



Modelling the energy cost of host resistance to gastrointestinal parasites in meat sheep

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PROJECT

WP3 - Genetic of trade-offs and synergies between resilience & efficiency related traits

- **Task 3.2:** better understand the biological mechanisms underlying those trade-offs & synergies and how they affect resilience and efficiency
- **Task 3.3:** develop prediction models to manage trade-offs and optimize resilience and efficiency in challenging conditions

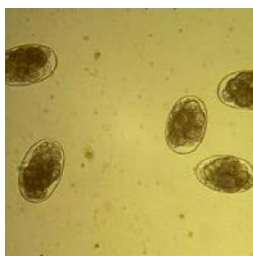
Biological model: selected lines of Romane meat sheep (females) at INRAE Bourges (indoor)

Challenge: artificial infection with gastro-intestinal parasite *Haemonchus contortus*



Longitudinal data

- Parasites fecal eggs count
- Blood haematocrit
- Body weight
- Body composition (ultrasound scanning of back fat and muscle)
- Voluntary feed intake



OUTLINE

(i) How selection for parasite resistance in lambs affect other traits?

- Experiment (Task 3.2)

- Lines selected for parasite resistance



(ii) Is there a trade-off between parasite resistance and feed efficiency?

- Experiment (Task 3.2)

- Lines selected for parasite resistance + lines selected for feed efficiency



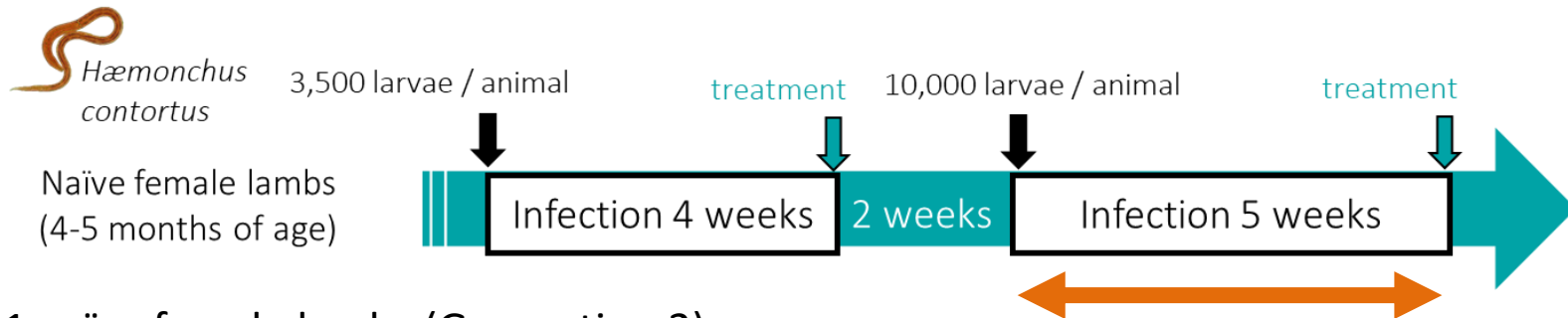
(iii) Is there a resource cost of host resistance that can lead to trade-off?

- Modelling (Task 3.3)

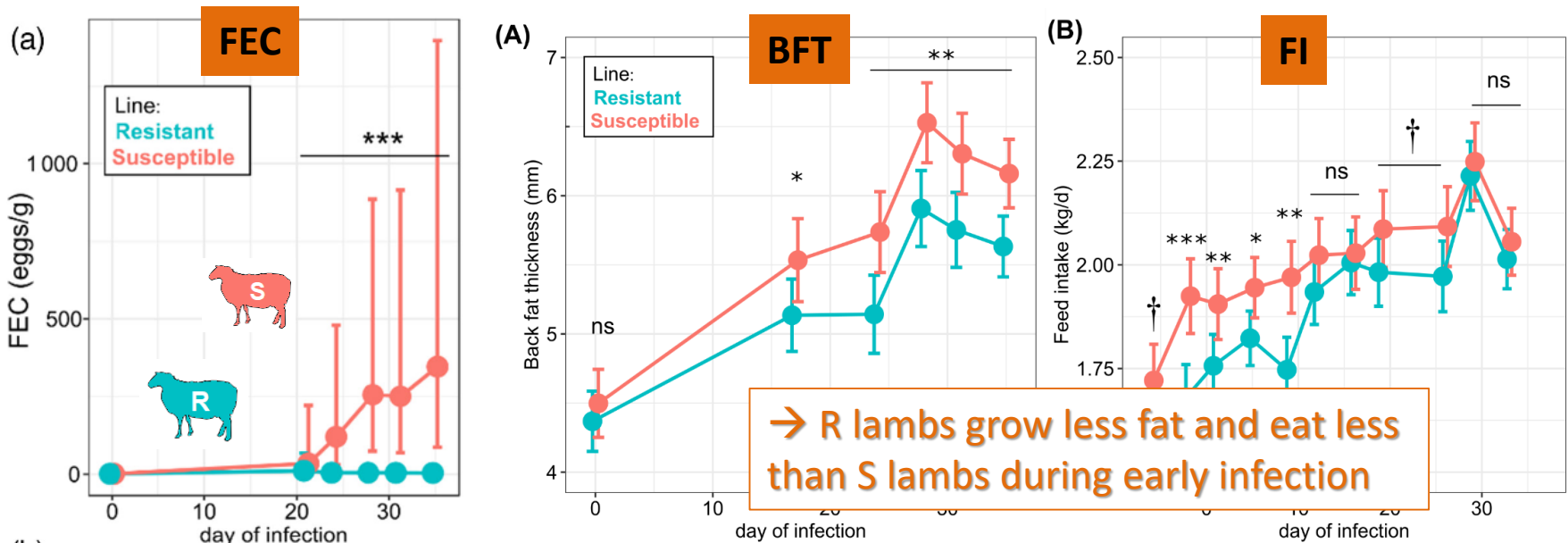
1. How selection for parasite resistance in lambs affect other traits?

1.1 During growth

Spring 2018



91 naïve female lambs (Generation 2)



1. How selection for parasite resistance in lambs affect other traits?

1.2 During reproduction

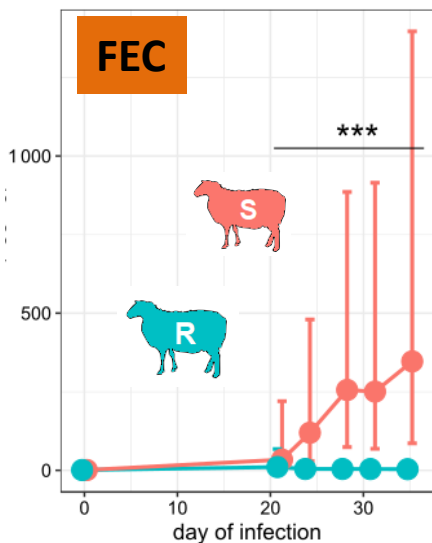
Spring 2018

Winter 2019

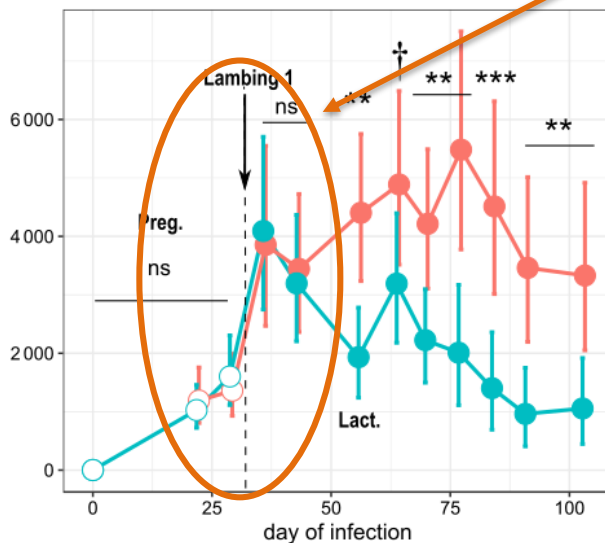
Periparturient relaxation
of immunity?

Winter 2020

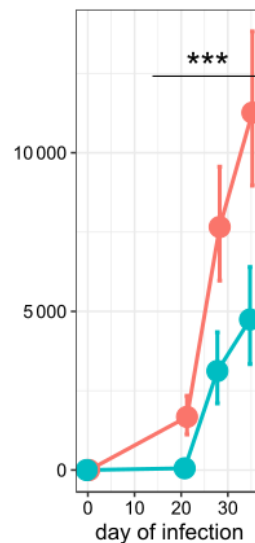
FEC



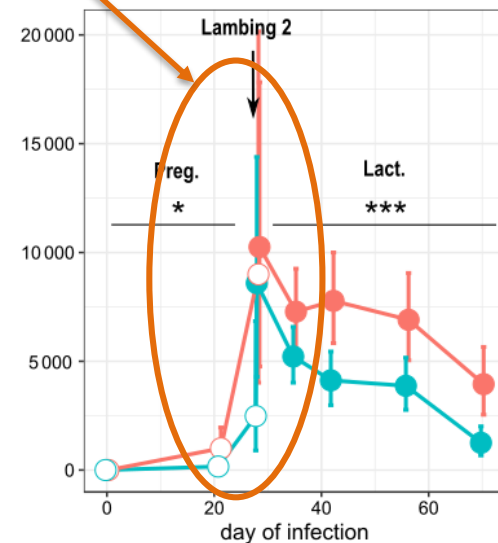
4-5 months



1 year



1^{3/4} years



2 years

→ Selection also effective during reproduction, except around lambing

No line difference in BFT, MT or BW

Around lambing 1 protein restriction reduces BFT, MT, BW but **no effect on parasite resistance**

OUTLINE

(i) How selection for parasite resistance in lambs affect other traits?

- Experiment (Task 3.2)

- Lines selected for parasite resistance



→ Little effects on production traits

(ii) Is there a trade-off between parasite resistance and feed efficiency?

- Experiment (Task 3.2)

- Lines selected for parasite resistance + lines selected for feed efficiency



2. Is there a trade-off between parasite resistance and feed efficiency?

2.1 During growth

Naïve female lambs (Generation 4)

→ effect of infection on feed efficiency?

Summer 2021



	R	S
INFECTED	31	30
CONTROL	15	15



	RFI+	RFI-
INFECTED	30	29
CONTROL	16	15



Hæmonchus contortus

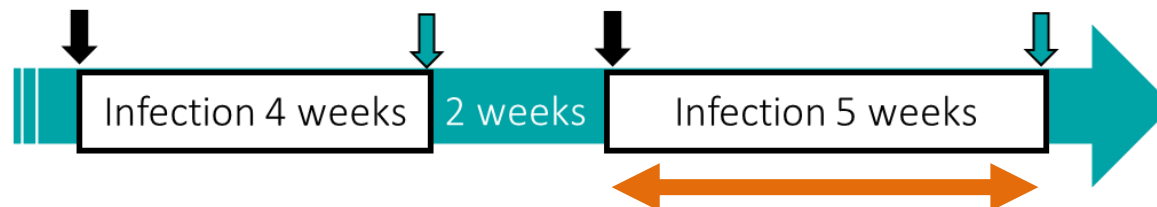
3,500 larvae / animal

treatment

10,000 larvae / animal

treatment

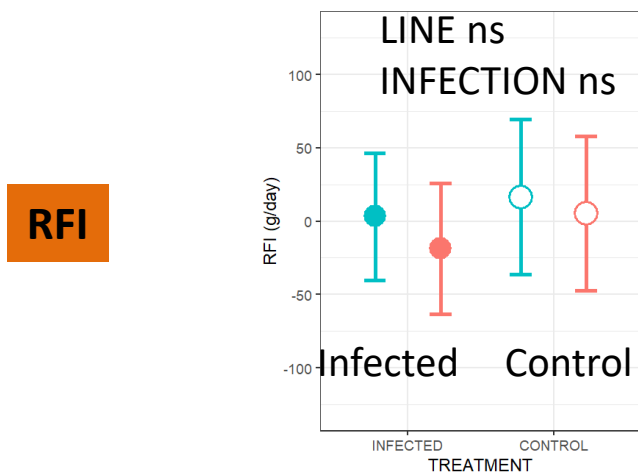
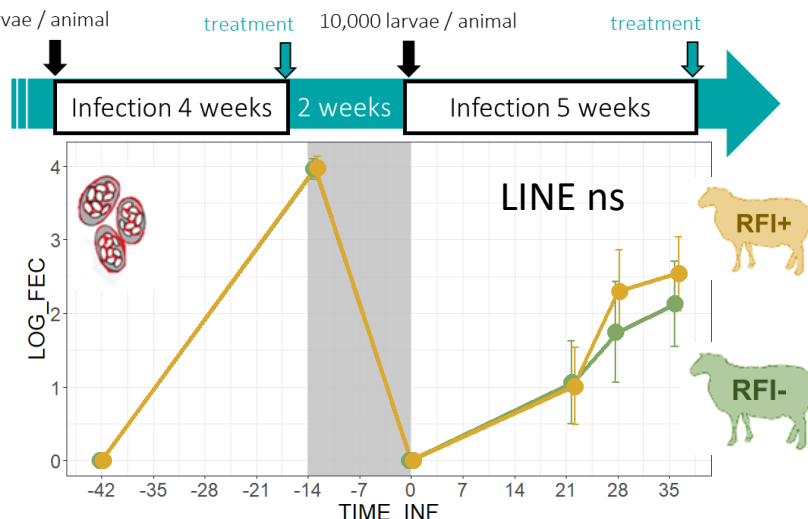
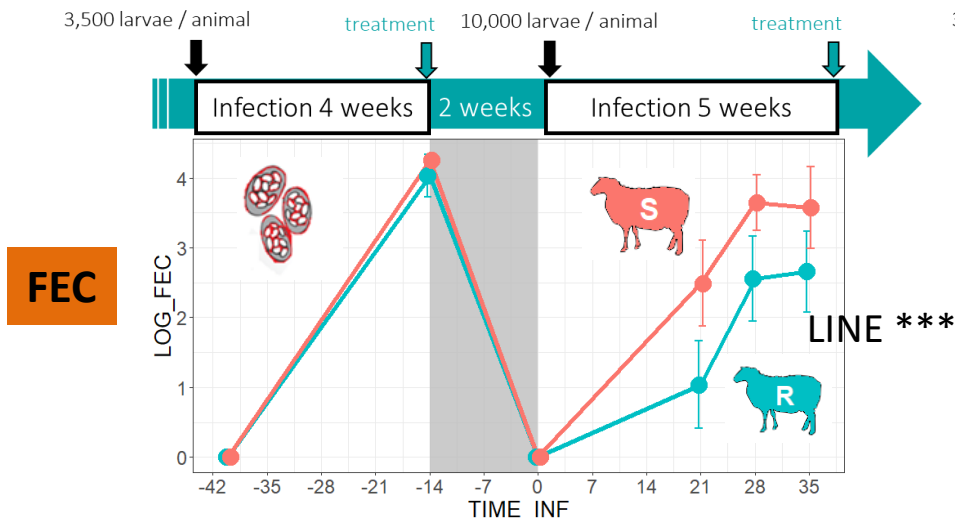
Naïve female lambs
(4-5 months of age)



$$RFI = FI_{obs} - FI_{pred}$$

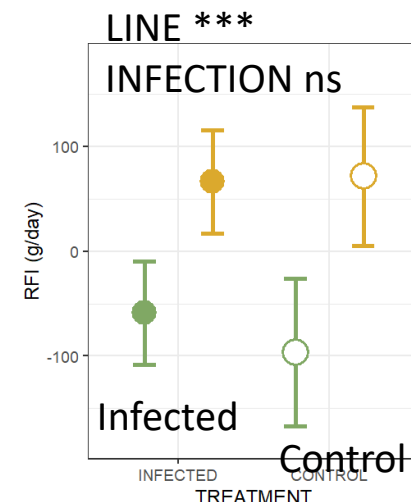
$$FI_{pred} \sim ADG + BFT_{end} + MT_{end} + BW^{0.75}_{end}$$

2. Is there a trade-off between parasite resistance and feed efficiency?



→ Apparent independence between parasite resistance and feed efficiency

(consistent with results from Urugayan sheep lines)



2. Is there a trade-off between parasite resistance and feed efficiency?

2.2 - During reproduction

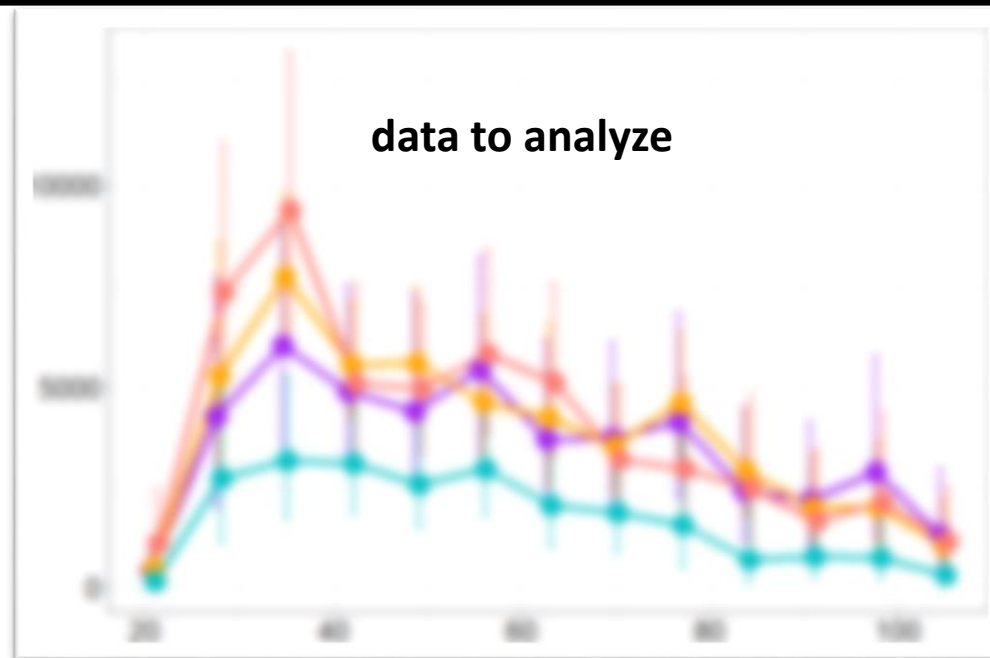
Winter 2023

Lambing

treatment

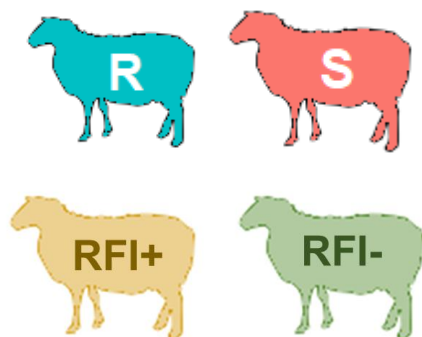
Infection 15 weeks

data to analyze



 *Hæmonchus contortus* 10,000 larvae / animal

96 females at last third of 1st pregnancy (4-5 months of age)



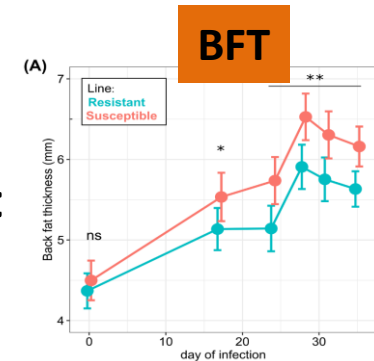
OUTLINE

(i) How selection for parasite resistance in lambs affect

- Experiment (Task 3.2)

- Lines selected for parasite resistance

→ Little effects on production traits



(ii) Is there a trade-off between parasite resistance and feed efficiency?

- Experiment (Task 3.2)

- Lines selected for parasite resistance + lines selected for feed efficiency



→ Independency between resistance and efficiency

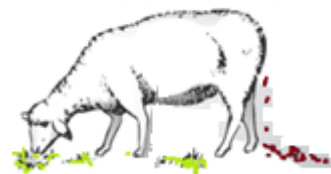
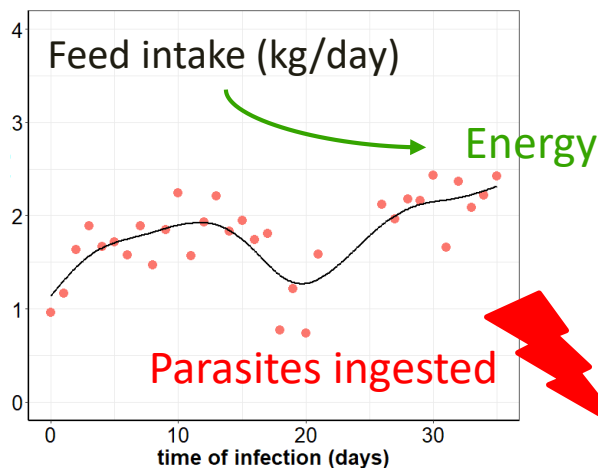
(iii) Is there a resource cost of host resistance that can lead to trade-off?

- Modelling (Task 3.3)

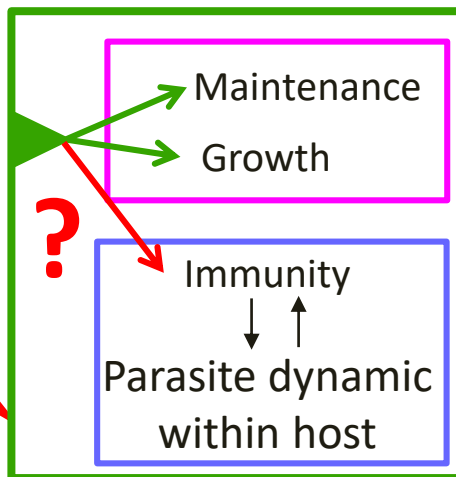
3. Is there a resource cost of host resistance that can lead to trade-off?

3.1 – A mechanistic model

MODEL INPUTS



host-pathogen
interaction model

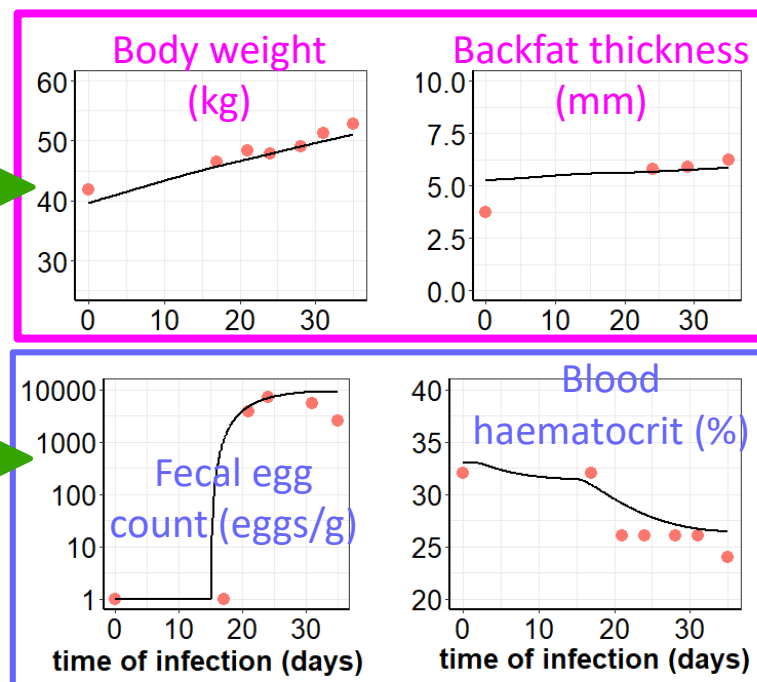


→ Individual fit to 42
lamb from R and S lines



— model prediction
● observation

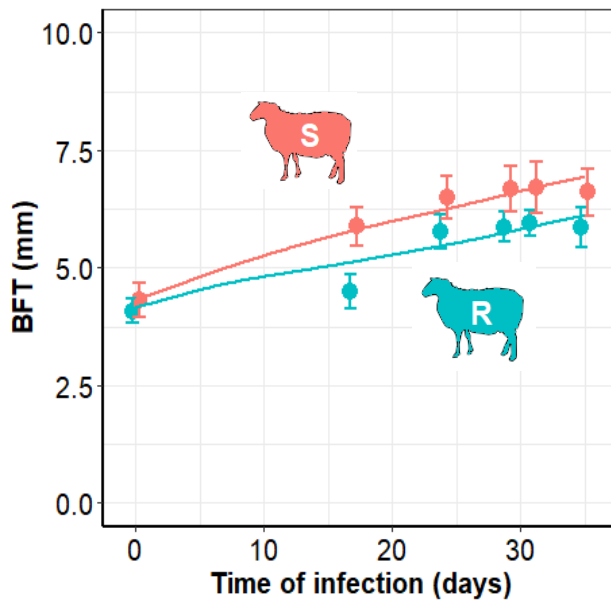
MODEL OUTPUTS



3. Is there a resource cost of host resistance that can lead to trade-off?

3.2 – Results of model fitting

$r = 0.40^{**}$



SUMMARY

(i) Selection for parasite resistance in lambs is also effective during reproduction, except around lambing

+ has little effects on production traits (except fat)

(ii) Infectious challenge of line selected for parasite resistance or for feed efficiency support the independence hypothesis

However

(iii) Responses from R sheep are consistent with the existence of an energy cost

→ Interest to combine experimental study with modelling

ACKNOWLEDGMENTS

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SMARTER PARTNERS



Thank you for your attention

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