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Control of Internal Parasites in Sheep

W. Dee Whittier, Extension Veterinarian, Extension Parasitologist, and Extension Animal Scientist, Virginia Tech
Anne Zajac, Extension Veterinarian, Extension Parasitologist, and Extension Animal Scientist, Virginia Tech
Steven H. Umberger, Extension Veterinarian, Extension Parasitologist, and Extension Animal Scientist, Virginia Tech

Introduction

Internal parasites, or worms, cause economic and production losses to Virginia sheep producers. According to a recent statewide survey of sheep producers, internal parasitism is recognized as the most prominent sheep disease in the state. Sheep infected with parasites may become ill and even die. Infected sheep either don't gain well or lose weight, become lethargic, and may have diarrhea. Sometimes losses occur which are undetected because the signs of parasitism are not obvious. The internal parasites responsible for the greatest losses to sheep in Virginia are the ones that infect the abomasum, or true stomach, of the sheep. Every flock in Virginia harbors some of these parasites. The most important of these is a parasite technically known as Haemonchus contortus, or the barberpole worm. Another worm called Ostertagia may also infect sheep and cause losses in some instances. A third abomasal worm called Trichostrongylus is considered to be less important. Intestinal worms, especially Trichostrongylus colubriformis and Oesophagostomum, may also cause problems. Lung worms are rarely a problem in Virginia flocks. Since control programs for Haemonchus usually result in the control of intestinal worms, they will not be considered separately in this discussion.

Life Cycle

An understanding of the Haemonchus life cycle is important to understanding effective control programs. The life cycle of Haemonchus is defined as direct. This means that it does not need any other animals in order to complete its cycle. Adult Haemonchus worms live in the abomasum and lay eggs in huge numbers that are then passed in the manure (Figure 1). Following passage onto the pasture in the manure, they must develop into infective larvae before they are capable of infecting the sheep. The period of time required for the hatching of the egg and development of the larvae is dependent on weather conditions, but it may be as little as five days or as long as several months. Larvae develop and survive best under warm, wet conditions. This explains why parasitism is a much greater problem in moist climates than in dry, arid climates. It also explains the seasonal occurrence of parasitic disease following periods of warm, moist weather.

After larvae have developed into the stage where they are infective, they must be eaten by the sheep in order to complete their life-cycle. The larvae have a limited ability to transport themselves from the manure onto the pasture plants. Therefore, continuation of the cycle depends on disintegration of manure during rains, which transports larvae in splashes and small currents to the surrounding grasses. When sheep are forced to graze pastures very closely, the number of larvae ingested usually increases because the concentration of larvae is higher in the lower parts of pasture plants. The fact that sheep naturally tend to graze selected areas of the pasture very closely, even when other pasture is available, is one of the characteristics that makes them so susceptible to worms.

Once the larvae are eaten, they must continue the development process before becoming adults and being able to lay eggs. This requires a very specific time period; about 14 days in the case of Haemonchus contortus. For Ostertagia and Trichostrongylus, it takes approximately 21 days of development after being eaten before the mature worm is able to produce eggs. These specific periods of time become important when strategic parasite control programs are initiated.

A factor that has important implications in the parasite life cycle is the discovery that stomach worms have the ability to go through a stage of arrested development (hypobiosis). Hypobiosis means that some of the larvae

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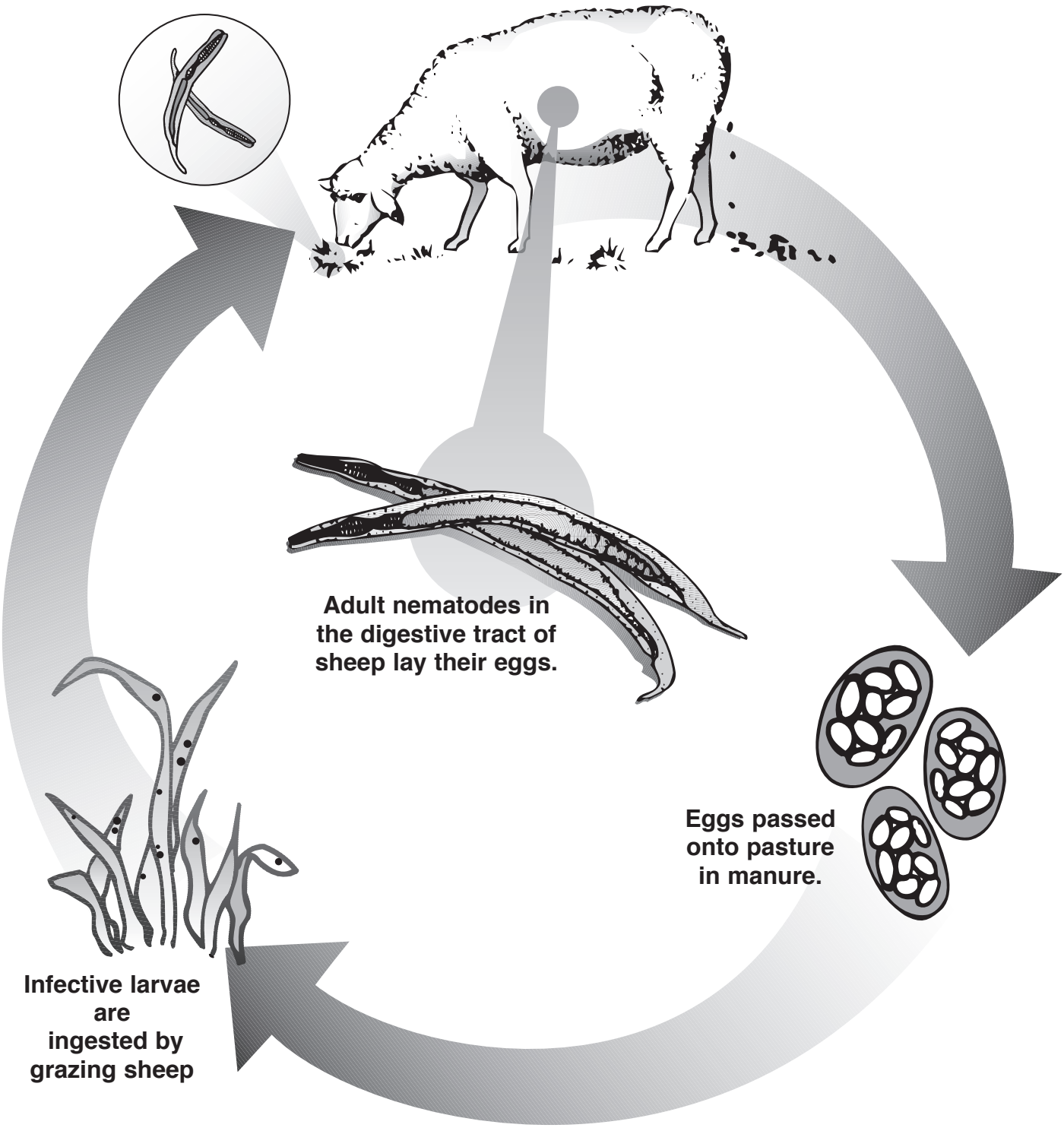
Figure 1 The life cycle of a typical stomach worm.



consumed by the sheep go into a dormant state instead of continuing their development. This allows them to get through periods of adverse climatic conditions for larval development and survival in the environment. This occurs in our area in the winter. These hypobiotic larvae accumulate and may reach large numbers. They may also be protected from some dewormers that are not effective against this stage of the parasite. In the spring or at lambing, a sudden resumption of their development to adult worms may occur and result in an increase in egg shedding onto the pasture and occasional disease signs in the sheep.

The damage caused by the parasite in the sheep is related to two factors. First, the developing larvae damage the gland cells of the stomach, which produces a disturbance of the digestive process. The second way that damage occurs is specific to Haemonchus. Haemonchus is a ravenous blood-sucker and removes considerable quantities of blood from the sheep. Blood loss can rapidly become greater than the animal is able to replace, resulting in anemia (a low blood cell level). Anemia may become so severe that animals are unable to transport adequate oxygen to tissues, resulting in the death of the animal.

Sheep Susceptibility to Parasitism

Sheep, as a group, tend to be very susceptible to parasites and their damage. Experts suggest that this is due to a combination of several factors, including:

1. The small fecal pellets of sheep disintegrate very easily thus releasing the worm larvae onto pastures.

2. Haemonchus is often the major parasite of sheep and its blood sucking characteristic makes it very damaging.

3. The ability and tendency of sheep to graze close to the ground where larvae numbers are higher drastically increases their exposure to parasites.

4. Sheep, unlike many other animals, have very little aversion to grazing areas of high fecal contamination.

5. Sheep have a flocking instinct that encourages them to graze close together.

6. The Haemonchus worm is a very prolific egg layer thus worm numbers can build up very rapidly.

7. Even older sheep are unable to develop immunity that controls the parasite life cycle.

Symptoms and Diagnosis

Stomach worms cause the loss of large quantities of blood and protein, which results in weakness and anemia. Anemia is characterized by paleness of the gums and the linings of the eyelids. When there is a rapid build-up in the number of parasites, sheep may die suddenly due to excessive blood loss, even if they are in good body condition and appear healthy. When the build-up is slower, sheep lose weight, become anemic, and their wool becomes brittle and may fall out. Weak animals may go down, develop pneumonia, and eventually die. A condition known as “bottle jaw” (where fluid accumulates under the skin of the lower jaw) may develop as a symptom of low protein levels.

Diarrhea may or may not occur as a result of parasitism. Diarrhea results from intestinal irritation and from disturbed digestion of food. Infections with Haemonchus very rarely result in diarrhea. The other worm species are more likely to cause diarrhea.

By the time symptoms appear, significant damage has already occurred, and prompt action is necessary to prevent further loss.

Many of the symptoms mentioned are also symptoms of other diseases. Therefore, it is wise to consult a veterinarian in order to arrive at an accurate diagnosis. Only after an accurate diagnosis is made can an effective treatment and control program be undertaken.

In addition to the examination of feces for parasite eggs, pasture grass may be examined to determine approximate levels of pasture contamination, and total parasite counts can be obtained from an autopsy

Parasite Larvae Numbers on Pastures

Research in recent years has increased our understanding of when and why build-ups of parasites occur. An understanding of seasonal changes in pasture larvae numbers is inherent to a successful control program. In the past, parasite larvae were considered to be relatively fragile and able to survive on pastures for only short periods. Recent research indicates that the larvae survive for considerably longer periods of time than once thought. In fact, many larvae survive on pastures through the winter or even longer.

As the lush grass growth of spring proceeds and grazing begins, the over-wintered larvae are picked up by grazing animals. The number of over-wintered larvae on grass tends to decrease during the spring season due to increased temperature and sunlight, which kill larvae. If sunny, dry conditions prevail, larvae numbers

may decline dramatically. Larvae eaten by sheep as they begin the grazing season go through the two-week development and begin to produce eggs. Since one larva can result in an adult that produces thousands and thousands of eggs, a multiplication in parasite numbers occurs. This is particularly true if moist, warm weather conditions are favorable to the development of larvae from eggs.

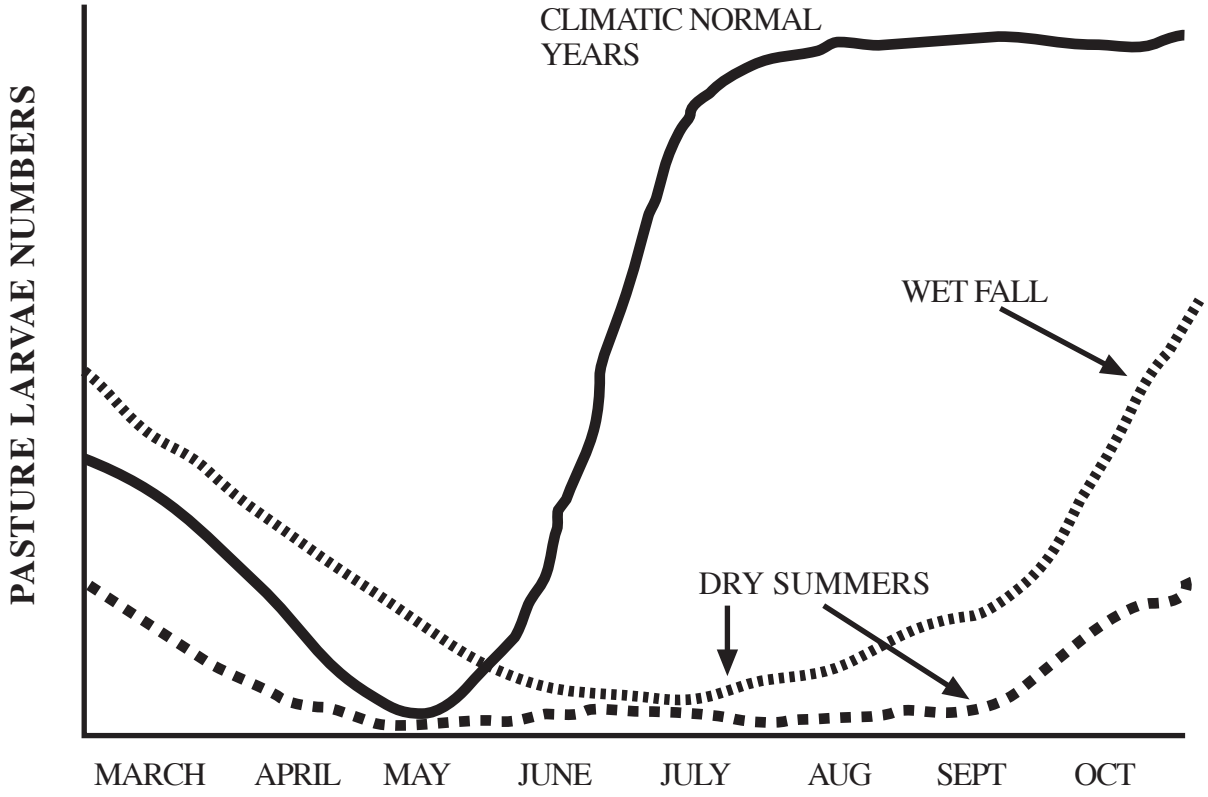
From mid-summer on, if weather conditions are appropriate, a large number of larvae accumulate on the pasture. This is referred to as the "midsummer explosion" in larval numbers. Depending on weather conditions, these larval numbers may remain high on pastures for the balance of the grazing season. If hot, dry weather conditions prevail, larval numbers will decrease due to the killing effect of drying. Figure 2 is a graph of typical numbers of larvae on the pasture during the grazing season.

Sheep Factors

Sheep have the ability to develop some immunity to parasites. As sheep get older, they are less susceptible to the negative effects of parasites. Also, if sheep have been exposed to parasites, they will, to a certain degree, be able to inhibit parasite development and egg laying. However, this resistance is not complete and may break down during times when sheep are challenged with high numbers of infective larvae of Haemonchus. Treatment of mature ewes is, therefore, important in an attempt to prevent infection of young animals. Sheep imported from areas where parasite exposure is considerably lower may have less resistance to parasites than sheep produced locally.

A phenomena called the periparturient (meaning around lambing time) egg rise must also be considered in parasite control programs. Beginning about two weeks before lambing, and continuing up to eight weeks after lambing, the ewe has a reduced ability to deal with worms. This process occurs regardless of when during the year lambing takes place and results in decreased ability to prevent development of incoming larvae, expel worms, and inhibit egg production by parasites already present in the stomach. These parasites produce large numbers of eggs that are shed in the manure. This is evidently a mechanism by which the parasite ensures the infection of the new generation of sheep about to be born. Effective parasite control programs must prevent this contamination of the surroundings into which very susceptible lambs will be born.

Figure 2. Relative numbers of infective worm larvae on pastures during the grazing season for years with normal rainfall and for dry summers.



Parasite Control Programs

Control programs are based on understanding these important principles. They have been developed and revised as some of the newer concepts discussed above have become known. The most effective programs require the use of dewormers to some extent. However, well planned programs will provide for a minimal amount of dewormer usage. This provides a number of benefits, including 1) decreased cost due to less dewormer usage, 2) decreased parasite resistance caused by indiscriminate use of dewormers, and 3) decreased production losses due to parasitism since dewormers are used to prevent rather than treat disease.

Many control programs used in the past, although well intentioned, resulted in the sheep having only a few days without worms before the process of reinfection began. Sheep quickly returned to worm burdens of essentially pretreatment levels. This resulted because the treatment programs did not stop the pasture contamination buildup; and therefore, sheep were dewormed and returned to very heavily contaminated pastures. Effective control programs should, therefore, combine the preventive use of dewormers with appropriate grazing management.

The required intensity of a parasite control program will be determined by the management on the farm. The two biggest management factors affecting this are stocking density and season of lambing. With low stocking rates, much less control is needed. If lambing and weaning occur such that young lambs are not grazing from midsummer on, then the intensity of the parasite control program may be greatly decreased.

The Safe Pasture Concept

A very useful concept in parasite control involves thinking in terms of safe and dangerous pastures. A safe pasture is one where infectivity is low enough that the parasite burdens of susceptible sheep increase slowly. It is not one free of infective larvae. Pastures that have been harvested for hay, silage, or small grain crops can generally be considered safe. Pastures that have been grazed by cattle, horses, or other species for a grazing season or longer are considered safe because only a small amount of cross-infection between species occurs. Contrary to previous belief, a pasture that has not been grazed for a few weeks cannot be considered safe. In fact, a year or more without grazing is required for ungrazed pastures to become safe. Most rotational grazing systems currently practiced do not aid in parasite control and, in fact, usually provide for an increased parasite challenge because sheep densities are higher on pastures!

If a flock is moved to a safe pasture after treatment, it may enjoy several weeks of low worm burdens rather than only two or three days as the result of treatment alone. A safe pasture should not be grazed by infected sheep; they must be treated before being allowed to graze. This treatment serves two purposes: 1) it removes the potentially harmful worm burden in the sheep, and 2) it protects the safe pasture from new contamination.

One control program is based on a concept termed "dose- and-move." The rationale behind this is to extend the effectiveness of a single treatment by moving animals to a safe pasture to limit reinfection. Thus, if sheep are treated in early June and moved to a safe pasture, they are unlikely to be exposed to the summer explosion in pasture infectivity. If sheep are treated and left on the same pasture, however, they will be exposed to heavy reinfection and derive little benefit from the treatment. Systems may be used where one portion of a pasture is used for grazing during the early part of the grazing season, while the other portion of the pasture is used to grow hay. After the hay is harvested and some regrowth has occurred in early June, sheep are dewormed, moved to the pasture from which hay has been harvested, and the contaminated pasture is allowed to grow hay during the latter part of the grazing season. The process of drying involved in hay making kills infective larvae on these plants so that this hay may safely be fed to sheep during the winter. Because some build-up often occurs late in the grazing season when move-and-dose is being practiced, two additional fall (September/October) dewormings should be given two weeks apart.

Preventive Treatment for Parasites When Grazing Permanent Pastures

Since many sheep pastures are unsuitable for hay production, the move-and-dose system will often not be applicable. In this case, preventive deworming treatments must be administered through the season to provide control of parasites. Such programs must take into consideration the fact that Haemonchus has a two-week period of development, from ingestion to maturity, before eggs may be passed. Treatment should begin when sheep first begin grazing and no longer are fed harvested feeds in the spring. Use of a product that will kill hypobiotic larvae for the first treatment is important because it will prevent the development of these larvae into adults that will subsequently contaminate pastures.

Following this initial treatment, several approaches can be taken. Sheep may be retreated with an effective dewormer every two weeks for several treatments. However, it is important to realize that treatment at two-week intervals can rapidly lead to the development of drug resistant parasites. Such a situation has developed in Australia, where some strains of Haemonchus are resistant to almost every anthelmintic available. The two-week treatment intervals prevent any worms from developing to the point that their eggs are passed in the manure. If a product with a residual effect (that is, a product where the product persists in the animal and continues to kill incoming larvae)is used, the treatment can be extended by the number of days of the residual effect. If weather conditions become dry during midsummer, deworming may be discontinued for a time. Remember that pasture larvae levels rebound quickly after a rain, so deworming should be immediately resumed if midsummer or fall rains come.

For these programs to be effective, it is essential to include all sheep. Mature ewes, any lambs over a few weeks of age, rams, and replacements must all be dewormed. Leaving a few untreated sheep mixed with sheep on the program may allow for enough parasite build-up over a period of weeks and months to destroy the entire earlier efforts.

An alternative program used by many producers involves monthly treatments throughout the grazing season. This program will probably fail in severe parasite years because the long interval between treatments allows reinfection and egg laying by the worms.

Table 1. Dewormer Products Approved and Under Development for Sheep

	Approved Products			**Products Under Development**		
Generic Names	**Levamisole**	**Thiabendazole**	**Ivermectin**	**Fenbendazole**	**Morantel**	**Albendazole tartrate**
Trade Names	Levasole, Tramisol, Prohibit	Equizole Suspension	Ivomec Sheep Drench	Panacur, Safe-Guard	Rumatel	Valbazen
Manufacturer	Malinckrodt, AgriLabs	Merck-Agvet	Merck-Agvet	Hoechst-Roussel	Pfizer	Smith-Kline Beecham
Dosage Forms	Drench, bolus	Drench, bolus, paste, feed pre-mix & top dress	Drench (injectable not FDA approved) paste	Drench, paste, feed block	Bolus, feed pre-mix	Drench
Parasites	Control	Control	Control	Control	Control	Control
Haemonchus						
Adults	All	All	All	All	All	All
Young (immature)	Most	Most	All	All	Most	All
Ostertagia						
Adults	All	All	All	All	All	All
Young (immature)	Some	Few	All	All	Few	All
T. Colubri formis						
Adults	All	All	All	All	All	All
Young (immature)	All	All	All	All	All	All
Lung worms	All	Few	All	All	None	all
Tapeworms	None	None	None	Most	All	all
Comments	Some documented resistance in the U.S.		Effective against nasal bots. Some external parasite control (sucking, lice, ticks, keds)		Cross resistance with thiabendazole	

Pre-lambing treatment is critical in a parasite control program and should be administered approximately two weeks before ewes lamb, thus preventing the contamination from the periparturient egg rise. This can conveniently be done when ewes are bagged prior to lambing or coupled with vaccination or crutching procedures. Waiting until lambing has occurred, or until ewes are turned out of the lambing barn with their lambs, results in considerable contamination of the environment prior to the treatment. If prelambing deworming is not possible, ewes can be dewormed at lambing and moved to safe pastures. It is important that animals be treated with a dewormer that is effective against hypobiotic larvae. Levamisole and ivermectin are approved products which have that ability. Thiabendazole does not remove hypobiotic larvae when given at approved dosages.

Sheep kept in dry lots do not pick up larvae from grazing and need only be dewormed when moved from pasture to dry lot.

Other Deworming Programs

Continuous feeding of a dewormer in the salt or mineral is sometimes used for parasite control. While this provides some parasite control, problems may develop because the dewormers available in these forms are not highly effective against all stages of parasites. Parasitism may, therefore, continue to cause production losses even though severe signs of parasitism are not seen. The low- level feeding of these dewormers also encourages the development of parasites that are resistant to the dewormer; consequently, the effectiveness of these programs decreases with time.

When winter lambing is practiced so that young lambs never graze, less strenuous control programs may be practiced. This is because all grazers have greater age and have acquired immunity. Pre-lambing deworming should still be practiced. Remember that young replacements must be grazed separately and given an effective parasite control program. Sheep imported from arid areas will usually be quite susceptible to parasites and will require an intensive control program.

Drugs of Choice

Drug resistance, the situation where parasites survive deworming, represents a major problem for the sheep industry. Several studies have reported resistance in the major parasite species against several drugs, especially the family of drugs to which thiabendazole belongs. Evidence in Virginia suggests that a high level of resistance to thiabendazole and related products exists. Four techniques have been suggested for reducing the development of resistance: 1) Use a full dose of dewormer whenever treatment is done, 2) Reduce dosing frequency by decreasing stocking rates or use dose-and- move. 3) Treat all new introductions with the best products available and perhaps with a double dose. 4) Avoid alternating dewormers during the grazing season. Alternating dewormers between seasons may be advisable.

Table 1 contains a list of dewormer products approved for use in sheep, and three drugs currently available for cattle and under development for use in sheep. The table provides information concerning trade names, manufacturers, dosage forms, and effectiveness of dewormers against the various important sheep parasites.

Although injectable ivermectin is not approved for sheep, it will keep numbers of parasite eggs low in the feces for three weeks after treatment compared to only two weeks when the drench product is used. The drench ivermectin product is approved for use in sheep but does not have as great a residual effect. Ivermectin is a broad-spectrum, safe dewormer that is highly efficient against all worm stages, including hypobiotic larvae. In addition, ivermectin will provide control of nasal bots and has varying efficacy against external parasites like lice, keds, and ticks

Tapeworms

The tapeworm of sheep (Moniezia) lives in the small intestine and is transmitted to sheep by a small non-parasite mite that lives on pasture. Sheep are infected when they ingest the infected mites on grass. Although tapeworms are often accused of causing weight loss and/or diarrhea, they rarely cause much damage. Effective drugs include fenbendazole and albendazole (not approved for use in sheep).

COCCIDIOSIS in Sheep

Coccidia in sheep are very common parasites. Most sheep are infected with several different types from an early age. Young lambs are highly susceptible to infection and clinical disease. Older animals are more resistant to disease but are often infected. Clinical coccidiosis is seen commonly in young lambs at the time of weaning, in confined conditions, or shortly after entering feedlots and in sheep which have been physically stressed by weather, handling, and shipping. Sheep on intensive grazing programs may suffer from coccidiosis. Lambs become infected with coccidia by ingesting the coccidia oocysts (eggs). This occurs by eating feed contaminated with manure, drinking dirty water, or grazing pastures heavily contaminated with

manure. The consumed oocyst then begins its life cycle. Through a complicated process the tiny parasite divides and enters gut cells with more and more damage done to the gut lining. Eventually, the parasite produces new oocysts which pass out in the manure. These oocysts need two to five days exposure to a wet damp environment before they become infective.

If a lamb is infected with a sufficient number of oocysts, the damage to cells in the gut wall may be extensive. This results in watery diarrhea, occasionally containing blood and mucus. Dehydration and weight loss often occur. If the condition is left untreated, lambs may die. Lambs surviving clinical disease will have their growth potential severely compromised. Coccidiosis can be diagnosed in a live animal by clinical signs and demonstrations of large numbers of oocysts in feces.

Control

Coccidiosis in sheep is usually related to stress, overcrowded conditions, and manure contamination. Frequent cleaning, proper sanitation, and the use of feeders and waterers designed to prevent manure contamination greatly reduces the infection rate and the incidence of clinical disease.

The administration of anticoccidial drugs before anticipated outbreaks can significantly reduce or eliminate clinical outbreaks of coccidiosis in sheep. Products containing the following anticoccidial drugs are commercially available : lasalocid, monensin, decoquinate and sulfaquinoxaline. Table 2 summarizes commercial product names and dosage levels. If clinical coccidiosis develops in a flock, sulfa antibiotics or amprolium may be prescribed by a veterinarian under the extra-label drug provisions since no product is approved to treat clinical coccidiosis.

Summary

Internal parasites continue to be a threat to sheep health and productivity. Increased understanding of the role and actions of internal parasites provides the basis for more effective control programs. Treatment programs should be based on the seasonal infectivity level of pastures. Preventive or move-and-dose systems, along with other management procedures, will allow for decreased use of dewormers and result in less loss from parasitism. The emphasis for these programs is on prevention rather than treatment. The two-week maturation period of Haemonchus after ingestion, the development of hypobiotic larvae, and the periparturient egg rise must all be considered in the implementation of effective parasite control programs.

Table 2. Products providing control for coccidia approved for use in sheep and other small ruminants.

	Approved Products		**Products approved for other small ruminants**	
Generic Names	Lasalocid	Sulfaquinoxaline	Decoquinate	Monensin
Trade Names	Bovatec	Purina Sulfa-Nox	Deccox	Rumensin 80
Manufacturer	Hoffman-La Roche	Purina Mills	Rhone-Poulenc	Elanco
Dosage Forms	15 % Medicated premix : Commercially available feeds, mineral packages and supplements	3.44% Liquid Water Additive	6% Feed Additive Commercially available feeds, mineral packages and supplements	Commercially available feeds and premixes
Dosage Rate	15 to 70 mg/hd/day for prevention of coccidiosis in sheep	0.015% water mix for 3 to 5 days for control of coccidiosis in sheep	22.7 mg/lb daily for prevention of coccidiosis in young goats. Feed for at least 28 days.	20 gm per ton of feed for prevention of coccidiosis in confined, fed, non-lactating goats

Trade names are used in this publication for information purposes only. Virginia Cooperation Extension, Virginia Polytechnic Institute and State University, and Virginia State University do not warrant those mentioned nor do they intend or imply discrimination against those not mentioned.