



Integrated Parasite Management: Train the Trainer Project

Simple Genetic-Selection Strategies to Manage the Barber Pole Worm

Genetic-selection tools can lift a seemingly grim parasite situation into a landscape that has hope. It will not happen in a year, but after several generations of careful breeding, you will begin to see some improvement in the resistance of your flock to the Barber Pole Worm, *Haemonchus contortus*. As in any other successful breeding program, focus on selecting for a balance of resistance and the other important economic traits, such as the number of lambs born, and maternal weaning weight. There are three genetic-selection tools we producers can use to lessen the impact of *Haemonchus* in our flocks: fecal egg counts, FAMACHA® scoring, and National Sheep Improvement Parasite Estimated Breeding Values. This tipsheet is intended to supplement the informative ATTRA publication, *Tools for Managing Internal Parasites in Small Ruminants: Animal Selection* <https://attra.ncat.org/attra-pub/summaries/summary.php?pub=398>.

Start Here First

When selecting individuals within flocks for potential replacements, there is one primary rule: your animals must be exposed to a parasite challenge. For example, if your average fecal egg count is not greater than 500 eggs per gram (epg), you do not have enough infection in the flock to genetically select for *Haemonchus*-resistant sheep. Similarly, if you are using FAMACHA scores to select for breeding replacements, at least 25% of your lamb population must score F3 to F5 (Morgan, 2018).

This rule also applies when purchasing breeding stock from other flocks. If your breeder is advertising sheep that are seldom dewormed while on irrigated pastures, you don't know if they are parasite resistant or if they have never been challenged. For this reason, parasite challenge is a requirement of all NSIP-proven sires. Sometimes the most obvious is forgotten.

The Real Deal: Fecal Egg Counts

The sires we use provide one-half of the genetic makeup of our flocks. A small number of rams are thus largely responsible for the genetic resistance our flocks have to the Barber Pole Worm. In fact, in four generations, 90% of the genetics is determined by the sires that we use (NSIP, 2015). Although not as important from an overall perspective, the ewe also determines one-half of the genetics of her own offspring. Selection for parasite-resistant sheep is well worth the trouble of identifying superior individuals in our flocks. Here is how:

- Conduct fecal egg counts on individuals from your prospective pool of ewe lamb replacements or ram lamb replacements.
- Individual fecal egg counts are the best means of determining the resistance of an individual to the Barber Pole Worm. This is because there can be a difference of three orders of magnitude (100 to 10,000 epg) between different individuals. No other productive trait can even come close to this range of difference between individuals. This offers a huge leverage in the selection pressure that can be applied. Additionally, the sheep's ability to cope with the infection—its resilience—is eliminated and does not mask primary resistance to the parasite. For a review of fecal egg counts and resistance vs. resilience, see the tipsheet



Genetic selection can limit the occurrence of bottle jaw in your flock. This is an advanced stage of Barber Pole Worm infection in which the ewe FAMACHA scored F5. Early spring periparturient rise and stress of lactation pulled this ewe down. Note, in contrast to her lamb, the droopy ears, swelling under the jaw, and thick upper eyelids—all signs of a sheep not feeling well. Photo: Dave Scott, NCAT

How Fecal Egg Counts Can Help You Fight Parasites, in this series. Fecal egg counts can be used very effectively to select for *Haemonchus*-resistant breeding stock in your flock. Here are two strategies.

– Platinum Plan. Take two fecal egg counts from ewe or ram lambs during the pasture season when the parasite challenge is the greatest. Again, to have a sufficient challenge, the average of the fecal egg counts from this group of lambs must be at least 500 epg. This is usually met if you are experiencing problems with Barber Pole Worm and if the sheep have been on irrigated pasture for at least 45 days.

- Conduct the fecal egg counts at weaning and two to three weeks post-weaning.
- Record the egg counts.
- Compare them. If the second count is significantly greater than the first, that lamb is demonstrating a low resistance to the parasite. Here is a sample of some typical ewe lamb keep/cull decisions in a flock on irrigated pasture.

Lamb ID	7/27 FEC	8/13 FEC	Change in FEC epg	Replacement KEEP/Cull	Reason
5987	1200	4520	3320	Cull	Change in FEC too high
5741	1200	1500	200	Keep	Low change in FEC
6545	500	1375	875	Keep	Low change in FEC
6782	2000	2200	200	?	Low change, but too high FEC?
6627	3700	3300	-400	Cull?	FEC too high
6710	280	490	210	Keep	< 500 epg

– Gold Plan. Take fecal egg counts once, two to three weeks after weaning. Post-weaning is generally when the Barber Pole Worm challenge is the greatest in lambs on irrigated pasture. It is also the time that reflects the greatest inherited resistance of the lamb to the parasite (Gauly and Erhardt, 2001).

- Select the top 35 to 40% of lambs for FEC, and from this group, select your replacements, considering in addition other desirable traits to balance out their genetics.

• General Reminders

– Evaluations must be made with animals of similar production stages, in similar environments, and in the same pasture season. Individual egg counts can then be compared against the average of a group of animals.

– Under most irrigated pasture systems, you will not see a lot of *Haemonchus* infection in lambs before 40 to 45 days after turning out to pasture. Fecal egg counts before this time period will probably not yield much information on how well your sheep are withstanding the parasite challenge because populations are not peaking yet. Because of periparturient rise, ewes are an exception to this rule (see the tipsheet in this series, *How Fecal Egg Counts Can Help You Fight Parasites*).

– It may be best to FAMACHA score weaned lambs at least two weeks post-weaning to assess the degree of *Haemonchus* infection. In flocks where infection is severe, waiting one more week could result in significant loss of gain or even death in some lambs. In order to save lambs, timing is critical!

– Wait four to five weeks after the last deworming to conduct fecal egg counts. Otherwise, the anthelmintic will influence the results.

- Fecal egg counts take some time if you do it yourself. Once you get accustomed to the procedure, six counts an hour is a likely rate. Performing egg counts on 50 or 100 ewe lamb replacements may not be feasible.

- Having a vet do FECs may be out of your budget.

So then what? How can you select for genetic resistance to the Barber Pole Worm in a large flock?

A Practical Alternative: FAMACHA Score

FAMACHA is another technique that can be used to identify sheep that are less susceptible to the Barber Pole Worm. It actually measures the sum of resistance and resilience, but for large flocks, it is a practical alternative to egg counts. You can FAMACHA score 150 animals an hour, which is 25 times faster than performing fecal egg counts. Here is one procedure:

- FAMACHA score all lambs at weaning.
- If you have *less* than 10% of lambs that score F4 to F5, do the following:
 - Deworm the FAMACHA score F3, F4, and F5 lambs. Wait three to four weeks and FAMACHA again.
 - Important: In order to have a sufficient parasite challenge, you need at least 25% of the lambs scoring F3, F4, or F5 (Morgan, 2018).
 - As a reminder, if you suspect a large worm infection, FAMACHA score at two weeks post-weaning. This will prevent loss of gain or death.
 - Apply these action steps:
 - Record all FAMACHA scores.
 - Deworm all lambs that are F3, F4, or F5. If you are seriously selecting for parasite resistance, do not use these ewe or ram lambs in your breeding program, no matter how attractive their other traits.

- Save ewe and ram lambs that score F1 or F2 both times for replacement candidates, incorporating a few other primary production traits as well.
- If you have a large number of lambs that pass this test, consider selecting further by selecting lambs that score F1 or F2 themselves and whose mothers scored F1 or F2 during the same pasture season.
- If you have **more** than 10% of lambs that score F4 or F5 at weaning, then take these actions:
 - Wait one week and FAMACHA score again.
 - Wait two to four weeks and FAMACHA score again. You will likely come up with a significant number of additional F3, F4, or F5 lambs.
 - Deworm all F3 to F5 score lambs at each FAMACHA scoring.
 - Compare the results and apply the same action steps as above.
 - Note: you may not be able to supply the needed ewe lamb replacements due to high susceptibility to Barber Pole Worm. Don't worry: after several generations of selection, you will. For now, supplement your replacement pool with ewe lambs from those that score F3. Keep lambs that score F4 and F5 out of the breeding pool.



FAMACHA scoring is fast, easy, and definitive. It can be used as a practical alternative for selecting ewe and ram replacement offspring within a large flock. Photo: Rich Myers, NCAT

- Dynamic biology is the driver of parasite infection. It is very hard to prescribe a certain set of rules, so you must monitor and adapt to what you see. In some years, on some farms, the F4 and F5 cases may continue for 60 days post-weaning. As an example, here is what we had at Montana Highland Lamb (total lambs = 258) in a particularly bad year:

Number of Lambs with Post-Weaning FAMACHA Scores of 3, 4, or 5

FAMACHA Score	7/23 Weaning	8/13	9/4 Off Pasture	9/4	9/11	9/26	10/15	Total
F3	8	25		22	16	21	17	109
F4 and F5	0	15		29	2	4	0	50
Total	8	40		51	18	25	17	159

Daily moves produced a paddock stocking density of 257 ewes and 368 lambs /acre. Lambs were weaned July 23 and stayed on pasture until September 4. On each of the FAMACHA scoring dates, we dewormed all the lambs that scored FAMACHA 3, 4, and 5. Two points:

- FAMACHA scoring August 1 might have prevented some of the F4 and F5 infections observed on August 13.
- *Haemonchus* is still affecting sheep after lambs are taken off pasture. There appears to be a three- to six-week lag period. Keep monitoring!

Get There Faster: Use Estimated Breeding Values

As previously mentioned, sires have an incredible amount of influence on flock genetics. Estimated Breeding Values developed by the National Sheep Improvement Program provide the fastest way to make tangible improvements in parasite resistance. Coupled with grazing practices to limit worm ingestion (as described in the tipsheet *Grazing to Control Parasites*), these two strategies represent a long-term solution to Barber Pole Worm control.

Purchasing outside rams with elite Estimated Breeding Values in parasite resistance (PFEC) is not only easier than selecting with fecal egg counts and FAMACHA scoring, it is a much more powerful way to make genetic progress in this trait. Currently, Katahdin and Polypay breeds have estimated breeding values for parasite resistance. Hopefully, in the coming years, more breeds will follow.

To select sires for ewe replacements, determine your production goals for the primary traits you wish to improve. Since genetic progress will be slower by selecting for a large range of traits, try to focus on two or three of the traits in the flock with the highest priority. For example, a sheep producer primarily selling lambs on irrigated pasture needs a large number of lambs born, enough milk in the ewes to raise twins successfully, and parasite resistance in both the lambs and the ewes. If losses due to the Barber Pole Worm are significant, make that your number-one priority and choose a ram with a parasite PFEC EBV in the top 20% of the breed. The number of lambs born (NLB) and maternal weaning weight (MWWt) can be assigned secondary priorities, and rams with trait EBVs in the top 40% nationally should also be included in your index. These rams can be purchased through private treaty (respective breeders are listed in the NSIP database) or in national ram sales. The searchable NSIP database (<http://nsip.org/searchable-database>) and a guideline on how to use it (<http://nsip.org/wp-content/uploads/2015/01/NSIP-Ram-Buying-Guide-FINAL-12-21-15.pdf>) are available.

The Polypay and Katahdin breeds that currently have PFEC EBVs will admittedly not fit into everyone's breeding program. The sheep industry needs to push for more breeds to develop PFEC-proven rams. Until then, breeding-flock selection using fecal egg counts and FAMACHA within flocks and in flocks with contemporaries (a minimum FEC mean of 500 epg and, ideally, similarly-sired offspring) are the tools that can be used. If not ideal, they are still a giant and pragmatic step forward.

Summary

Selecting for genetic resistance for parasites is one of the leading tools we can employ to combat the Barber Pole Worm. For flocks on irrigated pasture, future success may depend upon it.

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References

Gauly, M., and G. Erhardt. 2001. Genetic Resistance to Nematode Parasites in Rhön Sheep Following Natural Infection. *Veterinary Parasitology*. Vol. 102, Issue 3. p. 253-259.

Morgan, Jim, Katahdin Breed Representative, National Sheep Improvement Program. 2018. Personal communication.

National Sheep Improvement Program (NSIP). 2015. NSIP Ram Buying Guide.

<http://nsip.org/wp-content/uploads/2015/01/NSIP-Ram-Buying-Guide-FINAL-12-21-15.pdf>

Further Resources

ATTRA Resources

Don't Let the Barber Pole Worm Devastate Your Flock

<https://attra.ncat.org/multimedia/ppt>

Managing Internal Parasites in Sheep and Goats

<https://attra.ncat.org/attra-pub/summaries/summary.php?pub=215>

Managing Internal Parasites: Success Stories

<https://attra.ncat.org/attra-pub/summaries/summary.php?pub=493>

Tips for Managing Internal Parasites

<https://attra.ncat.org/attra-pub/summaries/summary.php?pub=495>

Tips for Preventing Internal Parasites

<https://attra.ncat.org/attra-pub/summaries/summary.php?pub=494>

Tips for Treating Internal Parasites

<https://attra.ncat.org/attra-pub/summaries/summary.php?pub=496>

Tipsheet: Organic Management of Internal and External Livestock Parasites

<https://attra.ncat.org/attra-pub/summaries/summary.php?pub=524>

Tools for Managing Internal Parasites in Sheep and Goats: Animal Selection

<https://attra.ncat.org/attra-pub/summaries/summary.php?pub=398>

Tools for Managing Internal Parasites in Sheep and Goats: Pasture Management

<https://attra.ncat.org/attra-pub/summaries/summary.php?pub=415>

Other Resources

American Consortium for Small Ruminant Parasite Control

www.wormx.info

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