**Section 4. What is anthelmintic RESISTANCE? How to Identify it?**

**Anthelmintic (dewormer) resistance is the heritable (genetic) ability of a parasite to survive a dose of anthelmintic, which would normally be effective**

Worms that are resistant to a dewormer can survive treatment at the recommended dose and pass on this resistance trait to future generations. Of particular concern, is the fact that gastrointestinal parasites such as *Haemonchus contortus* and *Teladorsagia circumcincta* (prominent parasites in Alberta), have developed resistance to the two main dewormer classesthat have been used in western Canada for many years such as ivermectin (Ivomec®) and the benzimidazoles fenbendazole (Safe-Guard®) and albendazole (Valbazen®). (Link to section 2)

**Anthelmintic resistance occurs because of genetic diversity: some parasites can carry mutations in their genes that confer the ability to survive anthelmintic treatment**

At its most basic level, anthelmintic resistance occurs due to the high genetic diversity that exists within populations of gastrointestinal roundworms. Some individual parasites may carry mutations that they inherited from their parents which help them survive exposure to dewormers. The parasites that carry these genes may become more prevalent on your farm due to selection pressure associated with regular dewormer use.

**Selection is the process by which resistant worms survive anthelmintic treatment and increase their frequency in the population over time**

**Susceptible** worms are the ones that will be eliminated by the dewormer and **resistant** worms are the ones that will survive the treatment. Selection is the process by which the **treatment with** a dewormer favours the survival of the resistant worms at the expense of the susceptible worms. This results in a gradual **increase in their numbers in the population over time.** For example (Figure 1), suppose you were treating ewes with a high *Haemonchus contortus* burden:

**Figure 1 Legend: Illustration on development of Anthelmintic resistance overtime**.

**Note:** this is an over-simplification of the process of selection which occurs over many years, one treatment will not kill 100% of susceptible worms as many are in **refugia** in the sheep and on pasture (For more details, see section 5).

Since resistance has a genetic basis, resistance to a drug may lead to resistance to drugs from same class (for example, parasites that acquire resistance to Safe-Guard become also resistant to Valbazen), however, the worms may still be susceptible to other drugs of other classes.

##### How to identify Anthelmintic resistance?

##### Anthelmintic resistance is suspected based on the clinical signs of Haemonchosis or Parasitic Gastroenteritis (PGE) or yet, signs of poor condition or growth

Anthelmintic (dewormer) resistance is a problem in Canada (Link to Section 2), as in the rest of the world, and can harm the flock’s health and productivity. The two most common signs of anthelmintic resistance in a flock are:

1. **Reduced weight gain, poor body condition, cases of anemia, diarrhea or sometimes deaths** **despite regular deworming**.
2. **Fecal egg counts remain high after treatment with the dewormer**.

If anthelmintic resistance is suspected based on these signs, you should review the drug label to ensure the drug is being administered properly and at the correct dose. Also, consider the different reasons why a dewormer may not appear to be doing its job in controlling the parasites on your flock. Further information is available on this in our other information sheet. (Link to section 3)

**Always consult with your veterinarian when you suspect anthelmintic resistance to come up with a plan to investigate the problem and develop a plan for the situation on you farm.**

##### The Fecal Egg Count Reduction Test (FECRT) is a Field test to diagnose anthelmintic resistance, based on the reduction in the number of parasites eggs after anthelmintic treatment

The Fecal Egg Count Reduction Test (FECRT) is an appropriate test to determine whether a parasite population on a farm is resistant to a dewormer. When a dewormer is effective, the fecal egg count should decrease by 95% approximately 2 weeks after deworming. If you would like to perform a FECRT discuss it with your veterinarian.

**Overview of the FECRT**

Although this process can be labour intensive, it is the recommended method for detecting anthelmintic resistance. The analysis and interpretation of the data can be complex and should be undertaken by your veterinarian.

**Collecting samples**

**Figure 2 Legend: Fecal sample collection by rectum**

1. 15 to 20 ewes are selected from the flock. Prior deworming should have been done more than 8 weeks ago.
2. Collect fecal samples of each ewe. *This should be done by using a small amount of lube on two fingers and gloved hands to collect feces from the rectum. If this is not possible, fresh samples may be collected from the ground trying to collect only from the top of the pile to reduce contamination*.
3. Deworm the ewes based upon individual weights.
4. Conduct fecal egg counts on all collected samples
5. About 14 days after deworming (see the table included below – efficacy times may vary depending on the dewormer) collect fecal samples from all animals (if you are testing multiple drugs, use a 14-day interval).
6. Conduct fecal egg counts

*Consult with your veterinarian for the interpretation of the results.*

**Table 1 Legend: Interval testing for different dewormers**

**Processing samples (see also this video on youtube:** [**https://www.youtube.com/watch?v=ZZQymZKe\_hs**](https://www.youtube.com/watch?v=ZZQymZKe_hs)**)**

Ideally, samples should be processed in the lab as soon as possible after collection (within 24 hours). They should not be refrigerated or frozen.

To process the samples collected, fecal egg counts are performed. We recommend the Paracount-EPG method kit (Paracount-EPG <https://www.vetslides.com>)

**The following procedure is to be used by the laboratory to conduct fecal egg counts:**

**What do you need?**

* McMaster slides with either 2 or 3 chambers
* Calibrated vial (there’s one with the McMaster kit, but if you only bought the McMaster slides you can use a plastic cup)
* 1 cc Syringe (often included in the kit)
* Saturated salt solution
* 10X microscope lens

**Figure 3 Legend: Materials to perform Egg counts: McMaster slides, syringes, Calibrated vials, Fecasol™ salt solution, Microscope.**

**How to do it:**

**Figure 4 Legend: Steps for Fecal Egg counts**

1. Fill the vial with Flotation Solution to **28 ml** line (the calibrated vial that comes with the kit there is a fill line for sheep feces).
2. Add feces to bring volume up to **30 ml** line (This is approximately 2 g of feces.).
3. Stir and mix thoroughly with a tongue depressor, to allow the eggs to float. (Make sure the feces is very well suspended in the solution. Make sure to have different tongue depressor for each sample).
4. Immediately draw fecal suspension from top of vial in syringe and use to fill one chamber of slide. Repeat to fill remaining 2 chambers.
5. **Count the eggs** after 1-2 minutes. Examine slide under microscope focusing on the grid line. Starting at one corner count all the eggs within the entire grid system for one chamber. Record the egg count. Repeat for remaining two chambers/grids.

**Calculate the eggs per gram (EPG)****.**

If you use a 2-grid chamber: Add the total number of eggs together from the 2 grids to obtain total, multiply the total number of eggs by **50** to get the number of eggs in the sample per gram (epg).

If you use a 3-grid chamber: Add the total number of eggs together from all 3 grids to obtain total. Multiply the total number of eggs by **16.66** to get the number of eggs in the sample per gram (epg).

**Calculate the eggs per gram reduction.**

Use the following formula to calculate the EPG reduction: $Reduction=100\%\*(1-\frac{postEPGmean}{preEPGmean})$, where “postEPGmean” is the average of the EPG counted after treatment and the “preEPGmean” is the average of the EPG counted before treatment. If there is less than 95% reduction for your flock, this may indicate anthelmintic resistance OR anthelmintic failure.

**Example:** Old MacDonald’s had a Pre-treatment EPG of **800** and a Post-treatment EPG of **40**.

**Figure 5 Legend: How to calculate Egg count reduction**

##### Although it is a good tool, FECRT cannot be interpreted in isolation

**Figure 6 Legend: Every flock is unique; a Fecal Egg Count Reduction Test cannot be interpreted in isolation**

Fecal egg counts cannot be simply interpreted in isolation and must be done so in the context of the class of animal, time of year, and the flock and grazing management situation.

Given the results of the fecal egg count reduction test, one may choose to switch to a more effective dewormer. As a producer, this is an important decision and should be made after consulting your veterinarian.