Phenotypic analysis of Beef-on-Dairy crossbred data

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Background

- Increasing use of beef semen in dairy herds to produce higher valued crossbred calves (‚Beef on Dairy‘)
- Crossbred calves show good fattening properties, higher carcass weights and superior meat quality
- Problem: Higher incidence of difficult calvings and stillbirths

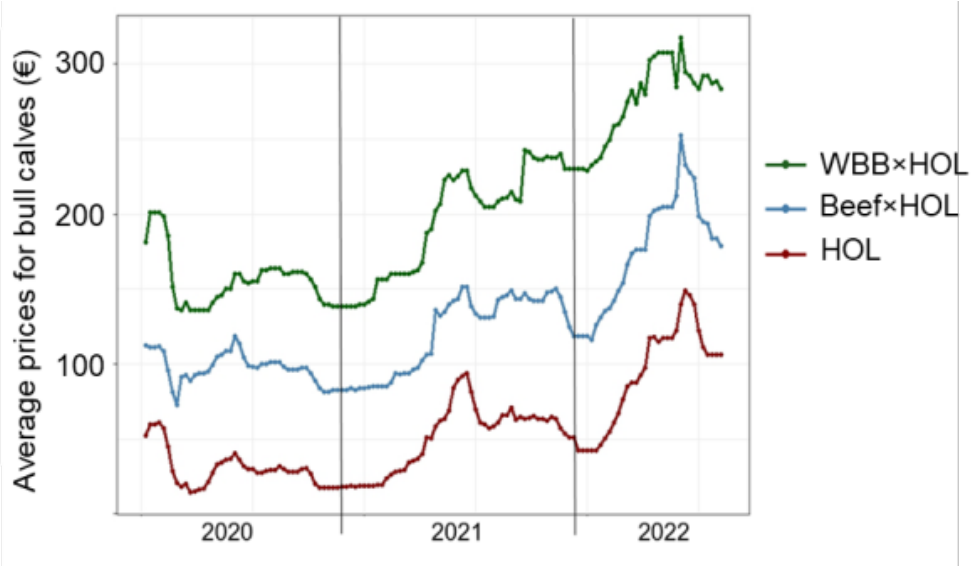

Fig 1. Average prices for crossbred and purebred bull calves in Euro (LWK SH, 2022)

Objectives of the Study

Phenotypic analysis of Beef-on-Dairy crossbred data

- Analysis of systematic effects on calving difficulty of Beef-on-Dairy crossbred calves
- Special focus on the influence of the sire breed and individual sires within the Belgian Blue sire breed

<u>Most common sire breeds for Beef-on-Dairy in Schleswig-Holstein:</u>

Belgian Blue (WBB)

Angus (ANG)

Limousin (LIM)

Wagyu (WAG)

Data

Data Recording

4,560 calves from 175 dairy farms

Recorded traits

- Weight of calves (recorded between day 0 and 30)
- Chest circumference

Additional Information

- Sex of the calf
- Type of calving (single/twins)
- Calving difficulty (0 no difficulty, 1 difficult calving)
- Sire breed and identity
- Dam identity
- Gestation length
- Number of calving

Fig 2. Measurement of chest circumference (RSH, 2022)

Data Processing

Quality Control

- Only Holstein (HOL) dams
- Farms with less then 3 records were excluded
- Twin calvings excluded

→ Final dataset contained 2,300 calves from 112 farms

Weight Correction

- Weight prediction for day 0 of calving based on linear regression model
- $y_{ij} = \mu + AGE_j + e_{ij}$

  y_{ij} = weight of calves

  μ = mean

AGE_j = fixed effect of age (0d to 10d, 11d to 30d)

e_{ij} = random residual effect

Table 1. Daily weight change within age groups

Age group (Days)	Weight (Kg)
0 - 10 (n = 1836)	0.73
11 - 30 (n = 464)	0.79

Materials & Methods

Model A: Calving difficulty – Binary logistic regression model for calving difficulty

$$y_{ijklmno} = \mu + WEIGHT\_CORR_i + SEX_j + GEST_k + SIRE\_BREED_l + CALVING\_NR_m + DAM_n + FARM_o + e_{ijklmno}$$

$y_{ijklmno}$ = calving difficulty (binary coded)

μ = mean

$WEIGHT\_CORR_i$ = effect of corrected birth weight

SEX_j = fixed effect of the sex

$GEST_k$ = fixed effect of gestation length

$SIRE\_BREED_l$ = fixed effect of sire breed

$CALVING\_NR_m$ = fixed effect of calving number

DAM_n = fixed effect of dam

$FARM_o$ = random effect of farm

$e_{ijklmno}$ = random residual effect

Materials & Methods

Model B: Calving difficulty – Binary logistic regression model for Belgian Blue breed

$$y_{ijklmno} = \mu + WEIGHT\_CORR_i + SEX_j + GEST_k + SIRE_l + CALVING\_NR_m + DAM_n + FARM_o + e_{ijklmno}$$

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$WEIGHT\_CORR_i$ = effect of corrected birth weight

SEX_j = fixed effect of the sex

$GEST_k$ = fixed effect of gestation length

$SIRE_l$ = fixed effect of WBB sires

$CALVING\_NR_m$ = fixed effect of calving number

DAM_n = fixed effect of dam

$FARM_o$ = random effect of farm

$e_{ijklmno}$ = random residual effect

Descriptive statistics

Table 2. Descriptive statistics of recorded traits of crossbred calves by sire breed

Breed (n = 2300)	**Calving Nr**		**Gestation length** (Days)		**Calving type** (Percentage)		**Weight** (Kg)		**Chest** (cm)	
	Mean	SD	Mean	SD	Easy	Difficult	Mean	SD	Mean	SD
WBB (n = 1613)	3.5	1.5	282.02	4.8	88.6	11.4	53.5	7.5	86.1	4.7
ANG (n = 475)	2.1	1.4	280.6	4.6	83.5	16.4	50.0	8.1	84.8	4.9
LIM (n = 130)	3.3	1.7	287.4	5.5	83.1	16.9	50.1	7.5	83.3	4.4
WAG (n = 82)	2.5	1.2	283	3.9	95.1	4.9	45.4	5.8	83.6	3.9

- ANG×HOL calves had lowest gestation length
- LIM×HOL calves had highest gestation length
- WBB×HOL calves had highest weight

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Table 3. Number of calves per sire breed and calving number

Calving	ANG	LIM	WAG	WBB
1st calving	187	6	11	13
2nd calving	156	51	38	479
3rd calving	68	26	27	468
4th calving	32	19	2	291
5th calving	17	18	1	179
6th calving	11	4	1	113

- Beef semen of ANG was mainly used in 1st and 2nd calving
- Beef semen of WBB, LIM and WAG was primarily used in 2nd, 3rd and 4th calving

Correlations between weight and chest circumference

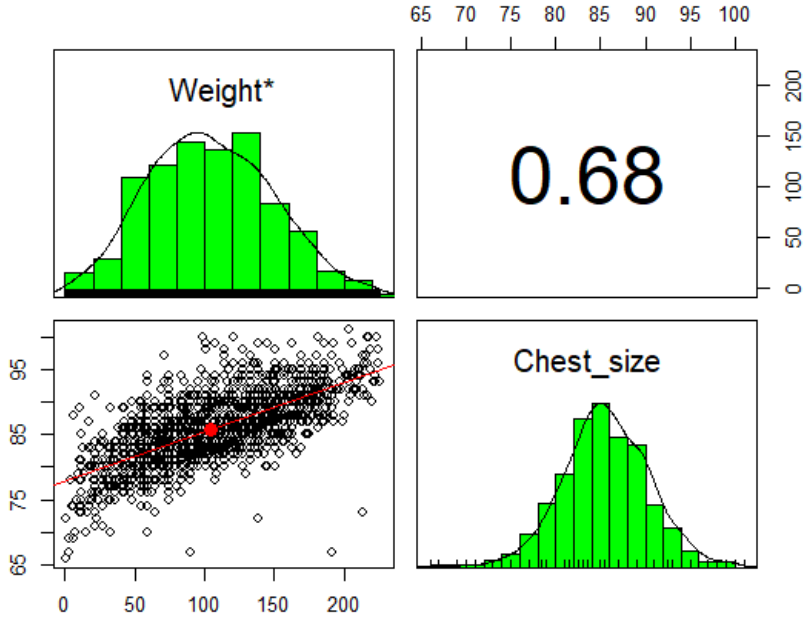

Figure. Pearson correlation of recorded traits across all calves

- Substantial correlation between weight and chest circumference

→ Chest circumference might serve as indicator trait for calving difficulty

Results

Model A: Binary logit regression model for calving difficulty across breeds

Table 4. Results of binary logit regression model for calving difficulty in breeds

Fixed effect	Reference	Estimate	Std. Error	P value
Weight_corr		0.07	0.01	<0.001
Sex	Female	-0.62	0.15	<0.001
Gestation		0.04	0.01	<0.01
Sire LIM	ANG	-0.46	0.42	0.28
Sire WBB	ANG	-0.91	0.23	<0.001
Sire WAG	ANG	-1.43	0.60	<0.05
Nr of calving		0.11	0.04	<0.05

- Sex of the calves has the highest influence on calving difficulty
- Gestation length and sire's breed has significant influence
- Highest calving difficulty observed in ANG crosses & lowest for WAG crossbreds

Results

Model B: Binary logit regression model for calving difficulty across Belgian Blue sires

Table 5. Results of binary logit regression model for calving difficulty in WBB breed

Fixed effect	Reference	Estimate	Std. Error	P value
Weight_corr		0.07	0.01	<0.001
Sex	Female	-0.45	0.20	<0.05
Gestation		0.01	0.02	0.37
Sire 2	Sire1	-0.57	0.79	0.47
Sire 3	Sire1	1.01	0.83	0.22
Sire 4	Sire1	-0.22	0.83	0.78
Sire 5	Sire1	-0.35	0.83	0.67
Sire 6	Sire1	-0.70	0.87	0.42
Sire 7	Sire1	0.26	0.82	0.74
Nr of calving		0.18	0.05	<0.001

- Calving difficulty varied across sires Belgian Blue but results were not significant
- In comparison, sire 3 has highest reported calving difficulty

Summary and Conclusions

Use of beef semen	Mainly used in 2nd and 3rd calving except for Angus breed semen
Weight & Chest	Highest weight & chest circumference observed for WBB crosses
Breed effect on calving difficulty	Significant variation in calving difficulty across different breed, highest for Angus
Sire effect on calving difficulty	Variation in calving difficulty exists across individual sires, but results were not significant

Questions??