

**Improving the effectiveness of
gastrointestinal nematode control for meat-
breed lamb production systems on the
Northern Tablelands, New South Wales.**

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Summary

The experiments reported in this thesis were designed to define and improve the effectiveness of ewe and lamb gastrointestinal nematode control in meat-breed production systems in a summer-dominant rainfall region of NSW Australia. The experiments (Chapters 2-7) reported in this thesis were written as a series of publications.

The first step in defining the effect of gastrointestinal nematodes (GIN) on meat-breed lamb production under grazing conditions is the creation and maintenance of uninfected control groups. Experiments conducted under grazing conditions are challenging with difficulties encountered in maintaining uninfected control groups as GIN-free. One method is to serially treat sheep with a combination of short and long-acting anthelmintics to provide effective and continual GIN-suppression. Chapter 2 investigated the effect of persistent larval challenge on growth of meat-breed lambs, suppressively treated with effective anthelmintics to determine if any production loss was associated with the host's immunological response to larval challenge. There was no effect of larval challenge on growth of grazing, meat-breed lambs when suppressively treated with effective anthelmintics. Therefore, the tested methodology was confirmed as a valid means of maintaining GIN-suppressed sheep in field experiments reported in subsequent chapters.

Chapter 3 investigated the importance of the immunological response of meat-breed lambs to *Trichostrongylus colubriformis* infection as measured by effects on lamb growth. *T. colubriformis* reduced growth rates of grazing meat-breed lambs with the greatest loss being associated with the host's immunological response rather than the direct effects of infection. Immune-mediated production costs may negate the benefits of greater host resistance and highlight the need to ensure that animals are also selected on other production traits.

Chapter 4 defined the effect of ewe GIN control on meat-breed lamb and ewe performance and investigated if the effects of GIN are reduced on farms using regional WormBoss integrated parasite management (IPM) programs. Production losses attributed to the effects of GIN were relatively small for ewes and their meat-breed lambs and highlighted the resilience of these sheep types to GIN infection when managed in productive systems. IPM strategies reduced worm egg counts (WEC) of ewes and lambs, and the number of drenches administered to ewes, but did not reduce the production loss associated with GIN infection. These findings support the use of IPM programs as a suitable approach to GIN control for meat-breed lamb production in a summer-dominant rainfall region.

Chapter 5 defined the effect of lamb GIN control on growth of meat-breed lambs over the pre and post weaning periods. There was no effect of GIN on growth of suckling meat-breed lambs, despite high WEC at weaning, indicating resilience to GIN in lambs growing at rates in excess of 200 g/day. GIN infection reduced post weaning growth, confirming the susceptibility of weaned lambs to GIN infection and highlights the importance of effective control measures during this time.

Risk factors for drench resistance in meat-breed production systems are reported in Chapters 6 and 7. Long-acting drenches are often administered to ewes pre-lambing to diminish the effects of the peri-parturient rise in WEC. When a drench is lipophilic, there is the potential for a portion of the dose to be partitioned to the mammary gland and transferred to the lamb via suckling. Chapter 6 investigated if there was evidence of milk transfer of anthelmintic actives from ewes to their suckling lambs by reference to lambs' WEC. The decline in WEC for lambs suckling ewes treated with lipophilic anthelmintics indicated that lambs ingested sub-therapeutic doses of anthelmintic active via milk which would increase selection pressure within the GIN population for anthelmintic resistance. The mobilisation and removal of the active as a consequence of lactation also reduces the concentration of the active within the ewe and, in the case

of persistent anthelmintics, this may shorten the expected period of protection against re-infection.

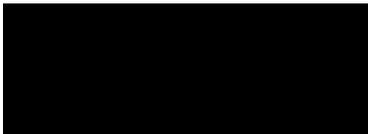
Clinical signs of diarrhoea and ill thrift are often associated with tapeworm infection, however there is little evidence that tapeworm are pathogenic and therefore not causative of these clinical signs. Producers who drench to remove tapeworm are restricted to drenches containing praziquantel as a mixture with one active ingredient to remove GIN burdens. Using single-active drenches is a known risk factor for the development of anthelmintic resistance. Chapter 7 investigated the effects of tapeworm infection on meat-breed lamb production. There was no effect of tapeworm on lamb growth, confirming that treating to remove tapeworm is not only unnecessary but will hasten the development of anthelmintic resistance.

The experiments reported in this thesis have shown that the effects of GIN on meat-breed lamb and ewe performance are small, indicating considerable resilience of these sheep types to GIN infection within a productive system. IPM programs led to lower WEC achieved with fewer drenches which will slow development of drench resistance and improve sustainability of GIN control. Collectively, outcomes from these experiments have provided a solid platform to improve GIN control programs appropriate to these breed types and production systems in a summer-dominant rainfall region.

Certification

I hereby certify that the substance of this thesis has not already been submitted for any degree and is not currently being submitted for any other degree or qualification.

I certify that any help received in preparing this thesis and all sources used have been acknowledged in this thesis.



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List of Abbreviations

Acronym	Abbreviation
GIN	Gastrointestinal nematodes
IPM	Integrated parasite management
TYP	Typical
RH	Relative humidity
VFI	Voluntary feed intake
MP	Metabolisable protein
ME	Metabolisable energy
PCV	Packed cell volume
WEC	Worm egg count
PPRI	Periparturient relaxation of immunity
PPR	Periparturient rise
BZ	Benzimidazole
ML	Macrocyclic lactone
LEV	Levamisole
IVM	Ivermectin
I/T	Imidazothiazoles/tetrahydropyrimidines
AAD	Amino-acetonitrile derivative
TST	Targeted selective treatment
IF	Infected
UIF	Uninfected
TX	Treated
UTX	Untreated
CRC	Controlled release capsule
CP	Crude protein
HCl	Hydrochloric

ELISA	Enzyme Linked Immunosorbent Assay
IF _Y	Infected
IF _N	Uninfected
SUP _Y	Immunosuppressed
SUP _N	Non-immunosuppressed
ASBV	Australian Sheep Breeding Value
epg	Eggs per gram
CT	Computerised tomography
SUP	GIN-suppressed
NSUP	Non GIN-suppressed
WECRT	Worm egg count reduction test
BCS	Body condition score
GI	Gastrointestinal tracts
Prazi	Praziquantel

List of publications

1. Dever, M. L., Kahn, L. P., & Bowers, S. F. (2013). Ewe but not lamb worm control increases weaning weight of prime lambs. In '*The 24th International Conference of the World Association for the Advancement of Veterinary Parasitology*', Perth, Western Australia.
2. Dever, M. L., & Kahn, L. P. (2013). Removal of tapeworm (*Moniezia* spp.) did not increase growth rate of prime lambs on the Northern Tablelands, NSW. In '*The Australian Sheep Veterinarians Conference*', Albany, Western Australia.
3. Dever, M. L., Kahn, L. P., Doyle, E. K., & Walkden-Brown, S. W. (2014). Worm egg counts in lambs decreased after administration of long acting anthelmintics to ewes. In '*The Australian Society for Parasitology Conference*', Canberra, Australia.
4. Dever, M. L., Kahn, L. P., & Doyle, E. K. (2015). Removal of tapeworm (*Moniezia* spp.) did not increase growth rates of meat-breed lambs in the Northern Tablelands of NSW. *Veterinary Parasitology*. 208, 190-194.
5. Dever, M. L., Kahn, L. P., & Doyle, E. K. (2015). Persistent challenge with *Trichostrongylus colubriformis* and *Haemonchus contortus* larvae does not affect growth of meat-breed lambs suppressively treated with anthelmintics when grazing. *Veterinary Parasitology* 209, 76-83.
6. Dever, M. L., & Kahn, L. P. (2015). Decline in faecal worm egg counts in lambs suckling ewes treated with lipophilic anthelmintics: Implications for hastening development of anthelmintic resistance. *Veterinary Parasitology*. 209, 229-234.
7. Dever, M. L., Kahn, L. P., Doyle, E. K., & Walkden-Brown, S. W. (2015). Partitioning production loss due to *Trichostrongylus colubriformis* into direct and immune-mediated components in grazing meat-breed lambs. In '*The 25th International Conference of the World Association for the Advancement of Veterinary Parasitology*', Liverpool, United Kingdom.

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9. Dever, M. L., Kahn, L. P., & Doyle, E. K., (2015). Integrated parasite management improves control of gastrointestinal nematodes in lamb production systems in a high summer rainfall region, on the Northern Tablelands, New South Wales. Accepted to *Animal Production Science*.
10. Dever, M. L., Kahn, L. P., & Doyle, E. K. (2015). Growth is impeded by gastrointestinal nematodes in weaned rather than suckling meat-breed lambs in a high summer rainfall region, on the Northern Tablelands, NSW. Accepted to *Animal Production Science*.

