

## American Consortium for Small Ruminant Parasite Control

Best Management Practices for Internal Parasite Control in Small Ruminants

# MANAGING DEWORMER RESISTANCE

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## WHAT IS DEWORMER (DRUG) RESISTANCE?

Internal parasite infections can impact the productivity of grazing animals significantly. Years of overuse and misuse of available dewormers has led to the development of drug resistance in worm populations on many farms. Drug resistance occurs when a drug loses its ability to effectively kill worms, and the worms continue to survive in the presence of therapeutic levels of the drug (standard prescribed dose). Drug resistance is inevitable and cannot be prevented. However, its development can be slowed down.



“What do you mean the drugs don’t work?”

Image by Molly Klein

## HOW DO I KNOW IF I HAVE DRUG RESISTANCE ON MY FARM?

Most producers start suspecting that there is a resistance issue on their farm when clinical signs persist and/or fecal egg counts (FEC) remain high following a properly administered drug treatment. There are currently two tests available for determining drug resistance;

- Fecal egg count reduction test (FECRT)
- Larval Development Assay (LDA; DrenchRite®)

With the FECRT, the effectiveness of a drug is determined by comparing the FEC of animals both before and 7-14 days after treatment or by comparing the FEC of treated and untreated control groups. It is recommended that at least 10 to 15 animals with a FEC of more than 250 eggs per gram (epg) be used to determine the effectiveness of a drug. This test is suitable for on-farm testing and can be conducted by trained producers, veteri-

narians, or extension personnel. Depending on the number of animals in a flock/herd, this might require multiple tests to determine resistance to all classes of dewormers.

The DrenchRite® test offers an alternative to the laborious task of performing a FECRT and can test for resistance to all dewormer groups in a single test. An added bonus is that the test also identifies the type of parasites in the sample. The test requires a pooled sample from at least 10 animals with FAMACHA® scores  $\geq 3$  (average FEC > 500 epg preferred). The only lab in the US that conducts the DrenchRite® test is located in the laboratory of Dr. Ray Kaplan at the University of Georgia (Howell and Storey, 2012). For both tests, a drug is considered effective if the FEC reduction is greater than 95%. Below 95% reduction in FEC, a dewormer will become increasingly less effective as the sole treatment option.

***Drug resistance is inevitable and cannot be prevented. However, its development can be slowed down.***

## HOW WIDESPREAD IS DRUG RESISTANCE ON US FARMS?

The results of numerous studies confirm the widespread existence of resistance to the three major classes of dewormers on sheep and goat farms in the US (Howell, et al., 2008, Crook et al., 2016). These classes of dewormers along with their tradenames are included in Table 1. Dewormers are separated into classes based on their chemistries and modes of action. Dewormers in the same class can exhibit cross-resistance.

**Table 1. Dewormers used in sheep and goats**

Drug Class	Drug name	Tradenames
Benzimidazoles	Fenbendazole, albendazole, oxdendazole	SafeGuard®, Valbazen®, Panacur®, Synanthic®
Nicotinic Agonists	Levamisol, morantel, pyrantel	Prohibit®, Leva-Med™, Strongid®, Positive Pellet®, Rumatel®
Macrocyclic lactones	Ivermectin, doramectin, eprinomectrin, moxidectin	Ivomec®, Cydectin®, Quest®, Dectomax®, Eprinex®

Source: Adapted from Susan Schoenian, <https://www.sheepandgoat.com/underantheel>

In a drug resistance study on sheep (n=14) and goat farms (n=20) in the Mid-Atlantic area (2008-2009), the following results were obtained: benzimidazoles were not effective on any farm, most farms had resistance to ivermectin (82%), many had resistance to moxidectin (47%; Cydectin®), and several had resistance to levamisole (24%). Drug resistance to all classes of drugs was present on four farms (12%).

More recently, sheep farms tested in Maryland, Virginia and Georgia had worms resistant to benzimidazole, ivermectin, moxidectin, and levamisole on 100%, 97%, 83%, and 50% of the farms tested, respectively. In addition, the percentage of farms tested with resistance to all tested drugs was 33% (Schoenian et al., 2017). These studies indicate the prevalence of drug resistance on farms and the need to continue efforts in getting more sheep and goat producers to employ sustainable integrated parasite management techniques on farms in order to prolong available drug efficacy (Figure 1).

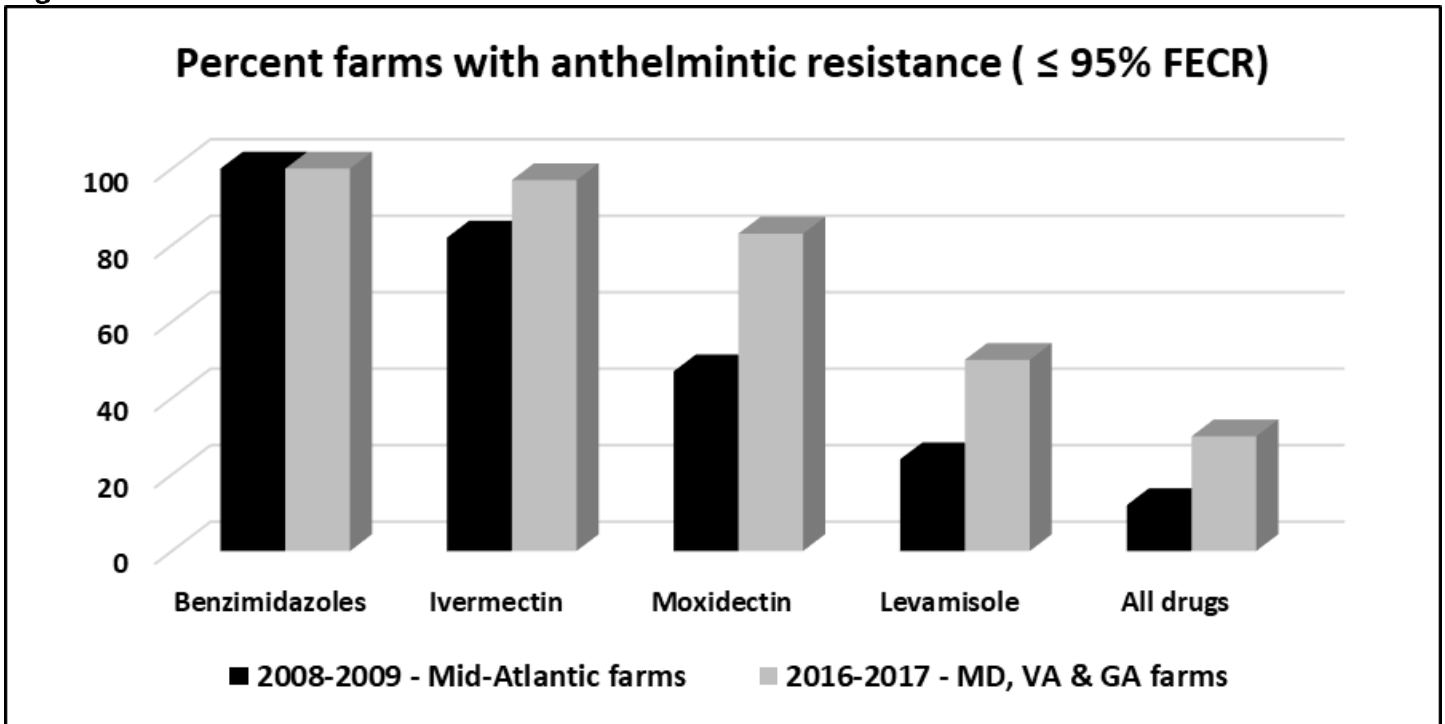
Drug resistance is not only an issue in the US. In other parts of the world such as New Zealand, Australia and South Africa, drug resistance has also become a major threat to the sustainability of their sheep and goat industry. Even with the development and availability of new drugs (monepantel; Zolvix® and dequantel/abamectin, Startect®) effective at killing worms re-



All dewormers should be given orally.

Image by Susan Schoenian

sistant to other drug classes, there has already been reports of resistance on some farms (Zolvix®; within 2 years of introduction). This emphasizes the point again that drug resistance is inevitable. If and when new dewormers become available to US producers, an integrated approach to parasite control, such as targeted selective treatment to promote refugia, would still be vital to preserving its efficacy.

**Figure 1.**

## I HAVE DRUG RESISTANCE-HOW CAN I MANAGE IT?

Internal parasite infections are a major cause for reduced productivity in the sheep and goat industry. While we're aware of the potentially devastating clinical effects that result from infection with the barber pole worm and others, most of us fail to realize that subclinical effects are much more common and could result in a greater loss in production. This is exacerbated when the worms on a farm have developed resistance to the drugs that are being used in a control program.

With an increasing number of farms experiencing drug resistance in the US, there has been research into and

the promotion of alternative strategies that support sustainability and slow down the rate of drug resistance on farms. Strategies including targeted selective treatment, fasting and repeat dosing for increasing drug efficacy, combination treatments, animal nutrition, pasture management, genetic selection, copper oxide wire particles, condensed tannins (e.g. sericea lespedeza) and others are now being recommended to manage drug resistance on farms. In the wake of drug resistance, the ultimate goal of any worm control program should be reducing the deworming/drug use frequency and slowing down the rate at which further resistance is occurring to all drugs.

## TARGETED SELECTED TREATMENT

Simply put, targeted selective treatment means deworming only those animals that require treatment or would benefit from treatment. Not only does this strategy help to manage drug resistance and decrease deworming frequency, it also helps identify animals that are susceptible (or not) to worm infections. This technique slows down resistance by increasing "refugia" (number of worms left in "refuge" from the drug).

There are two tools that were developed to help producers identify animals that require deworming. These tools include the FAMACHA® system and the Five Point Check®. The FAMACHA® system assesses *Haemonchus contortus* (barber pole worm) infection in sheep and goats by allowing the producer to assign an eyelid anemia score. The FAMACHA® card uses a scale of 1-5; with 1 being red and healthy and 5 being white and in danger of dying if not dewormed immediately with an effective drug.



The Five Point Check<sup>®</sup> addresses limitations of the FAMACHA<sup>®</sup> system by determining the need for deworming for all internal parasites (not just blood feeders like the barber pole worm) that impact sheep and goats. In addition to the eyelid (anemia) score, it has four other check points including nasal discharge (can substitute coat condition in goats), back (body condition), tail (fecal soiling), and jaw (swelling, “bottle jaw”). This tool is also helpful in deciding whether or not to deworm animals with borderline FAMACHA<sup>®</sup> scores. Every sheep and goat producer should be using these tools on their farms to manage drug resistance.

To receive a FAMACHA<sup>®</sup> card, you must attend a training or consult with your veterinarian. You can contact your local extension office or check [www.wormx.info/workshops](http://www.wormx.info/workshops) for any upcoming classes in your area. Online FAMACHA<sup>®</sup> certification is available at <https://web.uri.edu/sheepngoat/famacha/>.

What about FEC? Can it be used to determine the need for individual deworming? The simple answer is (most often) no. Quantitative egg counts are important in any internal parasite control program and can aid producers in monitoring the rate of pasture contamination. FEC can also be used to determine drug resistance as described above and also in selecting or culling particular animals. However, most of the time, FEC should not be used as the only indicator of when to deworm individual animals. If FEC are available, they should be used in conjunction with FAMACHA<sup>®</sup> and the Five Point Check<sup>®</sup> to determine the need for treatment. If an animal has an extremely



Collecting a fecal sample

Image by Susan Schoenian

high FEC (e.g. >4000 epg) and no other indicator of parasitism, it is still advisable to deworm. This will limit pasture infestation and exposure of more susceptible animals (young, sick, old) to worm larvae. Goats might need more frequent monitoring than sheep do as they tend to go downhill faster.

In addition to these tools, some sheep and goat experts advocate for the use of the “Happy Factor™” in determining the need to deworm individual animals. For instance, if an animal has decreased performance indicators, such as low average daily gains or no weight gain, then they might benefit from dewormer treatment.

## INCREASING DRUG EFFICACY

To effectively manage drug resistance, care must be taken to ensure that when individual animals are treated, they receive the correct dose and are not under-dosed. Under-dosing is a major contributor to resistance. To avoid this, sheep and goats should be weighed before being treated. If you do not have a livestock scale, then at a minimum you should be using a weight tape or measuring tape to estimate body weight, even if just on your heavier animals (Infovets, 1998). Also, animals

should always be drenched over the tongue towards the back of the mouth with a dosing syringe that has a long metal nozzle. Depositing the drug over the tongue increases drug efficacy by preventing the drug from bypassing the rumen.

Studies have also shown that restricting feed for 24 hours may also increase the availability and effectiveness of some drugs. Restricting feed slows down gut mo-



tility and leaves the drug in contact with the worms for a longer period of time. This strategy can be effective with benzimidazoles and ivermectin.

Repeat dosing is another method that can be used to increase drug efficacy and aid in managing drug resistance. Research showed that when two doses of fenbendazole (Safeguard®) were given 12 hours apart, drug efficacy increased by 42% (from 50 to 92%; Zajac and Gipson, 2000). This method can be done as an alternative to, or in addition to feed restriction. Again, it appears that benzimidazole drugs benefit the most from using this method. If this method is used with levamisole, the second dose should be administered at 24 hours later rather than at 12 hours to avoid possible toxicity issues (Kaplan, 2017).



**DrenchRite plate**

Image by Sue Howell

## COMBINATION TREATMENTS

We now know that rotating between dewormers will not aid in managing drug resistance or prevent it from worsening. As stated previously, with FEC reduction below 95%, the dewormer will become increasingly less effective as the sole treatment option.

Combination dewormers (products with more than one drug) are available in other countries but not in the US. Dewormers can be used at the same time (not in a single dosage, but each drug given separately) to increase treatment efficacy when individual dewormers are no longer effective. There is an additive effect when dewormers are given in combination (Kaplan, 2017).

On some farms, however, individual drug efficacy could be so low that even combination treatments will not be an effective treatment. In these cases, a producer might

consider combining an alternative treatment, such as copper oxide wire particles (COWP) with a dewormer for increased treatment efficacy. A recent study in lambs showed that when combined, COWP and Valbazen® resulted in a 99% FEC reduction whereas individually they resulted in only a 58% and 20% FEC reduction, respectively (Burke et al., 2016). The researchers believe that a combination of levamisole and COWP would also result in a more effective treatment than when either product is used individually.

Finally, never underestimate the importance of supportive therapy (a little TLC) when you have an animal severely parasitized (FAMACHA© score 4/5). Removal from contaminated pasture and supplementation with electrolytes, iron supplements, and B-vitamins, along with an effective drug can assist in a faster recovery time (Whitley, 2017).

## ANIMAL NUTRITION

One major implication of parasite infections in small ruminants is the reduction of nutrients that the animal needs for growth and maintenance. We know that improved nutrition can reduce production losses and mortality rates associated with worm infections.

Field trials in Australia have shown that the nutritional status of ewes impacts their ability to fight worm infec-

tions around the time of lambing. These trials suggest that increasing the protein intake of ewes during the last six weeks of pregnancy is effective in reducing the periparturient rise in FEC typically observed.

Maintaining females at a body condition score of 3 compared to 2) was also effective in reducing the rise of FEC around the time of giving birth (Meat & Livestock Australia, 2007). In addition, studies have shown that lambs



supplemented with protein have increased immunity and resistance to worm infection. Therefore, ensuring that your animals are receiving good nutrition and are fed a balanced ration with proper mineral supplementa-

tion will aid in reducing deworming frequency and subsequently slowing down the rate at which drug resistance is developing on your farm.

## PASTURE MANAGEMENT

Good pasture management practices, such as maintaining low stocking rates, rotational grazing to manage grazing heights, multi-species grazing and others can also help to control worms, reduce deworming frequency and keep sheep and goats healthy.

## GENETIC SELECTION

Resistance is the ability of the animal to limit infection. FEC is the easiest way to determine resistance as these animals will consistently demonstrate low FEC when measured. Even though some breeds are more “resistant” than others, there will be variability within every breed and some individuals will not have this trait. The same goes for the breeds considered “not resistant.” Therefore, individual animals should always be monitored for their own merit.

Studies in both sheep and goats have demonstrated that this ability to regulate worms is under genetic control and that it is a moderately heritable characteristic (20-40%). This means that resistant dams and sires will most likely produce resistant kids/lambs. The sire/male contributes 50% of the flock genetics. Therefore, selecting resistant sires may be the most cost-effective and



Good grazing practices can help to control worms. Image by Molly Klein

efficient method of making improvements in herd/flock resistance.

It is critical to remember the 70/30 rule. Worms are not evenly distributed in a herd/flock and approximately 70% of the worms will be shed from 30% of the herd/flock. Therefore, it is important to monitor animals and identify those with the most worms and cull them (remove from the breeding herd) in order to reduce pasture contamination, thus reducing deworming frequency. This allows you to select for those animals that are more ‘resistant’ to internal parasites.

## HERBAL/ALTERNATIVE DEWORMERS

Over the last few years, a number of studies have been done to test the effectiveness of commercially available herbal dewormers. Results have been contrary to claims made by the manufacturers and none have been proven to be effective in reducing worm loads in the animals studied.

Results from studies looking at the effectiveness of ginger, papaya, pumpkin, and garlic have lacked consistency. For instance, one study found that worm counts

were significantly reduced after two weeks when pumpkin seeds were fed to lambs for 21 days; however, more recent studies have not been able to support this claim.

Overall, when it comes to herbal dewormers, there is insufficient scientific data supporting claims of effective parasite control. Therefore, herbal products alone should not be relied on for controlling/treating worms. If their use is desired, they should always be combined with other worm management techniques.



## COPPER OXIDE WIRE PARTICLES (COWP)

It has been discovered that a low dose of COWP (0.5 - 1 g) can be effective at controlling the barber pole worm in sheep and goats. Caution should be taken to not over dose, especially in sheep, and when other sources of die-

tary copper are available. For information on the efficacy, use and dosage recommendations of COWP, see the Best Management Practices Fact Sheet on COWP.

## CONDENSED TANNINS (*SERICEA LESPEDEZA*)

Forages such as sericea lespedeza and sainfoin have been shown to reduce indicators of worm infection in sheep and goats. What these plants have in common is the presence of condensed tannins. It is believed that when animals consume these legumes, there is a disturbance in the biology of the worms and the way in which they cause infection, thereby promoting the health of sheep and goats (Hoste, 2017).

Sericea lespedeza has been extensively studied in the US and has been shown to reduce FEC when grazed and also when fed as a hay or pellets in many (but not all) studies. It is not only effective against the barber pole worm, but has also been shown to reduce coccidia levels as well. As noted with the use of COWP, sericea lespedeza can be used as part of an integrated parasite control strategy to reduce pasture infestation, subsequent worm loads in the animals, and slow down the rate of at which resistance develops to available drugs.

## OTHERS

A number of other alternative strategies, such as the use of diatomaceous earth (Whitley and Miller, 2015), and the development of vaccines has also been studied.

One method of parasite control that might hold a lot of promise for US producers is a nematode trapping fungi (*Duddingtonia flagrans*) (Miller, 2013). This fungi, when

fed, survives passage through the digestive tract of livestock, germinates and spreads on fresh feces producing specialized nematode trapping structures that restrict the development of parasite larvae. Studies have proven its efficacy and it might be available in the near future for use by US producers.

## SUMMARY

In summary, finding out that the worms on your farm have resistance to multiple drugs is not a death sentence. There are multiple practices/tools, as described above, which can be adopted to effectively manage dewormer resistance on your farm. Keep in mind that the

ultimate goal should be reducing your reliance on drugs by efficiently managing your available resources and selecting and breeding to develop a more worm resistant flock/herd.

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