



Worms in refugia as a tool to delay drench resistance

This R&D Brief explains refugia and how it can be used to help delay drench resistance in internal parasites on your farm. It outlines a research project that showed how keeping a population (or refuge) of susceptible worms on the farm can slow the build-up of parasites resistant to drenches.

There are different ways of achieving refugia (i.e. a worm population not exposed to drenching). Two practices being used by some New Zealand farmers are to leave all or part of ewe flocks undrenched at certain times, or to follow drenched lambs with undrenched ewes. A more recent suggestion for creating refugia is to leave a proportion of lambs or hoggets undrenched, at each drenching.

(1) The R&D Brief:

- Provides evidence that leaving a proportion of lambs undrenched can slow drench resistance.
- Gives guidelines as to what proportion and type of animals could possibly be excluded from drenching.
- Discusses the need to balance leaving parasites to dilute resistance while maintaining worm control.

Farmers are advised to discuss options for practising refugia with their veterinarian or advisor.

(2) What is resistance?

This is when previously susceptible worm populations (parasites) in the animal survive a correctly-applied, standard dose of anthelmintic.

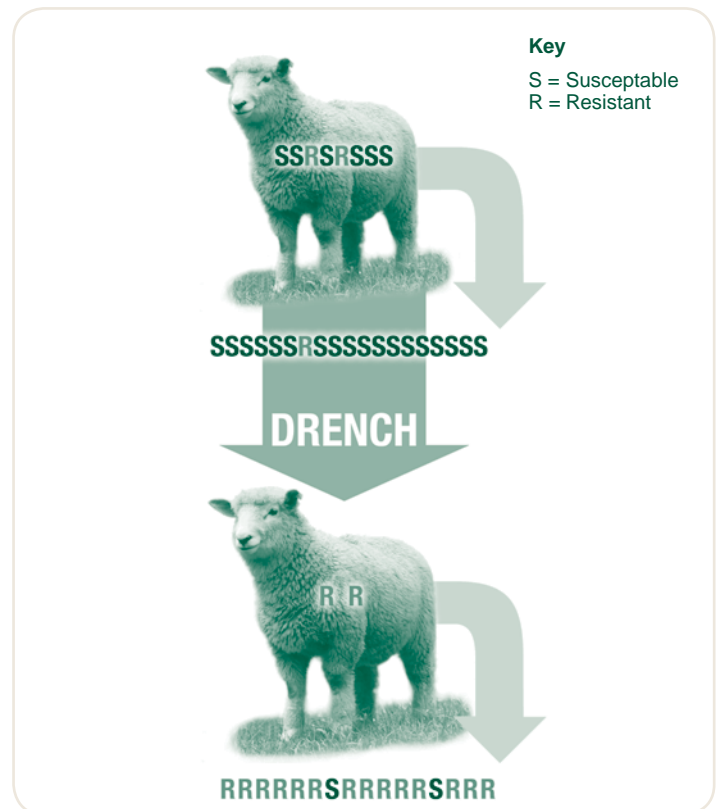
The worms do not die but carry on to breed.

There will always be some worms that have the genetic make-up to be resistant to a particular type of drench. Over time, these resistant worms will carry on breeding and pass on their resistant genes to their offspring (while non-resistant worms are killed). This means they make up an increasing proportion of the worm population on the farm.

This is a concern as, over time, they become dominant in the population. Recent surveys indicate that resistance has increased alarmingly in parasites of both sheep and cattle (Meat & Wool NZ, 2006).

In the worst case scenario, farmers drench their stock with a triple combination drench but the bulk of worms do not die. Production suffers severely but there are few control options left.

Figure A: How resistant worms become dominant



(3) What is refugia?

Refugia, when put into practice, involves making sure there are some susceptible worms inside the animal to reproduce. The idea is to create a 'refuge' for worms so that non-resistant (susceptible) worms still remain in the population base. The ideal is that the reservoir of susceptible larvae on pasture significantly outnumbers resistant larvae on the pasture.

Then, when worms breed in the animal, the gene frequency for resistance will be diluted.

Three methods to achieve refugia

One way to achieve refugia is by not drenching all the animals in a mob every time.

Another method is to put undrenched ewes on pasture previously grazed by drenched lambs. The susceptible worms shed by the ewes 'dilute' the population of resistant parasites left behind by the lambs by contributing to the next ingested (eaten) worm population.

A third way is to drench the mob and return them to the same infected pasture for a week or so before they go onto 'clean' pasture. This ensures that susceptible worms have already been deposited on that pasture.

(4) How do we know this refugia practice will work?

A field trial funded by Meat & Wool New Zealand showed that leaving 10% or 20% of lambs undrenched resulted in a significantly lower level of drench resistance in the worms on pasture, compared to when all animals were drenched.

This is the first research in the world to show that using refugia as a management tool can dilute resistant worms on pasture.

AgResearch scientist Dave Leathwick reached this conclusion by comparing the resistance status of worms shed by nine different mobs of Romney lambs. All nine mobs of lambs (20 lambs per mob) were uniformly infected with a mixture of albendazole-resistant and -susceptible parasites.

0%, 10% or 20% left undrenched

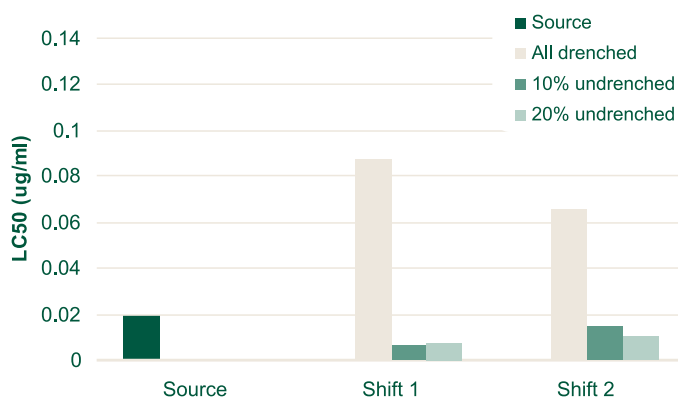
Different proportions of the mob were left undrenched (either 0%, 10% or 20%). After grazing their paddocks for seven weeks the lambs were again drenched and moved to a second set of 'clean' paddocks, again for seven weeks.

Worm-free 'tracer' lambs to sample worms on pasture

The worm populations created by the different treatments were measured by putting fresh 'parasite-free' lambs on the blocks three weeks later to sample the worm populations. Drench resistance was measured using larval development and egg hatch tests.

Results showed that when 20% of lambs were left undrenched, resistant worms on pasture were diluted 10 times compared to when all lambs in the mob were drenched.

Figure B: Leaving lambs undrenched really helped slow resistance.



Note: 'Source' is the original level of resistant parasites found in the lambs (i.e. 0.02).

This graph shows that when all lambs were drenched, the proportion of resistant worms in the population was significantly higher than when 10% or 20% of the lamb mob remained undrenched. The LC50 value is the estimated concentration of albendazole needed to kill 50% of worm eggs or larvae in the resistance assays.

Drenching all lambs increased resistance four-fold from original level

When all lambs were drenched and moved to low-contamination pastures the resistance status of the resulting worm population was greatly increased from the original 'source' level.

These results highlight the risk of drenching lambs onto low-contamination 'safe' pasture.

(5) Pasture larvae levels went up

The biggest negative from leaving some stock undrenched was that the level of larvae on the pasture increased in the trial. But some increase has to happen for refugia to work.

The essence is to allow enough worms through to dilute the resistant ones without significantly compromising productivity.

Figure C: Faecal Egg Counts (eggs per gram) of 'tracer' lambs that grazed after the treated lambs.

TREATMENT NO.	% LAMBS UNDRENCHED	FEC OF TRACER	
		20/03/06 FIRST-SHIFT	17/05/06 SECOND-SHIFT
1	0	325	533
2	10	1794	1563
3	20	1186	1855

In the trial, FEC levels of 'tracer' lambs (used to sample worms on pasture following original grazing) were highest in tracer lambs on the pasture where mobs of undrenched lambs had grazed. These contaminating lambs had been seven weeks without a drench. Results of other trials showed that production losses from leaving 10-15% of lambs undrenched were difficult to measure. This indicates that they may be very small.

However, the worms that were from Treatment 1 (lambs all drenched) were more likely to be resistant.

(6) Putting refugia into practice

Exact recommendations on how to create refugia will vary between farms. For example, when it is best to leave stock undrenched, what proportion to leave undrenched and what the implications on production might be.

It is suggested that farmers develop a plan with their veterinarian on how refugia could be used based on -

- The drench resistance status of the worms on the farm.
- Sheep/cattle ratio, stocking rate, other farm enterprises.
- Climate effects on worm life cycle.
- Key risk periods to stock from parasitism (i.e. when is it best for some stock to go undrenched).
- Current ewe management/drenching policy (i.e. can undrenched ewes shedding susceptible eggs be grazed after newly-drenched lambs).
- Feed quantity and quality.

While it is early days, the Wormwise Technical Advisory Group (made up of New Zealand experts) believes there are general principles that can be followed when practicing refugia in mobs of weaned lambs or hoggets.

General principles:

- If feed supplies are low/poor quality, there is a greater risk that parasitism in undrenched stock will impact on production. However, if feed quality/quantity is good, lambs are up to target weights and pasture is 'clean' then it would be an ideal time to leave some lambs undrenched.
- The benefit of leaving some lambs undrenched (and a refugia of susceptible worms) is greatest when lambs are going onto 'clean' pasture.
- Start conservatively: i.e. leave no more than 5% of lambs undrenched rather than 20%. Leaving too many undrenched may create a problem later in the season with accumulated parasite contamination of pastures.
- A maximum of 10% undrenched may be adequate (the trial showed the same beneficial impact on resistant worms whether 10% or 20% of lambs were left undrenched).



- Choose the best condition animals to remain undrenched each time. The heaviest animals are doing well so if they take a check from being left undrenched they will slip back into the 'drenched' portion of the mob next time round.
- It does not matter if the same animals are excluded at each drenching, as long as their condition is okay. Both animal welfare and animal production losses must be considered.
- A comprehensive drench test (faecal egg count reduction test and cultures) should be carried out regularly, with frequency depending on drench resistance risk factors on each farm.

Even if a test shows that worms on your farm are not resistant to any of the three main drench families, it would still be of benefit to practice refugia. This is because resistant genes are likely to be present on every farm and keeping them diluted is the best long-term option to retain the efficacy of your drenches.

Cattle:

It is likely that practicing refugia in cattle mobs would also reduce the proportion of resistant worms on the pasture.

(7) Finding a balance

Leaving a few animals undrenched can add a little to pasture contamination but it is likely that acceptable productivity will continue.

Resistance is a bigger long-term cost than short-term lower production.

The cost of lower production from leaving some young stock undrenched is going to seem more acceptable as resistance to drenches becomes more widespread.

For example, lower production in the short term may be worth it if it delays the onset of a situation where 100% of a hogget mob is 5kg lighter because of widespread drench resistance on a farm.

(8) Other practices to reduce/delay worm resistance to anthelmintics

The challenge ahead is to find ways to maintain low levels of pasture infestation, yet retain a useful pool of susceptible worms. Ways to do this include -

- Avoid drenching lambs onto 'clean' pasture unless you have a plan to introduce/maintain refugia (e.g. leave a proportion undrenched or follow with undrenched ewes).
- Avoid drenching more frequently than every 28 days unless there is a special need.
- Avoid treating the whole flock pre-lambing with a long-acting drench.
- Adopt a quarantine drench protocol for introduced stock.
- Use effective combination drenches, even if resistance has not been identified on your farm.
- Weigh animals so they are not under-dosed.
- Apply the correct dose using the correct technique as per the label instructions.

Figure D: Are they resistant? Adult internal parasite with eggs.



Acknowledgements & more information

A farmer and scientist mentor group helped guide the project, to ensure relevance to farmers. Members were Dave Smith, Chris Ridland, James Falloon, Mark Gilmour, Tony Rhodes, Bill Pomroy, Dave West and Alex Vlassoff.

For more see:

- Final report from Meat & Wool New Zealand trial by AgResearch: 05AR30.
- Wormwise: National Worm Management Strategy (email wormwise@meatandwoolnz.com or phone 0800 696 328 to register for ongoing information).

For the full reports phone Meat & Wool New Zealand on 0800 647 000 or visit www.meatandwoolnz.com Farming/ R&D/ R&D Briefs.

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