SOME ASPECTS OF

THE POPULATION DYNAMICS OF

COOPERIA ONCOPHORA

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Abstract

To develop better control strategies for *Cooperia oncophora* a detailed understanding of the population dynamics is desirable. To achieve this, aspects of the life cycle have been studied in a series of experiments, including the free-living and the parasitic phases.

To investigate the development from egg to third stage larvae, faeces containing *C. oncophora* eggs gathered from different donor animals were incubated at different constant and variable temperatures as well as under natural conditions in the field. To examine the survival of *C. oncophora* third stage larvae they were kept under similar conditions as for the development experiments. Based on the results at constant temperatures, parameters were calculated for a model to simulate the effect of temperature during the free-living phase of this nematode. A further experiment was conducted over an 11 month period to investigate the effect of host age and previous exposure on the establishment rate of third stage larvae in 3 groups of young calves. Two groups received a high or low dose of trickle-infection and the third remained as an uninfected control group.

At lower temperatures the development rate and success from egg-third stage larvae were both low but increased with higher temperatures. At 8°C 50% development was reached in 56 days with a success rate of 5.5% compared to 5 days and 26.4% respectively at 32°C. The highest development success rate of 37.4% was observed at 28°C. For larval survival, the median survival was 512.2 days at 8°C and decreased to 6.4 days at 37°C. Both development and survival were significantly ($p<0.05$) influenced by the host animal from which the faeces were sourced. Utilising these parameters in a model provides a useful tool to further understand the effect of temperature on the free-living stages.

The establishment rate of *C. oncophora* in the trickle-infected groups declined rapidly compared to the control group but was not significantly different ($p>0.05$) to the control group if the existing worm burden was removed before challenge. A decline in

establishment rate over the 11 month period of the experiment in the control animals was due to the age of the larvae.

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Tania Waghorn, Chris Miller, Lawrie McMurtry and Dean Reynecke at AgResearch provided help with the experiments. Tania provided motivating cheer-ups and help

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Our responsibility is to do what we can,
learn what we can,
improve the solutions,
and pass them on.

Richard P. Feynman

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List of Abbreviations

Abbreviation	Description
°C	Degree Celsius
µg	Microgram
µm	Micrometre
AM	Ageing model for *C. oncophora* third stage larvae
AR	Anthelmintic resistance
cm	Centimetre
DM	Development model for *C. oncophora* egg to third larval stage
DT50	Time to reach 50% development
epg	Eggs per gram
FEC	Faecal egg count
FMC	Faecal moisture content
g	Gram
h	Hours
IVM	Ivermectin
L1-L4	Larvae of stage 1-4
L3, [L3]	Ex- and ensheathed third stage larvae
LT50	Median survival time
m	Metre
mg	Milligram
min	Minutes
ml	Millilitre
ML	Macrocyclic lactone
nm	Nano metre
R^2	Coefficient of determination
RES	Ivermectin-resistant *C. oncophora* isolate
SEM	Standard error of the mean
sg	Specific gravity
SUS	Ivermectin-susceptible *C. oncophora* isolate
UV	Ultraviolet light
WAAVP	World Association for the Advancement of Veterinary Parasitology

Preamble

The results of a national survey of beef cattle farms on the North Island of New Zealand in 2004/2005 indicated that *Cooperia* spp. was the most abundant species of parasitic nematode and was already showing a high prevalence of resistance to ivermectin and benzimidazole anthelmintics. At that time there was no resistance to levamisole but this was considered an imminent risk. For the development of future control strategies a more detailed knowledge of the dynamics of this species was necessary. In 2008 the research involved with this thesis was commenced as a cooperation of Massey University and AgResearch Grasslands in Palmerston North, New Zealand. The funding was provided by the Foundation for Research Science and Technology under contract C10X0714.

From the beginning of October 2008 a group of six young calves were kept on the Massey University Farm Tuapaka on a weekly rotation of oral ivermectin treatment and re-infection with larvae to maintain a constant source of ivermectin-resistant *Cooperia oncophora*. The first experiment commenced in October 2008 and investigated the survival of third stage larvae kept under constant temperatures as this was expected to continue for a significant time. The development of egg to third stage larvae at constant temperatures was commenced early the following year. The number of constant temperatures in this experiment required this experiment to be split in two parts as the time needed to analyse the samples was a limiting factor. The survival of third stage larvae in the field was investigated in June 2009 (winter) and larval contaminations continued once a month for all seasons to March 2010. The first animal experiment investigating the efficacy of ivermectin for two *C. oncophora* isolates took place in the first half of 2010 and was repeated with another six animals in the second half of 2011, whereas the establishment of *C. oncophora* in calves was examined from September 2010 to September 2011. The last experiments on development of eggs to third stage larvae and the survival of the larvae at variable temperatures in the laboratory were conducted from May 2011 onwards.

All experiments involving the use of cattle have been approved by the Massey Animal Ethics Committee or the AgResearch Animal Ethics Committee.

Several chapters of this thesis (Chapter 2, 3, 4 and 6) describing different aspects of the life-cycle of *C. oncophora* are, or will be, submitted as publications in peer reviewed journals. All Chapters 2-6 are therefore included in a publication style format. However, the formatting as well as the style of the charts and figures have been partly changed for the purpose of being integrated into one document with section numbers etc. aligned to the particular chapter number in the thesis. These changes include also cross-references between sections and to additional information in the appendices. All references have been integrated into a single reference section.