Strategic "0-3-6-9" Parasite Control for Small Ruminants Designed to Reduce Environmental Contamination

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Gastro-intestinal nematode parasites are very important to both sheep and goats. As with cattle, parasitism in small ruminants causes considerable production losses by interfering with the health and well being of the animals. Parasites have been shown to adversely affect milk production, reduce breeding efficiency, reduce weight gains, decrease hair quality, reduce feed efficiency and negatively affect the immune system by decreasing the animal's ability to fight off other health problems. Parasitism can cause severe problems especially when these animals are forced to graze intensively. The most sever problems usually occur in late summer or early autumn when forage are often short supply and environmental contamination with parasitic larvae is at it highest level. Unlike cattle, it's not uncommon to find sheep and goats of all ages to develop clinical parasitism. In many cases immediate treatment is necessary just to save their lives.

Small ruminants are affected by many different parasites. Each type of parasite has its own preferred location within an animal where it lives causing specific damage to the host animal. All parasites cause damage to the animal. The most prevalent and well-known parasite of goats lives in the abomasum or 4th stomach and called *Haemonchus* (barberpole worm). Other very common and equally important parasites commonly found in goats are *Cooperia*, *Nematodirus*, Whipworms, Nodular worms, and Tapeworms (see Appendix I).

I. Sheep and Goats often develop very high levels of parasitism.

A. By nature, many small ruminants such as goats and deer are browsers eating leaves from trees and brush, but when placed on pasture or put in a situation where over-crowding exists, goats will become heavily infected with parasites. Since goats historically over the past several thousand years have not been forced to graze intensively, as a species; they seem to be less adapted to parasites than sheep or cattle and thus appear to be more susceptible to the ill effects from internal parasites when placed in an intensive grazing situation. It is not uncommon even for a small goat herd to lose several animals a year to parasitism.

B. Small ruminants often graze closer to the ground than cattle which can be a problem since this is where parasitic larvae are often concentrated. Parasitic larvae (L_1) hatch from eggs passed in the fecal material; these larvae undergo several molts ($L_1 - L_2$) until they reach an infective stage (L_3). This infective stage is mobile and moves with moisture trails onto nearby vegetation to be eaten by its intended host. Pasture covered with morning dew provides an ideal time for parasite transmission to occur. Parasitic larval contamination of the environment will continue to build up to very high numbers over the summer as the animals constantly re-infect themselves.

C. Fecal material excreted by goats is very concentrated and, therefore, worm egg counts can be very high. Fecal worm egg counts from goats can be 5 to 20 times greater than similar counts found in cattle. A small amount of goat's feces, therefore, can produce a very high level of parasite contamination.

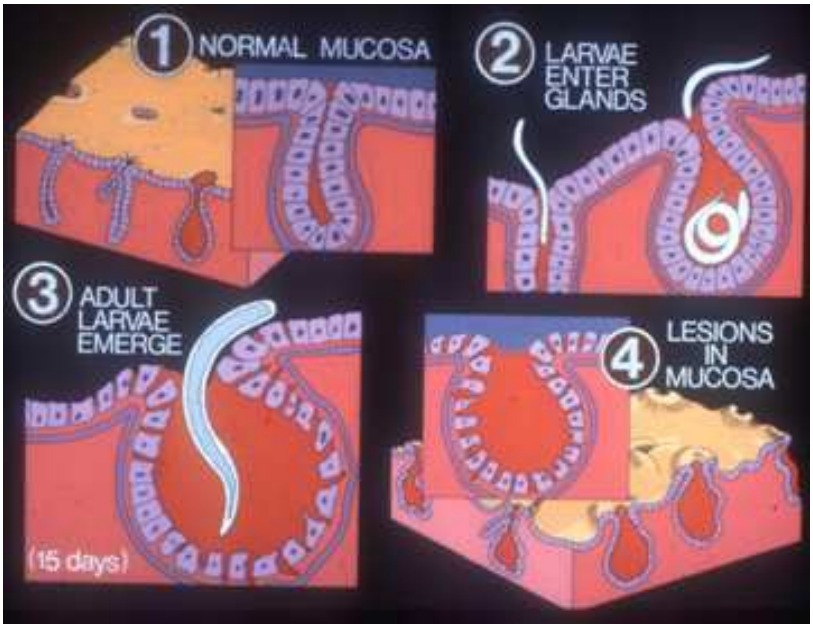
D. Parasite control programs recommended for goats over the years have been more therapeutic than preventative. Treating goats after heavy parasite loads are encountered has little impact on reducing future contamination of the environment. Furthermore, once high worm burdens are encountered, complete control is hard to achieve and often heavily infected goats continue to shed worm eggs back into the environment even after treatment is given.

E. A commonly recommended practice over the years has been to deworm goats every eight weeks while on pasture. Since the life cycle of parasites in goats is approximately three weeks as the time it takes for newly ingested larvae to develop into

egg laying adult parasite, this practice has allowed goats to be clean for three weeks, then wormy for five weeks, clean for three weeks, wormy for five weeks, etc. For an efficient parasite control strategy to work in goats, parasite challenge needs to be significantly reduced using a shorten interval between treatments otherwise high burdens will continue to develop as the season progresses.

II. The phenomenon of *Haemonchus* Larval Inhibition after Ingestion*:*

High worm burdens most often begins to occur in grazing goats approximately eight to twelve weeks after the beginning of the grazing season. This usually occurs in mid-spring to early-summer under southern climatic conditions and in mid-summer to early-fall under northern climatic conditions. When high worm burdens begin to build within the animal, the physiology of the gastrointestinal tract changes due to large numbers of larvae in the gastric glands shutting down the glands. This change, especially the decreased in acid content and an increase in the pH levels of the abomasum (4^{th} stomach), causes parasite development to slow and newly ingested larvae in the gastrointestinal wall and gastric glands begin to inhibit or become arrested as early 4th stage larvae. These arrested larvae may stay in the gastric glands for over a year.



Once larvae become inhibited, they are very difficult to eliminate or remove to by conventional deworming. Thousands of these larvae can become inhibited and require repeated dewormings just to keep the animals alive. It is often thought that some of the "parasite resistance" which has developed with various drugs may be due to drug tolerance to treatment because many of the dewormers used for goats have reduced efficacy against inhibited parasites naturally. The removal of the adult worms often triggers the development of inhibited larvae in the glands so that within a short time these larvae develop into egg laying adult worms. A positive fecal following treatment is often indicative of parasite "resistance" but instead may be caused by the development of inhibited parasites that are responsible for the continued egg shedding rather than true resistance.

III. Strategic Parasite Control for Reducing Environmental Contamination:

Prevention is the best method of controlling these parasites in the goat. Successful parasite control means reducing or eliminating environmental contamination and should include several key goals:

1). Goats should be as free as possible of parasites during periods of low or reduced nutrition such as during the wintertime.

2). The doe should be free of parasites at kidding time.

3). Recontamination of spring pastures should be eliminated for the first three months of the grazing season.

Phase I. Repeated strategic deworming in the spring is necessary to prevent high levels of parasitism from building-up on the pastures and in the animals themselves later in the year. Strategic deworming is designed to prevent parasite build-up on the pastures creating "parasite safe grazing" through repeated dewormings given to prevention pasture contamination during the first 60 to 90 days of the grazing season. This can be accomplished through repeated therapeutic dewormings given at three week intervals ("0-3-6-9" Strategic Program), parasite safe grazing can be established for the rest of the year. larvae until an egg laying adult parasite is present in the animal, the treatment interval should be no more than 21-days.

The treatment clock starts ticking as soon as grass growth begins in the spring. To make the program work, all animals need to be free of parasites at the beginning of the season. Depending upon location in the country, the animals treated in the fall or at kidding should still be parasite-free and not need the initial treatment at the beginning of the spring. If winter grazing takes place, the animals should be checked in the spring, if positive, all animals should be treated prior to spring grazing.

"0-3-6-9" Strategic Deworming Program: Once grazing starts, all goats grazing the same pasture should be dewormed every three weeks for a minimum of three to four times beginning three weeks after the start of spring grazing. This program works because the parasitic larvae that survived the winter and are present on the pasture in early spring, die off naturally if they're not eaten by the animals grazing the pasture during the first three months of grazing. If a pasture is left idle, for example, and if animals are not allowed on the pasture until July, nearly all the infective larvae present on the pasture in early spring will be gone from the natural die off and the pasture will be relatively safe from parasites after this time period. The reason that strategic deworming works is that the repeated dewormings keep the pastures from being recontaminated while the natural die off of infective larvae occurs.

Therefore, the key to the success of strategic deworming is that if the animals grazing spring pastures can be prevented from shedding additional worm eggs on the pasture

during the first three months of the season, parasite safe grazing can be maintained and parasite burden developing in the animals over the summer grazing season can be significantly reduced.

A treatment example at a given location would be, for example, if grazing starts around the first of April, the first spring treatment would be given around the third week
April, followed by a second deworming given in the middle of May followed by a third treatment given the first week of June, leaving the animals free from shedding parasitic worm eggs until approximately the first week of July.

Strategic deworming works at the beginning of the grazing season by timing the treatment to kill the parasites after the infection process has begun in the animal but before the parasites have developed sufficiently to become adults and begin to lay worm eggs, which pass back on the pasture. The animals, therefore, work like vacuum cleaners eating the parasitic larvae present on the herbage reducing pasture contamination while the 0-3-6-9 strategic timed treatments prevents further re-contamination of the pastures thus providing "parasite safe pastures" for the entire grazing season.

Phase II. A late fall deworming (given after the first of November or after the first heavy frost) will reduce the chance of winter parasitism. Depending on location in the country, this treatment should also help ensure that the does are clean at the time of kidding. If it is determined that the doe is not clean at kidding time, the doe should be retreated just prior to kidding. A late fall or early winter treatment eliminates any parasites developed during the summer grazing season and ensures the animals are parasite free to begin the grazing season in the spring. The late fall deworming also keeps animals parasite free during the winter when feeding cost are the highest.

Appendix I: The Most Common Parasites of Sheep and Goats:

A. Stomach Worms:

Haemonchus (the barber pole worm) is a blood-sucking parasite. This parasite is a very economically damaging parasite in sheep and is becoming one of the most important causes of death in these animals. Larval stages are found in the abomasal tissues and are extremely hard to kill (see section on the inhibition of *Haemonchus*). *Haemonchus* is a very prolific parasite, laying thousands of egg ever day and because of this high contamination rate is found to infect nearly all goats sometime in their life. The infective larvae, once consumed, invade the gastric glands in wall of the abomasum where they develop. Upon reaching the adult stage they emerge and live in the lumen of the abomasum where they reproduce and lay eggs which pass back down the gastro-intestinal

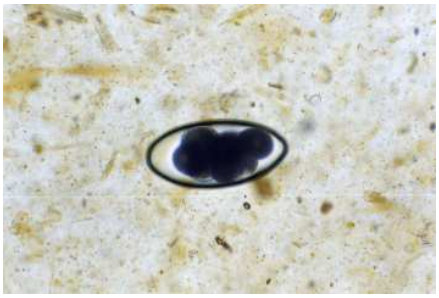
tract. If infections become very heavy these larval stages in the abomasums can undergo inhibition and remain inactive in the glands for months. Overall, *Haemonchus* is known to cause considerable blood loss with anemia being a key symptom of a heavy infection. What makes *Haemonchus* unique is that it is also one of the hardest parasites to control since it has a time during its development in the animal that the invading larvae can undergo a period of inhibition or period when larval development becomes arrested in the gastric glands of the abomasum at which point the parasite is refractory to most dewormers. Eggs are easily identified in a fecal exam.

Ostertagia (brown stomach worm) and ***Trichostrongylus*** **(**bankrupt worm) can be important in sheep but mostly low infections are found with these parasites.

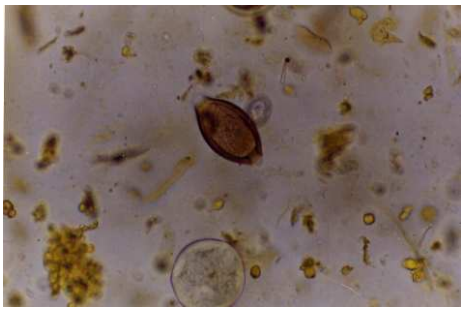
B. Intestinal Nematode Parasites:

Cooperia (coopers worm) disrupts digestive functions of the intestine. Not very prevalent in sheep.

Nematodirus (threadneck worm) is a very important parasite of sheep and most commonly is found in young animals but can be found in older animals and adult ewes. Larvae survive well in cold weather and can live for two years on pasture or in the environment of the animals. This parasite survives well off pasture and is considered an important "barnyard" infection. This parasite is a common cause of diarrhea and often times death in young animals. Because it is very pathogenic, older animals acquired a strong immunity against this parasite. The egg is very large and is easily identified in fecal exam.



Trichuris (whipworm) is another very important and damaging parasite in sheep, especially in young animals. This parasite is most commonly encountered under "barnyard" conditions in pens or on dirt lots. Often times symptoms are confused with coccidiosis because of the bloody diarrhea associated with this parasite. Several hundred worms can kill a young lamb. The egg is very characteristic and looks like a small

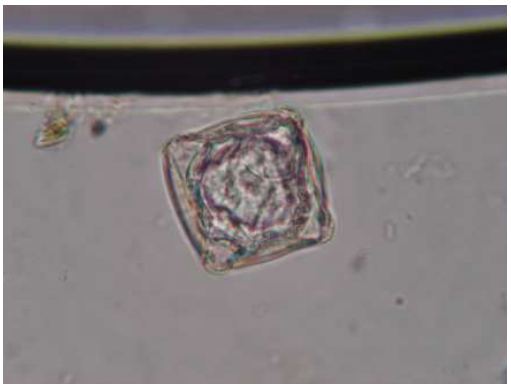


football with polar caps on each end. The female worm is not prolific and eggs are often missed in the fecal exam unless carefully conducted.

Bunostomum (hookworm) and ***Oesphagostomum*** (nodular worm) is becoming more important in recent years because intestines are often condemned at slaughter if nodules caused by the nodular worms are found in large numbers. Parasites are most commonly found in ewes and older yearling animals.

C. Intestinal Cestode Parasites (Tapeworms):

The tapeworm (*Moniezia*) is very common in sheep. This parasite undergoes an intermediate stage when it develops in the soil or grain mite, which is then ingested by sheep to keep the infection going. The develop time to reach an adult after ingestion is reported to be from six to eight weeks. The adult tapeworm lives in the small intestine and can grow to be 1 inch wide and six feet long. They absorb nutrition through their cuticle. In high numbers tapeworms can block the intestine. Tapeworm eggs are distinct and easily picked up on a fecal exam.



D. Lungworms (*Dictyocaulus viviparous*):

Lungworms are acquired almost exclusive through grazing. Lungworm larvae are not very mobile and, therefore, often require a heavy rain to move out away from the manure pat. Sheep on rotational and intensive grazing systems are often exposed to lungworms. Deer are thought to contribute to lungworm infections in sheep The eggs are coughed up and hatches as it moves down the intestinal tract so lungworm is hard to diagnose through a general fecal exam but rather the fecal must be subjective to a separate test called a “baermann test” to find lungworm larvae. Post-mortem check for lungworms entails removing the lungs and trachea intact, filling with warm water with a garden hose and then pouring the contents on a flat surface to look for lungworms which are easily visible with the naked eye.

E. Meningeal Worms (Parelaphostrongylus tenuis) is common almost everywhere white-tailed deer occur in eastern North America. Little or no disease is apparent in white-tails, but when domestic small ruminants.

E. Trematodes Parasites (Liver flukes):

Fascioloides magna **(deer fluke)** found in the Great Lakes region is relatively untreatable in sheep. Diagnosis can be done accurately only upon necropsy. Infections can be spread with deer with an intermediate snail host. Keeping animals away from wet areas and streams where deer congregate is currently the only method of control.

F. Protozoan Parasites of Sheep:

Coccidia are single celled protozoan parasites that all cattle are believed to be exposed to sometime in their life. Coccidia are very host specific such that coccidia of cattle, swine, dogs, and chickens won't infect sheep. The reverse is also true. Coccidia are ingested through fecal contaminated feedstuff. Wet muddy conditions usually increase infection levels. Sheep housed in dirt lots often become heavily infected with coccidia. Sheep become infected when they ingest oocysts (egg like structure) containing sporozoites, which escape the oocysts and penetrate the intestinal wall. A disease condition called coccidiosis occurs when coccidia numbers become high and the immune system of the animals becomes low. Coccidiosis often occurs when an animal becomes stressed. Sheep shedding high number of oocysts indicate cell damage is ongoing. Coccidia oocysts can easily be found in a fecal exam.

APPENDIX II: Diagnosis of Parasitism in Small Ruminants:

The easiest and most accurate method used to find the presence or absence of internal parasites is through a fecal check. Since *Haemonchus* is a prolific egg layer it can easily be detected on a fecal float. Since high egg counts are frequently encountered, nearly all types of fecal examinations are reliable. *Nematodirus*, Whipworms and Tapeworms are only routinely found using the "Modified Wisconsin Sugar Flotation Method," The Modified Wisconsin Sugar Floatation Method is a very sensitive method but only one gram of fecal material (usually 2 small fecal pellets) should be used whereas with cattle a three gram sample is used. Too much fecal material makes the slide hard to read because of the amount of fine material that floats up with the worm eggs. If the samples are consistently hard to read, the fecal material can be mixed in water first and centrifuged to get rid of the fine material before the sample is mixed in the sugar solution.

Sending samples for fecal worm egg counts:

1). Send fresh or refrigerated samples. Heat causes worm egg to develop. Freezing can destroy eggs.

2.) Send small individual samples. Each sample should be no larger than a golf ball (half a dozen pellets). Do not composite sample.

3.). Send samples in plastic bags enclosed in a small box or styrofoam container with freezer pack or frozen water bottle in priority or second day air. (Do not send ice!) Samples can be collected by inverting bag over hand to pick up sample then re-invert bag and seal.

4). Take samples from adults, replacement does, and young or yearling animals.

5). Label each sample with animal name or number or if taken from large group of animals, identify group where sample was taken. Include address, e-mail or fax number for lab to return results.

Mailing address for commercial lab in conducting fecal worm egg counts on small ruminants:

Dr. Don Bliss
MidAmerica Ag Research
3705 Sequoia Trail
Verona, WI 53593
Phone: 608-798-4901