

Improvement of feed efficiency: lessons from residual feed intake studies in pigs – part 2



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OUTLINE

Part1

- ❖ From feed efficiency to residual feed intake (RFI)
- ❖ Properties and measures of RFI
- ❖ Selection experiments for RFI
- ❖ Genetic parameters and correlated responses to selection
- ❖ Biological bases of RFI

Part2

- ❖ Measuring (residual) feed intake / bio-markers for RFI
- ❖ Management rules and RFI
- ❖ What selection strategies ?

Summary

- RFI: heritable, responds to selection
- Selection for reduced RFI has resulted in
 - Pigs that eat less but that are slightly leaner (and grow slower)
 - Limited changes in body composition - decreased fatness
 - Limited impact on meat quality
 - Changes in behavior – faster eaters – less active
 - Reduced maintenance requirements, tissue turnover rates
 - Low impact on digestive efficiency (but not challenged?)
- No detrimental impacts on litter size and litter performance
- No detrimental impacts on response to stress ...

➔ Selection rules – Biomarkers

Bio-markers for RFI **Measuring RFI**



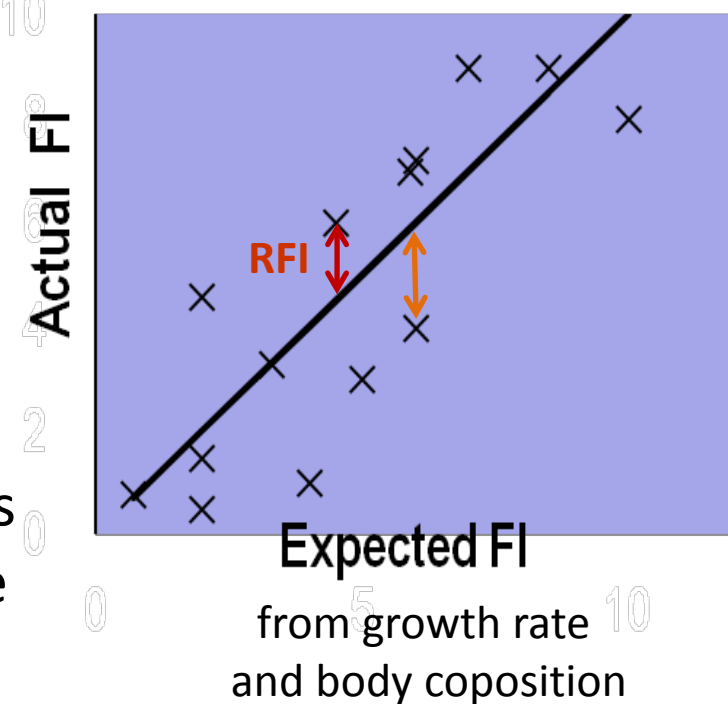
Costly
automatic feeders

Measure sub samples of animals
Measure a period of feed intake

Inaccurate

DFI measurement errors and data processing
measuring body composition

➔ Biological markers needed



Selection experiments for RFI **Selection experiments**



Yorkshire - Large White

Low RFI line

High RFI line

Develop divergent lines for RFI

to study

the responses to selection for RFI

the biological/physiological basis

of ingestion and feed efficiency

Propose tools to improve feed efficiency



Major genes

MC4R → impact on DFI, ADG, BF, no allele selected in selected lines

RN → impact on DFI, not FCR, RFI unknown

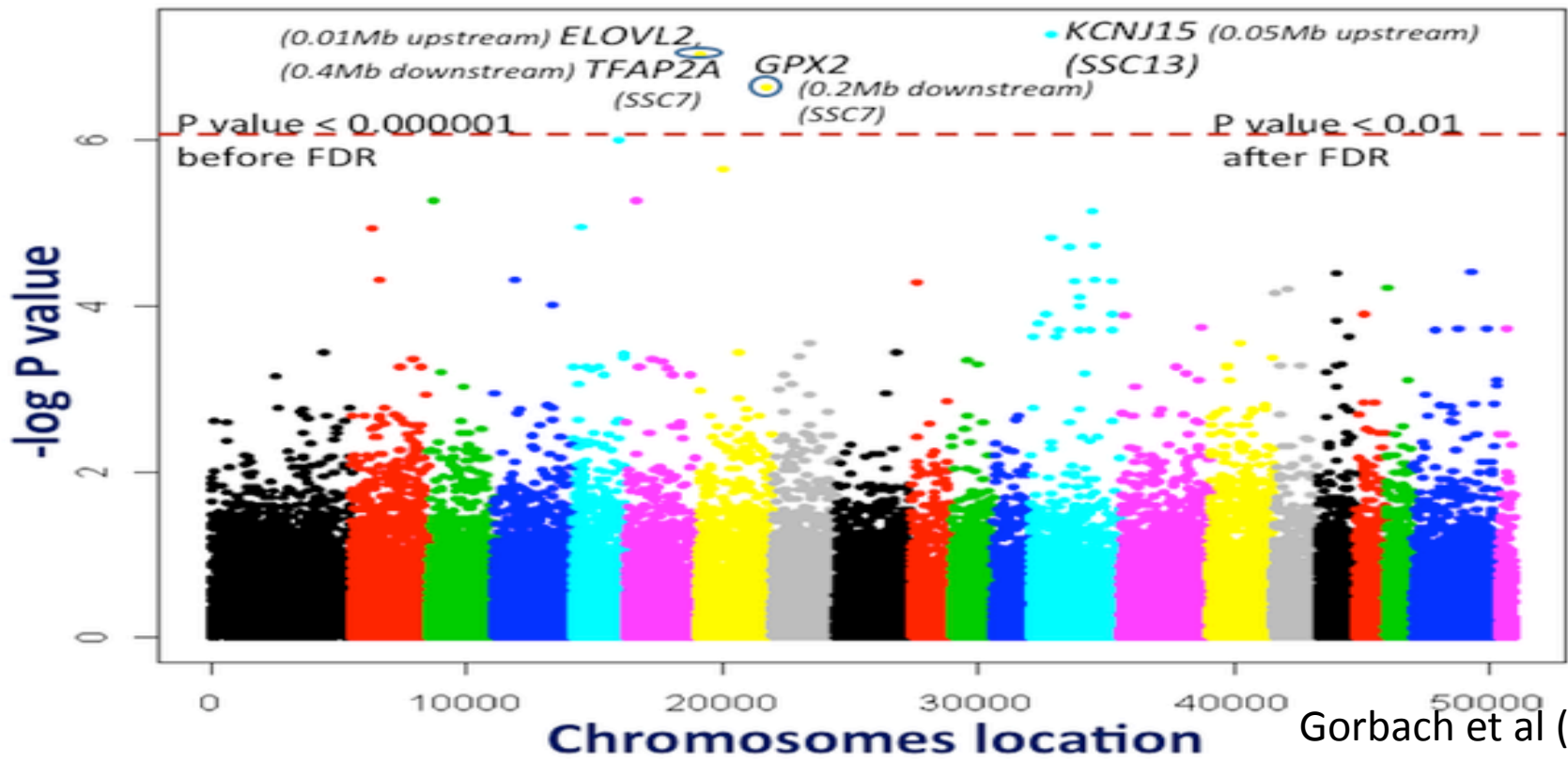
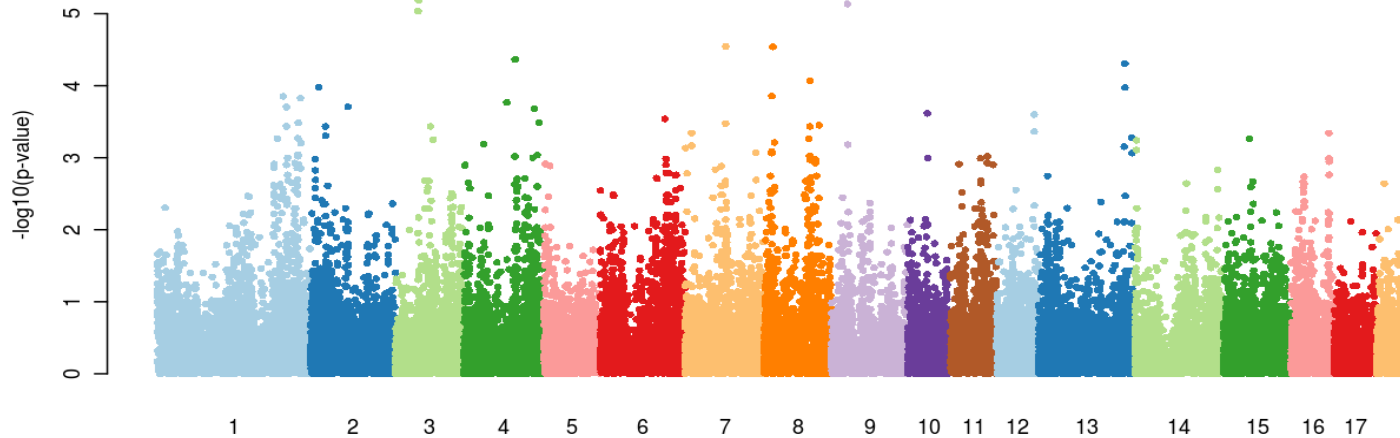
HAL → impact on DFI, FCR, not RFI (Saintilan et al, 2011)

DFI and feed efficiency not often recorded in QTL detections

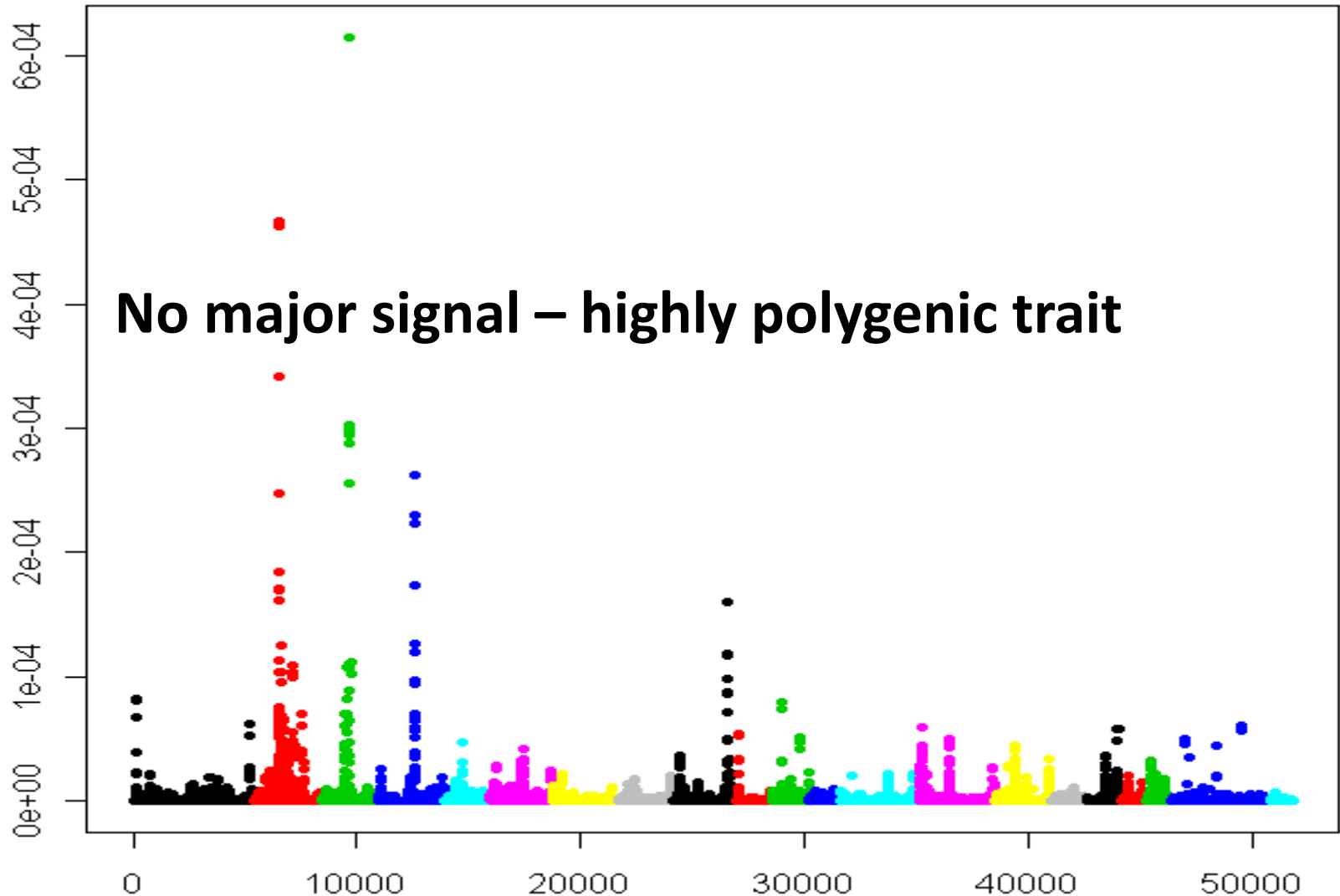
Some QTL for FCR, more for ADG and BF

RFI rarely reported, but no large signal up to now

Bio-markers for RFI SNP allele frequency



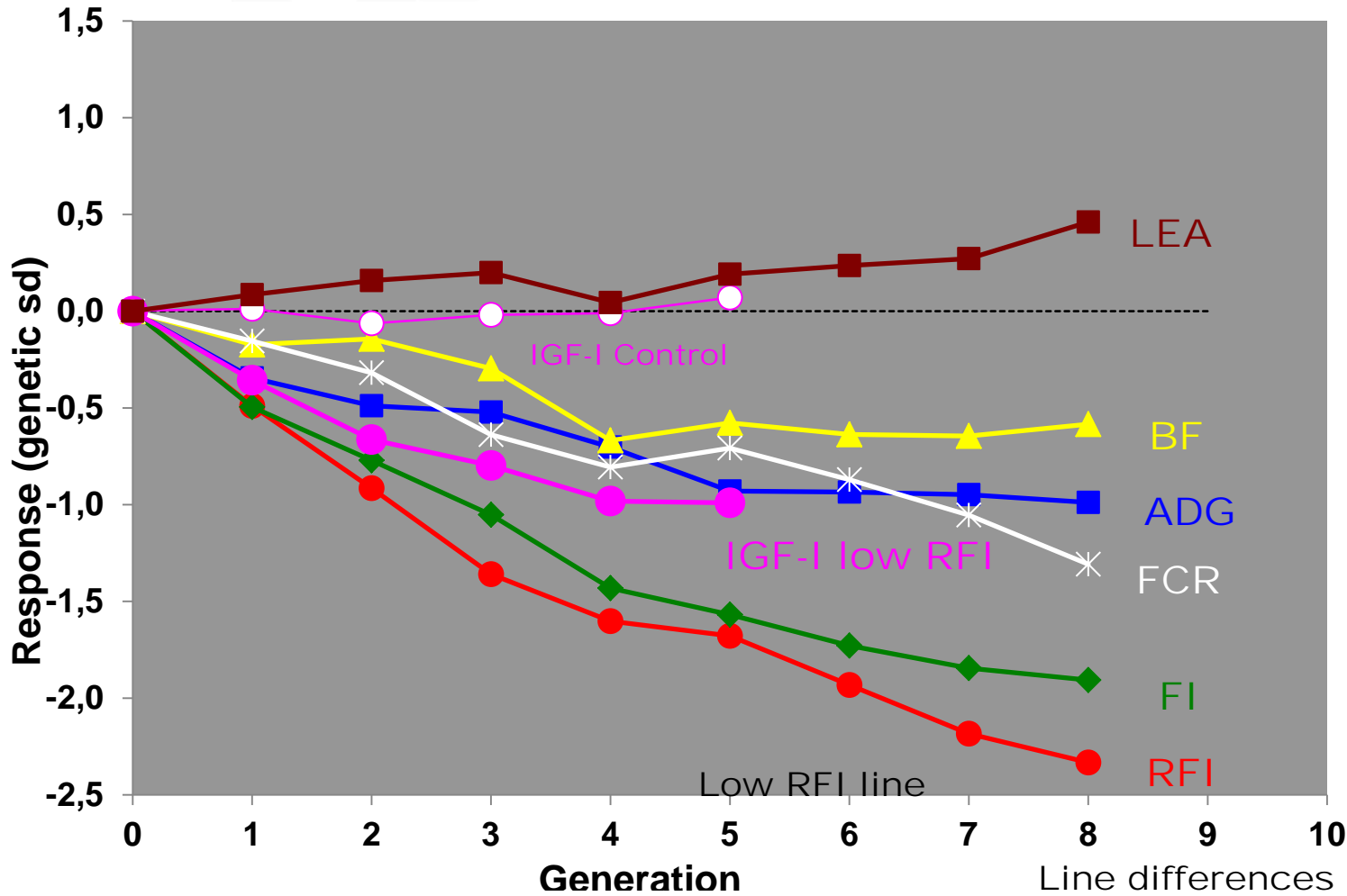
PROP. OF GENETIC VARIANCE





Serum IGF-1 at 35-42 days

IGF1 : related to growth, mechanisms unknown



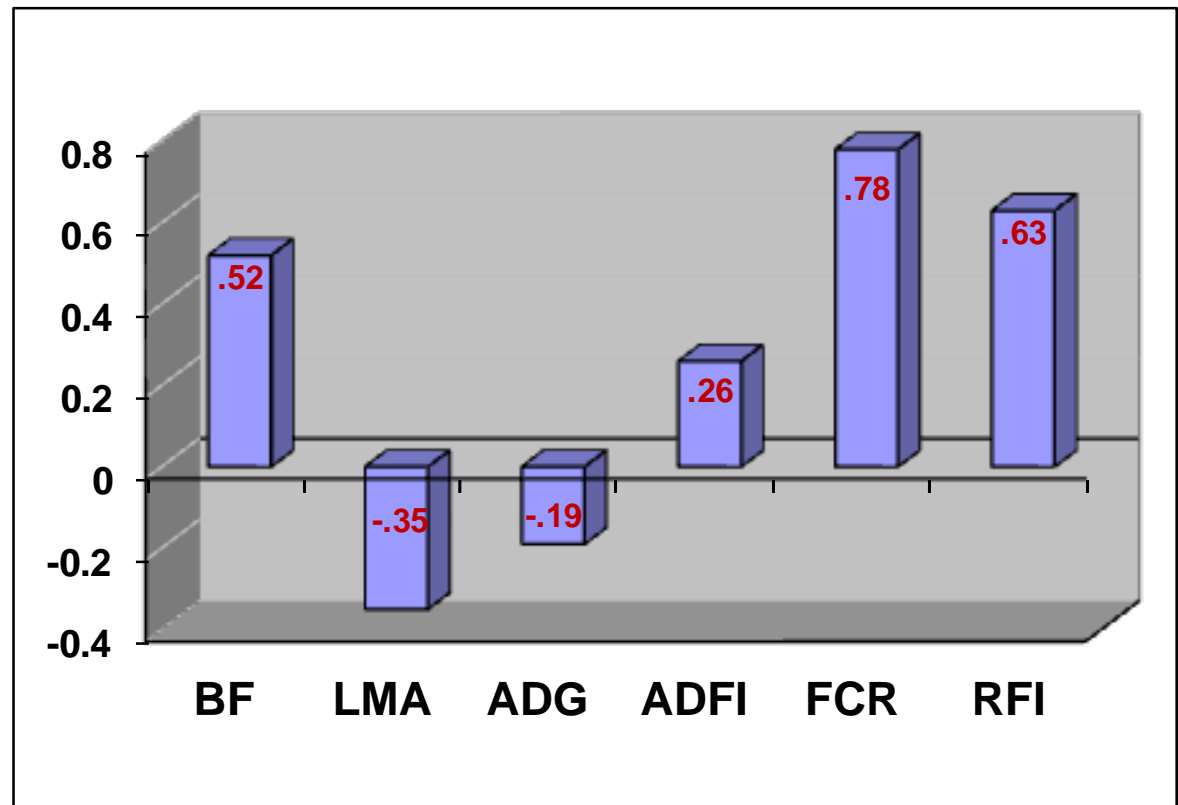
Bunter et al 2010

Bio-markers for RFI **Physiological markers**

Serum IGF-1 at 35-42 days

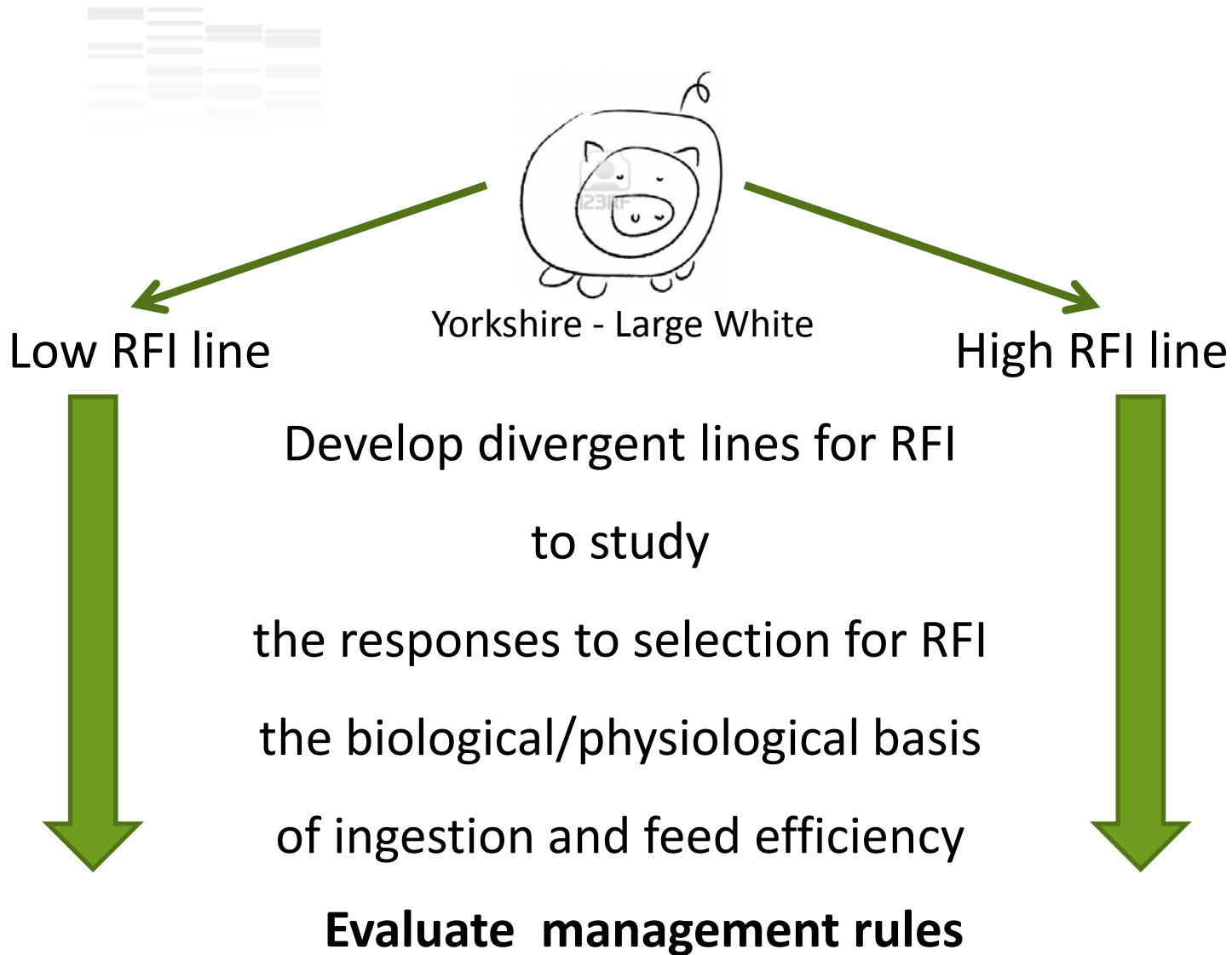
IGF1 : related to growth, mechanisms unknown

Caution?

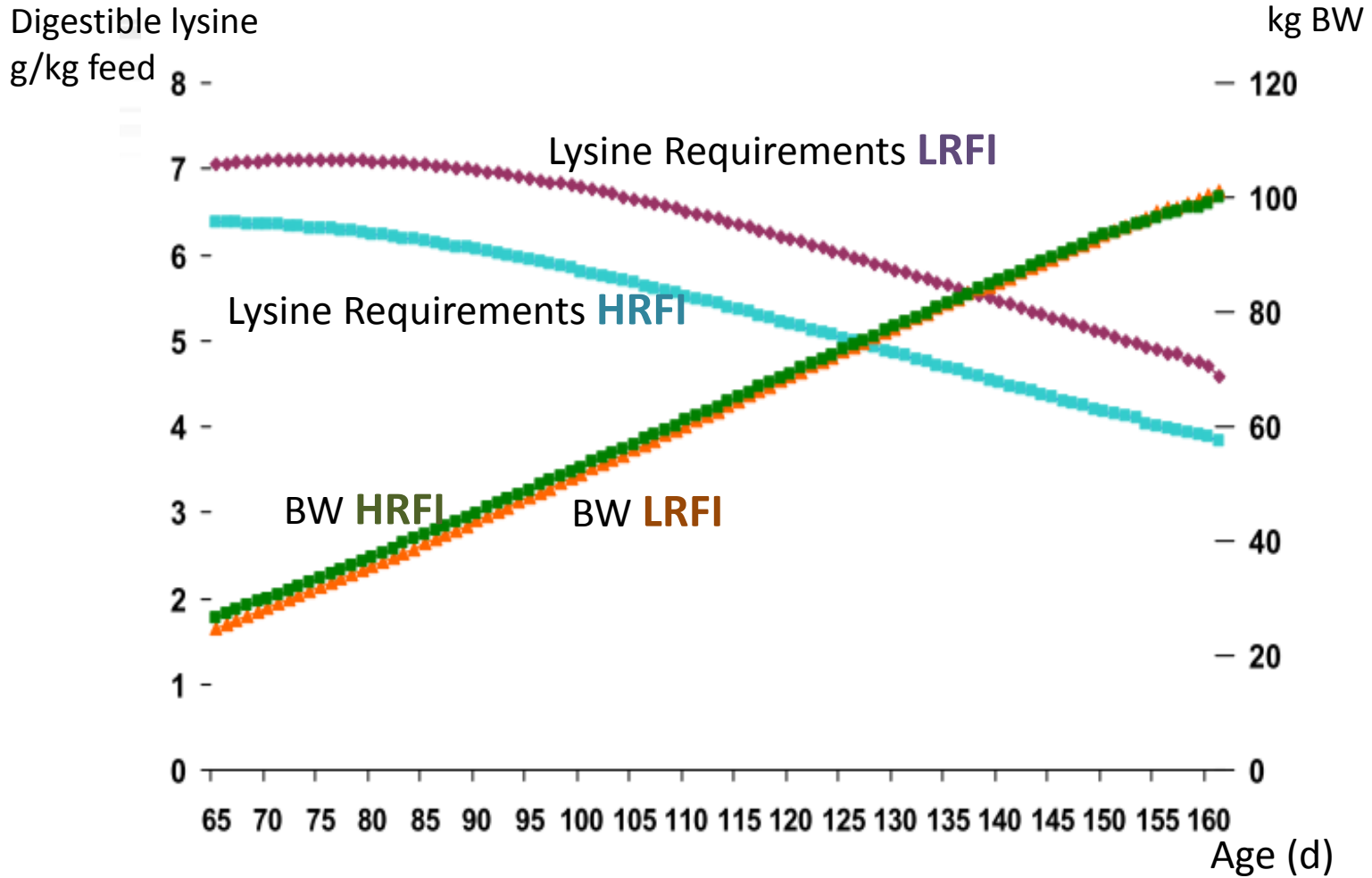


Bunter et al 2010

Selection experiments for RFI **Selection experiments**



Management rules and RFI Nutrient requirements

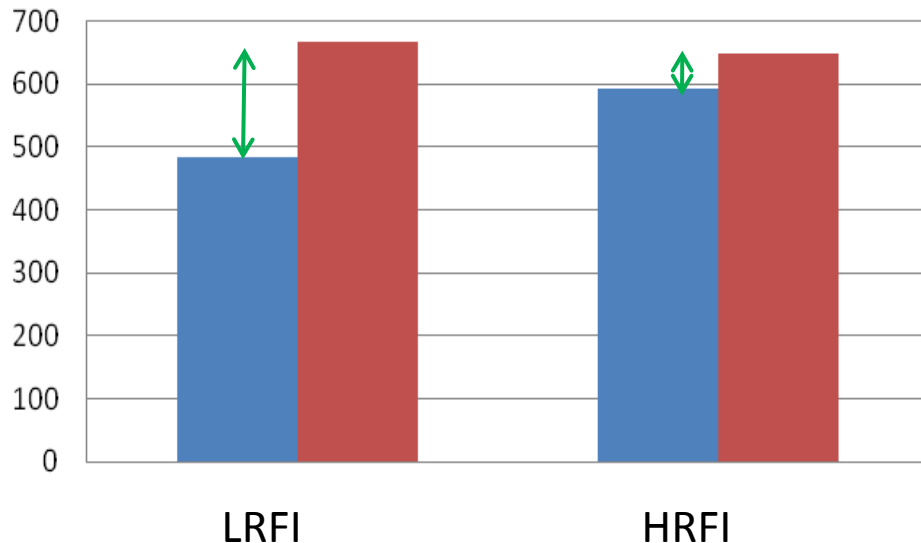


LRFI: larger AA requirements / kg feed
Effect of restriction?

Management rules and RFI Nutrient requirements



Average Daily Gain

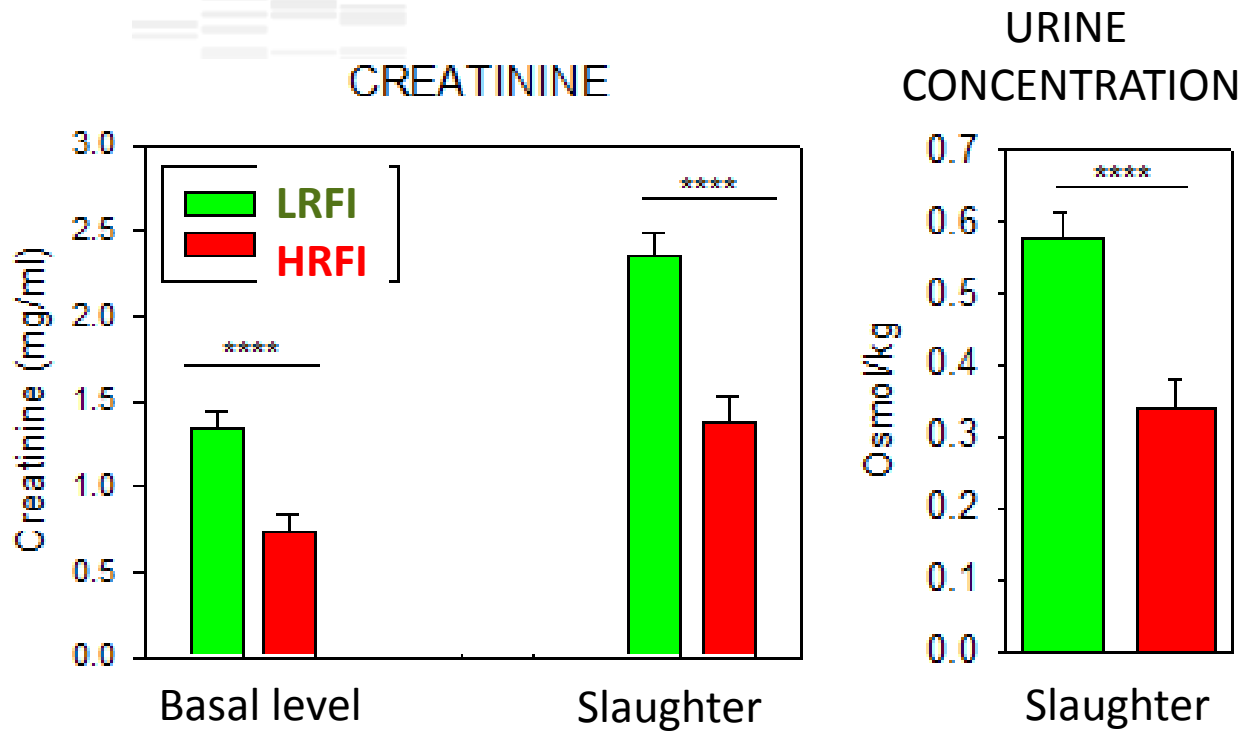


- Restricted diet to requirements of 25% lowest LRFI pigs
- Control

LRFI: larger ADG decrease (~25%) in response to challenge
→ Individual feeding management

Brossard et al

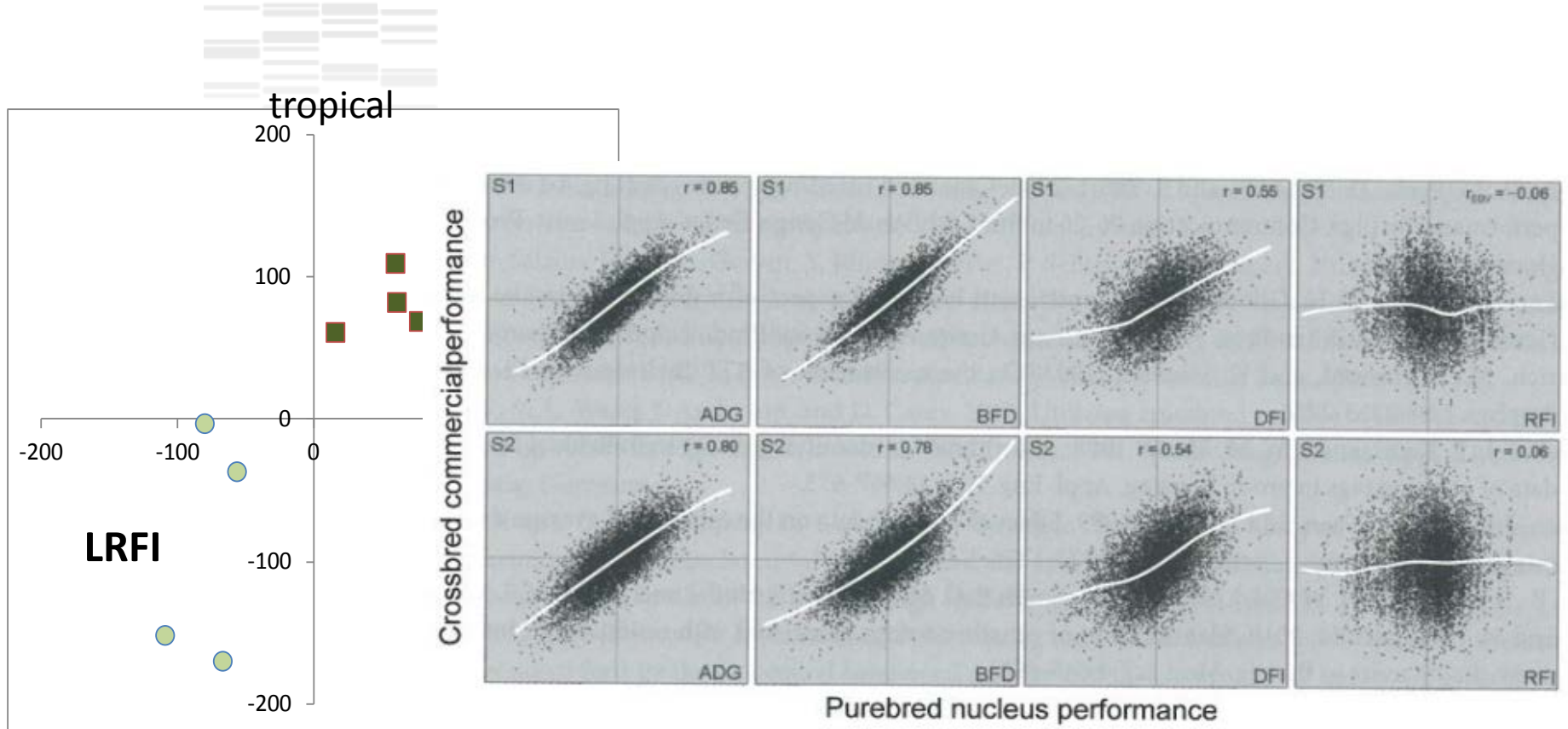
Management rules and RFI **Inputs and outputs**



Water intake: reduced more than proportionally to DFI in LRFI pigs

Excretion: ↓ FCR → ↓ excretion

Environment and RFI Environmental specificity



Knap and Wang 2012

- Further work needed
1. to identify appropriate standardized testor E (feed, sanitary conditions ...)
 2. to evaluate GxE interactions

What selection strategies ?

« residual feed intake provides no additional genetic information over and above that provided by its component traits »

Kennedy et al, 1993

+

No specific deleterious responses to selection identified
(MQ and AA requirements)

→ No specific strategies?

What selection strategies ?

But: evaluating RFI is the key to quantify the proportion of responses to selection on GFE not due to production

Accuracy needed

→ Quantify potential genetic progress on FE achieved without affecting ADG and BF

Maternal lines?

Recording ADFI or Biomarkers
Genomics

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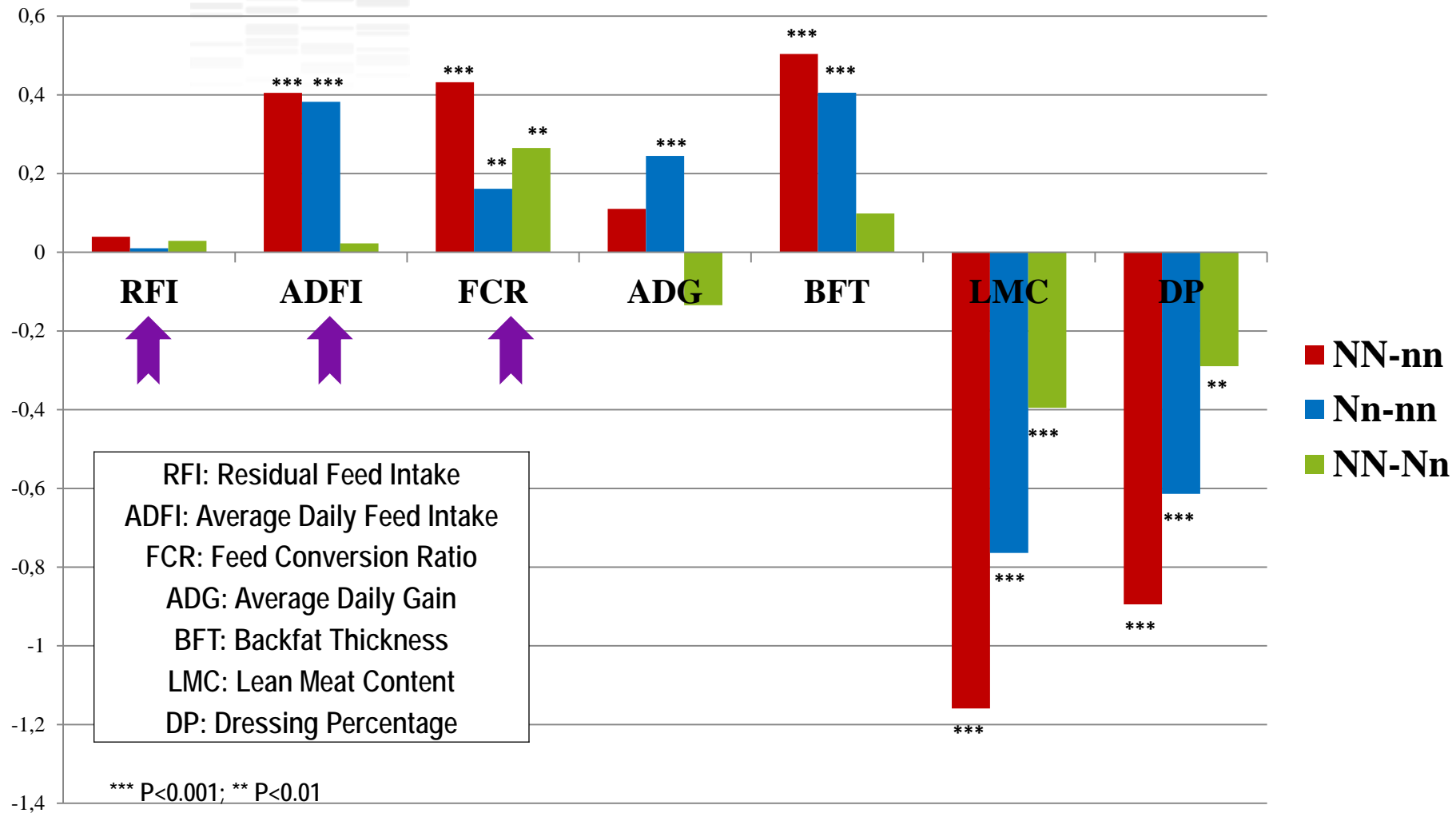
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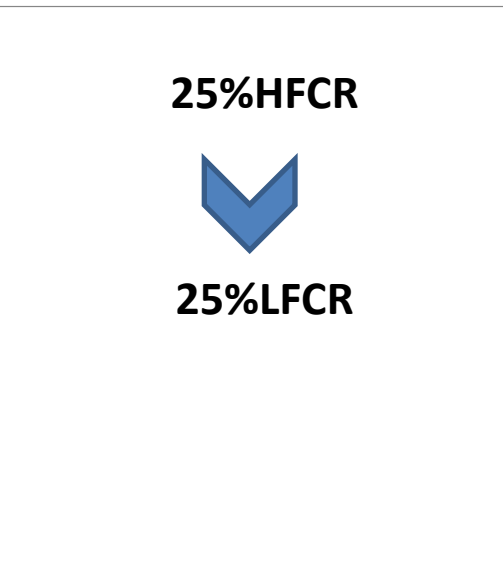
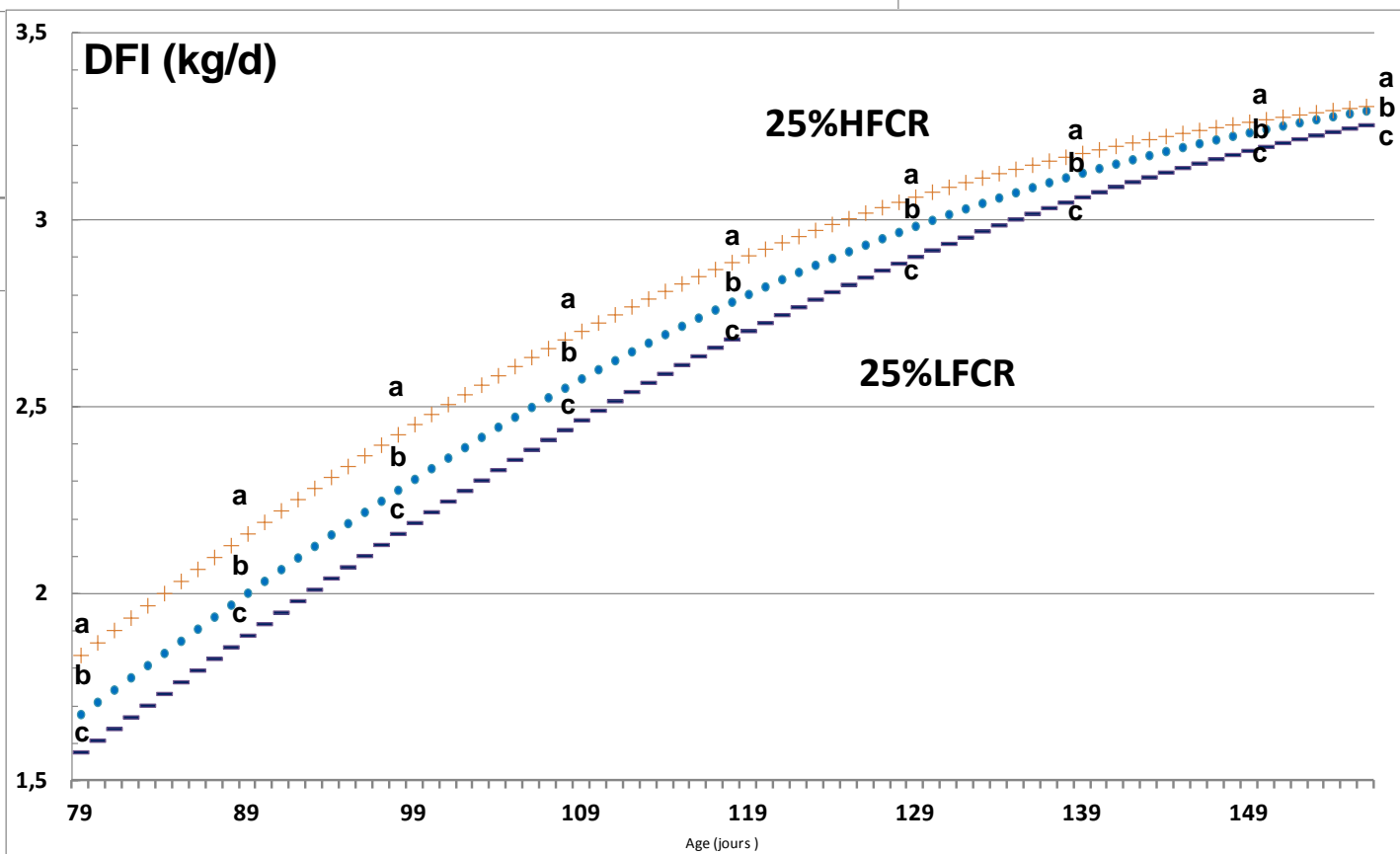
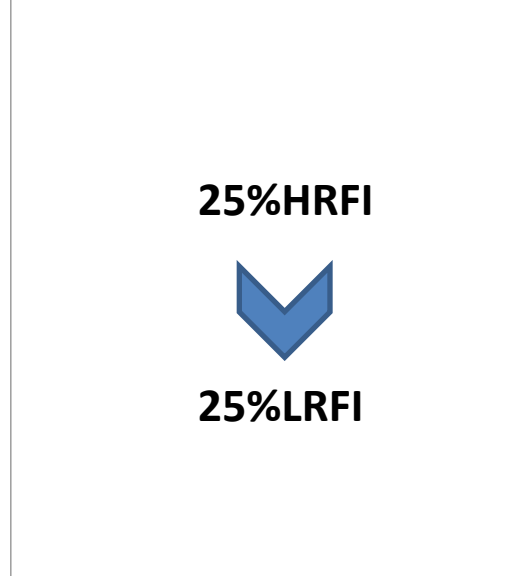
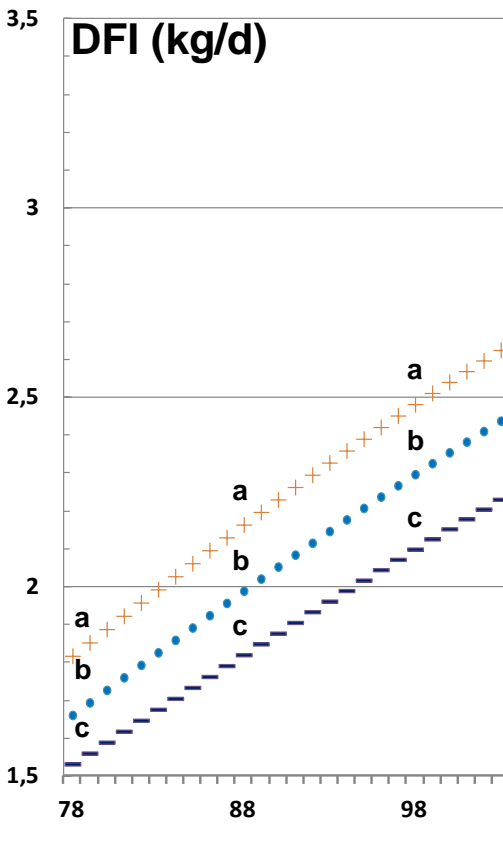
Bio-markers for RFI Halothane and RFI

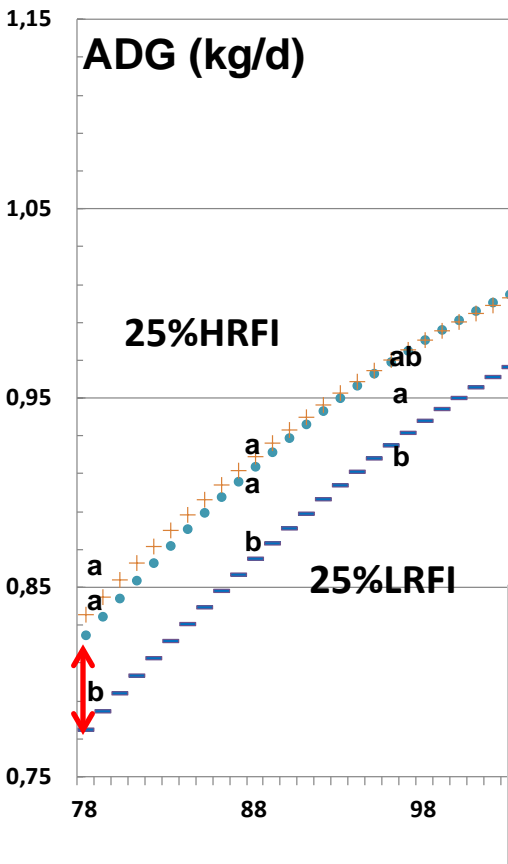
Phenotypic SD unit



RFI: Residual Feed Intake
 ADFI: Average Daily Feed Intake
 FCR: Feed Conversion Ratio
 ADG: Average Daily Gain
 BFT: Backfat Thickness
 LMC: Lean Meat Content
 DP: Dressing Percentage

Saintilan et al. 2011





Lower early ADG
Larger late ADG
Same global ADG

