SMAll RuminanTs breeding for Efficiency and Resilience

Breeding program modelling for resilience & efficiency in Lacaune sheep

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Introduction

Modelling of resilience & efficiency (R&E) traits in a selection index framework

AIMS

1. Assess long-term (20 year) impact of breeding for R&E traits on sheep and goat populations
2. Test how new genomics tools can improve populations faster
3. Assess sensitivity of outcomes to changes in weightings, correlations, etc.
4. Provide recommendations to the breeding program

Through 3 case studies using real breeding program characteristics

- Lacaune sheep → Functional Longevity (*FL*) and Feed Efficiency (*FE*)
- Alpine goats
- Saanen goats

M&M – program parameters

General selection index theory framework developed by AbacusBio

Requires breeding program parameters obtained from INRAE

- Weights on index traits
- Data on the selection candidates (performance records/ genomics)
- Breeding program parameters (mating ages/ ratios)
- Selection intensity
- Genetic parameters (h2, corelations etc.)

Total Merit Index (*TMI*) traits measured on ewes only

$$TMI = 1 \times PROD - 0.5 \times LSCS + 0.5 \times UDDER$$

Production and udder sub-indexes

$$PROD = 0.5 \times FY + 0.925 \times PY + {}^{1}/_{25} \times FC + {}^{1}/_{64} \times PC$$

$$UDDER = -0.25 \times TA + 0.5 \times UD + 0.25 \times TP$$

M&M – program parameters

Simulate a range of breeding program scenarios:

- Information sources, ram selection proportions, and index weights within a scenario kept the same
- Only changes due to adding *FL* and *FE* with phenotypic data, or phenotypic and genomic data

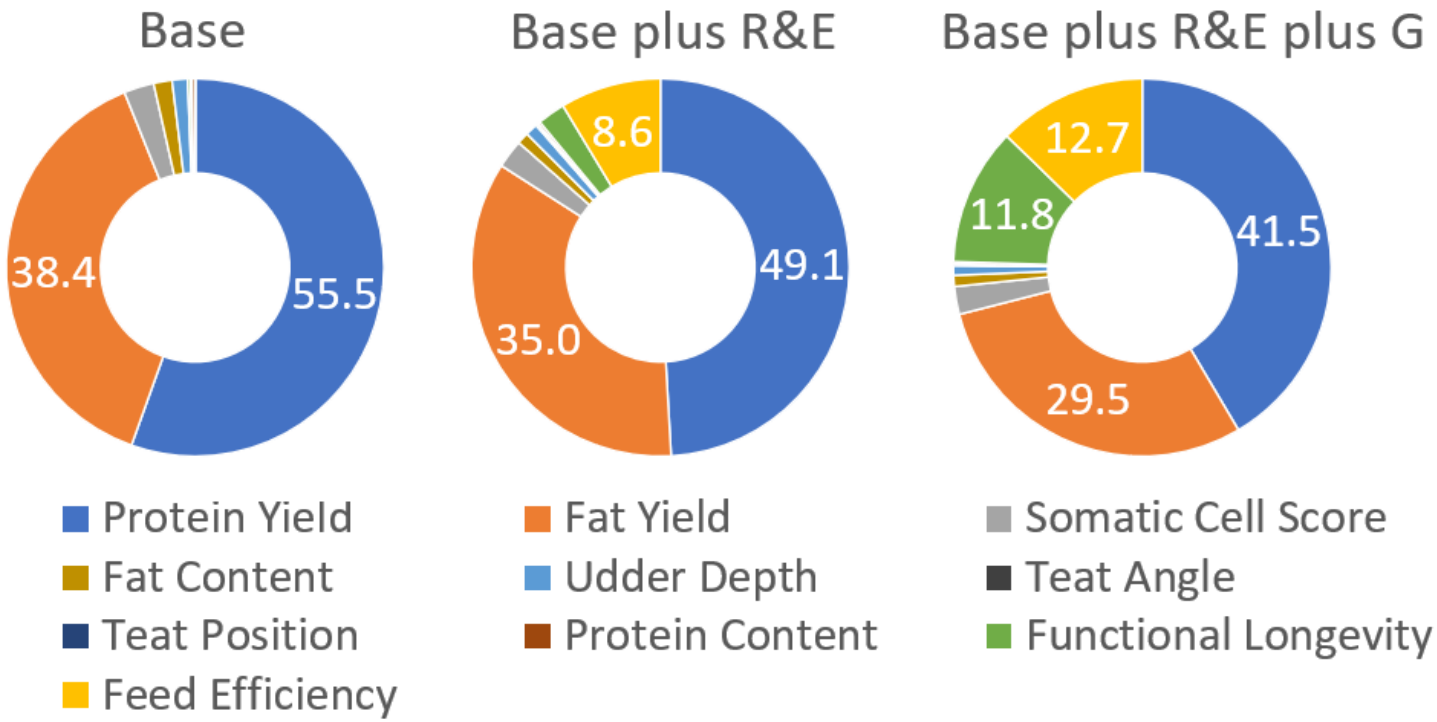
Modelling framework applied selection pressure to young rams, emerging sires, and proven sires

	Direction
Available information sources	↑
Age	↑
Selected proportion	↓

Results - scenarios

Relative trait emphasis in the index

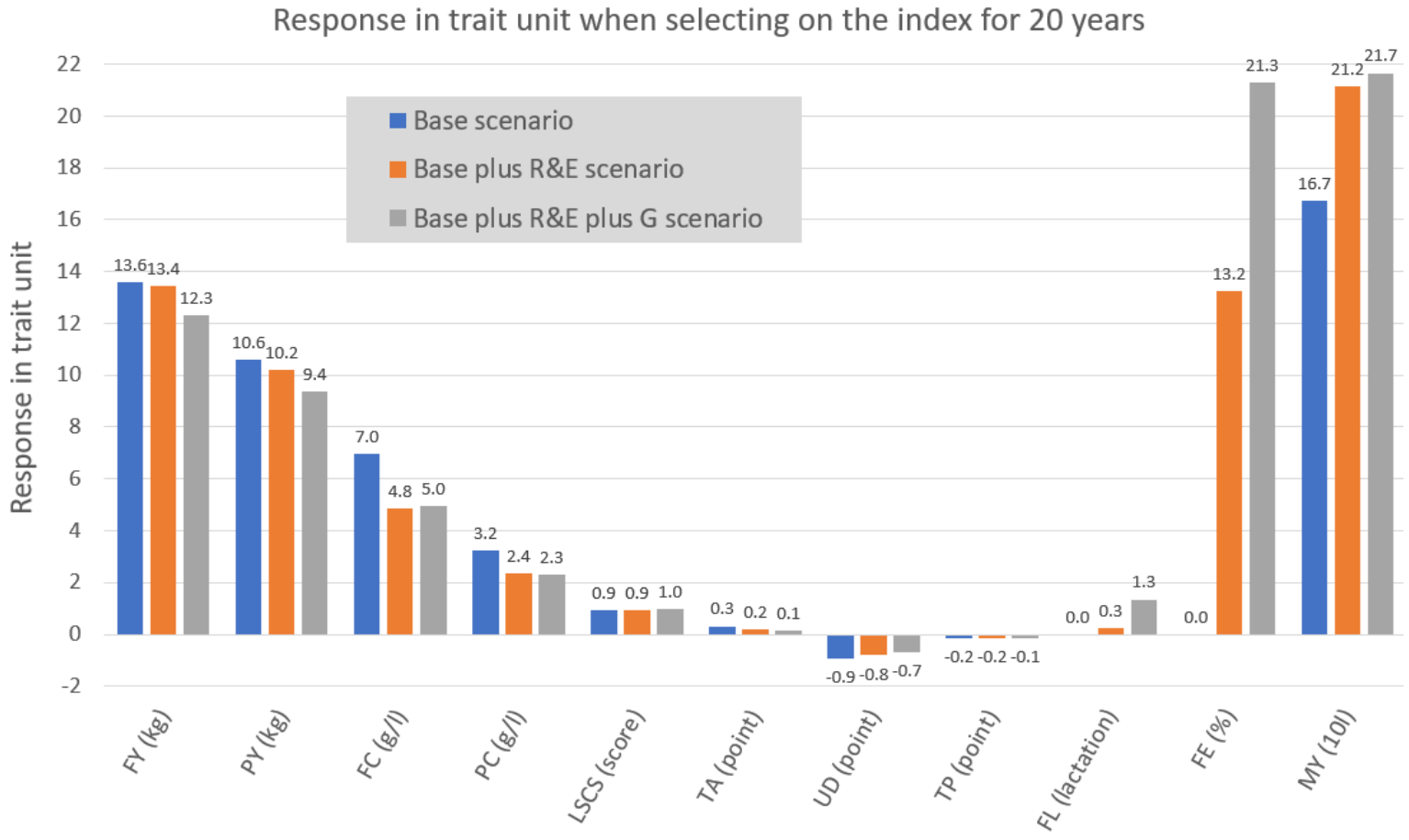
- Reasonable trait emphasis for FL and FE when added to the index
- Reduction in emphasis of current index traits, most noticeable in PY and FY



Results - scenarios

Long-term (20 year) response to selection in trait units

- Adding FL and FE to the index produces responses:
- FL +0.3-1.3
- FE +13.2-21.3%
- FY -0.2-1.3kg
- PY -0.4-1.2kg
- FC -2.0-2.2g/l
- PC -0.8-0.9g/l
- MY +45-50 litres
- Undesired response to selection for LSCS, TA, UD, and TP

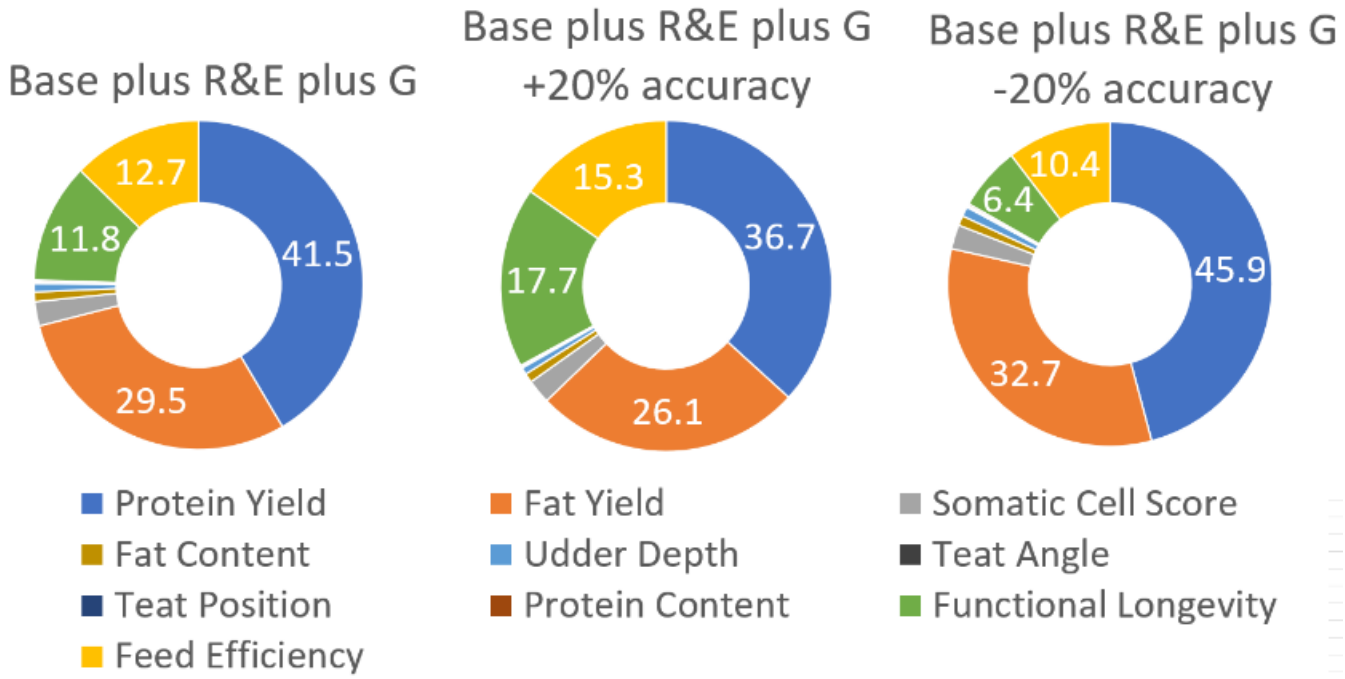


Results - sensitivity

Response to selection in other (yield) index traits are sensitive to FL and FE weightings, correlations with MY etc.

Biggest differences observed when changing the gBLUP accuracies from 50% to either 30% or 70%

However, no information about genetic correlations between FE and index traits



Conclusions & recommendations

Case study – Lacaune sheep modelling outcomes

- Meaningful long-term response to selection possible for *FL* and *FE*
- Reduction in relative trait emphasis and response to selection in other (yield) index traits
- Outcomes are most sensitive to accuracy of *FL* and *FE* gBLUPs

Breeding program recommendations

- Estimate genetic correlations between *FE* and index traits (only one available is between *MY* and *FE*)
- Consider proxies (e.g., MIR spectra) for *FE* and early in life predictors for *FL*
- Use economic values to set weights and add additional traits (like *FL* and *FE*), to represent farmer profit

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Thank you for your attention

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