Dairy conformation trait group report

Anahit Nazari-Ghadikolaei[1] and Valentina Palucci[1]

1- Interbull Centre. Department of Animal Biosciences, Swedish University of Agricultural Sciences (SLU), Uppsala, Sweden

Introduction

The current report focuses on 16 EU-member countries in addition to three non-EU European countries providing national performance recording description for dairy cattle conformation traits. including trait definitions, scale of the trait, measurement methods, recorded animals, sire categories, method and models, publication criteria, system validation and etc. However, such information does show a lot of variability when several information from several countries are compared as they might be provided in different expressions, with a different level of accuracy and on individual flat forms making it difficult to get an easy overview between countries and recording systems applied. Interbull Centre, in its role of EU reference center (EURC) has a great interest in having such information as much standardized as possible so to lead to an easier comparison and harmonization in methods and definitions between countries. In order to achieve this, Performance Recording, Evaluation and Publication database (PREPdb) has been developed to collect such information for different trait groups including "Conformation". The PREP electronic form has also been updated n with the most standardized options, for trait definition for example, available from both the International Committee for Animal Recording (ICAR), and the World Holstein Frisian Federation (WHFF). In the current report information about national evaluation systems traits definition, method of measurement/recording, model applied and the parity/lactation's information of the recorded animals from the European countries have been compared. The Interbull conformation trait group includes 18 individual linear traits for Holstein (HOL), 16 individual linear traits for Jersey (JER), Guernsey (GUE) and Red dairy cattle (RDC) and 25 linear traits for Brown Swiss (BSW) breed. It is important to note that, to date, NO conformation traits are evaluated for the Simmental (SIM) breed on an international level due to the dual purpose of the breed. In addition to linear traits, three composite traits are also evaluated which are overall conformation score (ocs), overall feet and leg score (ofl) and overall udder score (ous) evaluated for HOL, JER, RDC, GUE and BSW breeds plus overall rump (oru) and overall

frame (ofr) evaluated just for the BSW breed. All traits with related abbreviations sent and used in international evaluation for each breed have been presented in Table 1.

Table1. List of standard conformation traits with the abbreviations submitted to Interbull Centre for International evaluation in dairy cattle.

Trait (abbreviation)	**Breed**
Stature (sta)	HOL,JER,RDC.GUE,BSW
Chest width (cwi)	HOL,JER,RDC.GUE,BSW
Body depth (bde)	HOL,JER,RDC.GUE,BSW
Angularity (ang)/ Rib structure	HOL,JER,RDC.GUE,BSW
Rump angle (ran)	HOL,JER,RDC.GUE,BSW
Rump width (rwi)	HOL,JER,RDC.GUE,BSW
Rear leg side view/ rear leg set (rls)	HOL,JER,RDC.GUE,BSW
Foot angle (fan)	HOL,JER,RDC.GUE,BSW
Fore udder attachment (fua)	HOL,JER,RDC.GUE,BSW
Rear udder height (ruh)	HOL,JER,RDC.GUE,BSW
Rear udder attachment width (ruw)	HOL,JER,RDC.GUE,BSW
Udder support (usu)	HOL,JER,RDC.GUE,BSW
Udder depth (ude)	HOL,JER,RDC.GUE,BSW
Front teat placement (ftp)	HOL,JER,RDC.GUE,BSW
Teat length (ftl)	HOL,JER,RDC.GUE,BSW
Rear teat placement (rtp)	HOL,JER,RDC.GUE,BSW
Overall conformation score (ocs)	HOL,JER,RDC.GUE,BSW
Overall udder score (ous)	HOL,JER,RDC.GUE,BSW
Overall feet and leg (ofl)	HOL,JER,RDC.GUE,BSW
Locomotion (loc)	HOL
Body condition score (bcs)	HOL
Heel depth (hde)	BSW
Rear leg rear view (rlr)	BSW
Rump length (rle)	BSW
Top line (tpl)	BSW
Thurl position (thp)	BSW
Hock quality (hoq)	BSW
Fore udder length (ful)	BSW
Udder balance (udb)	BSW
Tear direction (tdi)	BSW
Teat thickness (tth)	BSW
Overall rump (oru)	BSW
Overall frame (ofr)	BSW

Breeds evaluated for the conformation traits

Holstein (HOL) appears to be the breed where such genetic evaluation is mostly applied, with 13 participants within EU and two Non-EU member countries of United Kingdom (GBR) and Switzerland (CHE) outside of the EU in Europe (Table 2). Brown Swiss (BSW) is the second common breed among six EU countries and two non-EU counties (Table 2). Jersey breed has been evaluated in Denmark-Finland-Sweden (DFS), Italy (ITA), the Netherlands- Dutch and Flemish (NLD) from the EU countries in addition to CHE and GBR (Table 2). Ayrshire and Red dairy cattle (RDC) breeds have been evaluated in Czech Republic (CZE), DSF, Germany-Austria-Luxemburg (DEU), Latvia (LVA), NLD plus Norway (NOR) outside of the EU country. There is no evaluation for Guernsey (GUE) breed within the EU countries, although GBR is the only country in Europe but outside of the EU, which does the evaluation for conformation traits for GUE breed (Table 2).

Conformation traits in national evaluations, definitions and method of recording

List of conformation traits and alternative trait definition for the linear conformation traits for HOL, JER, RDC, GUE and BSW breeds used in Interbull international evaluation can be found on https://interbull.org/ib/cop_chap6.

According to the ICAR guidelines regarding conformation traits in dairy cattle, there are 18 standardized conformation traits for dairy cattle plus five more conformation traits as "common standard traits", namely *Hock development*, *Bone structure*, *Rear udder width*, *Teat thickness* and *Muscularity*. As it has been mentioned in the ICAR guideline, the main composite conformation traits in dairy cattle are: frame (including rump), dairy strength, mammary and feet and leg. The ICAR document for Conformation traits can be found in https://www.icar.org/Guidelines/05-Conformation-recording-Appendix-1.pdf. There is also a harmonization document recommended by WHFF for linear conformation traits for dairy cattle in order to harmonize and standardize the conformation traits definition to make international evaluation more comparable with more accurate predictions and higher across country correlations (https://whff.info/type-harmonisation/). As part of the conformation trait harmonization for dairy cattle, WHFF has recently replaced the Angularity trait by Rib structure with the latter having a new trait definition where openness of the ribs is **NO** longer part of it. Although the procedure for conformation trait harmonization is still in progress, there are some countries including NLD, DEA and DFS that

have already changed the trait definition for Angularity to make it in line with the new "rib structure" trait provided in the new harmonization document from WHFF (https://whff.info/type-harmonisation/).

All of the 13 European countries within the EU have provided information for almost all 18 defined and approved standard linear conformation traits for HOL breed. Among them, there are some countries which have provided more than 21 traits for HOL or different trait group for the certain breeds in their national evaluation (shown in *italics* in Table 2), for instance Belgium (BEL) have included *chest depth*, *loin strength*, *rump length*, *hips width*, *bone quality*, *teat placement* (*side view*), *udder texture*, *rear udder width* (*ruw)*, *overall development*, *overall rump* (*oru*), *overall fore udder*, *overall rear udder*, *overall dairy character* for HOL breed (Table 2). Another example is Ireland (IRL), including *bone*, *texture*, *teat placement side view*, *overall dairy*, *overall body*, plus adding *temperament* and *milking speed* in its national evaluation (Table 2). Regarding including some "*workability* traits" within conformation traits evaluation, France (FRA), also has considered *temperament* and *milking speed* in its national conformation evaluation (Table 2). Same situation has been observed for BSW breed, where FRA has included *hock position* and *milking speed* in the conformation traits evaluation (Table 2).

Regarding trait definition, in some cases substitute traits are used at national level for some type of evaluation, an example is the trait heel depth (hde) which can be used for the evaluation of *Deep Heel* or *Hoof Height* or the trait Foot angle (fan) that can be used as *Pasterns*, *Central ligament* that can be used for udder support, or the trait rear leg rear view (abbreviation?) that can be sent for *Locomotion*. Beside the different names of the traits, some countries might have provided some different definitions of the same trait. One example is the trait stature (sta) which has been defined as height at sacrum in FRA and DEU. In general, for linear conformation traits, 11 countries out of 16 within EU, including CZE, Estonia (EST), Hungary (HUN), Italy (ITA), DEU, Poland (POL), PRT, Slovakia (SVK), Latvia (LVA), and Spain (ESP) used the standard definition provided by ICAR or WHFF.

Based on the ICAR guideline for conformation (linearly scored type traits) in dairy cattle, the linear conformation traits are recommended to be recorded in scale of 1-9, which must cover the expected biological extremes of the population in the country of assessment if they use another scoring scale. The recommendation for subjectively scored composite traits is 50-97 points for

dairy and dual purpose cattle. There were some countries like ITA for HOL and JER breeds that has used linear scale of 1-50 for linear traits. For overall /composite score traits BEL has applied 55-99 points, CZE 50-91, ITA for JER breed used 70-89 points, LVA used 90-100 points, NLD used 70-99 points, DEA applied 60-90 points and ESP used 65-92 points (Table 2). It is good to mention that stature has been evaluated in centimeter in POL, NLD, DEA, ESP, SVN and CHE.

Statistical models and parity/lactation of recorded animals

Multiple trait (MT) model has been applied in eight EU countries and single-trait (ST) has been applied in nine EU countries. In addition, Italy has been used MT model for HOL, JER breeds and ST model for BSW breed and also for stature trait in HOL breed (Table 2).

Moreover, BEL, CZE, DFS, EST, DEA, DEU, HUN, IRL, ITA, POL, PRT, SVN, and ESP evaluated conformation traits using single breed (SB) model. FRA did use the Multi breed (MB) model for Prim'Holstein and Pie Rouge (HOL), Normande, Montbéliarde joint with SIM breed, and NLD did utilize MB model for all breeds except BSW. Among the EU countries FRA and DFS have been using single-step genomic (ss) approach in their national conformation traits evaluation (Table 2).

Looking at the parity or lactation of recorded animals, BEL, CZE, Estonia, DEA, DEU, HUN, IRL, ITA, NLD, POL, PRT, SVN and ESP recorded the animals in first parity/ lactation. There are some countries which recorded animals in parities/ lactation 1-2 or 1-3 as is shown in Table 2. According to the ICAR guidelines for recording conformation traits and more specifically udder type traits, automatic milking system (AMS) can be a cost effective option for countries to collect the udder linear traits during the whole lactation and also over lactations. Among the countries, DFS has been using AMS for rear teat placement, udder balance and udder depth traits. There is also shown a high genetic correlation between the linearly scored traits and AMS method (Byskov et al., 2012; Poppe et al, 2019). For DFS such correlations using different methods were pretty high between 0.91 for front and rear teat placement and 0.94 for udder balance (https://nordicebv.info/wp-content/uploads/2024/05/NAV-routine-genetic-evaluation-May-2024.pdf).

Table 2. Country, breeds, conformation traits included in the national level, recording scale, evaluation model and lactation/parity of recorded animals in European countries for conformation traits.

Country	Breeds	Conformation traits [a]	Recording scale	Evaluation Model [b]	Parity/lactation of recorded animals
BEL	Red and Black HOL	sta ,cwi ,bde, *Chest Depth*,*Loin Strength*, rle, ran, *Hips Width*, rwi, fan, rls, *Bone Quality*, rlr (as loc), udb, ude, *Teat Placement Side*, usu, *Udder Texture*, Fore Udder ,ftp, ftl ,ruh, *Rear Udder Width*, rtp, ang, *Overall Development*, *oru*, *ofl ous Overall Fore Udder*, *Overall Rear Udder* Overall Dairy Character, ocs, bcs	linear traits: scale 1- 9, composites traits :55-99 points by classifiers, BCS is taken by milk recorder	MT- SB-AM, for bcs: MT-TDM-ML-RR-AM	All 1st lactations or all cows at the farm
CHE*	BSW	sta, cwi, bde, ang, ran, rwi, rls, fan, hde ,fua ruh, ruw, usu, ude, ftp, ftl, rtp, ocs, ous, ofl, tpl, rle, thp, hoq, ful, udb, tdi, tth, ofr ,oru	Linear description and scoring by official classifiers, sta in centimeter	MT- SB -REP-BLUP-AM	1st lactation
	HOL	sta, cwi, bde, ang, ran, rwi, rls, rlr, fan, fua, ruh, usu, ude, ftp, ftl, rtp, ocs, ous, ofl, loc, bcs	Linear traits: scale 1-9, sta in centimeter	MT- SB - BLUP-AM	1st parity
	JER	sta, cwi, bde, ang, ran, rwi, rls, rlr, fan, fua, ruh, usu, ude, ftp, ftl, rtp, ocs, ous, ofl	Linear description and scoring by official classifiers, sta in centimeter	MT- SB - BLUP-AM	1st parity
CZE	HOL	sta, cwi, bde, ang, ran, rwi, rls, rlr, fan, fua, ruh, usu, ude, ftp, ftl, rtp, ocs, ous, ofl, loc, bcs	linear traits: scale 1- 9, composites traits :50-91 points by special technicians	ST- SB- BLUP-AM	1st lactation
DEA	BSW	sta, cwi, bde, ang, ran, rwi, rls, fan, hde ,fua,ruh, ruw, usu, ude, ftp, ftl, rtp, ocs, ous, ofl, tpl, rle, thp, hoq, ful, udb,tdi, tth, ofr ,oru	linear traits: scale 1- 9, sta, bde and rwi in cm composites traits: 60-90 points by classifiers	ST – SB- AM – BLUP	1st lactation

DEU	HOL, RDC	sta, cwi, bde, ang (rib structure), ran, rwi, rls, rlr, fan, fua, ruh, usu, ude, ftp, ftl, rtp, ocs, ous, ofl, loc, bcs	linear traits: scale 1- 9, by classifiers	MT – SB- BLUP – AM	1st lactation
DFS	Red and Black HOL	sta, cwi, bde, ang(rib structure), *tpl*, ran, rwi, rls, rlr, *hoq*, *bone quality*, fan, fua, ruh, ruw, usu, ude, *udb*, ftp, ftl, rtp, udb, *Temperament*, ocs, ous, ofl, loc, bcs	linear traits: scale 1- 9, sta in cm by daughter group or herd group classification system	SS-MT-SB-ML-AM	Parities 1-3
	JER	sta, cwi, bde, ang (rib structure), *tpl*, ran, rwi, rls, rlr, *hoq*, *bone quality*, fan, fua, ruh, ruw, usu, ude, *udb*, ftp, ftl, rtp, udb, *Temperament*, ocs, ous, ofl	linear traits: scale 1- 9, sta in cm by daughter group or herd group classification system	SS-MT-SB-ML-AM	Parities 1-3
	RDC	sta, cwi, bde, ang, *tpl*, ran, rwi, rls, rlr, *hoq*, *bone quality*, fan, fua, ruh, ruw, usu, ude, *udb*, ftp, ftl, rtp, udb, *Temperament*, ocs, ous, ofl	linear traits: scale 1- 9, sta in cm by daughter group or herd group classification system	ST-MT-SB-ML-AM	Parities 1-3
ESP	HOL	sta, cwi, bde, ang, ran, rwi, rls, rlr, fan, fua, ruh, usu, ude, ftp, ftl, rtp, ocs, ous, ofl, loc, bcs	Linear traits: scale 1-9. Overall Feet and Legs: 65 - 92 points By classifiers, sta in centimeter	MT- SB -BLUP-AM	1st parity mainly, 2nd and 3rd parities with lower frequency
EST	HOL	sta, cwi, bde, ang, ran, rwi, rls, rlr, fan, fua, ruh, usu, ude, ftp, ftl, rtp, ocs, ous, ofl, loc, bcs	linear traits: scale 1- 9 By special classifiers	ST – SB- BLUP – AM	1st lactation
FRA	BSW	sta, cwi, bde, ang, ran, rwi, rls, fan, hde ,fua, ruh, ruw, usu, ude, ftp, ftl, rtp, ocs, ous, ofl, tpl, rle, thp, *Hock position*, ful, udb, tdi, tth, ofr,oru, *Milking speed*	linear traits: scale 1- 9, Milking speed: 1-5 By technicians	ST-SB-AM-BLUP-SS-SB	1st parity, if missing parity 2
	Prim'Holstein and Pie Rouge (HOL), Normande, Montbéliarde	sta, cwi, bde, ang, ran, rwi, rls, rlr, fan, fuh, ruh, usu, ude, ftp, ftl, *tdi Rear*, ocs for Interbull (ocs is replace by the international predictor), ous, ofl, loc, bcs, *Milk Speed*, *Temperament*	linear traits: scale 1- 9, Milk Speed and temperament: 1-5 By technicians	ST-SB-AM-BLUP-SS-MB	Parities 1-2

GBR*	BSW	sta, cwi , bde , ang , ran , rwi , rls , rlr , fan , fua , ruh ,usu, ude , ftp , ftl , rtp , Total Score , Mammary ,ofl	Linear traits: scale 1-9 overall traits are subjectively evaluated by classifiers	MT – SB -AM- BLUP for linear and ST- SB - BLUP for composite	1st lactation
	GUE	sta, cwi, bde, ang, ran, rwi, rls, fan, fua, ruh, *usu*, ude, rtp, *Teat Placement Side*, ftl,ocs, ous (Mammary), ofl	Linear traits: scale 1-9 overall traits are subjectively evaluated by classifiers	MT- SB -BLUP- AM	Heifers 20-45 months
HUN	HOL	sta, cwi, bde, ang, ran, rwi, rls, rlr, fan, fua, ruh, usu, ude, ftp, ftl, rtp, ocs, ous, ofl, loc, bcs	linear traits: scale 1- 9 composites traits :50-99 points by technicians	ST-SB- REP-AM	1st parity
IRL	HOL	sta, cwi,bde, ang, ran, rwi, bcs, rls , *rlr*, fan,loc, *Bone*, fua , usu, ude, ruh,*Texture*, rtp, rtp, *Teat Placement Side View*, ftl, *Temperament*, *Ease of Milking*,ocs, *Overall Dairy* , *Overall Body*, ofl,ous	linear traits: scale 1- 9 by classifiers	MT- SB- AM	1st parity
ITA	BSW	sta, cwi, , bde, tpl, rle, ran, rwi, thp, rls, hoq, fan, hde, ful, fua,ruw, ruh, usu, ude, udb, ftl, tth, tdi, ftp, rtp, ocs, ofr, oru, ofl, ous	linear traits: scale 1- 9 by Evaluators of linear traits	ST- SB- BLUP- AM	1st lactation
	HOL	sta, cwi, bde, ang, ran, rwi, Rear Leg Set, rlr, fan, fua, ruh, usu, ude, ftp, ftl, rtp, ocs, ous, ofl, loc, bcs	Linear traits: scale 1-50, BCS: 1-5 By classifiers	MT- SB- AM – ST- SB- AM for bcs	Only first parity cows (age in months 18-42). BCS: 20-38
	JER	sta, cwi, bde, ang, ran, rwi, rls, rlr, fan, fua, ruh, usu, ude, ftp, ftl, rtp, ocs, ous, ofl	Linear traits: scale 1-50, composites traits: 70-89 By classifiers	MT- SB-AM	Only first parity cows (age in months 20-38)
LVA	HOL (HO; RW) RDC (AY; BSW; NR; SR; MO; SM) European Red Dairy Breed (Danish Red; Angeln; Latvian Brown; Lithuanian	sta, cwi, bde, ang, ran, rwi, Rear Leg Set, rlr, fan, fua, ruh, usu, ude, ftp, ftl, rtp, ocs, ous, ofl, loc, bcs	Linear traits: scale 1-9, three main composite traits: body, Feet/Legs and Mammary with maximum 90 points, 95 points and 100 points for each composite trait by classifiers	ST – REP - BLUP – AM	Lactation 1-3

	Red) Latvian Blue Lithuanian Grey				
NLD	All	sta, cwi, bde, ang (rib structure), ran, rwi, rls, rlr, fan, fua, ruh, usu, ude, ftp, ftl, rtp, ocs, ous, ofl, loc, bcs	Linear traits: Scale 1-9 Composites traits: 70-99 points, sta in centimeter	MT- MB -BLUP-AM	1st parity
	BSW	sta, cwi, bde, ang, bcs, ran,rwi, fan, hde, fua, ruh, ruw, usu, ude, ftp, ftl, rtp, ocs, ous, ofl, loc	Linear traits: Scale 1-9 Composites traits: 70-99 points By technicians, sta in centimeter	MT- SB- BLUP-AM	1st parity
NOR*	RDC	sta, cwi, *Heart Girth*,bde,ang, rwi, ran,rls, rlr, fan, fua, ruh, ruh, ruw, usu, *Distance Udder-Floor*, ude, *Distance between front teats* , ftp, ftl, tth, rtp, *Udder Type*,udb, *Supernumerary Teats*,ocs, *Bone Quality*, hoq, tpl, ous, ofl, *Claw health , Hoof Quality, Laminitis related claw disorders , Infectious claw disorders, Corkscrew claw*	Linear traits: scale 1-9 sta, Heart girth, Distance Udder floor are recorded in cm. Overall traits and claw health recorded as index. Laminitis related claw disorders, infectious claw disorders and corkscrew claw are recorded as binary 0/1 traits. By technicians and dairy advisors	MT- SB - REP-AM	Conformation: First parity only, until 2014. Then, 1st to 3rd parity; and from 2018, 1st to 5th parity. Claw health: All parties.
POL	HOL	sta, cwi, bde, ang, ran, rwi, rls, fan, fua, ruh, *central ligament*, ude, ftp, rtp, ftl, ocs, ous ofl, loc, bcs	Linear traits: scale 1-9, sta in centimeter	ST- SB- BLUP – AM	1st parity
PRT	HOL	sta, cwi, bde, ang, ran, rwi, rls, rlr, fan, fua, ruh, usu, ude, ftl, ftp, rtp, loc, bcs, *strength*, *dairy character*, *Bone structure*, *Strength*, ruw, tth, *Muscularity (Sirloin strength), Anterior third*, ofl, mammary system (ous), ocs	Linear traits: scale 1-9 By classifiers	ST- SB - BLUP-AM	1st lactation
SVN	BSW	sta, cwi, bde, ang, ran, rwi, rls, fan, hde ,fua ruh, ruw, usu, ude, ftp, ftl, rtp, ocs, ous, ofl, tpl, rle, thp, hoq, ful, udb,tdi, tth, ofr ,oru	Linear traits: scale 1-9. sta in cm, Composites traits: in points By classifiers	MT – SB - AM – BLUP	1st parity

	HOL	sta, cwi, bde, ang, ran, rwi, rls, rlr, fan, fua, ruh, usu, ude, ftp, ftl, rtp, ocs, ous, ofl, loc, bcs	Linear traits: scale 1-9. sta in cm, Composites traits: in points By classifiers	MT – SB - AM – BLUP	1st parity/lactation

*: Non-EU countries in Europe

[a] Traits in *italics* show the ones that are extra traits at the national level but not included and evaluated in the international evaluation for the given breed

[b] Abbreviations: AM=Animal Model, ST=Single Trait, MT= Multi Trait, SB= Single Breed, MB= Multi Breed, ML= Multi lactation, BLUP= Best Linear Unbiased Prediction, REP= Repeatability, RR=Random Regression, SS= Single-step genomic evaluation, TDM= Test Day Model.

Conclusion

To conclude, most of the European countries used the standard traits, definition and recording system in their national evaluation. However, the term for some conformation traits could be different among some European countries at the national level or some countries included more conformation traits for a given breed than what evaluated internationally. Moreover, there were more variations for using different method/model. The goal is to harmonize such traits in order to make them as standard as possible, in order to estimate more accurate prediction and higher correlation across countries for the international evaluation.

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