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Worm control in SE Australia – is management of ‘refugia’ necessary?



Options for manipulating low ‘refugia’ populations:

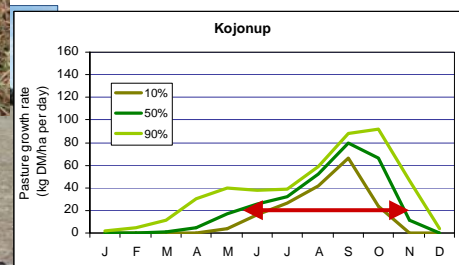
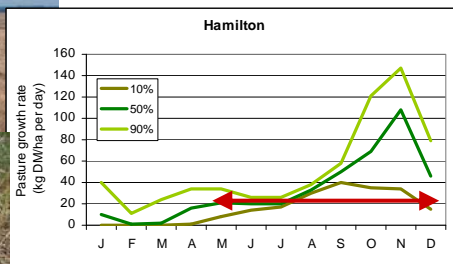
- 1) Targeted (selective) treatments:
 - BWT or CS (‘resilient’ sheep)
- 2) Delay 2nd summer drench
- 3) Leave X% sheep undrenched
 - Achieve a ‘target’ WEC (eg. 25-50 epg)
- 4) Move & treat
- 5) Graze contaminator mobs

Two important points:

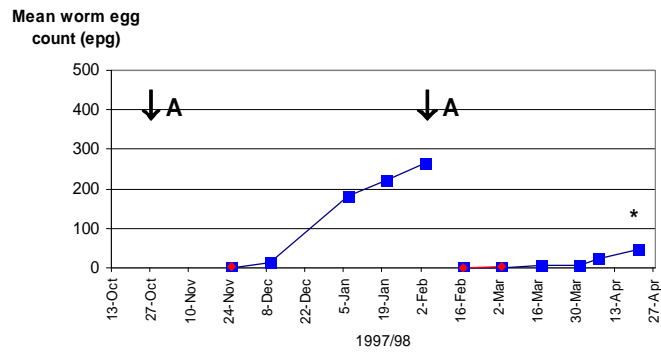
1. Worm ecology and control programs differ markedly between regions:
 - *Amount & distribution of rainfall*
 - *Length of growing season*



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2. Eggs deposited in Summer & Autumn are very important



Niven et al (2002) - AVJ 80:559-566



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Two key questions:

1. What proportion of refugia is needed to delay resistance?
2. What refugia populations have we got in western Victoria?
 - estimates of over-summering populations



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1) How much refugia do you need to slow selection for drench resistance?

THE IMPACT OF REFUGIA ON THE DEVELOPMENT OF THIABENDAZOLE RESISTANCE IN *HAEMONCHUS CONTORTUS*

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Abstract—MARTIN P. J., LE JAMBRE L. F. and CLAXTON J. H. 1981. The impact of refugia on the development of thiabendazole resistance in *Haemonchus contortus*. *International Journal for Parasitology* 11:35-41. Beginning with a mixture of 5% thiabendazole-resistant and 95% non thiabendazole-resistant *Haemonchus contortus* larvae, worm free sheep were artificially infected with either 10,000,9000,7000,2500 or zero larvae. Four weeks later, the infected sheep were treated with 44 mg/kg of thiabendazole. Seven days after anthelmintic treatment the same sheep were infected with zero, 1000, 3000, 7500 or 10,000 larvae respectively so that each sheep was given a total of 10,000 larvae. The larvae given after thiabendazole treatment are referred to as being in refugia (defined as an area where individual members of a population can escape exposure to a drug). This was repeated for six generations of parasites, maintaining the same proportion of larvae in refugia in each generation. The egg hatch assay for resistance indicated that refugia delayed the development of resistance in *Haemonchus contortus*. Where none or a small proportion of larvae were in refugia, a rapid increase in resistance occurred. With an increased proportion of larvae in refugia, resistance was slower to develop. Population size, as estimated by faecal egg counts done after anthelmintic treatment and corrected for the number of larvae given in each treatment, was lower at the higher levels of refugia. This was due to a lower level of resistance in the higher refugia lines and consequently a greater effect of the drug. However, the estimate of population size, from egg counts done after the larvae introduced from refugia had matured, were similar in all lines.

Int J Parasitol 1981;
11: 35-41

• Tested 0%, 10%, 30%,
75% & 100% refugia over
6 generations

• Need a large proportion
of the population to
escape Ant T't to delay
resistance



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Estimates of over-summering larval populations in Victoria (1)

Location	Year	Winter tracer worm counts after contamination in:		Spring contribution
		Oct-Dec	Feb-Mar	
1. Mortlake ^A	1971	48,756	75,444	39%
	1972	16,460	8,940	65%

^A N. Anderson (1983) – AJAR 34:583-592



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Estimates of over-summering in Victoria (2)

Location	Year	Winter tracer worm counts after:		Spring contribution
		Reduced contamination in summer	Standard contamination	
2. Gnarwarre ^B	1998	12,300	23,000	53%
	1999	7,500	24,300	31%
3. Ballarat ^C	2004			
	2005			
4. Rokewood	2009			
	2010			

1998 – Dry summer: 62% Ost., 41% Trich
1999 – Wet summer; 42% Ost., 14% Trich

^B Niven et al (2002) – AVJ 80:559-566

^C Larsen et al (2009) – AVJ 87:130-137

Winter worms derived from 'Spring' contamination (2)

Location	Year	Winter tracer worm counts after:		Spring contribution
		Reduced contamination in summer	Standard contamination	
2. Gnarwarre ^B	1998	12,300	23,000	53%
	1999	7,500	24,300	31%
3. Ballarat ^C	2004	75,750	130,990	58%
	2005	45,460	86,492	53%
4. Rokewood	2009	3,250	8,700	37%
	2010			

^B Niven et al (2002) – AVJ 80:559-566

^C Larsen et al (2009) – AVJ 87:130-137

Conclusions – SE Australia

1. Already ample over-summering ('refugia') populations of infective larvae in western Victoria
2. As a broad recommendation?
 - *Managing refugia needs a lot more monitoring*
 - *Increased risk of unacceptable production losses*
 - *Unlikely to make a big difference if genes for Rx are dominant/ semi-dominant*
3. Identify risks of extremely low refugia:
 - *Drought & Crops*
 - *Devise & monitor a strategy with an adviser*



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Conclusions – SE Australia

4. Stick with proven principles:
 - *Strategic ('summer') treatments*
 - *Monitor WECs*
 - *Grazing management – weaners (& maiden ewes)*
 - *Test for Drench resistance*
 - *Avoid under-dosing*
 - *Introduced sheep*
 - *Use rams with low WEC (& low dag) EBVs*

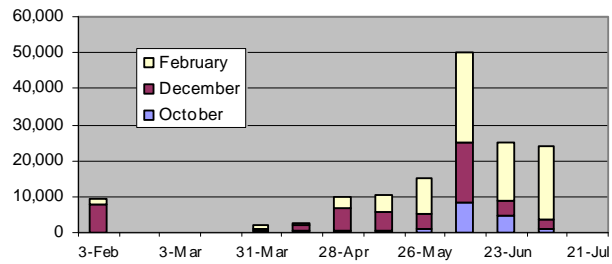


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Worm ecology in Victoria

Worms/ 100 million eggs
Tracer worm counts from eggs deposited at different times



N. Anderson (1983), AJAR 34:583-592



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