Session 26, Theatre Presentation 3

How do worm-resistant sheep reduce faecal egg count?

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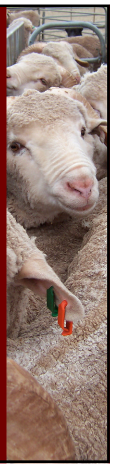
Key messages

- Breeding for worm-resistance has changed host-parasite relationship
- Host-parasite changes are worm species dependent, i.e.
  - *T. colubriformis:* reduced adult numbers
  - *T. circumcincta:* suppression of worm development & fecundity

…background issues

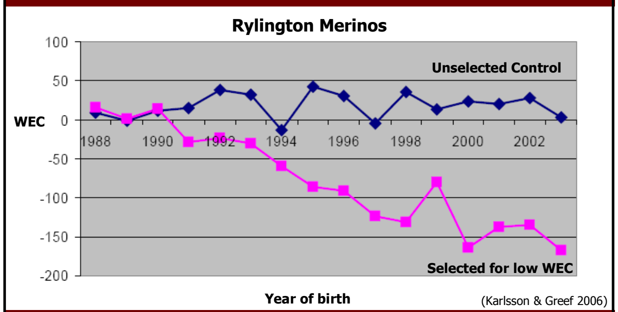
Worms are a problem



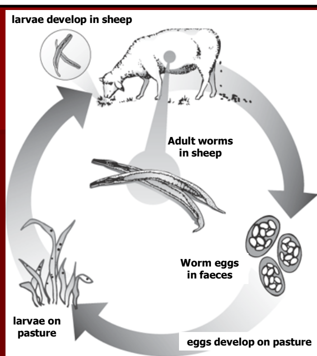
- Causes underperformance & death in sheep
  - £83M/pa, UK (Nieuwhof & Bishop 2005)
  - $369M/pa, Australia (Sackett et al. 2006)
- How to manage?
  - Anthelmintic drenches
  - Breeding resistant sheep (h^2~0.3) (Bishop & Morris 2007)

Breeding for resistance to worms

Successful using faecal worm egg count (WEC)



(Karlsson & Greef 2006)



Sheep host the reproductive stage of the worm's lifecycle

By regulating this stage sheep can regulate the worm's lifecycle

…but how do worm-resistant sheep affect the worm population?

Our experiment

Hypothesis

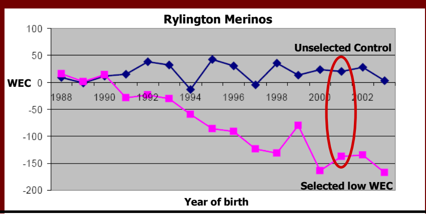
worm-resistant sheep will reduce WEC by reducing both number of adult worms & adult worm fecundity

WEC ~ number adults x egg production/adult

1. Infect worm-resistant & control sheep
2. Measure changes in worm population
   i. worm burden
   ii. worm fecundity

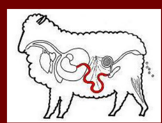
Experimental Design – Resistant and control genotypes

- Mature rams, 18-months old
- Resistant (n=19) and unselected control (n=10)
- Bred for worm-resistance to natural challenge
  - mostly *T. colubriformis* and *T. circumcincta*



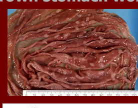
Experimental Design – Concurrent infection with

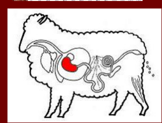
T. colubriformis
[Black scour worm]



small intestine
100-200 eggs/day

T. circumcincta
[Brown stomach worm]





4th stomach (abomasum)
50-100 eggs/day

3,000 L_3 each species thrice weekly for 18-weeks

Experimental Design – measurements on genotypes

18-weeks of infection ------------->

weeks 3 -17

Faecal worm egg count
(eggs/gram faeces)

week 18

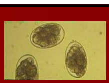
Necropsy
Both species:
- Number adults
- Fecundity (20 worms/sheep)
  - Worm length
  - Mature Females with eggs

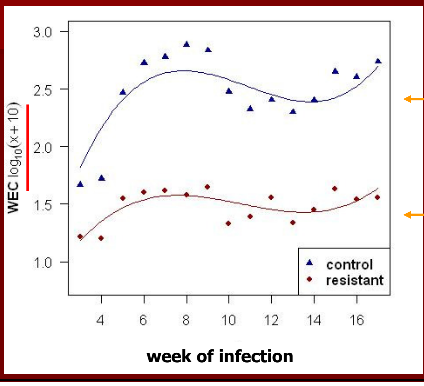
***T. circumcincta* only**
- Number immature worms

Data Analysis

- Faecal worm egg count
  - Transformation [$\log_{10}(x+10)$]
  - Mixed model with up week^3 effect
- Necropsy traits:
  - Bootstrapping for significance of genotype differences
    - Number of worms
    - Worm fecundity
      - Worm length
      - Female worms with eggs (%)

Results – faecal worm egg count

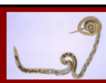




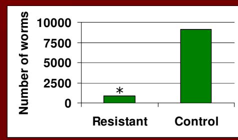
mean: 724epg (C)

mean: 134epg (R)

Results – *T. colubriformis*

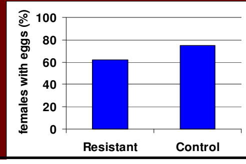


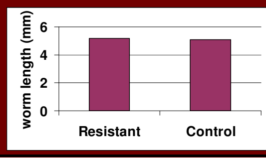
ADULT BURDEN:
90% reduction (P<0.05)



FECUNDITY:
Poor worm recovery from animals
- Resistant (40-50%) & control (70-90%)

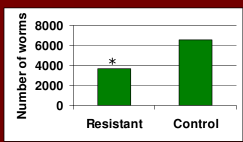
From animals measured no difference between genotypes (P>0.05)



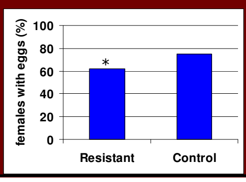


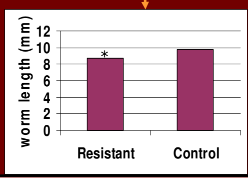
Results – *T. circumcincta*

ADULT BURDEN:
44% reduction (P<0.05)

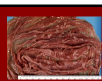


FECUNDITY:
11% reduction in worm length (P<0.05)
17% reduction in egg-carrying females (P<0.05)

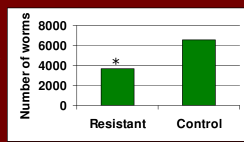




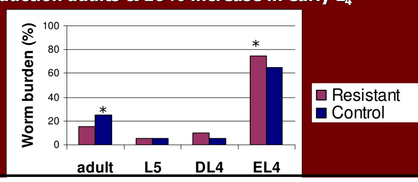
Results – *T. circumcincta*



ADULT BURDEN:
44% reduction (P<0.05)



TOTAL BURDEN:
No change in total burden (R: 22,520 *vs.* C: 23,100)
Relative to total burden;
10% reduction adults & 10% increase in early L_4



Our results….

- **Breeding for worm-resistance is successful**
  - 81% reduction in mean WEC
- **Resistant genotype animals:**
  - Reduced *T. colubriformis* adults by 90%
  - Reduced *T. circumcincta* adults by 44% & worm fecundity by 11-17%
    - increased proportion of immature stages

Our conclusions

Key messages

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Thanks to....

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Dieter Palmer & John Karlsson

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BSAS – Murray Black Award