Appendix Ib to the EURC 2019-2020 Final Report

Dairy cattle genetic evaluation in EU countries

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Twenty-two EU member countries have established the systems for dairy cattle genetic evaluations and submit these to the Interbull Centre for International genetic evaluations. These countries, in addition to other outside Europe countries, are collecting within-country performance records for national evaluation. The results from national evaluations are shared with Interbull Centre and processed by Interbull geneticist in International (across countries) evaluation. Not only results of national evaluations that are shared with Interbull but also information/descriptions about each national evaluation system including how performance data have been collected, adjusted, analyzed, validated, published etc. However, to date this information is provided in different expressions, different forms, sometimes incomplete and thus difficult to use in providing an overview and comparison between countries and systems. The Interbull Centre, in its role as EU reference centre has a great interest in having this information standardized and therefore comparable. This can lead, via better comparability of information, to harmonization[1] in methods and definitions between countries. This in turn may lead to better breeding programs with higher genetic progress.

According to Interbull guidelines, genetic evaluation systems are best defined per country x breed x trait group. In this current period we collected and compared the information about national evaluation systems, sent to Interbull Centre by the countries participating in the international evaluation for production traits group (milk, fat, protein yields). The current report focuses on dairy production's traits in twenty-two (22) EU member States (at the time this included United Kingdom).

Almost all of the 22 EU Member States have a national evaluation for dairy production. The only exceptions are where a joint evaluation is in place (Table 1). This is the case for: Denmark-Finland Sweden and Germany-Austria-Luxembourg for HOL, JER and RDC breeds; Germany-Austria for BSW breed and Germany-Austria-Czech Republic-Slovak Republic for SIM breed. Country-wise a special case is represented by Belgium where the

[1] Standardization is expressing the same, already existing things in the same words, harmonization is changing the procedures/methods/calculations etc. to do the same thing than the others.

Walloon Region has a separate evaluation while the Flemish Region is evaluated jointly with The Netherlands.

Table 1 Breeds, traits and evaluation models that are included in the dairy cattle genetic national evaluation system of EU member states, as well as United Kingdom, Norway, and Switzerland

Country	Breeds Evaluated	Breeds	Dairy Production traits	Records	Evaluation Model
Belgium "Walloon"	J	All dairy and dual-purpose breeds	Milk kg, fat kg, protein kg, fat %, protein %	24-hours	MT-ML-RR-TD-AM-BLUP
Croatia	S	HOL, SIM	Milk kg, fat kg, protein kg	24-hours	ST-ML-FR-TD-AM-BLUP
Czech Republic	S	HOL	Milk kg, fat kg, protein kg	24-hours	ST-ML-RR-TD-AM-BLUP
Denmark-Finland-Sweden	S	HOL include red danish Holstein, RDC, JER	Milk kg, fat kg, protein kg	24-hours	MT-ML-RR-TD-AM-BLUP
Estonia	S	HOL	Milk kg, fat kg, protein kg, fat %, protein %	24-hours	ST-ML-RR-TD-AM-BLUP
	S	Estonian Red (RDC)	Milk kg, fat kg, protein kg, fat %, protein %	24-hours	ST-ML-RR-TD-AM-BLUP
France	J	Prim' Holstein and Pie Rouge (HOL), Montbéliarde (SIM FRM), Normande (NMD), Simmental Française (SIM FRA), Brune (BSW), others including Abondance, Tarentaise, Bleue du Nord, Rouge des prés (ex Maine Anjou), Flamande, Bretonne Pie Noire, Salers	Milk kg, fat kg, protein kg, fat %, protein %	305-days	ST-RP-AM-BLUP
Germany-Austria-Luxembourg	J	HOL, RDC, JER	Milk kg, fat kg, protein kg	24-hours	ST-ML-RR-TD-AM-BLUP
Germany-Austria	S	BSW	Milk kg, fat kg, protein kg	24-hours	ST-ML-RR-TD-AM-BLUP
Germany-Austria-Czech-Slovak	S	SIM	Milk kg, fat kg, protein kg	24-hours	ST-ML-RR-TD-AM-BLUP
United Kingdom*	J	HOL, JER, GUE, BSW, MON(SIM), SHO, AYR (RDC), all crossbreds	Milk kg, fat kg, protein kg	24-hours	ST-ML-RR-TD-AM-BLUP
Hungary	J	HOL, SIM	Milk kg, fat kg, protein kg	305-days	ST-RP-AM-BLUP
Ireland	J	HOL, JER, RDC, SIM	Milk kg, fat kg, protein kg	24-hours	ST-ML-RR-TD-AM-BLUP
Italy	S	HOL	Milk kg, fat kg, protein kg	24-hours	MT-ML-RR-TD-AM-BLUP
	S	JER	Milk kg, fat kg, protein kg,	305-days	ST-ML-RP-AM-

			fat %, protein %		BLUP
	S	BSW, SIM	Milk kg, fat kg, protein kg	24-hours	ST-ML-FR-TD-AM-BLUP
Lithuania	J	HOL, RDC	Milk kg, fat kg, protein kg, fat %, protein %	24-hours	ST-ML-RP-AM-BLUP
Latvia	J	HOL, RDC, Cross Red (RDC bull- HOL dam), Cross B&W (HOL bull-RDC dam)	Milk kg, fat kg, protein kg, fat %, protein %	24-hours	ST-ML-RP-AM-BLUP
Netherlands-Belgium"Flemish"	J	All breeds.	Milk kg, fat kg, protein kg	24-hours	ST-ML-RR-AM-BLUP
Norway*	S	Norwegian Red (RDC)	Milk kg, fat kg, protein kg	305-days	ST-ML-RP-AM-BLUP
Poland	S	HOL	Milk kg, fat kg, protein kg	24-hours	ST-ML-RR-TD-AM-BLUP
Portugal	S	HOL	Milk kg, fat kg, protein kg, fat %, protein %	24-hours	ST-ML-FR-TD-AM-BLUP
Slovenia	S	HOL, BSW, SIM	Milk kg, fat kg, protein kg	24-hours	ST-ML-RR-TD-AM-BLUP
	S	BSW, SIM	Milk kg, fat kg, protein kg	24-hours	ST-ML-FR-TD-AM-BLUP
Slovak Republic	S	HOL	Milk kg, fat kg, protein kg	24-hours	ST-ML-RR-TD-AM-BLUP
Spain	S	HOL	Milk kg, fat kg, protein kg	305-days	ST-RP-AM-BLUP
Switzerland*	S	BSW, JER, HOL, SIM	Milk kg, fat kg, protein kg, somatic count	24-hours	MT-ML-RR-TD-AM-BLUP

*: Not EU member. S: breeds evaluated separately. J: breeds evaluated jointly. ST: single trait. MT: single trait. ML: multi lactation. RR: random regression model. FR: fixed regression model. RP: repeatability model. TD: test day. AM: animal model. BLUP: best linear unbiased prediction.

Breed Structure

As a consequence of its high productivity and Holsteinization-process it is not surprising to see that **Holstein** (HOL) is the only breed routinely evaluated in all 22 EU countries (Table 1). Ayrshire together with the other "Red" breeds which have been grouped under the "**Red Dairy Cattle**" category (RDC) are evaluated in 11 countries: Denmark-Finland-Sweden, Estonia, Germany-Austria-Luxembourg, Ireland, Lithuania, Latvia, and Netherlands-Belgium (Flemish). **Simmental** breed (SIM) is evaluated in only 10 countries: Croatia, France, Germany-Austria-Czech Republic-Slovak Republic, Hungary, Italy, Netherlands-Belgium (Flemish) and Slovenia. **Jersey** breed (JER) is evaluated in 9 countries: Denmark-Finland-Sweden, Germany-Austria-Luxembourg, Ireland, Italy, and Netherlands-Belgium (Flemish). **Brown Swiss** breed (BSW) is evaluated in only 4 countries: France, Germany-Austria, Italy, and Slovenia.

Within each national evaluation system, a group of breeds can be evaluated either **separately i.e. via a single breed evaluation (SB) or jointly, i.e. via a multi-breed evaluation (MB**). The latter is applied in Belgium (Walloon), France, Netherlands-Belgium (Flemish), Lithuania and Latvia. Germany does apply a single breed evaluation for SIM and BSW breeds while using a multi-breed evaluation for HOL, RDC and JER breeds. All other of the 22 EU counties do apply a single breed evaluation (Table 1).

Traits

Five traits are generally considered within the dairy production's trait group: Milk, fat and protein yields, and milk fat and protein percent. All 22 EU countries in this report have evaluation for the three yield traits. Fat and protein percentage are additionally evaluated in the following countries: Belgium, Estonia, France, Italy (limited to Jersey), Lithuania, Latvia, and Portugal. All EU countries in this report apply a single-trait evaluation with the exception of Belgium "Walloon", Denmark-Finland-Sweden and Italy (HOL breed only) where such traits are evaluated jointly in a so-called multi-trait evaluation (MT).

Data Recording

All evaluation systems in the 22 EU countries in this report include records from 1st, 2nd and 3rd lactations. Some evaluation systems additionally include records from lactations higher than 3rd.This is the case for Ireland, Netherlands-Belgium"Flemish", Germany-Austria and Germany-

Austria-Czech Republic-Slovak Republic. Looking at the information available, countries do collect such data according to two distinct methods: every 24-hours (method generally known as Test Day (TD)) or averaging the production after 305-days of milking (known as lactation records).

In the past, often actual TD records were firstly extended into 305-days lactation records and then included into a particular evaluation model able to account for repeated measures and for this reason known as repeatability (RP) evaluation model. More recently, inclusion of TD records into the evaluation model has been possible using a more complicated model called random regression (RR) model (Jamrozik and Schaeffer, 1997) which allowed inclusion of TD data without the need to extend them into a 305 lactation's curve. Currently, almost all 22 EU countries make use of the 24-hours records (TD) via a regression model with either random (RR) or fixed (FR) effects[2], exception to this, France, Hungary, Italy (Jersey) and Spain where a 305-days records via a repeatability model is still applied.

In conclusion, the most common definition for dairy production traits is milk, protein and fat yields recorded during the first three lactations on a 24-hours interval basis and mostly analyzed applying a regression model, fixed or random.

[2] Difference between FR and RR is a difference in data modeling technique. In RR, random effects in addition to some of fixed effects are weighted by weights extracted from curves of lactations across days, whereas in FR, only some of fixed effects are given such weights. Genetic effects are always modeled as random. Almost (but not all) of environmental effects are always modeled as fixed.

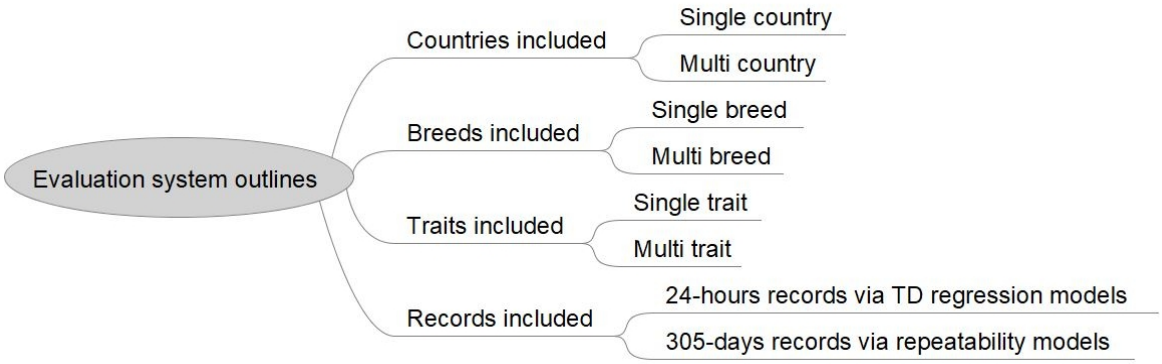

Figure 1 presents a graphical representation of the most common practices within the 22 EU countries considered by this report.

References

Jamrozik, J., Schaeffer, L.R., 1997. Estimates of Genetic Parameters for a Test Day Model with Random Regressions for Yield Traits of First Lactation Holsteins. Journal of Dairy Science 80, 762–770. https://doi.org/10.3168/jds.S0022-0302(97)75996-4