Choice of Scales for Delivery of Genetic Evaluations to the Public

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Introduction

Base changes provide an opportunity to redefine scales or traits to make genetic evaluations simpler to interpret for both domestic and foreign breeders. National survey forms (Interbull, 2004) indicate that 18 of 25 countries plan to update their genetic bases for yield traits every 5 years as recommended; 6 of 25 update every year, and 1 updates at each evaluation. Several countries plan to change their bases in January or February of 2005, but many did not yet indicate the exact month. Table 1 summarizes base change plans and the scales used for evaluating somatic cell and longevity. Comparisons of means and SD may help countries to decide if trait scales should be revised.

Table 1. Base change schedules and udder health and longevity scales.

	Base Change		Udder Health (Somatic Cell) Scales					Longevity Scales	
Country	Years	Month	Unit	Mean	SD	Dir[1]	Log	Mean	SD
NLD	5		RBV	100	4	+	2	100	4
DNK	<1	each	RBV	100	5	+	?	100	5
SWE	1	Jan	RBV	100	7	+	10	100	7
NOR	1		RBV	100	7	+	2		
FIN	1	Jan	RBV	100	10	+	e		
EST	5	Feb	RBV	100	12	+	2		
DEU	5		RBV	100	12	+	2	100	8
FRA	1	Jun	STA	0	1	+	2	0	1
ESP	5		STA	0	1	+	2	0	1
ITA	5	Jan	STA	4	1	+	2	3	1
HUN	5		STA	0	1	–	2		
USA	5	Feb	PTA	3.1	.22	–	2	0	1.7
CAN	1	Feb	PTA	3.0	.25	–	2	3	0.2
BEL	5		EBV	3.0	.47	–	2		
JPN	5	Feb	EBV	2.4	.42	–	2		
CHE	5		EBV	0	.53	–	2	0	4.1
AUS	5		EBV	0	.11	–	10	0	1.9
ZAF	5	May	EBV	0	.14	–	e		
ISR	5		PTA	0	.26	–	2	0	7.0
GBR	5	Feb	PTA	0	13	–	e	0	0.3
NZL	5		EBV					0	11.0
IRL	5		STA					0	1
POL	5								
CZE	5								
SVN	5								

[1] Direction of + indicates that higher numbers are desired; – indicates lower are desired.

Trait scales

Udder health (UH) scales currently are reversed in 9 of 19 countries so that lower somatic cell score (SCS) results in higher evaluations. The four countries that report clinical mastitis evaluations all reverse their scales. Six countries in northern Europe report relative breeding values (RBV) with a mean of 100 but different multipliers (4, 5, 7, 10, or 12) of genetic standard deviation (SD). The variety of evaluation scales is surprising because each country begins by measur-ing the same metric unit: somatic cells per ml of milk.

Longevity is always reported with favorable positive numbers even when the original parameter is culling rate. Standardized evaluations are common, with 4 of 15 countries reporting RBV and 3 reporting standardized genetic merit (STA's) with a mean of 0 and a variance of 1. Other countries report actual units for longevity including AUS, CHE, and USA with months, CAN and GBR with lactations, and NZL and ISR with days. As a result, SD are not consistent.

Conformation scales are more similar because actual units are not used when 19 or more traits are displayed as a group. Linear trait scales are designed to equalize phenotypic variance, but most countries standardize again to equalize genetic variance by dividing by genetic SD. Of the countries with conformation evaluations, 9 of 21 report STA's, while 8 of 21 report RBV's with means of 100 and SD multipliers that are constant within a country but different across countries. A few countries (ISR, NZL, ZAF, and USA non-Holstein breeds) report EBV or PTA without dividing by genetic SD, and 1 country (CAN) stan-dardizes PTA to a mean of 0 and a SD of 5.

Yield trait scales differ for several reasons. Most evaluations are expressed as EBV kg except four countries (GBR, IRL, ISR, and USA) that report PTA, four (DNK, FIN, NOR, and SWE) that report RBV, and 1 that reports pounds. Actually, milk is most often measured by volume rather than weight as it leaves the cow, fills the bulk tank, and is sold to consumers. Dairy cattle breeders still refer to kgs (or lbs) rather than liters because, long ago, milk recording in-volved hanging buckets of milk on suspended weight scales. Five countries (AUS, FRA, ITA, NOR, and USA) adjust yields to mature equivalent using multiplicative age factors and four countries (DNK, IRL, SWE, and ZAF) adjust to first lactation yield, but most now adjust genetic variances to average age or to average of the first three lactations. Even if all countries adopted identical units, SD of evaluations would differ across countries because variances of yield traits increase as yields increase.

Although fat testing is generally uniform, protein testing differs across countries. Two protein standards are in use: crude protein, which includes some non-protein nitrogen; and true protein. True protein percentage equals crude protein percentage minus 0.19%. For example, 3.19% crude protein equals 3.00% true protein. Consequently, true protein yields are 5 to 6% less than crude protein yields. In a recent survey, VanRaden and Powell (2000) indicated that four countries (AUS, FRA, HUN, and USA) report true protein.

USA revisions

New genetic evaluation models or trait scales were introduced at each previous USA base change as indicated in Table 2. In August 2000, true protein yields and percentages replaced crude protein to be consistent with bulk tank samples and milk payments that are based on true protein. Also, Net Merit units were multiplied by 3 to convert from per-lactation to lifetime profit dollars.

Table 2. History of model and trait scale revisions occurring at USA base changes.

Year	Revision
1965	Mean yield was subtracted (Predicted Difference replaced Predicted Average).
1974	Modified Contemporary Comparison was introduced.
1984	Red/White and Holstein bases were separated.
1989	Animal Model was introduced. Red/White and Holstein bases were merged.
1995	New age-parity adjustments decreased estimates of genetic trend.
2000	Net Merit was converted to lifetime dollars. True protein replaced crude protein.

At the next base change in February 2005, the United States may convert predicted transmitting ability (PTA) for SCS to the reversed, standardized scale used by France and Spain with mean of 0 (instead of breed mean) and SD of 1. Current evaluations are converted to PTA UH using the formula PTA UH = −5 (PTA SCS − breed mean). The range for PTA UH is then the same as for con-formation traits and slightly less than for productive life and daughter pregnancy rate. Selection index formulas will need slight revision if any of the traits in-cluded are expressed using a different scale.

The genetic variance base for yield traits was last updated in 1995. As a result, the SD of PTA will increase by about 11% when the USA base is updated in 2005. For most traits, genetic progress during the last 5 years was similar to progress during the previous 5 years.

International revisions

International marketing is difficult because so many different genetic eval-uation scales are in use. Many customers do not understand all of the numbers regardless which of the 25 national scales is used. Thus, marketers often advertise using only pictures and no genetic evaluations. For example, no genetic evaluations were displayed in 9 of 19 full-page advertisements for individual bulls in the March 2004 issue of Holstein International magazine. The advertised bulls were from 9 countries. Genetic evaluation results on about 12 different national scales were listed together in the same table. To compare bulls, readers of such magazines must either learn foreign scales or just look at the pictures.

Recommended scales may give countries a good excuse to change trait definitions, because few domestic cust-omers request change. A common SD multiplier would be very helpful for countries that report RBV. Most breeders are familiar with the standard normal distribution used for conformation eval-uations and might accept standardized evaluations for other traits, including milk, fat, and protein yields. Holstein USA has provided STA for all traits in the graphs of their Sire Summaries book for 20 years. Most countries publish only RBV or STA for longevity and health traits. Real units may appear to provide more information, but few breeders can remember all of the different units that the scales represent due to the growing number of traits. Standardization using SD of true BV instead of EBV seems more appealing in theory. Comparisons are easier when means and genetic SD are more similar across traits and countries.

Before scales or models are updated, evaluations should be submitted to an Interbull test run. The only test run before the recommended base change in 2005 occurs September 1, 2004. National evaluation programs must be modified for the test run, then the former programs used for the next evaluation, and then the new programs implemented in 2005. A schedule change might be preferred so that a test run would immediately pre-cede the recommended base change date. However, countries also need to allow time to prepare educational materials (Powell *et al.,* 2000).

Conclusions

Genetic evaluations and selection indexes would be easier to compare if units, bases, and directions were more similar across countries, breed associa-tions, and computing centers. Trait advertising is easier if positive numbers indicate better bulls. Common units eventually may be needed for presenting results from global evaluations of com-bined data (Fikse *et al.,* 2003) or for comparing national scales to a global scale (Powell and VanRaden, 2002). Scale changes and base changes intro-duced together make sense because both changes affect mean and SD. When many traits are evaluated, sub-indexes can provide the public and marketers with fewer numbers that are easier to compare and to display. Each country may define their own scales and bases of expression, but international marketing would be simpler with greater uniformity and harmonization.

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