New indices to improve feed efficiency in crossbred pigs

5 Years of research for breeding towards improved feed efficiency

Michael Aldridge, Rob Bergsma, Mario Calus











Feed efficiency.

Feed Efficiency = Average daily gain Daily feed intake

Feed
Conversion =
RatioDaily feed intake
Average daily gain





New traits and opportunities from Feed a Gene.

- Digestibility
- Feeding behaviour
- Welfare indicators
- Indirect genetic effects

- Biomarkers
- Group records
- Perturbations
- Meat quality
- Genomic prediction





Can we use Feed a Gene to address a key issue?







The dataset from Topigs Norsvin is a great asset

Trait	Pure and Crossbred genetic correlation		
Feed conversion ratio	0.57		
Average daily gain	0.51		
Daily feed intake	0.54		









Perturbations....



Root mean square error (RMSE) Daily feed intake Mean 0.49Phenotypic variance 0.009 Heritability 0.06

Topigs Norsvin

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Putz, A Frontiers in Genetics 9 (2019)





Selection index theory.

Selection indexes

Hazel, LN (1943) Genetics 28, 476-490.

Breeding programs

a (economic weights)

 $\mathbf{b} = \mathbf{P}^{-1}\mathbf{G}\mathbf{a}$ (Index weights)

SelAction

 $\mathbf{R} = \mathbf{b}' \mathbf{G} (\mathbf{b}' \mathbf{P} \mathbf{b})^{-0.5}$ (Response to selection)





New traits and opportunities from Feed a Gene.

27 Traits in total, with 20 Novel traits from 8 categories

- 22 Traits have a genetic correlation with FCR_PB
- All traits have a genetic correlation with FCR, ADG, and/or DFI

- The correlation matrix was completed:
 - Or a low correlation (±0.10)
 - Using matrix completion theory
 - A sensitivity of 10% was tested





The genetic correlation is not one!

100 years

Para	meter	Selection for Purebred	Selection for Crossbred	
Information available		FCR, ADG, DFI of PB animals		
Economic value	FCR	-€16.70 on PB	-€16.70 on CB	
	ADG	€0.06 on PB	€0.06 on CB	
	FCR_PB (1.99)	-0.031	-0.039	
Response (Current mean)	FCR_CB (2.59)	-0.028	-0.035	
	ADG_PB (1061)	42.53	38.23	
	ADG_CB (882)	13.44	12.48	
			9	

Adding purebred recorded production traits

Economic value for: FCR_CB ADG_CB

Data available for traits: FCR, ADG, DFI

Novel production PB Group and Social

Perturbation PB RMSE of DFI







Adding purebred recorded production traits



100 years







Adding group recorded crossbred traits

Economic value for: FCR_CB ADG_CB

Data available for traits: FCR, ADG, DFI

RMSE of DFI

CB Group records







Adding group recorded crossbred traits





ADG of crossbreds

20 15 10 5 0 BASE index Purebred production Série1 12.48 20.83 13.387

Base index €1.33 per sow joined

Purebred production €1.63 per sow joined

Crossbred group €1.44 per sow joined



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Adding a trait from all categories

Economic value for: FCR_CB ADG_CB

Data available for traits: FCR, ADG, DFI

Minimum of one trait per category









Adding purebred recorded production traits



100 years



ADG of Crossbreds

25 Trait response (kg/kg) 20 15 10 5 0 Purebred Crossbred **BASE** index All traits production group Série1 12.48 20.83 13.387 23.151

Base index €1.33 per sow joined

Purebred production €1.63 per sow joined

Crossbred group €1.44 per sow joined

All traits €1.75 per sow



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Adding genomic prediction

Economic value for: FCR_CB ADG_CB

Genomic prediction for: FCR_CB Acc = 0.4, $h^2=0.99$

Data available for traits: Minimum of one trait per category







No GP GP

Adding genomic prediction

100 years

WAGENINGEN





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What happens to robustness and welfare?

Trait	Trait Mean	PB	СВ	ALL	ALL_GP
RMSE_PB	0.663	-0.005	0.016	0.003	-0.005
RMSE_CB	0.492	0.028	-0.003	-0.003	-0.008
TLC	28.0	0.042	-0.034	0.009	0.001
JLC	0.101	0.023	-0.001	0.009	0.001





- Adding new traits can increase response to selection
- Recording production traits is important
- Including genomic prediction is beneficial
- If possible record traits on Crossbreds





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