The Life Cycle of a GIN Parasite

Which ones are important? Why?
What are their life cycles?

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Know the Enemy:

– *Haemonchus contortus*
  • barber pole worm, blood worm, red stomach worm (~2-3 cm)

– *Teladorsagia circumcincta*
  • brown stomach worm (1 cm)

– *Trichostrongylus* spp. (3 species)
  • stomach hair worm, black scours, bankrupt worm (~1/2 cm)

– *Nematodirus* spp. (3 species; 1 pathogenic)
  • thread-necked worm (~1cm)

All infect sheep and goats; some also infect deer, cattle or llamas
Where are they?

- **Abomasum**
  - *Teladorsagia circumcincta*
  - *Haemonchus contortus*
  - *Trichostrongylus axeii*

- **Small Intestine**
  - *Trichostrongylus spp*
  - *Nematodirus spp*
The Basic Life Cycle

– All nematodes: four larval stages, 4 moults
– Eggs hatch in faeces; first two larval stages (L1, L2) feed on bacteria – not parasitic
– L3 is infective but does not feed (L2 cuticle forms a protective sheath) - moves onto herbage if conditions are humid or moist; waits to be eaten
– When eaten, L3 exsheathes (XL3) and burrows into the gut wall
– XL3, L4 and adults can contribute to disease
L1: feed on bacteria

L2: feed on bacteria

L3: infective stage, non feeding

L4 in the gut

XL3 in gut wall

SHEEP ABOMASUM OR INTESTINE

ON PASTURE

Eggs in faeces

Adult in the gut

4th moult

3rd moult

2nd moult

1st moult

hatch
Overwinter Survival Strategies

- Teladorsagia and Trichostrongylus survive winter as L3’s – in soil or in the gut wall
- Haemonchus (subtropical) does not survive winter in the soil – only in the gut wall: HYPOBIOSIS

L3’s picked up in the Fall.....

..... Remain dormant in the sheep/goat till spring
Hypobiosis

- Hypobiosis (larval arrest): survival in unfavourable environment (cold/dry season; host immunity)
- L3’s moult but remain in the gut wall as L4’s
- Re-emerge to mature in spring, especially around lambing/kidding
- Mass emergence can cause disease (Type II disease)
- Contamination of pasture in spring
Haemonchus

- Adults and L4’s in the abomasum are blood feeders
- Females produce thousands of eggs/day (5,000+)
- Larvae develop rapidly in hot weather (5 days)
- L3’s can survive for weeks - months on pasture
- A subtropical species
- Few or no larvae survive on pasture over winter in our climate – only in hypobiosis
Haemonchosis – the Disease

• Adults and L4’s: sharp lancet pierces the mucosa
  – Haemorrhage as well as blood feeding causes anaemia

• 500 worms can cause disease

• 1 adult = loss of 0.05 ml blood/day
Haemonchosis – the Disease

- 1,000 worms = 50 ml blood loss/day = worm egg count of 5,000 eggs/gram faeces (epg)
- A 25 kg lamb/kid only has 2,000 ml blood
- Counts can be >30,000 epg in heavy infections

This lamb had a count of 69,100 epg - almost 700 ml blood lost per day

Photos: D. Thibault
Haemonchosis – the Disease

- Anaemia
  - Hematocrit often <12% vs. 25-35%
- Pale mucous membranes
- Bottle jaw (low blood protein)
- Poor appetite
- Poor growth or weight loss
- Severe infections can cause sudden death (e.g. 30,000 worms)
Type II Disease

- Severe disease in ewes/does in spring as worms resume development from hypobiosis:
  - Example: In 2011: a 2 year old ewe nursing twins
  - 3 weeks after lambing
  - No bottle jaw but extremely pale
- Sudden death from a heavy load of *Haemonchus* picked up in the fall
Teladorsagia and *Trichostrongylus*

- Both cause diarrhoea, poor appetite, weight loss; occasionally bottle jaw
- Usually mixed infections

![How worm burdens affect lambs](Eblex.org.uk)
**Teladorsagia Trichostrongylus axeii**

- Both live in the abomasum
- Larvae invade gastric glands in the abomasal mucosa – cause scarring and inflammation
- Damage causes decreased acidity, poor protein digestion and malabsorption
- 5,000 worms cause significant disease (both species)
Trichostrongylus spp

- T. colubriformis and T. vitrinus damage the wall of the intestine: enteritis with dark diarrhoea, bottle jaw
  - Blood and protein loss
  - Excess mucus
  - Erosion of villi
- Milder infections: loose faeces, poor growth

Image: (Left) Normal surface of the small intestine (Right) The wall of the small intestine damaged by black scour worm
(Source: Dr Ian Beveridge, University of Melbourne)
**Nematodirus spp.**

- 2 common species (*N. filicollis, N. spathiger*) cause little or no disease
- But *N. battus* causes disease in spring in U.K.
  - Severe diarrhea
  - Loss of condition, thirst
- *N. battus* was common in our samples (23/24 farms in 2013)
Nematodirus battus

- Life cycle is adapted to short summers (an Arctic parasite)
  - L3’s develop in the egg
  - Do not hatch until spring temperatures reach 10-11°C – next year
  - Last year’s lambs/kids infect this year’s
Is it ever a problem here?

- Spring scour: Early June (only in some years)
- Eggs seen in faeces by 20 May in 2013
- But no scouring in 2013 although some lambs had high faecal egg counts (>500 egg/gram)
- Long, slow, cool springs may help avoid mass hatching?

April..May..June?
What about...

• Tapeworms?
• 2 kinds of life cycle
  – Sheep and goats can host adult tapeworms in the gut or larval tapeworms in muscle, liver, etc.
• Adult tapeworms (*Moniezia*) are not usually a health concern

• Larvae can cause carcass condemnation (*Cysticercus ovis*) in some regions (not N.S.)

• *C. ovis* is adult in dogs – deadstock disposal!

*Moniezia...a common sight*
• Treating tapeworms is generally unnecessary
• Anthelmintics are not necessarily effective – e.g. macrocyclic lactones
• Dosing with an ineffective drug can hasten selection for resistant nematodes
Figure 1. Life Cycle of a Gastrointestinal Nematode Parasite of Sheep & Goats

1. L3 moult to L4 in GI tract.
2. L4 feeds on protein &/or blood.
3. If late summer-fall, L4 becomes hypobiotic, i.e. arrested in its development.
4. Moult to adult worm which produce eggs.
5. L3 are eaten with the grass.
6. L3 leave the fecal pellet: Warm & moist, migrate up blades of grass; Hot & dry, stay in pasture mat.
7. Adult female worms lay eggs in the GI tract which are then passed in feces onto pasture.
8. Time from ingestion to egg production: 16 to 21 days.
9. Time for eggs to develop to L3: avg 2-3 wks (range: 4 days to 12 wks).

After molting to L3, the L2 cuticle remains and protects the larvae, but also prevents feeding. The L3 remain alive until stored nutrients are exhausted, weeks to months later depending on the weather.

Each egg hatches and releases 1 first-stage larva (L1) which then molts to L2. Both of these free-living stages feed on bacteria contained in the fecal pellet.