



Recommendations on Female Fertility traits harmonization

Introduction

Female fertility traits have been internationally evaluated by Interbull since 2007. Within the fertility trait group, there is a large diversity in national trait definitions and which traits that are submitted for international evaluations. Such diversity is expected to negatively affect the across-country correlations of the international evaluation, due to differences in trait definitions. One of the MACE evaluation principles is to exploit across-countries genetic correlations for a given trait, and in order to get the most benefit from the evaluation it is desirable to maintain the genetic correlations as high as possible.

To investigate the effect of the large diversity for female fertility, information on the different national evaluations was gathered from the relative GE-forms and used to analyze the across-country correlations using data from the MACE January 2022 test run. Across-country correlations were grouped together based on the traits submitted by the various countries, differences between the groups were analyzed. The results showed that there is a clear difference in across-country correlations depending on the submitted traits, with the use of recommended traits giving the highest correlations.

Female fertility traits

Five traits are included in the international evaluation for Female fertility:

- Maiden heifers' ability to conceive (**HCO**)
- Lactating cows' ability to recycle after calving (**CRC**)
- Lactating cows' ability to conceive measured as a rate trait (**CC1**)
- Lactating cows' ability to conceive measured as an interval trait (**CC2**)
- Lactating cows' measurement of interval calving conception (**INT**).

Currently, there is a total of 22 countries/populations participating in at least one international evaluated trait. The highest participation is for traits CC2 and INT. 9 populations participate in all five traits, while the average participation is 3.6 traits per population. The type of traits sent in

for each of the international evaluated trait may vary between countries. Some countries send the same trait for more than one of the international evaluations, thus contributing to increased variation in the type of data included.

Variation in submitted traits is assumed to negatively affect the between-country correlations. To get a detailed view on the traits recorded at national level and submitted for the Female fertility's international evaluation, the latest provided GE forms for this trait group were reviewed: Participating countries reported 16 different nationally recorded traits sent to Interbull for international evaluation. With such traits appearing to be recorded in more ways than what is defined and recommended by ICAR or Interbull. The list of the 16 national traits, together with their abbreviations and number of countries reporting them is presented in Table 1.

Interbull has defined which of the nationally recorded traits should be considered as the primary choice to use as a substitute trait. Although it is considered to be in the countries' best interest to follow given recommendations for assigning certain traits to corresponding evaluations, participating countries can, and do, provide any traits even outside the recommended list. The Interbull recommendations for the primary choice of traits is presented in table 2, where ** indicates that the trait is "highly recommended" and * indicates that the trait is considered as an "accepted" substitute trait. Table 2 also shows the national traits submitted to the MACE-evaluation by each of the participating countries.

Table 1: National traits submitted for international female fertility evaluations, as reported in GE-forms.

National trait	National Abbreviation	Number of countries
Days between calving and first insemination	CTFS/CFS/ICF/CF/DF/D TFS/ICI/PM21	16*
Cow Conception rate after X months from insemination or between inseminations	CR/CCR/CR42	10*
Days open - days between calving and conception	DO	9
Days between first insemination and conception, on the cow	FSTCc/IFLc	8
Calving interval – time between calvings or lactations	CI/CIV	7
Heifer Non-Return Rate at 56 days after first insemination	NRRh	6
Cow Non-Return Rate at 56 days after first insemination	NRRc/NRC/NR56	6
Heifer Conception Rate	CRh/HCO	6
Pregnancy rate	PR/DPR	4*
Number of inseminations	NS	4*
Days between first and last insemination, heifer	FSh/IFLh	3
Heifer age at first insemination in months	AFI	2
Lactation length	LL	1
Twenty-five-day first service non-return rate	FNRR	1
Early fertility disorders	EFD	1
Ovarian cysts	CYS	1

* different parities or other country-specific conditions reported within the trait

Pregnancy Rate and Interval Traits

A particular attention should be given to the submission of Pregnancy Rate (or Daughter Pregnancy Rate) to any of the two Interbull's interval traits (cc2 and int). The submission of such trait as a substitute for either cc2 or int shall be considered *only* when the trait is clearly calculated as a function of Days Open (DO). Within the above condition, the level of recommendation for submitting pregnancy rate (or Daughter Pregnancy Rate) is reported in Table 2.

Table 2. Recommendation for inclusion of ICAR-defined traits for international evaluations for Female Fertility traits,

	Conception Rate (CR)	Pregnancy Rate (PR)	Interval first-last insemination (FL)	Interval first insemination –conception (FC)	Number of inseminations (NI)	Non-return rate (NR)	Interval calving-first insemination (CF)	Days open (DO)	Calving interval (CI)
HCO	**		*	*	*	*			
CRC							**	*	*
CC1	**					**			
CC2		*	**	**	*			*	*
INT		**						**	**
** - highly recommended trait; * - accepted trait;									

Effect on across-country correlations

To investigate the effect of the various traits on the across-country correlations, Holstein data from the January 2022 test run were analyzed. Traits CC2 and INT were selected for investigation, as they are the two traits with the highest number of countries' participation and showing the most variation in the type of traits submitted. Correlations between countries submitting the same trait and countries submitting different traits were evaluated, and the results showed that countries submitting the same trait had higher correlations with each other than countries submitting different traits.

To check the effect of the Interbull recommendations on which traits to submit, countries were grouped together according to the type of trait submitted. Countries submitting a “highly recommended trait” were placed in group **R**, countries submitting an “accepted trait” were placed in group **A**, and the remaining countries were placed in group **N**. As there were no traits defined as accepted for INT, the **A**-group was not available for this trait.

The difference in average correlations based on the recommendation level of the traits are shown in figure 1 for CC2 and figure 2 for INT. Both figures clearly show that the correlations are highest when both country pair submitted “highly recommended” traits (R-R). This is particularly true for the CC2 trait, where the variation in the correlations in this group are also considerably lower than for any other recommendation groups. Likewise, it can be seen that correlations are on average the lowest when both country pair submitted non-recommended traits (N-N).

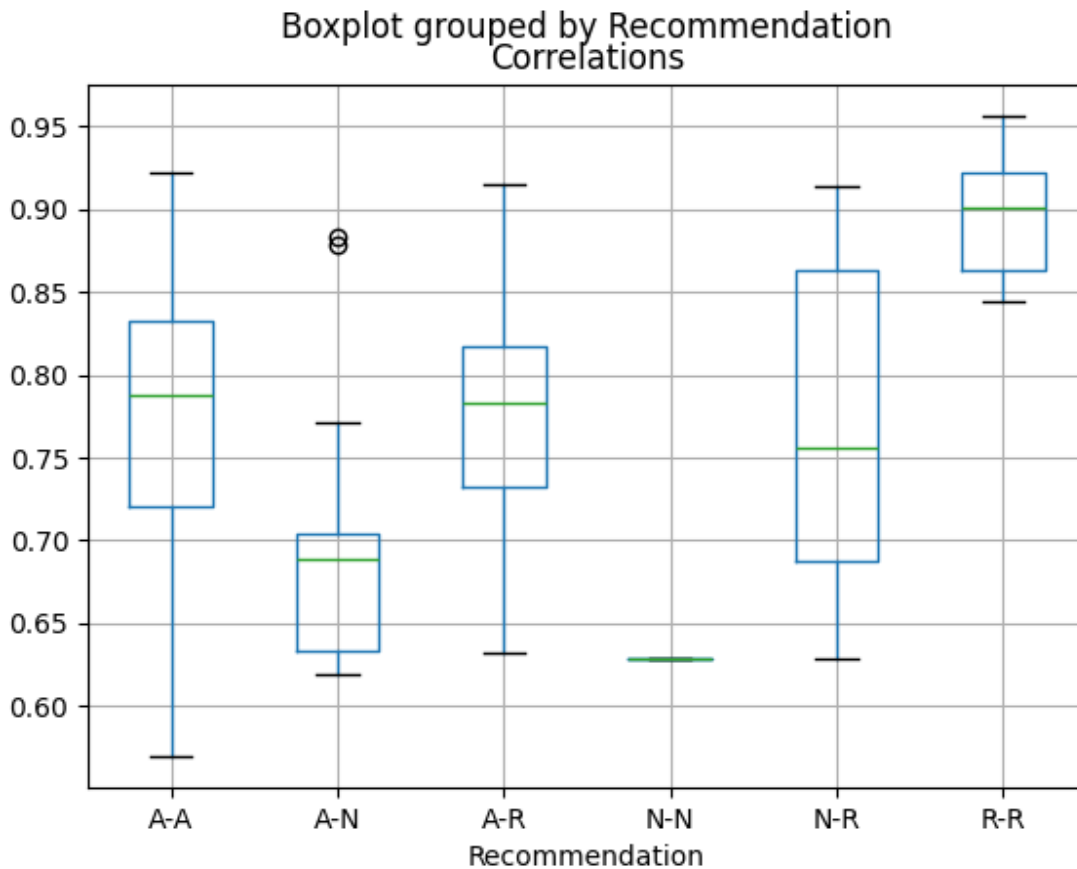


Figure 1. Correlations between countries' combinations for national traits sent to the **CC2 MACE evaluation** using highly recommended traits (R), accepted traits (A) and not recommended traits (N). Data from Holstein breed from January test run 2022

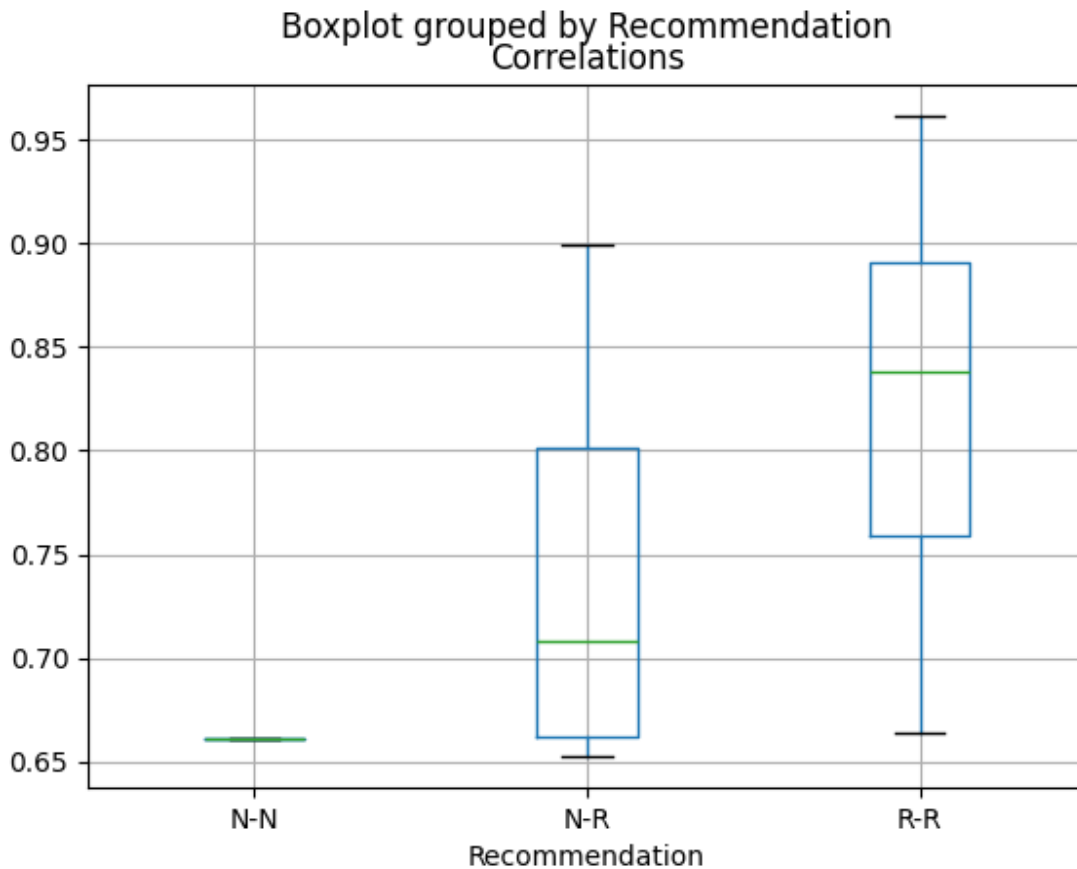


Figure 2: *Correlations between countries' combinations for national traits sent to the INT MACE evaluation using highly recommended traits (R) and not recommended traits (N). Alternative (accepted) traits were not defined for this trait. Data from Holstein breed from January test run 2022*

Final considerations

Investigation of the effect of submitted traits on the across-country correlations showed that using traits defined as “highly recommended” by Interbull yields higher correlations than when “accepted” or “non-recommended” traits are used. Countries participating in the MACE evaluation are therefore encouraged to follow the recommendations on which traits to submit for international evaluation in order to improve the current level of across-country correlations. By doing so, the countries will also increase the benefit of participating in the international evaluation for female fertility traits.

References

ICAR and Interbull recommendations – ICAR Guidelines Section 7 – Bovine Functional Traits: Guidelines on Female Fertility in Cattle (Extract #2): <https://www.icar.org/index.php/icar-recording-guidelines/>