Genetic parameters of body weight and body measurements of Austrian dairy cattle

C. Pfeiffer[1]. B. Fuerst-Waltl[1]. F. Steininger[2] and C. Egger-Danner[2]

[1] Divison of Livestock Science. Department of Sustainable Agricultural Systems. University of Natural Resources and Life Sciences Vienna (BOKU). Gregor-Mendel-Str. 33. 1180 Vienna. Austria

[2] ZuchtData EDV-Dienstleistungen GmbH. Dresdner Str. 89/19. 1200 Vienna. Austria

Background (I)

- Increasing interest of efficiency

- New phenotypes
  - Easy and cheap to record on farm
  → **Big challenge**

- Ways for genetic improvement of efficiency for cattle breeding under Austrian circumstances

Background (II)

- Project **„Efficient Cow"**
  - Recording of new phenotypes

- Body weight as a potential trait?
  - Promising?
  - Recording on farm?
  - Repeatability?
  - Auxiliary traits?

Objectives

- Estimation of heritabilities, repeatabilities, and genetic correlations between body weight and various body measurements of different Austrian cattle populations

Materials & methods (I)

- Traits
  - Body weight (**BW**)
  - Waist lenght (**WL**)
  - Chest lenght (**CL**)
  - Muscularity (**MU**)
  - Body condition score (**BCS**)

Materials & methods (II)

- Populations
  - 3,512 Fleckvieh cows (**FV** - Dual purpose Simmental)
  - 1,385 Brown Swiss cows (**BS**)
  - 1,187 Holstein Friesian cows (**HF**)

- Data selection
  - Non-breed gene proportion (≤50%)
  - Days in milk (1 to 320)
  - Cows/farm (at least 3)
  - Year of calving (2013-2015)

Materials & methods (IV)
Model

- Univariate or bivariate linear animal model

$$y_{ijklmnop} = \mu + CY_i + S_j + CAC_k + J_l + JJ_m + JM_n + b_1\,(\text{days}) + b_2\,(\text{days})^2 + a_o + pe_{np} + e_{ijklmnop}$$

y … record of BW. WL. CL. MU. BSC of *cow o*

CY_i … Calving year

S_j … Calving season

CAC_k … Calving age class

J_l … Judge

JJ_m … Year of jugdment

JM_n … Month of jugdment

days … days in milk fitted as covariate

a_o … Additive genetic effect of cow

pe_{np} … Permanent environment

Results and Discussion (I)
Mean. STD. minimum. maximum

	Fleckvieh		Brown Swiss		Holstein	
	Mean ± STD	Min-Max	Mean ± STD	Min-Max	Mean ± STD	Min-Max
Body weight kg	729±86	438-1088				
Waist lenght cm	258±14	192-310				
Chest lenght cm	213±10	178-260				
Muscularity 1-9	5.7±1.3	1-9				
BCS 1-5	3	1-5				

Results and Discussion (I)
Mean. STD. minimum. maximum

	Fleckvieh		Brown Swiss		Holstein	
	Mean ± STD	Min-Max	Mean ± STD	Min-Max	Mean ± STD	Min-Max
Body weight kg	729±86	438-1088	648±76	417-975		
Waist lenght cm	258±14	192-310	249±12	220-280		
Chest lenght cm	213±10	178-260	204±9	175-230		
Muscularity 1-9	5.7±1.3	1-9	4.5±1.3	1-9		
BCS 1-5	3±0.5	1-5	3±0.5	1-5		

Results and Discussion (I)
Mean. STD. minimum. maximum

	Fleckvieh		Brown Swiss		Holstein	
	Mean ± STD	Min-Max	Mean ± STD	Min-Max	Mean ± STD	Min-Max
Body weight kg	729±86	438-1088	648±76	417-975	660±77	383-945
Waist lenght cm	258±14	192-310	249±12	220-280	254±13	220-300
Chest lenght cm	213±10	178-260	204±9	175-230	210±9	180-247
Muscularity 1-9	5.7±1.3	1-9	4.5±1.3	1-9	4±1.5	1-9
BCS 1-5	3±0.5	1-5	3±0.5	1-5	3±0.7	1-5

Results and Discussion (II)
Heritabilities and repeatabilities

	Fleckvieh		Brown Swiss		Holstein	
	h²	r	h²	r	h²	r
Body weight kg	0.33±0.04	0.80				
Waist lenght cm	0.28±0.03	0.60				
Chest lenght cm	0.37±0.04	0.79				
Muscularity 1-9	0.25±0.03	0.53				
BCS 1-5	0.22±0.03	0.55				

Results and Discussion (II)
Heritabilities and repeatabilities

	Fleckvieh		Brown Swiss		Holstein	
	h²	r	h²	r	h²	r
Body weight kg	0.33±0.04	0.80	0.43±0.06	0.78		
Waist lenght cm	0.28±0.03	0.60	0.33±0.05	0.60		
Chest lenght cm	0.37±0.04	0.79	0.49±0.07	0.78		
Muscularity 1-9	0.25±0.03	0.53	0.28±0.05	0.51		
BCS 1-5	0.22±0.03	0.55	0.29±0.01	0.57		

Results and Discussion (II)
Heritabilities and repeatabilities

	Fleckvieh		Brown Swiss		Holstein	
	h²	r	h²	r	h²	r
Body weight kg	0.33±0.04	0.80	0.43±0.06	0.78	0.32±0.07	0.77
Waist lenght cm	0.28±0.03	0.60	0.33±0.05	0.60	0.36±0.06	0.63
Chest lenght cm	0.37±0.04	0.79	0.49±0.07	0.78	0.37±0.07	0.74
Muscularity 1-9	0.25±0.03	0.53	0.28±0.05	0.51	0.30±0.05	0.53
BCS 1-5	0.22±0.03	0.55	0.29±0.01	0.57	0.26±0.05	0.58

Results and Discussion (III)
Genetic and phenotypic correlations

Fleckvieh	BW	WL	CL	MU	BCS
BW		0.76±0.04	0.85±0.03	0.32±0.07	0.37±0.08
WL	0.55		0.71±0.04	0.26±0.09	0.26±0.09
CL	0.39	0.41		0.32±0.07	0.42±0.08
MU	0.18	0.20	0.18		0.73±0.04
BCS	0.30	0.20	0.24	0.34	

* Not significantly different from 0

Conclusions

- Heritabilities and repeatabilities were moderate

- Genetic correlations between BW and body measurements were high

- Genetic correlations were similar for different populations

Perspectives

- Weight was easier to measure than waist or chest length and there is a possibility for automation
- Discussion to include weight into TMI started in Austria
  - Economic weight would be positive - Desired gain needed
  - Conformation traits (frame muscularity) as auxiliary traits
  - All results and ideas have to get discussed with our partners in genetic evaluation from Germany and Czech Republic