

INTERBULL breeding values calculated August 2019

This newsletter is primarily written for VikingGenetics staff and breeding advisors in Denmark, Sweden and Finland, but can also be of interest for dairy farmers.

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International breeding values for the traits and breeds shown in table 1 have been published 13.08.2019.

Current evaluation	
Daughter proven bulls: Yield Conformation Somatic cell count and udder health Longevity Calving – maternal and direct Female fertility Milking speed and temperament NTM for Nordic and foreign bulls Changes since last routine run	Young genomic tested bulls: Yield Conformation Somatic cell count and udder health Longevity Calving – maternal and direct Female fertility Milking speed and temperament Changes since last routine run

Table 1. Traits and breeds for which international breeding values are published.

Trait:	International breeding values for the breeds:
Yield	Red breeds, Holstein and Jersey
Conformation	Red breeds, Holstein and Jersey
Udder health	Red breeds, Holstein and Jersey
Longevity	Red breeds, Holstein and Jersey
Calving – maternal and direct	Red breeds and Holstein
Female fertility	Red breeds, Holstein and Jersey
Milking speed	Red breeds, Holstein and Jersey
Temperament	Red breeds and Holstein

You can find Interbull breeding values for all bulls with international breeding values on www.nordicebv.info

On the page you can search within breed or country. You can also search with the herdbook number or the name of the bull. Click on the herdbook number of the bull and view a graphical representation of the bulls breeding values.

You can sort the bulls by different breeding values by clicking on the top line of the table.

Bulls from Denmark, Finland and Sweden are in the following grouped under DNK/FIN/SWE

Daughter proven bulls

In the tables below, only sires that have breeding values based on daughter information is shown

Yield

In tables 2-4 is a comparison of the genetic level of yield for bulls from different countries. The analysis includes bulls born in 2012 or later, that have more than 60 daughters in the genetic evaluation.

Table 2. Genetic level for yield traits, Red breeds. Bulls born in 2012 or later.

Country	No. of bulls	Milkindex	Fatindex	Proteinindex	Y-index	Y-index STD
Australia	15	94,9	93,5	91,8	91,9	13
Canada	29	88,0	88,8	84,2	85,9	8,0
Germany	10	101,0	106,0	100,8	103,7	9,6
DNK/FIN/SWE	322	101,2	102,8	103,4	103,7	8,0
Estonia	14	97,0	99,6	97,1	98,6	9,5
UK	7	87,9	95,3	83,7	89,1	10,1
Norway	274	94,5	94,2	95,2	94,9	9,5
New Zealand	22	85,0	89,7	84,5	87,3	9,4
USA	7	74,7	74,4	68,0	69,9	13,7

Table 3. Genetic level for yield traits, Holstein. Bulls born in 2012 or later.

Country	No. of bulls	Milkindex	Fatindex	Proteinindex	Y-index	Y-index STD
Australia	82	95,0	100,0	95,0	97,8	5,7
Austria	6	102,5	103,8	97,3	99,8	8,0
Belgium	35	102,1	103,0	100,6	101,5	9,3
Canada	651	107,4	107,8	104,7	105,7	8,4
Switzerland	105	91,3	97,6	91,3	94,8	9,4
Czech Republic	38	104,6	104,7	100,2	101,6	7,0
Germany	887	107,7	105,6	104,7	104,5	9,4
DNK/FIN/SWE	509	102,4	103,6	104,4	104,4	9,2
Spain	104	107,5	103,4	101,2	100,8	7,4
Estonia	40	100,8	97,3	94,7	94,6	6,5
France	433	104,0	101,3	102,4	101,4	7,9
UK	167	101,0	103,8	98,9	101,2	13,6
Hungary	7	107,9	104,6	102,9	102,4	6,4
Ireland	98	77,9	93,2	84,8	91,2	9,1
Israel	104	98,5	105,8	97,8	102,1	7,2
Italy	392	103,4	103,9	101,4	102,3	8,3
Japan	65	107,1	105,0	103,0	103,0	9,5
Luxembourg	8	108,9	110,5	104,9	106,9	9,9
Netherlands	953	102,8	103,8	102,5	103,2	9,8
New Zealand	663	78,7	94,1	88,0	93,6	6,8
Poland	218	99,1	99,2	95,8	96,9	8,7
Slovenia	33	93,6	88,3	87,5	86,5	8,0
USA	2999	108,2	108,6	104,7	106,0	9,1

Table 4. Genetic level for yield traits, Jersey. Bulls born in 2012 or later.

Country	No. of bulls	Milkindex	Fatindex	Proteinindex	Y-index	Y-index STD
Australia	22	107,6	89,7	105,8	94,8	5,8
Canada	9	108,0	97,1	102,6	97,4	13,8
DNK/FIN/SWE	113	100,5	103,9	102,7	104,2	8,5
UK	5	103,8	90,4	99,4	92,2	9,0
New Zealand	378	97,0	88,8	96,4	91,3	7,7
USA	500	116,9	100,8	110,8	102,5	9,8

International comparison for yield among most important populations shows that:

- Red breeds: DNK/FIN/SWE have higher genetic level than Norway and Canada
- Holstein: DNK/FIN/SWE, Canada, Germany, USA, and Netherlands have similar genetic level
- Jersey: Denmark has same genetic level than USA, but higher genetic level than New Zealand

Conformation

The international genetic evaluation is done for 16 linear traits for Holstein, Red breeds and Jersey. In addition, frame condition score and locomotion are included in this trait group.

Breeding values for frame

EBV for frame is calculated from the 6 linear traits that are part of the international genetic evaluation. The composite NAV breeding value for frame also includes topline. There is no international genetic evaluation of topline.

We calculate international breeding value for frame based on a regression of NAV breeding values for the 6 linear international traits on NAV EBV for frame for Danish, Swedish and Finnish bulls born in 2004-05. The estimated regression coefficients are used to calculate international breeding value for frame for foreign bulls. This method is used to ensure the same relative weight between traits in NAV and international composite traits.

Breeding values for feet and legs

EBV for feet and legs is calculated from the 3 linear traits that are part of the international genetic evaluation. The composite NAV breeding values for feet and legs also include hock quality and bone quality. There is no international genetic evaluation for these two traits.

We calculate international breeding value for feet and legs based on a regression of NAV breeding values for the 3 linear international traits on NAV EBV for feet and legs for Danish, Swedish and Finnish bulls born in 2004-05. The estimated regression coefficients are used to calculate international breeding value for feet and legs for foreign bulls.

Breeding values for udder

The international genetic evaluation for udder includes 7 traits. The Nordic genetic evaluation for udder also includes teat thickness and udder balance. There is no international evaluation for these two traits.

We calculate international breeding value for udder based on a regression of NAV breeding values for the 7 linear international traits on NAV EBV for udder for Danish, Swedish and Finnish bulls born in 2004-05. The estimated regression coefficients are used to calculate international breeding value for udder for foreign bulls.

Genetic level of composite conformation traits

In tables 5-7 is a comparison of genetic level of composite conformation traits for bulls from different countries. The calculation includes bulls that have at least 25 daughters in genetic evaluation.

Table 5. Genetic level for conformation traits, Red breeds. Bulls born in 2012 or later.

Country	No. of bulls	Frame		Feet&legs		Udder	
		Average	STD	Average	STD	Average	STD
Canada	47	100,1	6,0	102,0	4,3	108,1	8,5
Germany	23	105,3	9,9	106,7	3,5	101,7	10,1
DNK/FIN/SWE	361	98,4	10,6	100,3	5,2	101,3	8,3
UK	10	104,5	7,7			109,0	7,8
Norway	150	104,0	6,8	98,8	4,6	87,7	7,9
USA	5	104,2	8,7	104,6	2,5	108,8	11

Table 6. Genetic level of conformation traits, Holstein. Bulls born in 2012 or later.

Country	No	Frame		Feet&legs		Udder	
		Average	STD	Average	STD	Average	STD
Australia	44	113,1	9,1	98,8	4,2	98,6	13,4
Belgium	36	112,3	12,6	103,4	6,5	106,3	10,8
Canada	562	115,7	9,6	101,0	5,6	111,0	9,3
Switzerland	137	114,3	9,3	100,1	5,4	108,1	8,0
Czech Republic	43	113,7	7,4	101,8	4,8	101,1	11,9
Germany	885	111,5	9,6	102,3	6,0	106,7	9,2
DNK/FIN/SWE	500	101,4	11,1	101,3	6,3	103,7	8,6
Spain	138	117,2	9,4	100,8	6,0	107,8	7,8
Estonia	40	105,3	5,7	100,0	5,2	93,7	10,7
France	416	114,0	10,6	100,9	5,6	108,2	9,1
UK	118	112,9	11,8	100,0	4,9	106,5	12,1
Hungary	7	110,6	6,7	101,3	6,8	103,6	8,7
Ireland	40	92,0	12,9	96,5	6,3	79,6	14,7
Italy	374	114,4	10,1	100,6	4,6	108,3	9,6
Japan	427	114,6	9,1	100,4	4,6	104,6	8,9
Korea	11	110,8	5,9	96,5	3,2	102,0	5,2
Luxembourg	8	110,6	7,3	101,1	2,3	102,6	6,1
Netherlands	871	110,7	10,2	103,0	6,3	105,4	9,7
New Zealand	629	85,5	10,1	105,0		92,0	
Poland	276	108,9	9,9	100,0	4,4	96,2	8,7
Slovenia	29	102,0	12,2	98,3	6,2	94,8	8,3
USA	1594	113,3	10,0	100,8	5,3	110,8	8,8

Table 7. Genetic level of conformation traits, Jersey. Bulls born in 2012 or later.

Country	No	Frame		Feet&legs		Udder	
		Average	STD	Average	STD	Average	STD
Australia	8	108,9	8,6	102,4	4,2	89,4	9,5
Canada	17	113,5	7,4	104,4	5,5	100,8	8,2
DNK/FIN/SWE	141	100,6	9,6	100,4	6,6	101,1	9,0
UK	8	103,9	6,0			101,1	7,7
USA	537	113,2	8,7	102,8	6,7	99,8	8,0

International comparison for conformation traits among most important populations show that:

- Red breeds: Canada have generally higher genetic level for udder than DNK/FIN/SWE. Compared to Norway, DNK/FIN/SWE have similar genetic level for feet&legs and higher level for udder
- Holstein: DNK/FIN/SWE has lower genetic level for frame than most other populations. North America, Spain, France, Germany, UK, Netherlands and Italy have the highest genetic level for frame. Populations with grass based dairy farming like Ireland and New Zealand has lower genetic level for frame. For feet&legs there are only small differences between populations. DNK/FIN/SWE has a below average genetic level for udder. North America has the highest genetic level for udder.
- Jersey: Denmark has lower genetic level for frame than USA, but same level for udders

Somatic cell count and udder health

Interbull does two international genetic evaluations – one for somatic cell count and one for udder health. In the first one only somatic cell count is included for all countries. NAV sends breeding values for somatic cell count to Interbull, so Nordic bulls get official breeding values for somatic cell count in countries where this trait is official. In the second evaluation breeding values based on mastitis diagnoses are included. NAV's official breeding value for udder health is used. For countries that do not record mastitis diagnoses, somatic cell count is included in this evaluation.

Index for udder health is published in the Nordic countries, when reliability is 40% or higher. In tables 8-10 is a comparison of genetic level of udder health for bulls from different countries.

Table 8. Genetic level for udder health, Red breeds. Bulls born in 2012 or later.

Country	No. of bulls	Average	STD
Australia	14	96,0	7,9
Canada	7	94,9	7,2
Germany	11	95,4	9,6
DNK/FIN/SWE	392	100,9	8,7
Estonia	15	93,1	11,2
Norway	274	95,3	10,8
New Zealand	38	90,1	10,0
USA	9	92,7	12,2

Table 9. Genetic level for udder health, Holstein. Bulls born in 2012 or later.

Country	No. of bulls	Average	STD
Australia	118	94,3	8,3
Austria	6	101,5	6,4
Belgium	41	97,9	8,8
Canada	286	96,7	8,3
Switzerland	13	94,8	5,6
Czech Republic	41	97,1	7,5
Germany	910	97,2	8,7
DNK/FIN/SWE	499	102,2	7,8
Spain	133	94,5	8,2
Estonia	40	94,0	8,4
France	395	98,0	6,8
UK	100	95,9	8,7
Hungary	8	98,7	6,6
Ireland	155	94,8	9,7
Israel	110	99,0	9,0
Italy	364	97,4	8,4
Japan	375	93,0	8,1
Korea	30	90,8	5,8
Luxembourg	7	97,3	6,7
Netherlands	945	98,5	7,6
New Zealand	733	90,7	8,8
Poland	299	94,3	8,8
Slovenia	34	92,3	9,9
USA	906	98,8	8,1

Table 10. Genetic level for udder health, Jersey. Bulls born in 2012 or later.

Country	No. of bulls	Average	STD
Australia	19	88,5	6,6
Canada	9	84,3	12,2
DNK/FIN/SWE	125	100,6	7,3
UK	8	87,6	9,2
New Zealand	418	94,5	8,4
USA	617	90,7	8,4

International comparison for udder health among most important populations show that:

- Red breeds: DNK/FIN/SWE has higher genetic level than Norway
- Holstein: DNK/FIN/SWE have higher genetic level than other major European populations, USA and Canada
- Jersey: Denmark is substantially better than USA

Longevity

In tables 11-13 is a comparison of genetic level of longevity for bulls from different countries. Bulls are included if they have at least 40 daughters in the genetic evaluation.

Table 11. Genetic level for longevity, Red breeds. Bulls born in 2011 or later.

Country	No. of bulls	Average	STD
Australia	19	93,0	8,7
Canada	51	89,1	9,4
Germany	27	91,5	7,4
DNK/FIN/SWE	350	101,8	8,1
UK	8	81,0	5,6
Norge	310	91,2	7,6
New Zealand	54	84,9	5,9
USA	11	81,9	7,7

Table 12. Genetic level for longevity, Holstein. Bulls born in 2011 or later.

Country	No. of bulls	Average	STD
Australia	109	88,8	5,8
Austria	7	92,4	2,4
Belgium	60	99,9	9,1
Canada	789	98,4	9,2
Switzerland	166	88,8	7,6
Czech Republic	7	99,2	8,3
Germany	1150	99,6	9,2
DNK/FIN/SWE	610	102,2	8,2
Spain	174	96,5	6,2
France	628	92,4	7,8
UK	198	96,8	8,3
Hungary	11	95,1	5,7
Ireland	221	91,5	6,2
Israel	142	92,7	5,0
Italy	493	96,6	6,8
Luxembourg	11	97,6	10,1
Netherlands	1286	98,6	8,4
New Zealand	927	89,0	6,4
Poland	492	91,7	7,7
Slovenia	47	89,6	8,2
USA	3441	103,8	9,2

Table 13. Genetic level for longevity, Jersey. Bulls born in 2011 or later.

Country	No. of bulls	Average	STD
Australia	29	87,4	6,4
Canada	19	90,4	7,3
DNK/FIN/SWE	121	100,8	7,0
UK	6	87,2	6,4
New Zealand	544	91,1	6,2
USA	578	94,0	7,5

International comparison for longevity among most important populations shows that:

- Red breeds: DNK/FIN/SWE has higher level than the other populations
- Holstein: France have the lowest level, while USA and DNK/FIN/SWE have the highest level
- Jersey: Denmark has higher genetic level than other populations

Calving – maternal and direct

For Red breeds Canada, Denmark, Finland, Norway, Sweden and the United States send data to this evaluation. It has not been possible to obtain sufficient high correlations between countries for still birth so the international evaluation only includes calving ease (maternal and direct) for Red breeds.

In the Holstein group there are international breeding values for both still birth (maternal and direct) and calving ease (maternal and direct), but only for first lactation. In the Nordic countries also information from later lactations and from birth weight is included in calving, maternal and calving, direct.

We have calculated international indices for calving, maternal and calving, direct by performing a regression between NAV breeding values for still birth and calving ease and NAV breeding value for calving for Nordic bulls born in 2001-2006. The calculated regression coefficients are used to calculate a calving index for foreign bulls - same method is used for calving, maternal and calving, direct.

In Tables 14 and 15 the average genetic level for Red breed and Holstein bulls is shown for different countries. Only bulls born in 2011 or later are included. Bulls need to have breeding values for yield to be included.

Table 14. Genetic level for calving, maternal and calving, direct, Red breeds. Bulls born in 2012 or later.

Country	Calving, direct			Calving, maternal		
	No. of bulls	Average	STD	No. of bulls	Average	STD
Canada	47	95,4	6,9	16	98,8	5,1
DNK/FIN/SWE	330	100,7	7,7	322	101,6	6,6
Norway	274	99,2	8,3	274	88,8	7,0
USA	5	89,2	9,1	0		

Table 15. Genetic level for calving, maternal and calving, direct, Holstein. Bulls born in 2012 or later.

Country	Calving, direct			Calving, maternal		
	No. of bulls	Average	STD	No. of bulls	Average	STD
Australia	128	95,4	6,0	4	97,0	8,2
Austria	8	93,9	7,6	6	95,7	7,2
Belgium	39	96,9	6,1	36	99,1	6,7
Canada	707	97,8	6,4	631	100,1	8,7
Switzerland	157	93,8	6,4	99	93,4	9,8
Germany	932	97,6	7,1	791	98,8	9,3
DNK/FIN/SWE	518	101,4	7,2	510	102,1	7,8
Spain	81	95,6	5,0	36	98,4	4,2
France	458	97,6	7,2	398	100,4	9,5
UK	158	98,7	5,6	57	98,8	7,9
Hungary	6	96,3	5,6	5	97,4	5,5
Ireland	154	100,8	4,9	1	120,0	
Israel	40	96,1	6,4	118	96,1	6,0
Italy	406	95,5	6,6	152	96,7	8,4
Luxembourg	9	94,2	8,7	7	98,4	6,5
Netherlands	947	97,5	6,5	790	97,7	8,4
New Zealand	725	99,9	5,1	1	99,0	
USA	3290	98,5	5,9	2601	104,9	6,8

International comparison for calving traits among most important populations shows that:

- Red breeds: DNK/FIN/SWE and Norway have similar genetic level for calving, direct. For calving, maternal DNK/FIN/SWE has a higher level than Norway
- Holstein: DNK/FIN/SWE are among the best populations for both calving, direct and calving, maternal.

Female fertility

NAV calculates breeding values for female fertility based on linear regression between NAV breeding values for female fertility and NAV breeding values for the sub-indices in female fertility. Basis for the regressions are Nordic bulls born in 2001-2005 – see more information below. The estimated regression coefficients are used to calculate international breeding value for female fertility for foreign bulls.

In practice 3 regressions are calculated with different explaining variables (Jersey only 2 and 3):

- 1: Female fertility = Ability to conceive (R^2 , HOL = 0,05) (R^2 , Red breeds = 0,35)
- 2: Female fertility = Days open (R^2 , HOL = 0,87) (R^2 , Red breeds = 0,85) (R^2 , Jer = 0,87)
- 3: Female fertility = Ability to return to recycle after calving + ability to conceive + Days open (R^2 , HOL = 0,96) (R^2 , Red breeds = 0,94), (R^2 , Jer = 0,94).

R^2 (degree of explanation) indicates the proportion of the variance of the index for female fertility, that the traits in the regression can explain. Since the regression is used on foreign bulls, and the genetic correlations between international and NAV traits are not 1, the observed degree of explanation will be lower.

For each foreign bull we use the regression with the greatest explanatory power given the international sub-indices that are available. The degree of explanation therefore depends largely of the traits being available from the different countries.

Table 16. Genetic level for female fertility, Red breeds. Bulls born in 2012 or later.

Country	No. of bulls	Average	STD
Australia	13	98,6	11,3
Canada	29	95,3	9,0
Germany	9	88,3	7,4
DNK/FIN/SWE	305	100,0	8,6
UK	7	100,4	4,5
Norway	253	114	8,9
New Zealand	22	99,1	5,8
USA	7	94,9	7,9

Table 17. Genetic level for female fertility, Holstein. Bulls born in 2012 or later.

Country	No. of bulls	Average	STD
Australia	73	88,1	7,9
Austria	6	94,5	13,6
Belgium	33	97,8	9,7
Canada	633	94,0	9,8
Switzerland	105	94,0	3,7
Czech Republic	30	95,9	2,5
Germany	790	93,9	8,8
DNK/FIN/SWE	512	101,9	10,5
Spain	40	91,0	7,6
France	365	94,0	8,6
UK	168	97,5	8,7
Ireland	98	107,6	3,5
Israel	98	97,8	2,5
Italy	353	92,8	7,7
Japan	65	87,5	8,3
Luxembourg	8	92,3	7,4
Netherlands	886	95,0	8,6
New Zealand	662	100,1	5,0
Poland	189	90,6	7,7
USA	2890	97,6	9,2

Table 18. Genetic level for female fertility, Jersey. Bulls born in 2012 or later.

Country	No. of bulls	Average	STD
Australia	18	91,9	8,5
Canada	9	88,4	9,9
DNK/FIN/SWE	127	100,7	10,6
UK	5	94,6	10,2
New Zealand	378	98,7	6,6
USA	478	86,5	11,5

International comparison for female fertility among most important populations shows that:

- Red breeds: DNK/FIN/SWE has a lower level than Norway
- Holstein: DNK/FIN/SWE and USA are the populations with the highest genetic level. However Ireland have the highest genetic levels
- Jersey: Genetic level is higher in Denmark than the other major countries

Milking speed and temperament

In Tables 19-21, the genetic level for bulls from different countries, born in 2012 or later are shown for Holstein, Red breeds and Jersey.

Table 19. Genetic level for milking speed and temperament, Red breeds. Bulls born in 2012 or later.

Country	Milking speed			Temperament		
	No. of bulls	Average	STD	No. of bulls	Average	STD
Australia	11	99,3	3,3	11	102,6	4,3
Canada	45	93,3	9,7	43	92,4	8,1
Germany	21	102,5	5,9	21	102,4	4,2
DNK/FIN/SWE	348	101,5	8,0	311	100,7	9,8
Norway	201	96,8	2,1	203	97,6	2,8
New Zealand	23	100,8	6,3	23	99,9	5,3

Table 20. Genetic level for milking speed and temperament, Holstein. Bulls born in 2012 or later.

Country	Milking speed			Temperament		
	No. of bulls	Average	STD	No. of bulls	Average	STD
Australia	88	103,1	6,4	88	101,9	5,8
Austria	8	93,4	6,4			
Belgium	21	95,4	8,4	20	101,3	8,6
Canada	478	99,8	9,0	467	103,7	8,4
Switzerland	145	94,0	7,5	145	99,5	7,4
Germany	738	98,4	9,2	576	103,1	10,6
DNK/FIN/SWE	496	99,3	8,7	324	102,5	14,4
France	350	97,3	8,8	348	103,1	9,3
UK	136	101,1	15,1	124	102,5	10,4
Italy	364	98,9	8,2	360	103,7	6,0
Luxembourg	8	102,9	9,7	6	100,9	3,1
Netherlands	765	96,8	9,9	723	102,7	8,9
New Zealand	666	103,9	4,8	666	99,2	2,6
Slovenia	35	96,4	4,8			
USA	643	100,5	11,1	625	106,0	10,3

Table 21. Genetic level for milking speed, Jersey. Bulls born in 2012 or later.

Country	No. of bulls	Average	STD
Australien	20	98,5	7,1
Canada	15	91,4	10,3
DNK/FIN/SWE	123	99,8	9,5
New Zealand	361	98,6	7,4
USA	45	96,1	8,2

International comparison for milking speed and temperament among most important countries show that:

- **Red breeds:** DNK/FIN/SWE has a higher genetic level for milking speed than Norway and Canada. For temperament the levels are similar
- **Holstein:** DNK/FIN/SWE has similar level as other populations for milking speed and temperament.
- **Jersey:** Denmark has similar genetic level as New Zealand and USA

NTM for Nordic and foreign bulls

NTM index is calculated for all bulls (Nordic and others) that have official breeding values (NAV breeding values or international EBVs) for yield, udder health and conformation.

Interbull NTM is calculated by weighing the Interbull / NAV breeding values for yield, female fertility, calving (maternal and direct), udder health, longevity, feet&legs, udder, milking speed and temperament. The same economic weight factors are used as for NAV breeding values.

Rules for calculation of NTM based partly or entirely on international breeding values are stated below in order of priority.

1. Bull has NAV breeding value for a trait

If the bull has NAV breeding value for a specific trait, this is used in the calculation of NTM - no matter if the bull also has international breeding value for that trait.

2. Bull has no NAV breeding value, but has an international breeding value for a trait

If the bull does not have NAV breeding value for the trait, the international breeding value is used, provided that Interbull calculates international breeding values for that trait and the bull comes from a country which provides data for that trait.

3. Bull has no NAV or no international breeding value for a trait

For traits where no Interbull EBV is available or the bull has no Interbull EBV, and at the same time it is not tested in the Nordic countries, a pedigree index is used. Pedigree index is calculated as $\frac{1}{2} (EBV_{\text{sire}} - 100) + \frac{1}{4} (EBV_{\text{maternal grand sire}} - 100) + 100$. The contributions from the sire and maternal grand sire can be based on either NAV breeding values or international breeding values. If EBV_{sire} or $EBV_{\text{maternal grand sire}}$ are unofficial the pedigree index is set to 100.

Publication rules for NTM

All foreign and Nordic bulls that have Interbull breeding values for yield, udder health and udder get a public Interbull NTM. This NTM is calculated with a lower reliability than an NTM for Nordic proven bulls, where information for all traits is always available.

Genetic level for Interbull NTM

In tables 22-24 genetic level for Interbull NTM for Jersey, Red breeds and Holstein are shown. Bulls included are born in 2011 or later.

Table 22. Genetic level for NTM, Red breeds. Bulls born in 2012 or later.

Country	No. of bulls	Average	STD
Canada	15	-14,7	10,3
Germany	10	-0,6	7,8
DNK/FIN/SWE	321	6,1	8,8
Norway	150	-7,5	10,3

Table 23. Genetic level for NTM, Holstein. Bulls born in 2012 or later.

Country	No. of bulls	Average	STD
Australia	29	-9,6	8,0
Belgium	34	-0,1	10,5
Canada	315	1,7	9,1
Switzerland	13	-7,0	11,0
Czech Republic	38	-0,9	6,4
Germany	852	1,5	9,9
DNK/FIN/SWE	503	8,0	8,9
Spain	104	-4,1	8,1
Estonia	40	-11,2	7,2
France	377	-1,7	8,1
UK	130	2,0	9,5
Hungary	7	-1,7	6,2
Ireland	43	-10,2	7,9
Italy	362	-1,8	9,3
Japan	65	-4,0	9,8
Luxembourg	8	1,9	6,9
Netherlands	886	0,9	9,3
Poland	212	-10,8	9,0
Slovenia	33	-19,5	7,5
USA	908	7,5	8,8

Table 24. Genetic level for NTM, Jersey. Bulls born in 2012 or later.

Country	No. of bulls	Average	STD
Australia	8	-12,5	3,3
Canada	5	-9,6	11,6
DNK/FIN/SWE	112	4,8	8,2
USA	411	-6,1	8,6

International comparison of NTM among most important populations shows that:

- Red breeds: DNK/FIN/SWE is better than Canada and Norway
- Holstein: DNK/FIN/SWE and USA have the highest level
- Jersey: Denmark's average NTM is 11 index points better than USA

Changes since last routine run

In the routine evaluation in August 2019 the following changes are done compared to April 2019 routine evaluation in major countries:

Yield

- All breeds from USA have change in information due to seasonal trend

Fertility

- All breeds from New Zealand have decrease in information due to update of data
- All breeds from USA has fixed error in definition of management groups. Further drop in information due to seasonal variation

Calving

- All breeds from USA have decrease in information due to seasonal trend

Conformation

- No change

Udder health

- All breeds from Netherlands has corrected error in genetic merit information

Longevity

- No change

Milking speed and temperament

- Following countries and breeds have made base changes:
 - Holstein in Italy

Genomic tested young Holstein bulls

In the tables below, only Holstein sires that have breeding values based on genomic information and no daughters is shown

Averages are only shown for countries with more than 20 bulls.

Yield

In tables 25 is a comparison of the genetic level of yield for bulls from different countries.

Table 25. Genetic level for yield traits, Holstein. Bulls born in 2016 or later.

Country	No. of bulls	Milkindex	Fatindex	Proteinindex	Y-index	Y-index STD
Belgium	135	107,4	107,7	106,0	106,4	9,1
Brasil	5	108,4	114,8	107,6	110,2	7,5
Canada	536	117,3	120,2	117,6	118,7	6,8
Switzerland	16	104,4	106,4	103,5	104,5	7,4
Germany	509	115,7	115,3	116,7	116,3	6,8
DNK/FIN/SWE	201	107,0	113,6	112,4	113,9	6,8
Spain	75	115,0	109,1	111,4	109,8	8,4
France	349	110,7	112,2	112,9	113,1	6,7
UK	41	107,4	116,4	110,0	113,1	14,2
Hungary	63	112,6	111,5	108,3	108,8	9,0
Italy	146	114,1	115,7	115,6	116,0	6,0
Luxembourg	10	119,6	119,8	117,4	118,0	5,2
Netherlands	328	110,5	115,9	114,7	116,0	7,4
Poland	105	112,5	111,8	112,3	112,0	6,9
USA	1132	115,3	121,1	116,1	118,3	6,8

International comparison for yield shows that DNK/FIN/SWE, has nearly similar level as other major countries

Conformation

The international genetic evaluation is done for 16 linear traits for Holstein. In addition, frame condition score and locomotion is included in this trait group.

Calculation of frame, feet&legs and udder follows same principles as for daughter proven bulls.

In tables 26 is a comparison of genetic level of composite conformation traits for bulls from different countries.

Table 26. Genetic level of conformation traits, Holstein. Bulls born in 2016 or later.

Country	No	Frame		Feet&legs		Udder	
		Average	STD	Average	STD	Average	STD
Belgium	135	114,5	7,1	102,5	3,3	111,8	6,0
Brasil	5	113,4	6,2	100,8	3,8	106,6	6,5
Canada	536	114,5	8,5	100,9	3,9	115,4	7,3
Switzerland	16	118,1	8,6	102,1	3,2	118,2	7,4
Germany	509	113,2	8,5	104,7	4,5	115,7	6,7
DNK/FIN/SWE	201	105,4	9,6	103,9	4,2	113,1	6,8
Spain	75	117,3	10,0	104,9	5,8	117,7	8,1
France	349	119,0	9,6	104,5	4,4	118,7	7,7
UK	40	105,6	9,2	100,6	3,6	109,1	9,1
Hungary	63	114,2	7,7	100,1	4,1	108,4	7,8
Italy	146	116,5	8,3	102,4	4,3	114,2	7,5
Luxembourg	10	115,7	8,1	101,7	3,8	114,2	7,1
Netherlands	327	110,5	8,7	106,5	5,2	111,7	8,2
Poland	105	115,1	8,8	102,8	4,5	109,5	7,1
USA	1132	111,2	8,8	101,3	4,0	112,6	7,8

International comparison for conformation traits among most important populations shows that DNK/FIN/SWE has lower genetic level for frame than most other populations. For feet&legs and udder there are only small differences between populations.

Somatic cell count and udder health

In tables 27 is a comparison of genetic level of udder health for bulls from different countries.

Table 27. Genetic level for udder health, Holstein. Bulls born in 2016 or later.

Country	No. of bulls	Average	STD
Belgium	135	98,3	6,8
Brasil	5	100,4	3,0
Canada	536	99,6	5,7
Switzerland	16	96,4	5,8
Germany	509	102,1	6,5
DNK/FIN/SWE	201	107,0	6,6
Spain	75	104,1	8,8
France	347	106,9	6,4
UK	40	102,0	5,5
Hungary	63	94,7	8,1
Italy	146	102,6	7,6
Luxembourg	10	100,2	7,3
Netherlands	327	104,2	6,8
Poland	105	102,2	6,4
USA	1137	99,0	5,5

International comparison for udder health among most important populations show that DNK/FIN/SWE, Netherlands and France have higher genetic level than other major European and North American populations

Longevity

In tables 28 is a comparison of genetic level of longevity for bulls from different countries.

Table 28. Genetic level for longevity, Holstein. Bulls born in 2016 or later.

Country	No. of bulls	Average	STD
Belgium	17	109,1	8,6
Brasil	5	103,5	4,2
Canada	536	109,8	4,9
Switzerland	16	102,9	6,1
Germany	508	112,9	6,4
DNK/FIN/SWE	201	115,2	6,0
Spain	75	108,8	8,2
France	347	109,5	5,8
UK	41	110,8	6,9
Hungary	63	103,1	6,1
Italy	146	107,9	5,3
Luxembourg	10	110,9	3,8
Netherlands	327	111,5	6,5
Poland	52	105,5	7,0
USA	1138	110,0	5,3

International comparison for longevity among most important populations shows that DNK/FIN/SWE has the highest level closely followed by Germany

Calving – maternal and direct

In Tables 29 the average genetic level for bulls is shown for different countries.

Table 29. Genetic level for calving, maternal and calving, direct, Holstein. Bulls born in 2016 or later.

Country	Calving, direct			Calving, maternal		
	No. of bulls	Average	STD	No. of bulls	Average	STD
Belgium	134	98,6	4,4	135	102,9	5,2
Brasil	5	100,6	6,2	5	106,4	5,2
Canada	519	101,0	4,1	536	109,3	5,1
Switzerland	15	96,9	5,5	16	101,1	5,5
Germany	485	100,8	5,2	504	106,1	5,5
DNK/FIN/SWE	177	103	5,1	201	107,4	5,5
Spain	70	99,0	4,3	70	103,6	5,3
France	345	98,8	4,9	346	106,3	6,3
UK	40	100,5	3,4	40	108,4	5,1
Hungary	63	98,6	4,6	63	104,6	5,0
Italy	146	99,7	4,8	146	105,7	5,3
Luxembourg	10	100,6	5,5	10	107,9	3,3
Netherlands	305	102,5	5,1	327	105,5	5,7
Poland	52	99,7	3,6	52	104,8	6,9
USA	1054	102,3	4,4	1132	110,2	4,9

International comparison for calving traits shows that DNK/FIN/SWE is the best population for calving and have a similar level as most other countries for calving, maternal.

Female fertility

In Tables 30 the average genetic level for bulls is shown for different countries.

Table 30. Genetic level for female fertility, Holstein. Bulls born in 2016 or later.

Country	No. of bulls	Average	STD
Belgium	135	96,3	4,1
Brasil	5	96,6	7,6
Canada	536	101,2	7,1
Switzerland	16	98,4	8,6
Germany	509	100,5	7,2
DNK/FIN/SWE	201	107,1	7,1
Spain	75	96,7	7,7
France	349	99,5	6,7
UK	37	105,3	8,3
Hungary	30	97,5	6,3
Italy	146	99,2	7,0
Luxembourg	10	97,3	6,2
Netherlands	327	100,9	7,3
Poland	105	96,6	7,4
USA	1130	100,8	6,1

International comparison for female fertility among most important populations shows that DNK/FIN/SWE is in the top.

Milking speed and temperament

In Tables 31, the genetic level for bulls from different countries.

Table 31. Genetic level for milking speed and temperament, Holstein. Bulls born in 2016 or later.

Country	Milking speed			Temperament		
	No. of bulls	Average	STD	No. of bulls	Average	STD
Belgium	15	99,4	4,8	14	107,6	5,6
Brasil	5	93,0	2,7			
Canada	536	100,4	2,6	523	107,1	4,1
Switzerland	16	101,4	3,8	492	106,1	7,0
Germany	501	99,5	4,2	197	105,8	5,5
DNK/FIN/SWE	201	102,7	3,4	69	107,0	1,5
Spain	70	95,7	2,0	339	106,6	6,1
France	340	98,5	2,6	35	107,4	1,5
UK	36	101,4	2,9	27	106,7	2,4
Hungary	30	99,0	2,9	136	106,2	5,1
Italy	146	99,3	3,8	10	104,7	1,6
Luxembourg	10	100,0	1,8	323	105,8	10,8
Netherlands	327	98,4	4,5	44	104,8	2,2
Poland	51	98,1	2,2	1097	107,1	4,5
USA	1112	101,8	3,0	14	107,6	5,6

For temperament and milking speed there are only small differences between populations.

Changes since last routine run

In the routine evaluation in August 2019 the following changes are done compared to April 2019 routine evaluation:

Yield

- Holstein from Spain have changed from a GBLUP model to a SNPBLUP model and changed base change

Fertility

- Holstein from Spain have changed from a GBLUP model to a SNPBLUP model and changed base change

Calving

- No change

Conformation

- Holstein from Spain have changed from a GBLUP model to a SNPBLUP model and changed base change

Udder health

- Holstein from Spain have changed from a GBLUP model to a SNPBLUP model and changed base change
- Holstein from Holland has changed error in genetic merit information

Longevity

- Holstein from Spain have changed from a GBLUP model to a SNPBLUP model and changed base change

Milking speed and temperament

- No change

Dates of publication of Interbull breeding values in 2019:

Table 32. Dates of publication in 2019

Month	Date
April	2
August	13
December	3

The indices can be found at the national databases in Denmark, Sweden and Finland 2-3 days after they have been published by Interbull.

Regards

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