Jukka Pösö, Faba co-op, Ph +358-(0)207472071 jukka.poso@faba.fi