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EFFICIENT & ECOLOGICALLY-FRIENDLY PIG AND POULTRY PRODUCTION.

ECOFCE

A WHOLE-SYSTEMS APPROACH TO OPTIMISING FEED EFFICIENCY AND REDUCING THE ECOLOGICAL FOOTPRINT OF MONOGASTRICS.

BASIC DATA

Funding:
EU-FP7
(€ 6 million)

Start date:
1 February 2013

Duration:
48 months
(2013 to 2016)

The ECO-FCE project is funded by the European Union Seventh Framework Programme (FP7 2007/2013) under grant agreement No. 311794.

COOPERATION

Proper modelling of feed efficiency in breeding programs revealed through novel Bayesian response to selection methodology: RFI vs FCR

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FCR occupies large proportion of breeding objectives in pig breeding programs

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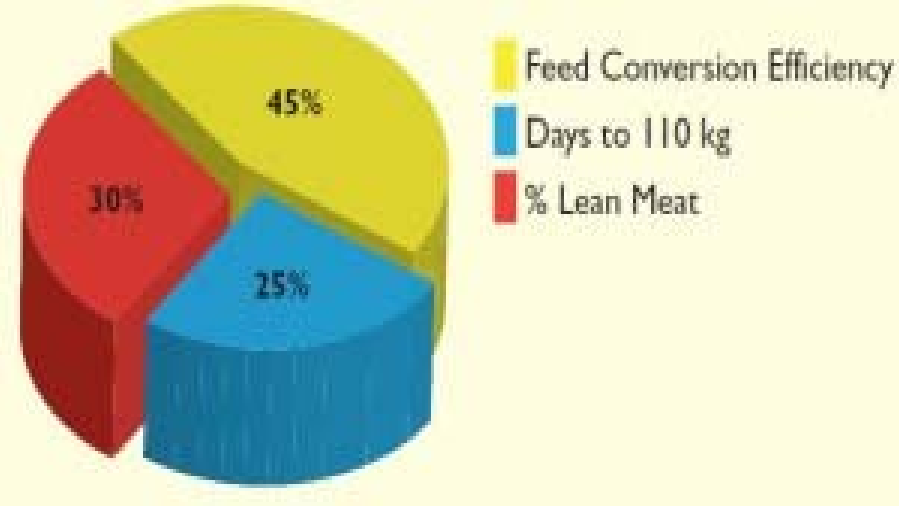
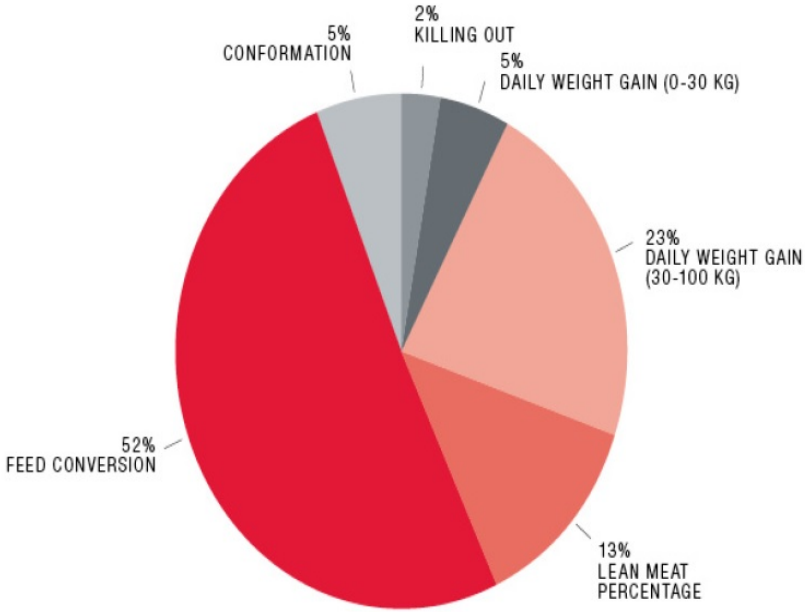
The Pig Breeding Company Hermitage Genetics

The MAXGRO™ terminal line

Licensed by Dan Avl

The Danish Duroc terminal line





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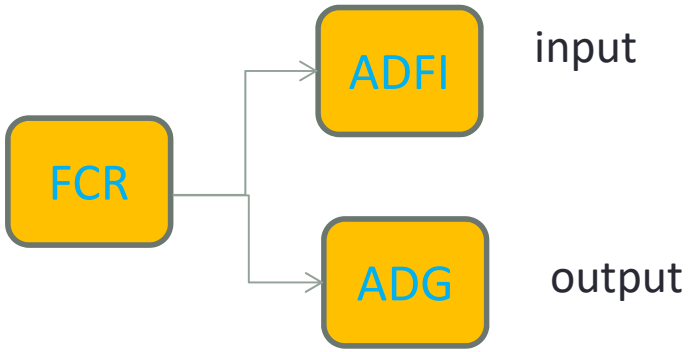
Measures of feed efficiency

FCR: gross measure



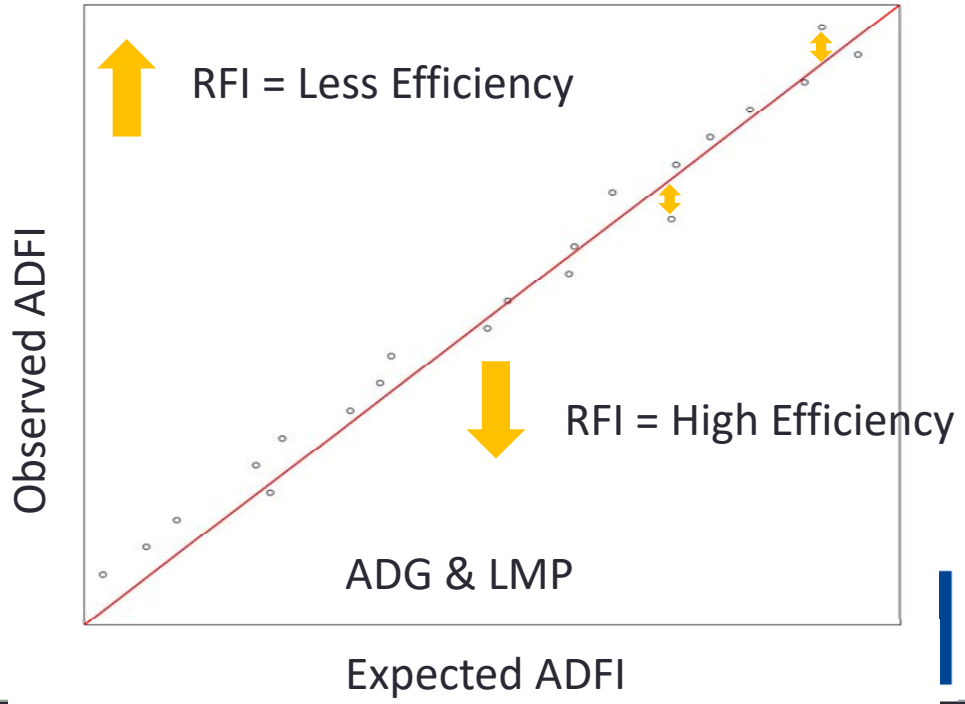
FCR = Less Efficiency

FCR = High Efficiency

RFI: partial measure

RFI = Observed ADFI – Expected ADFI

RFI = ADFI - b_1 ADG – b_2 LMP



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- Traits
  - ADFI: 2.61 (0.39) kg/d
  - ADG: 1.12 (0.15) kg/d
  - LMP: 62.7 (1.97) percent

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Statistical model: Bayesian analysis

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$$y_{ijkl}^{ADFI} = Gender_{ij} + Parity_{ik} + YS_{il} + b^{ADFI}(SBW_i) + a_i^{ADFI} + pe_i^{ADFI} + e_{ijkl}^{ADFI}$$

$$y_{ijkl}^{ADG} = Gender_{ij} + Parity_{ik} + YS_{il} + b^{ADG}(SBW_i) + a_i^{ADG} + pe_i^{ADG} + e_{ijkl}^{ADG}$$

$$y_{ijkl}^{LMP} = Gender_{ij} + Parity_{ik} + YS_{il} + b^{LMP}(EBW_i) + a_i^{LMP} + pe_i^{LMP} + e_{ijkl}^{LMP}$$

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Modelling residual feed intake (RFI)

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RFI = ADFI − E(ADFI)

Genetic RFI (RFI_g)

$$a_i^{RFI_g} = a_i^{ADFI} - b_{g.1}\, a_i^{ADG} - b_{g.2}\, a_i^{LMP}$$

Phenotypic RFI (RFI_p)

$$a_i^{RFI_p} = a_i^{ADFI} - b_{p.1}\, a_i^{ADG} - b_{p.2}\, \hat{a}_i^{LMP}$$

$$\begin{bmatrix} \boldsymbol{G}_{RFI} & \boldsymbol{G}_{RFI,p} \\ \boldsymbol{G}_{p,RFI_g} & \boldsymbol{G}_p \end{bmatrix} = \boldsymbol{B}\,\boldsymbol{G}\,\boldsymbol{B}'$$

$$\begin{bmatrix} \boldsymbol{P}_{RFI} & \boldsymbol{P}_{RFI,p} \\ \boldsymbol{P}_{p,RFI} & \boldsymbol{P}_p \end{bmatrix} = \boldsymbol{B}\,\boldsymbol{P}\,\boldsymbol{B}'$$

$$\boldsymbol{B} = \begin{bmatrix} \mathbf{I}_{fi} & -\boldsymbol{b}_{fi\,p} \\ 0 & \mathbf{I}_p \end{bmatrix}$$

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Feed conversion ratio (FCR) estimation

$$a_i^{FCR} = \frac{\mu_{ADFI} + \hat{a}_i^{ADFI}}{\mu_{ADG} + \hat{a}_i^{ADG}} - \frac{\mu_{ADFI}}{\mu_{ADG}}$$

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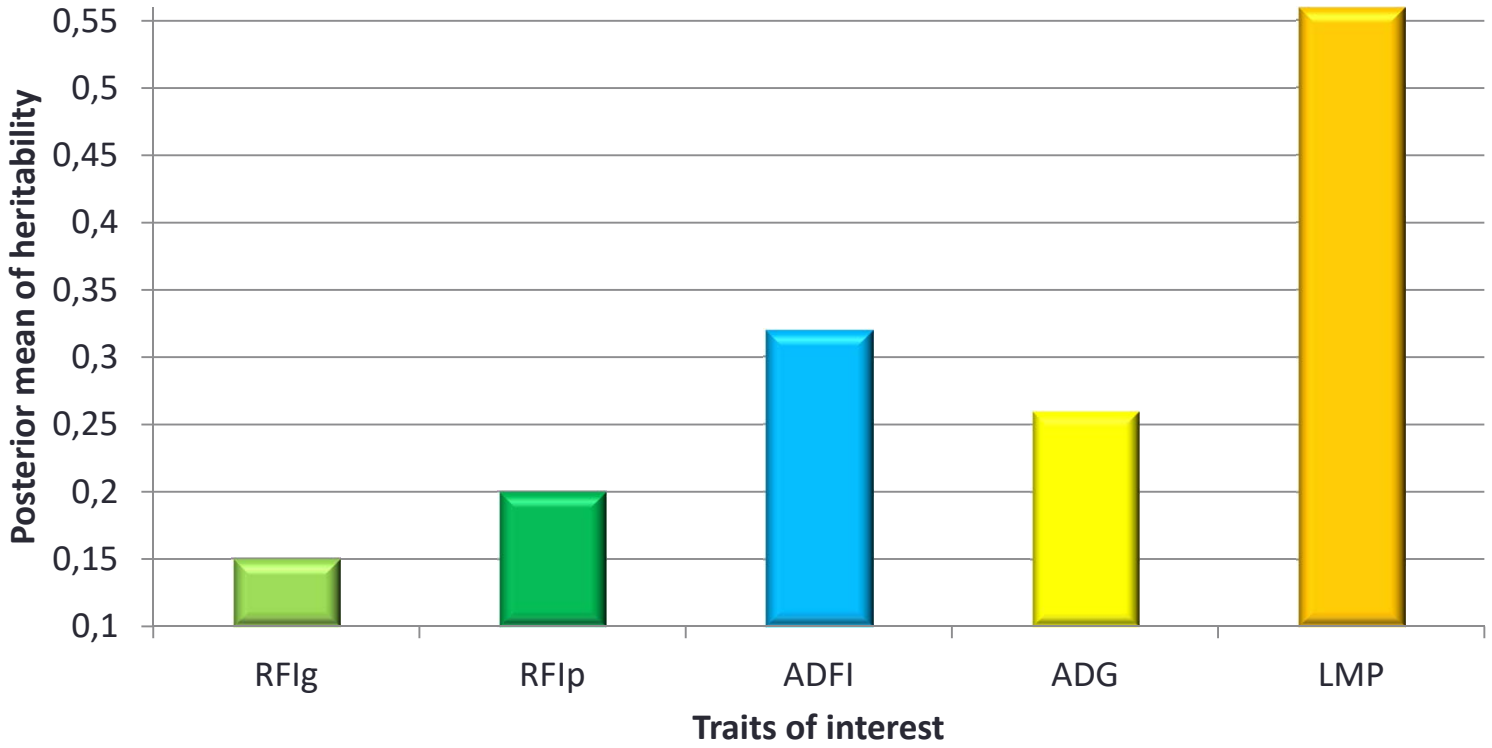
One use of heritability is to determine how a population will respond to selection



26.45% with 5.58 PSD of the genetic variation in ADFI is explained by RFI_g.

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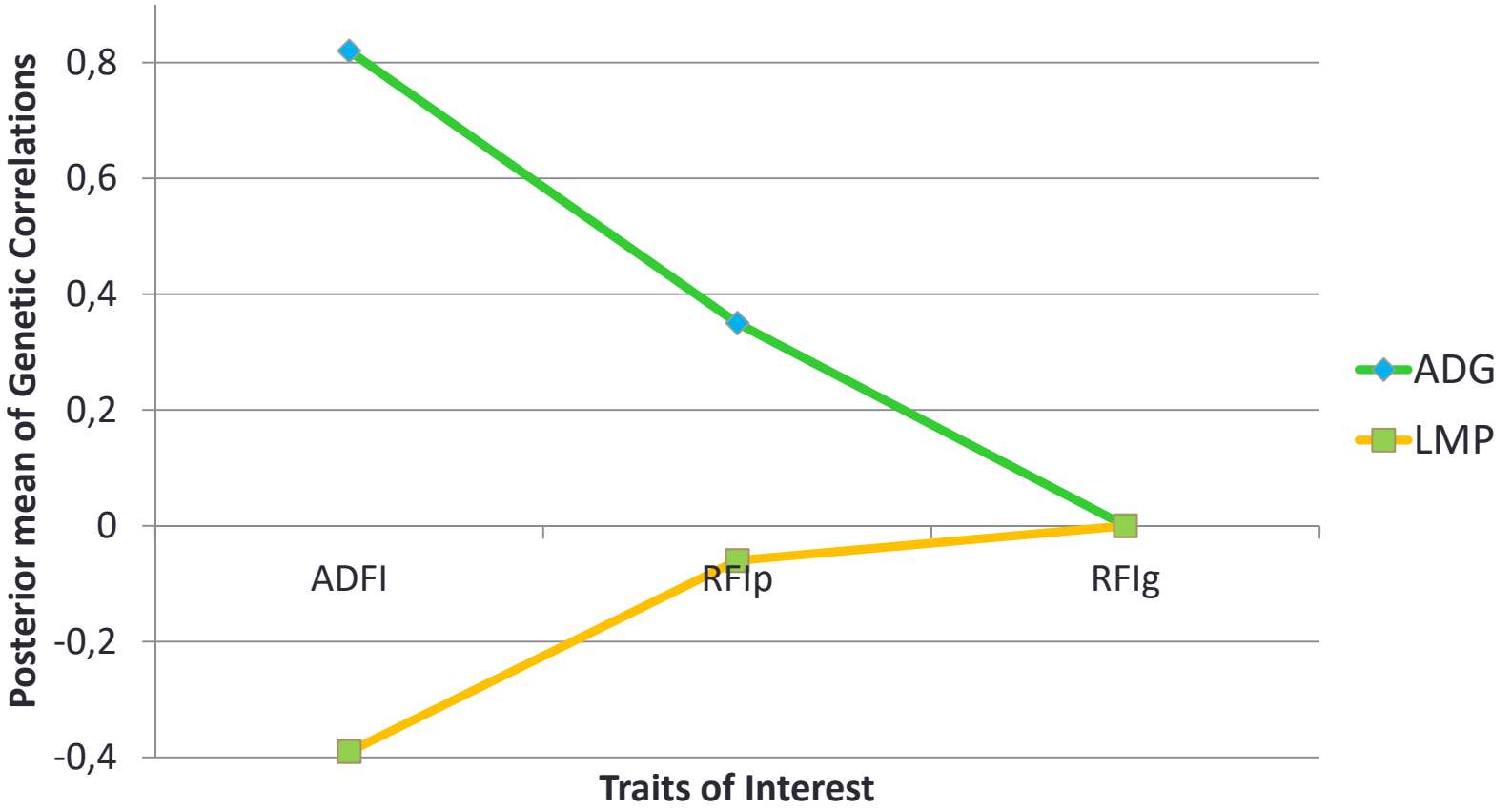
RFI_g is independent of production traits



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Selection for RFI results in reduction of ADFI without altering the production traits

Selection for FCR results in disproportional selection on its component traits

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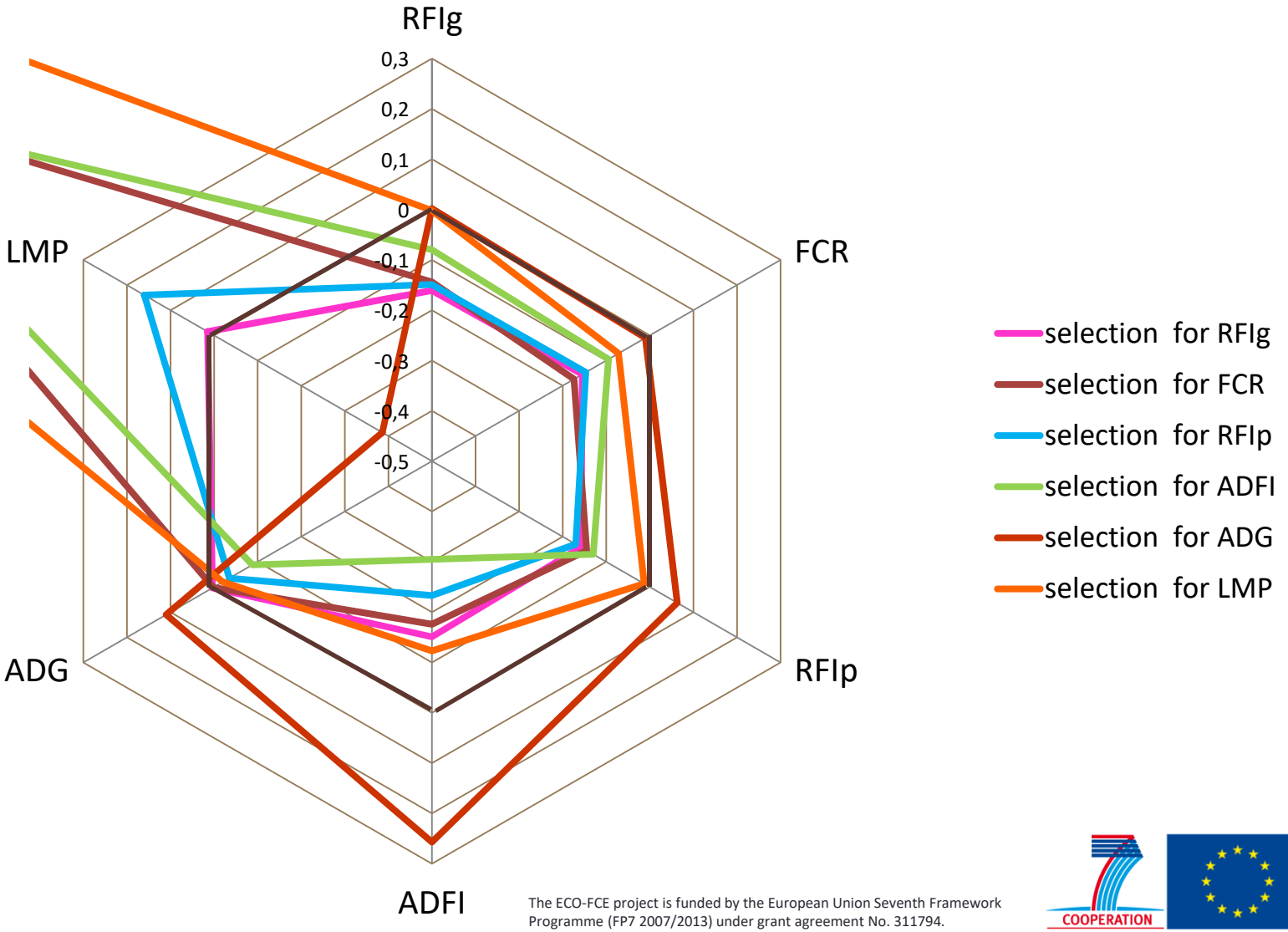

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Selection for FCR results in disproportional selection pressure on its component traits and also LMP

RFI_g *allows*

1) *selection on the proportion of feed intake that is independent of production; and*
2) *easier and better selection index weights for the traits in the breeding programs*

Selection for improved feed efficiency is likely best achieved through multiple-trait selection on RFI_g *and production traits*

Joint selection for feed intake and production traits can also result in genetic improvement of feed efficiency

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The Pig Breeding Company
Hermitage Genetics

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