







# Research on feet and legs in the dairy industry

- Moderate genetic relationships with type traits and longevity (Dekkers et al., 1994)
- Longevity tends to be lowly heritable (Vollema and Groen, 1997)
  - -0.09-0.13
  - -Indicator traits would be useful to help select for longevity

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### Heritabilities

–Foot angle	0.09-0.12
-Rear leg side view	0.15-0.22
-Rear leg rear view	0.06 -0.11
-Composite score	0.13-0.41
<ul> <li>Composite score</li> </ul>	0.13-0.41

(Vollema and Groen 1997, Onyiro and Brotherstone 2008, Laursen et al. 2009, and Wright et al. 2012)

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	Research <ul> <li>Australian Angus</li> <li>Heritabilities (SE)</li> </ul>	On feet (Jeyarubar and genet	and leg et al. 2013 ic correlati	s in the 2), approxi ons (SE) us	beef in mately 700 ing linear r	dustry 10 records nodel	
TT		FA	FC	RA	RC	RH	RS
	Front foot angle (FA)	0.32 (0.04)	0.79 (0.06)	0.87 (0.04)	0.57 (0.09)	0.22 (0.13)	0.32 (0.11)
	Front foot claw (FC)		0.33 (0.04)	0.40 (0.10)	0.69 (0.07)	0.01 (0.13)	0.08 (0.12)
	Rear foot angle (RA)			0.29 (0.05)	0.62 (0.09)	0.33 (0.12)	0.68 (0.09)
	Rear foot claw (RC)				0.29 (0.05)	0.07 (0.14)	0.34 (0.13)
	Rear leg hind view (RH)					0.17 (0.04)	0.47 (0.12)
	Rear leg side view (RS)						0.21 (0.04)
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	KSU feet and leg scoring system						
	Front Feet Claw Shape						
Ĵ	Open Divergent 20 30 40 Normal Consistent Claw 0 10 20 30 40 50 60 70 80 90 100 Claw Structure						
2007.00	SAS STATE VERSITY						

























15.1		Mean of fee	t and leg traits	
TY.	Trait	Mean (std dev)	Trait	Mean (std dey)
	Front Feet Hoof Angle	56.6 (4.6)	Front Leg Side View	46.0 (3.7)
S]]	Front Feet Heel Depth	57.2 (4.6)	Front Leg Knee Orientation	53.7 (3.0)
	Front Feet Claw Shape	57.5 (6.4)	Front Leg Hoof Orientation	55.8 (5.0)
	Rear Feet Hoof Angle	58.4 (5.6)	Rear Leg Side View	55.2 (5.4)
	Rear Feet Heel Depth	59.7 (5.7)	Rear Leg Rear View	56.6 (3.8)
	Rear Claw Shape	52.8 (5.8)	Composite Score	31.4 (4.0)
	Hoof Size	49.6 (5.4)		
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15.4	Heritability of feet and leg traits									
	Series of divariate linear animal models (91)									
	PCS	Avg n <sup>2</sup> (std error)	Front Log Side View	Avg n² (std error)						
5] <u>4</u> ]	Eropt Foot Hoof Aprilo	0.11(0.04)	Front Log Knop Orientation	0.10 (0.05)						
	Front Feet Hool Angle	0.20 (0.06)	Front Leg Mee Orientation	0.17 (0.05)						
	Front Feet Flew Change	0.17 (0.05)	Profit Leg Foot Orientation	0.17 (0.05)						
	Rear Feet Hoof Angle	0.09 (0.04)	Rear Leg Side VIEW	0.50 (0.06)						
	Rear Feet Heel Denth	0.15 (0.00)	Composite Score	0.12 (0.05)						
	Rear Foot Claw Shano	0.23 (0.00)	composite score	0.12 (0.03)						
	Hoof Size	0.17 (0.05)								
	1001 3120	0.50 (0.06)								
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Genetic correlations of int	erest (among feet)
Traits Front feet hoof angle and front feet heel depth Front feet hoof angle and rear feet heel depth Front feet hoof angle and rear feet heel depth Front feet heel depth and rear feet heel depth Rear feet hoof angle and rear feet heel depth Front feet claw shape and rear feet heel depth Front feet claw shape and rear feet heel depth	genetic correlation 0.89 (0.06) 0.88 (0.08) 0.85 (0.09) 0.85 (0.10) 0.94 (0.06) 0.75 (0.17) an be combined
<ul> <li>Front and rear claw shape highly correlation, perh</li> <li>Feet angle/depth uncorrelated with claw shape</li> </ul>	aps combined as well Kansas State University

	Genetic correlations of interest	t (front feet with legs)
	Traits	genetic correlation
<b>∥</b> Ľ,	Front feet hoof angle and front leg side view	0.46 (0.19)
	Front feet heel depth and front leg side view	0.45 (0.19)
	Front feet hoof angle and rear leg side view	0.63 (0.15)
	Front feet heel depth and rear leg side view	0.51 (0.17)
	Front feet hoof angle and rear leg rear view	0.36 (0.23)
	Front feet heel depth and rear leg rear view	0.51 (0.22)
	<ul> <li>Front leg and rear leg modest correlation with</li> <li>Could leg traits be indicators for hoof attribute</li> </ul>	front feet angle and depth 5? <u>KANSAS STATE</u> UNIVERSITY

#### Genetic correlations of interest (rear feet with legs)

Traits	genetic correlation
Rear feet hoof angle and rear leg side view	0.72 (0.15)
Rear feet heel depth and rear leg side view	0.56 (0.15)
Rear feet hoof angle and rear leg rear view	0.51 (0.21)
Rear feet heel depth and rear leg rear view	0.63 (0.19)
Rear claw shape and front leg knee orientation	0.41 (0.21)
Rear claw shape and front leg hoof orientation	0.38 (0.21)
Rear claw shape and rear leg side view	-0.36 (0.18)
<ul> <li>Rear leg and front leg modest correlation with rea</li> <li>Could leg traits be indicators for hoof attributes?</li> </ul>	r feet angle, depth and claw shape

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	Genetic correlations of interest (a	mong legs)
112	Traits gene	etic correlation
	Front leg knee orientation and front leg side view	-0.59 (0.21)
	Front leg hoof orientation and front leg side view	-0.75 (0.18)
1 <u>5</u> ]	Front leg hoof orientation and front leg knee orientation	0.95 (0.07)
	Rear leg side view and front leg knee orientation	-0.38 (0.19)
	Rear leg side view and front leg hoof orientation	-0.46 (0.18)
	Front leg traits relatively highly correlated with each other	er
	<ul> <li>Moderate negative correlations between some front and not different from 0</li> </ul>	l rear leg traits, most are
	<ul> <li>Front leg hoof orientation and knee orientation appear t</li> </ul>	o be the same trait
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	Traits	genetic correlation
間目	Body condition score and front feet claw shape	0.51 (0.28)
[#]_*]&	Body condition score and hoof size	0.40 (0.19)
3]]]	Body condition score and front leg knee orientation	-0.68 (0.26)
13/	Body condition score and front leg hoof orientation	-0.70 (0.24)
	Composite score and front feet hoof angle	-0.33 (0.24)
	Composite score and front feet heel depth	-0.36 (0.24)
	Composite score and rear feet hoof angle	-0.44 (0.22)
	Composite score and rear feet heel depth	-0.57 (0.18)
	Composite score and front leg side view	0.87 (0.19)
	Composite score and rear leg rear view	-0.64 (0.18)
	<ul> <li>An evaluator's overall impression of soundness appe and rear feet angle and depth, and side view of front</li> </ul>	ars to be highly influenced by front t and rear legs
		RANSAS STAT







	BW	ww	YW	MILK	ME	HPG	CEM	STAY	HERD	GRII
RHA	-0.06*	-0.08**	-0.06*	0.07**	-0.002	0.01	-0.004	0.01	0.01	-0.01
RHD	0.06**	-0.01	-0.01	-0.01	-0.03	0.001	-0.08**	-0.06*	-0.09**	-0.03
RCS	0.03	-0.04	-0.04	0.06**	0.07**	-0.06**	0.06*	-0.14***	-0.11***	-0.02
RSV	-0.10***	-0.01	0.002	0.02	0.02	0.02	0.10***	0.12***	0.15***	0.03
RV	0.06*	-0.005	-0.01	-0.01	-0.03	0.001	-0.08**	-0.06*	-0.09**	-0.03
сомр	-0.07**	0.01	0.01	0.01	0.03	0.0001	0.08**	0.06**	0.10***	0.03



	Comparis	son of Scoring S	ystems	_
1000		1-100 scale h2 (SE)	1-10 scale h2 (SE)	
	Front feet hoof angle	0.20 (0.06)	0.18 (0.06)	
	Front feet heel depth	0.17 (0.05)	0.12 (0.04)	
	Front feet claw shape	0.09 (0.04)	0.08 (0.04)	_
[]* }	Rear feet hoof angle	0.19 (0.06)	0.17 (0.05)	
9]]]	Rear feet heel depth	0.25 (0.06)	0.24 (0.06)	_
<i>1</i>	Rear feet claw shape	0.17 (0.05)	0.15 (0.05)	_
	Front leg side view	0.16 (0.05)	0.15 (0.05)	_
	Front leg knee orientation	0.17 (0.05)	0.11 (0.05)	_
	Front leg hoof orientation	0.17 (0.05)	0.15 (0.05)	_
	Rear leg side view	0.30 (0.06)	0.29 (0.06)	_
	Rear leg rear view	0.14 (0.05)	0.11 (0.04)	_
	Hoof size	0.36 (0.06)	0.29 (0.06)	_
	Composite score	0.12 (0.05)	0.09 (0.04) <b>K</b>	– <u>Ansas Stati</u>



