News about development of the BLUP system: Implementation of competition data.

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In April of this year competition results will be incorporated into the BLUP calculations for Icelandic horses. Until now, the calculations have been based solely on breeding assessments, but from now on, they will include competition results from selected events in sport and gæðingakeppni competitions as well.

Below are the key points, with more detailed explanations in the accompanying text:

- In the updated BLUP calculations, data from sport and gæðingakeppni competitions will be used alongside breeding assessments.
- Competition data from World Ranking events, major gæðingakeppni competitions, and pace competitions in adult classes from 2006 will be included.
- Results from the following competition tests will be used:
    - Tölt (T1, T3, T2, and T4)
    - Four gaits (V1, V2, and B-class)
    - Five gaits (F1, F2, and A-class)
    - Pace tests (250-meter pace, 100-meter pace, and pace test)
- The genetic correlation between similar tests, such as T1 and T2 or four-gait and B-class, is extremely high, therefore these tests are combined into the four abovementioned competition traits.
- Adding the competition data to the BLUP calculations increases the accuracy of the estimated breeding values and allows for the publication of breeding values for competition traits.
    - More extensive data = greater accuracy of the breeding values.
- The accuracy of the new competition traits will be published, but it is always important to consider this accuracy when interpreting BLUP values.
- The heritability of the competition traits ranges from 0.27-0.29, with a very high genetic correlation between them and the traits assessed in breeding assessments.
- The heritability of the competition traits is lower than that of breeding assessments (which is about 0.4), so the primary emphasis will remain on breeding assessments in the BLUP calculations.
- Breeding assessments are strong predictors of competition success and provide valuable insights into the potential use of assessed horses in breeding for competition.
- The updated breeding values will be published in WorldFengur around April 20.

Background

This innovation is based on the doctoral thesis of Elsa Albertsdóttir from 2010, where she demonstrated a strong genetic correlation between the traits assessed at breeding shows and competition results. At the end of 2022, Dr. Þorvaldur Árnason and Gísli Guðjónsson (a master's student at the Swedish University of Agricultural Sciences) updated these findings. They reassessed the heritability of competition traits and their genetic correlation with breeding assessment traits.

Heritability and Genetic Correlation

Heritability indicates the extent to which traits are determined by genetics (both breeding assessment and competition traits are influenced by genetic and environmental factors). It shows how much the assessments reveal about the genetic value of a horse; the higher the heritability, the more informative the assessments are about genetic potential.

The heritability of combined competition traits ranges from 0.27-0.29, which is lower than the heritability of the breeding assessments (which is about 0.4). This means that while competition traits help evaluate breeding potential, greater emphasis will be placed on breeding assessments in the BLUP calculations.

Genetic correlation between two traits indicates how much they are influenced by the same genes. The higher the correlation, the more the traits are influenced by the same genetic makeup.

When examining the genetic correlation between competition tests and breeding assessment traits (see table), it becomes clear that the correlation is extremely high between comparable traits. For example, there is a 93% genetic correlation between *Tölt* in breeding assessments and Tölt competition tests. Moreover, there is a 92% genetic correlation between *Pace* in breeding assessments and Pace competition tests. The genetic correlation between *General impression* and oval track competition tests is high, confirming that this trait strongly predicts competition performance on the oval track.

This demonstrates the significant benefits of incorporating competition data into the BLUP evaluations. This additional information on the traits included in the breeding goal for the Icelandic horse will enhance the current BLUP calculations.

Breeding assessments:	Tölt (comp.)	Four-gait (comp.)	Five-gait (comp.)	Pace (comp.)
Tölt	0.93	0.90	0.85	0.36
Trot	0.81	0.90	0.78	0.28
Pace ≥ 5.5	0.35	0.22	0.79	0.92
Gallop	0.83	0.88	0.75	0.23
General impression	0.95	0.93	0.91	0.42
Rideability	0.90	0.88	0.91	0.71
Walk	0.19	0.53	0.47	0.06
Slow tölt	0.96	0.95	0.82	0.17
Canter	0.76	0.86	0.60	-0.13

Table: The genetic correlation between riding ability traits assessed at breeding shows and the combined competition traits.

Utilization of Data

The updated BLUP values for all conformation and performance traits, height at withers, total score, total score without pace, and competition traits, will be based on data from breeding assessments and the specified competition events.

For example, when evaluating the BLUP value for *Tölt* for an individual, data from its own breeding assessment, assessments of parents/ancestors and offspring, and information from related traits (due to genetic correlation) are used. These related traits include traits evaluated at breeding assessments (such as trot and pace) and the competition traits incorporated into the BLUP evaluation. Thus, competition traits are not weighted separately but are integrated into the system based on their genetic correlation with conformation and riding ability traits.

In breeding evaluations, only one breeding assessment is used for each horse—the highest age-adjusted score. However, all individual horse's competition scores will be used, increasing accuracy with the number of recorded competition results. The accuracy of BLUP values for competition traits in horses with results from at least 4-5 competitions becomes nearly comparable to the accuracy of one breeding assessment despite the lower heritability of individual competition scores.

Additionally, competition traits will be included in **Stallion Selection** and **Virtual mate selection** in WorldFengur, allowing stallions to be ranked based on their BLUP values for specific competition traits. This is particularly beneficial for breeders focusing on producing top competition horses.

Attendance to breeding assessment or competition.

In the current BLUP calculations, the trait *"attendance at breeding assessments"* is only defined for mares. However, this trait will apply to both sexes in the updated BLUP values and will be based on attendance at both breeding assessments and/or competitions.

When this value is calculated, all horses aged six years and older will receive an attendance record (0 = no attendance, 1 = attendance), influencing their BLUP values and that of related horses. The impact varies for different traits, depending on the genetic correlation with the attendance trait.

Attendance has a **heritability of 0.4** and is most strongly correlated with the traits rideability, general impression, tölt, trot, neck-withers-shoulders, and gallop (correlations of **0.39-0.56**). The genetic correlation between attendance and competition traits is **0.24**. Research has shown that the attendance trait helps correct for selection bias, which could otherwise skew the BLUP values.

The fact that a breeding horse produces offspring that are likely to be presented for breeding assessment or competition provides valuable insight into its overall quality. This information strengthens breeding decisions and has been successfully used in the breeding of racehorses.

Accuracy of the updated BLUP values

The accuracy of the updated BLUP values increases **by an average of 10%** when competition data is included. Incorporating the competition data significantly enhances the information about the quality of the horses.

The competition dataset currently includes **121,938 records** for a total of **19,921 horses**. The increase in accuracy is most significant for horses with limited existing data. For stallions, for example, with many offspring, the BLUP values change very little with the addition of competition data.

Regarding the ranking of horses in the new evaluation compared to the current one, the correlation is extremely high (**99%**). The following changes in total score were observed:

- **2.97%** of horses increased by **≥ 5 points**
- **0.39%** increased by **≥ 10 points**
- **0.014%** increased by **≥ 15 points**
- **2.05%** of horses decreased by **≥ 5 points**
- **0.001%** decreased by **≥ 10 points**
- **0%** decreased by **≥ 15 points**

Variance of the BLUP values.

If the variance of the updated BLUP values is examined, it is little bit less than before, which is solely due to how the updated BLUP values are scaled. Because of this, most horses get a slightly lower BLUP value for the total score in the new evaluation (by about 2–3 points).

Benefits

The benefits of incorporating competition results into the BLUP calculations are significant:

- Valuable additional information on gaiting ability, temperament, and general rideability.
- More data on a more significant number of horses increases the accuracy of the BLUP values.
- More valuable insights for the breeding of competition horses.
- Future possibilities of adding more competition tests to cover a broader range of horse types.
- Future potential to assess **longevity** of Icelandic horses based on competition data.