Integrated Parasite Management (IPM) in Small Ruminants

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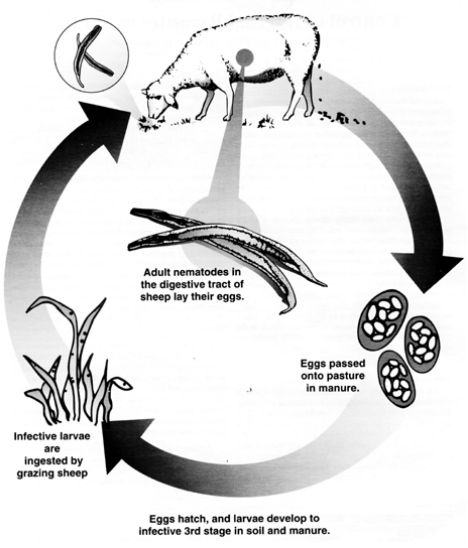
Internal parasites are the #1 health problem affecting small ruminants. Sheep and goats are more susceptible to internal parasites than other livestock, due to their grazing behavior and slow developing immunity. In the past, producers relied heavily on anti-parasitic drugs, called "anthelmintics" to control internal parasites in their flocks. Unfortunately, parasites have become increasingly resistant to many of the anthelmintics. In addition, few anthelmintics are FDA-approved for use in sheep and goats, and due to the costs involved in developing new drugs, it is unlikely that any new products are going to come onto the market anytime soon. As a result, producers can no longer rely on deworming alone to control parasites in their flocks. A more integrated approach will be necessary. On the plus side, internal parasites are a major area of study among scientists in Australia, New Zealand, South Africa, and the United States and new discoveries will likely be made in years to come.

Major parasites of concern – stomach worms (roundworms, nematodes)



The parasite that causes the most problems to small ruminants is *Haemonchus Contortis*, better known as the "barber pole" worm. The barber pole worm is a blood-sucking parasite that pierces the lining of the abomasums (stomach), causing blood plasma and protein loss to the host. The symptom most commonly associated with barber pole infection is anemia, characterized by pale mucous membranes, especially in the lower eye lid; and "bottle jaw," an accumulation of fluid under the jaw. Diarrhea (scours) is not the usual symptom of barber pole infection. The barber pole worm is a prolific egg producer with a short, direct life cycle. It can cause significant death loss in sheep and goats.

Other stomach worms include *Trichostrongylus*, *Ostertagia*, and *Cooperia*, but instead of causing blood and protein loss to the host, these worms cause digestive disturbances such as diarrhea and weight loss. These worms do not cause the degree of death loss as the barber pole worm, but contribute to the general debilitation of the animal.

Worm larvae (eggs) love warm, moist conditions, but can survive winter by going into a dormant or arrested state and not resuming their life cycle until the spring when environmental conditions have improved. When environmental conditions are ideal, the life cycle of the barber pole worm can be as short as 7 days. In normal climatic years, the number of worm larvae on pasture usually peaks in mid-summer (July-August). The peak may occur in the fall, if a dry summer is followed by a wet fall. In drought years and in dry climates, parasites tend to be less of a problem.

Other parasites of concern

Other parasites of concern are tapeworms, lungworms, liver flukes, and coccidia. Tapeworms have an indirect life cycle, requiring pasture mites to complete their life cycle, and are generally considered to be non-pathogenic. However in some situations, tapeworm infestations can cause diarrhea, weight loss, and even death in sheep and goats. Not all anthelmintics (only the benzimidazoles) kill tapeworms.

Sheep and goats become infected with lungworms when they consume the larvae in feces. The larvae then travel to the lungs where they can cause respiratory problems in severe cases. Normally, there aren't any obvious clinical signs associated with lungworms. In addition, parasite control programs for stomach worms usually control lung worms.

Liver flukes are generally not considered to be a problem in the Mid-Atlantic states. They have an indirect life cycle and require open water and snails to complete their life cycle. The only anthelmintic that is effective against adult liver flukes is Albendazole (Valbazen).

Coccidia are single-cell protozoa that can cause significant losses in a sheep and goat flocks. Young sheep and goats are especially susceptible to coccidia. What's important to note is that each species of livestock is affected by different species of coccidia. In addition, the drugs that are effective against stomach, tape, and lungworms are not effective against coccidia. Coccidiosis is treated with sulfa drugs and Amprolium (Corid™) and prevented with Lasalocid (Bovatec™), Monensin (Rumensin™) and Decoquinate (Deccox™). Bovatec is FDA-approved for use in feed lot lambs. Rumensin is approved for goats. Deccox is approved for both species.

Another parasite that can be of concern in some areas is the meningeal worm or deer or brain worm. It is a parasite of the White Tail Deer, and small ruminants are an abnormal host. The deer worm has an indirect life cycle and requires snails and slugs to complete its life cycle. Once an infected snail or slug is ingested, the larvae travel from the animal's intestinal tract to its spinal cord, eventually reaching its brain, resulting in paralysis and death. Early indications of a meningeal worm infection are gait abnormalities and lameness. There is no way to diagnose the condition in a live animal. Successful treatment involves heavy doses of anthelmintic drugs and use of anti-inflammatory drugs. Prevention relies upon limiting deer contact, controlling the snail and slug habitat, and monthly deworming.

Integrated Parasite Management (IPM)

Parasite control starts with good management and common sense. Good sanitation will go a long way in controlling parasites, especially coccidia. Feed should not be fed on the ground. Feeders that minimize waste and contamination should be used. Water should always be clean

and free from fecal matter. Pens should be dry and well bedded. Pens and pastures should not be overstocked. All new arrivals to the farm should be isolated for at least 30 days and dewormed aggressively.

The use of clean(er) or safe(r) pastures will help to control internal parasite problems. A clean or safe pasture is one in which sheep or goats have not grazed for 6 to 12 months. Pastures that have been renovated or rotated with row crops are clean, as are pastures in which a hay or silage crop has been removed. A pasture grazed by cattle and/or horses is also considered safe.

Producers grazing more than one species livestock report fewer internal parasite problems. This is because sheep and goats are generally not affected by the same stomach worms as cattle and horses. Pastures can be alternated between small ruminants and cattle or horses to create clean or "safer" pastures for each respective species. If small ruminants are co-grazed with cattle or horses, each species will consume the other's worm larvae without ill effect.

Rotational grazing generally does not help to control internal parasites unless pasture rest periods are long enough (e.g. >70 days). In fact, management intensive grazing (short duration, high intensity grazing) may exacerbate parasite problems in small ruminants if animals are returned to a contaminated pasture, though there will be some trade-off if the animals are in better body condition as a result of improved nutrition due to rotational grazing. Sheep and goats that browse or graze tall-growing forages have fewer internal parasite problems, though woodland grazing may increase the risk of meningeal worm infection. There are some forages that may have anti-parasitic effects. These include Birdsfoot Trefoil, Chicory, Sericea Lezpedeza, and other forages containing condensed tannins.

Livestock on a higher plane of nutrition and/or with a higher body condition score are better able to withstand parasite challenges. Nutrition in early pregnancy increase fat stores and has been shown to increase the immune response to parasites. Ewes receiving increased protein levels during late gestation are better able to mount an immune response to parasites. Since worms need grass to develop, animals raised in confinement have fewer parasite (stomach worm) problems and those put in confinement are less likely to get re-infected.

Genetics may offer the best long-term solution to internal parasitism in small ruminants. Genetics affect both an animal's ability to resist infection, as well as withstand infection. Resistance is defined as the animal's ability to resist infection. It is measured by fecal egg counts (FEC) and is 20 to 40 percent heritable. Resilience is defined as the animal's ability to withstand infection, i.e. remain productive despite infection. It is measured by blood hematocrit or packed cell volume (PCV), a measure of anemia.

It is important to manage both resistance and resilience in a flock. In a flock, since only a small number of animals shed the majority of worm eggs, ideally, these animals should be identified and removed from the herd. Animals which require frequent treatment should also be removed from the herd. Some sheep and goat breeds are more resistant (and resilient) to parasites. These include hair sheep and the Gulf Coast Native, the common brush goat, Spanish goat, and Myotonic. The Kiko may be more resistant to parasites due to its New Zealand background (wet climate). Dairy goats and wooled sheep are more susceptible to internal parasites as are Boer

and Angora goats due to their origins in hot, dry climates.

Anthelmintics

There are three families of drugs which are used to treat internal parasites in livestock. They include:

1. Benzimidazoles – Fenbendazole, Albendazole, Oxybendazole, Thiabendazole
2. Nicotinics – Levamisole, Pyrantel, Morantel
3. Macrolides– Ivermectin, Doramectin, Moxidectin

The Benzimidazoles (Safeguard™, Panacur™, Valbazen™, Synanthic™), also called "white dewormers" are broad spectrum and safe to use. They are effective against tapeworms. Albendazole is effective against adult liver flukes, but should not be used in pregnant ewes or lactating does.

Levamisole (Levasol™, Tramisol™, Prohibit™), also called a "clear dewormer" is broad spectrum dewormer, effective against arrested larvae. However, it has a narrower margin of safety, especially in the injectable form. Pyrantel (Strongid™) is only effective against adult worms. Moratel (Rumatel™) is an oral feed additive that is only effective against adult worms.

The Macrolides are the newest family of drugs. They can further be divided into two groups. The Avermectins include Ivermectin (Ivomec™) and Doramectin (Dectomax™), while the Milbemycins include Moxidectin (Cydectin™, Quest™). The Macrolides have broad efficacy and a wide margin of safety. They are also effective against external (biting) parasites, including nose bots. Moxidectin is a persistent-activity dewormer that continues to kill worms after it is administered. In a sheep trial in Virginia, treatment with Moxidectin (Cydectin) at 8 week intervals was more effective than treatment with Ivermectin at 4 week intervals.

Only Fenbendazole and Rumatel are FDA-approved for use in goats. Ivomec drench, Valbazen drench, and Levamisol drench and oblets are approved for use in sheep. Use of any product which is inconsistent with its label constitutes "extra-label" drug use and requires a veterinary prescription and valid veterinarian-patient-client relationship. Exaggerated withdrawals should be used when administering drugs extra-label. For example, while the withdrawal period for Cycdectin is 0 days when applied topically to cattle, it is recommended that at least a 30 day withdrawal period be followed when the drug is administered orally to sheep or goats.

Currently, there are no non-chemical dewormers (including herbs and diatomaceous earth) which have been shown to be effective at reducing parasite infection (fecal egg counts) in livestock. Hopefully, research will eventually be able to identify effective, natural methods of parasite control.

Anthelmintic use

Anthelmintics should not be used indiscriminately. Frequent deworming (> 3 times per year) is costly and accelerates the development of anthelmintic-resistant worms. The routine use of anthelmintics is prohibited under the new National Organic Standards.

Strategic deworming may help to control parasite burdens in the animals and on pastures. The most important time to deworm a sheep or goat is prior to parturition (2 to 4 weeks pre-lambing/kidding). This will help to prevent the "periparturient rise" in worm eggs that generally occurs around lambing/kidding time. It will also reduce the number of eggs that the ewe/doe sheds into her environment that could potentially infect her newborn lambs/kids. Other strategic times to treat with anthelmintics are prior to moving animals to a safe or "cleaner" pasture, at the start of the grazing season when the grass first starts to green up, in the mid-summer when worm larvae numbers are typically the highest, and in the fall after the first frost.

Anthelmintic treatments should be targeted to the most susceptible animals in the herd. This would include young stock, lactating females, and high producers or highly stressed animals. Leaving some animals untreated will help to slow anthelmintics resistance. The refugia (worms not exposed to drug treatment) will remain sensitive to drug treatment and will help to dilute the resistant genes in the worm population. Returning treated animals to a contaminated pasture will also help to prevent resistance problems. If you return treated animals to a clean pasture, the only worm larvae that will end up on the clean pasture will be larvae that are resistant to drug treatment.

It is important to maximize the effect of a single treatment. Underdosing is another cause of anthelmintic resistance. Animals should not be underdosed. Ideally, animals should be weighed or measured with a tape to determine the proper dosage. When deworming a group of animals, the dose should be set for individual animals or at least the heaviest animals in the group, not the average. Anthelmintics should be administered orally, over the tongue of the animal. Research has shown that benzimidazoles are more effective when the animals are fasted 12 to 24 hours before treatment or when two treatments are given 12 hours apart. Goats metabolize anthelmintics differently (it clears their system faster) than sheep and cattle and require higher doses, typically 1.5 to 2 times the cattle/sheep dose. Producers should consult with their veterinarian to determine the proper dosage for goats.

<u>Anthelmintic resistance</u>

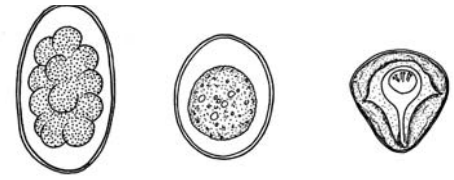
Anthelmintic resistance is when the drug no longer works because the worms have developed a tolerance or resistance to it. Anthelmintic resistance is determined by a fecal egg count reduction test (FECRT). Animals are weighed and treated with the anthelmintic and fecal egg counts are conducted at the time of treatment and 7 to 14 days after treatment. Fecals from a second group of untreated animals (control group) must also be analyzed to make the sure the change in egg counts is a result of treatment and not something else. If the anthelmintic kills 90 percent or more of the worm eggs, it is considered to be effective. If it kills 60 to 90 percent of worm eggs, it is considered to have a moderate level of resistance. Anthelmintics killing less than 60 percent of worm eggs are considered to have severe resistance. The DrenchRite test, available from the University of Georgia, can also be used to determine if worms are still susceptible to drug treatment.

Resistance to anthelmintics in the benzimidazoles is considered to be widespread and a world wide problem. Resistance to Ivermectin is widespread. Resistance to Levamisole is reported worldwide, but recent studies in the U.S. have shown Levamisole to still be effective. Moxidectin is still considered to be an effective dewormer. In addition, anthelmintics in which

widespread resistance has been reported may still be effective on individual farms and may be potent enough to alleviate clinical symptoms.

You can slow anthelmintics resistance on your farm by not introducing anthelmintic resistance to your farm. New arrivals should be isolated and dewormed with products from at least two families of drugs. Care should be taken not to underdose animals. Combinations of products may slow down resistance. Anthelmintics should be rotated annually or a product should be used until it is no longer working. Leaving some animals untreated and focusing treatments on susceptible animals will slow down resistance.

Two tools for integrated parasite management



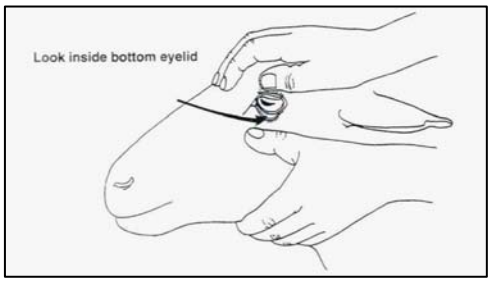
There are two tools that producers can use to more effectively control internal parasites: fecal egg counting (FEC) and FAMACHA© Fecal egg counts can be used to determine the level of pasture contamination and the need for flock treatments. Fecal egg counts are most useful for determining the effectiveness of a deworming program. FAMACHA© is a system whereby you examine the lower eyelid of the animal and administer anthelmintic treatment only if signs of anemia are present.

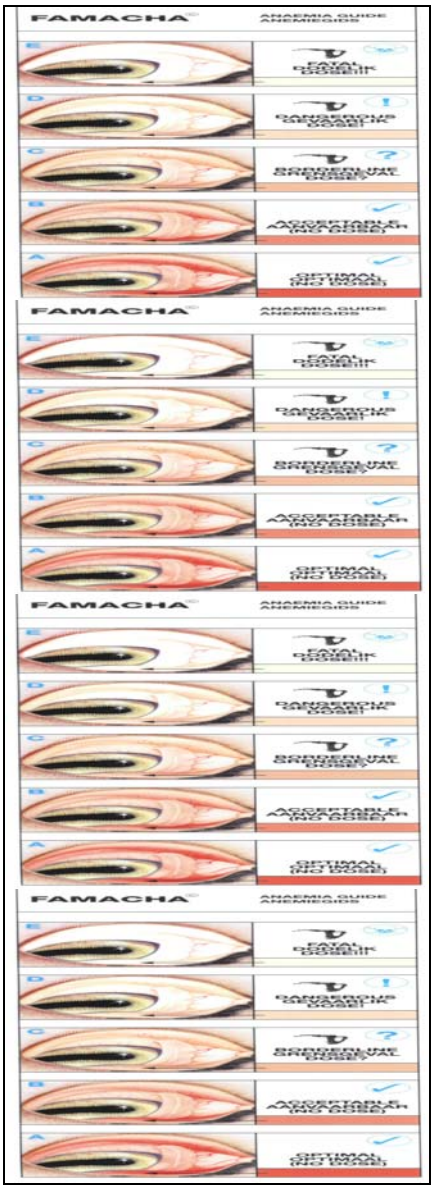
In order to do fecal egg counts, you need a microscope, flotation solution, plastic or paper cuts, spoon or something to mix fecal slurry with, a straining device, slides, and cover slips. A microscope with 200x magnification is sufficient. Microscopes which connect to computers will also work. Commercial flotation solutions are available or you can mix your own saturated salt or sugar solution. A McMaster slide has chambers that allow you to count the number of eggs in order to calculate eggs per gram whereas regular slides can be used to determine general worm loads – high, medium, or low.

FAMACHA© is a technique developed in South Africa in which a color eye chart depicting varying degrees of anemia is used to determine the need for anthelmintic treatment. It was developed as a tool for anthelmintics resistance management and integrated parasite management. It only works for the barber pole worm. It was developed for sheep, but will work for goats with slight modifications. The FAMACHA© technique reduces the number of treatments because only animals showing physical signs of infection are dewormed. It identifies worm susceptible animals for culling and slows anthelmintics resistance, as worms have less exposure to the drugs.

FAMACHA

Clinical category	Color	PCV	Treatment
A	Red	> 30	Optimal - No Dose
B	Red-Pink	25	Acceptable – No Dose
C	Pink	20	Borderline – Dose?
D	Pink-White	15	Dangerous – dose
E	White	10	Fatal -Dose





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