American Consortium for Small Ruminant Parasite Control

Best Management Practices for Internal Parasite Control in Small Ruminants

Organic control of parasites

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In today's world, consumers are increasingly concerned about the residual effect of drugs and pesticides in meat and other products. They have expressed interest in meat sources, healthy food production systems, animal welfare, and environmentally sustainable food production practices. There is a perception that organic methods may satisfy those interests. For organic certification of a product, organic livestock production prohibits the use of anthelmintics (dewormers), antibiotics, growth stimulants, synthetic fertilizers and pesticides, and genetically-modified organisms (GMOs).

The US Congress passed the Organic Foods Production Act which mandated USDA to develop standards for the organic production of food. The web site of the USDA National Organic Program (NOP) contains all current NOP regulations, consumer information, a list of certifying agents and organic feed suppliers, and all needed information for organic livestock production. Producers can also contact their organic certifying agents to obtain the most recent regulations. To become certified, producers must develop and submit a production plan that meets all organic production requirements.

Problem: internal parasites

According to a 2015 USDA survey, internal parasites were the leading cause of non-predator loss of sheep and goats in the US. Infected animals have lower growth rates, delayed maturity, decreased immunity, and increased chance of death. Dewormers are not permitted to be used in animals raised for certified organic meat, milk, or fiber. Alternative methods of parasite control need to be used in order to maintain animal health and welfare while meeting organic standards. Management practices including the breeding of healthy animals can be adopted to minimize parasitic problems in the flock or herd.

The barber pole worm

The barber pole worm (*Haemonchus contortus*) is a blood-sucking parasite that causes severe anemia, protein loss, and death. Sheep and goat producers regard this as the #1 health problem in their animals. Although goats are generally more susceptible than sheep, both lambs and kids have a low level of immunity and are the class of animal most susceptible to this and other parasites. Sheep/goats only start to develop immunity after 7 to 8 months of age (depending on species and breed). Pregnant ewes and does during late gestation and early lactation, due in part to a negative energy balance and suppression of the immune system, suffer a temporary reduction in immunity to parasites.

Life cycle

The life cycle of the barber pole worm is about 21 days. Warm and humid weather provides suitable conditions for the eggs to hatch to larvae. The infective larvae emerge from fecal pellets, climb up onto grass blades, often up to 3 to 4 inches on the forage, and are ingested by the host animals. Infective larvae are converted into adults in the host stomach (abomasum). Adult female barber pole worms can lay 5,000 to 10,000 eggs per day, which pass in the feces onto pasture to complete their life cycle.

Clinical signs

In case of severe infection, barber pole worms can consume as much as one-tenth of the blood volume of the host (or 0.2 ml of blood per adult worm) in a single day. Thus, anemia is the typical symptom that can be identified by looking at the color of the mucus membrane of the lower eyelid. A normal healthy animal has red mucus membranes while heavily parasitized animals exhibit pale pink or white membranes. Ingestion of a large number of infective larvae over several weeks can causes anemia, bottle jaw, thriftiness, lethargy, and death in the host..

The barber pole worm causes anemia, as evidenced by pale mucous membranes.

Worm control measures for organic production

Understanding parasite lifecycles and managing pastures and animals effectively is key for organic producers. Because infective parasite larvae are found at the highest levels in the first 2 to 4 inches of grass, managing pastures, stocking rates and forage types are all important. It can be beneficial to keep animals inside in the barn during the peri-parturient period to minimize the effect of the pasture-worm-burden. In doing so, animals will avoid feeding on the ground and keep areas clean and dry which minimizes coccidia oocyte infection. However, for organic production animals must graze on pasture for at least 120 days out of the year, and animals must have a minimum of 30 percent dry matter intake from pasture during the grazing season. Rules may be different for animals that are finished for slaughter and for dairy animals .

For many regions of the US, out-of-season breeding (May-June) for fall lambing/kidding can result in less parasitic burden in young animals. It may not be possible with some breeds in an organic system. Genetic or breed selection for out-of-season breeding may be possible over time, but the best form of genetic selection is for animals resistant to parasites.

Animals in good body condition, indicating optimal nutritional status, are more able to expel infected larvae from the body to reduce infection and can also withstand worm infection better, lessening parasite impacts on individual animals and the herd/flock. Organic producers may struggle to keep animals in good body condition if proper pasture and animal management is not considered.

Role of pasture management

Because survival of barber pole worm larvae depends on warm temperatures and adequate rainfall, general recommendations include moving animals to new pastures every 3 to 4 days when conditions are warm and wet. The recommendation is every 7 days if it is cold and dry. This should be followed by a 35-day rest period (65-days when the weather is cold and dry). Grass pastures that cannot be rested long enough due to quick regrowth can be harvested as hay or grazed with other livestock species (cattle or horses). When larvae are rolled into a bale, they will die within a month and the hay is no longer infective. Direct sunlight to the ground kills eggs and infective larvae.

Sheep and goats share the same worms but not with horses or donkeys. Cattle share a few common worms but are less impacted by them and carry them at lower worm loads. When ingested by these species, worms may not complete their life cycle but instead are expelled from the animal. Thus, grazing cattle with sheep or goats may help to break the parasitic life cycle. So, pasture may be considered safer if grazed by cattle after sheep or goats.

Larval load in the pasture can also decrease by lowering the stocking rate (fewer animals/acre). General recommendations are 3 to 5 sheep or goats per acre for parasite control but may differ according to forage quality/quantity or type, environmental conditions, use of multi-species grazing, and more. Allowing animals access to browse (woody shrubs/trees) and taller growing forbs (weeds) is beneficial, especially for goats who prefer to graze above shoulder height and generally have less resistance to parasites. However, it is important to manage browse so as not to overgraze and remove it from pasture.

Grazing condensed tannin-rich forages such as sericea lespedeza can be an effective tool to help manage parasites, including gastrointestinal nematodes (worms) and coccidia. Condensed tannin-rich plants or plant by-products such as sericea lespedeza, pine bark, black locust trees, and birdsfoot trefoil may reduce barber pole worms in sheep and goats. Tannins in plants have been shown to reduce both fecal egg count and inhibit larval development.

Providing animals access to browse or taller growing forages will reduce the risks of parasitism.

Allowing young animals (4 to 7 months old) to graze in the safer or cleaner pastures ahead of mature animals can decrease the exposure of young animals to parasite larvae. The parasitic load is heavy where animals congregate, especially near water troughs and under shade areas, so making sure those areas are dry and trying to keep animals from eating off the ground in those areas can be helpful.

Importance of nutrition

Nutritionally stressed and thin animals are highly susceptible to worms and thus proper nutrition is vital. In addition to being nutritionally stressed, pregnant females suffer immunity loss that begins two weeks before parturition and continues until approximately eight weeks after. Because the dam can serve as a potent source for worm infection and the young lambs and kids lack a strong immune system, it is critical to manage parasites in ewes/does around the time of giving birth and during lactation.

Feed intake decreases in parasitized animals and nutrients can leak from the intestines as well, resulting in slower growth of infected young animals. Nutrition is an important factor in promoting immunity (ability to prevent worm infection) and resilience (ability to

maintain productivity despite internal parasites) to parasitic infection. Supplementation of protein reduces the negative impact due to parasites, helps to heal the damaged gastrointestinal lining, and enhances the immune system against worms. Protein supplementation during the last trimester has also been shown to effectively reduce worm burden in pregnant animals.

Minerals and vitamins are also important for the immune system. Some worm infections can cause diarrhea leading to the loss of mineral electrolytes (sodium, potassium, and chloride). Minerals must be replaced to restore normal physiology. Phosphorus, copper, zinc, selenium, manganese, iron, and iodine play important roles in reducing worm burden.

Genetic selection

Host resistance is the ability of an animal to suppress establishment and eliminate parasites, while host resilience is the ability of an animal to remain healthy when parasitized. Both are heritable traits. On most farms 20 percent of the animals carry 80 percent of the parasites; therefore, selection can be done to cull these animals to build a more parasite-resistant flock/herd.

There are three ways to select parasite-resistant animals: 1) On-farm selection by measuring fecal egg counts and FAMACHA© scores, 2) Central Performance testing : (ram/buck tests) done in several locations across the US; and 3) Estimated Breeding Values (EBVs) for fecal egg count. Assuming little resilience, the selection of animals for breeding that do not need deworming (or rarely need it) despite exposure to parasites can also help build a genetically parasite-resistant herd.

Resistant males should be used for breeding.

Copper oxide wire particles

Some organic certifiers (not all) allow the use of copper oxide wire particles (COWP) to control barber pole worm infections. It is important to talk to your certifier before using copper oxide wire particles. Copper oxide wire particles were initially investigated for the treatment of copper deficiency in sheep and goats. Commercially available COWP are less than 5 mm long and 1 mm in diameter. Copper oxide wire particles are wrapped in gel capsules and administered orally to sheep and goats. Studies show that COWP reduces fecal egg count.

Excess copper in the diet causes copper toxicity. However, COWP remains in the abomasum for several weeks and slowly releases copper. Copper oxide is slowly absorbed in comparison to copper sulphate, and hence the chance for developing toxicity is minimal if very low doses are used. Sheep are more susceptible to copper toxicity than goats.

One-half to 1 g of copper oxide capsules are given for kids and lambs whereas adults require 1 to 2 g capsules. Doses can be repeated every 4 to 6 weeks for up to four treatments in worm season if 0.5 to 1g is used and excess copper is not available to the animal. If 1 or 2 g are used, animals should not receive more than two treatments per season. It has been found that COWP are effective at reducing abomasal worms (barber pole worms) but not intestinal worms. Copper oxide wire particles can be combined with sericea lespedeza or other management tools and are safe for animals of all ages, including pregnant and periparturient females.

Control of coccidia organically

Introduction

Coccidiosis is another common parasitic disease of small ruminants. It is caused by single-celled protozoan parasite (*Eimeria* spp.). Coccidia is host-specific, meaning coccidia that affect poultry (or other animals) do not affect sheep or goats and vice-versa. Similarly, sheep coccidia do not affect goats and vice-versa. There are several different species of coccidia that can infect sheep and goats, but not all are capable of causing disease.

Immunity to coccidia develops with exposure and with the age of the animal, so adults are less likely to develop coccidiosis, though any stressed or weak animal can be infected and become ill. Coccidia mostly affects recently weaned kids or lambs causing diarrhea and poor growth. High stocking rates and weather stress (high humidity and warm weather) predispose animals to coccidia. Lambs and kids are less vulnerable after 5 months of age. Coccidiosis is more common in intense production systems (in barns or dry lots) but can less commonly occur on pasture in wet and/or shady areas where animals congregate and graze nearby.

Lifecycle

The entire complex life cycle of coccidia takes 2 to 3 weeks. The host ingests oocytes (eggs) from the surroundings, they hatch in the intestines, invade intestinal cells, and multiply dramatically. Infestation with one single oocyst results in the production of 10,000 new oocysts in the intestines, and after repeated multiplication, the animal can excrete millions of oocytes per gram of feces. It takes two to three weeks from ingestion of oocytes from the mouth to excrete the first batch of oocytes in feces. There are many stages inside the intestinal cells with cells destroyed in each stage, releasing blood, resulting in body protein loss, and impaired nutrient absorption due to cell damage. One oocyst can damage up to 50 million intestinal cells. Pathogenic coccidia species infect both the small and large intestines and without prompt treatment can cause permanent damage and sometimes death.

Coccidia is probably the second most problematic parasitic disease of small ruminants.

Clinical signs

Lambs and kids of 1 to 5 months of age are most susceptible. Mature animals constantly ingest oocysts through feces, contaminate their surroundings, acting as a reservoir of infection but are largely immune to coccidiosis. Coccidiosis depends on what species of coccidia are present, the level of infection, and their pathogenicity. While oocyst counts of more than 5,000 oocyst/gram is considered clinically significant not all of the species may be pathogenic. And, during the asexual phase, there may not be any oocysts in the feces but clinical disease is apparent.

Thus, fecal egg counts are not always a reliable measure of infection. They must be coupled with observation of clinical signs: diarrhea and ill thrift. Bloody diarrhea results from most pathogenic species. Salmonella, *E-coli,* cryptosporidium and Strongyloides infections, among other things, result in similar symptoms as coccidia, making confirmatory diagnosis difficult. Other stressors or diseases (i.e., gastrointestinal nematodes, diseases such as sore mouth and pneumonia, etc.) can worsen coccidiosis, so it is recommended to manage these diseases. Once the clinical signs are seen, damage may have already occurred, so treatment is necessary.

Control measures for coccidia

Coccidia oocytes can survive for long periods in the environment and can withstand extreme weather. Coccidia oocytes require moisture, oxygen, and warm temperatures to mature (sporulate) before they become infective. It is most important to clean pens where kids or lambs were previously housed. Minimize fecal contamination in forage and grain feeders. Keep bedding clean and dry. Oocysts are resistant to environmental conditions and are difficult to kill with disinfectants, particularly organic materials review institute (OMRI) approved. Sunlight will help to kill oocysts on pasture, but it is more difficult inside a barn or shelter on pasture. Barn or shelter disinfection with removal of bedding, old feed, manure, and water is necessary to get rid of oocysts. Oocysts sporulate to become infective outside of the animal within 2 to 4 days at temperatures as low as 50° F. Ammonia-based disinfectants, if approved through organic certifiers, are more effective than others and should be applied when there are no animals in the barn.

The role of housing

All animals must have year-round access to outdoors, shade, exercise areas, fresh air, and direct sunlight. Any indoor housing with a restricted exit must be approved by the organic certifier. When keeping animals inside the barn, it is recommended animals have at least 32 square feet of space. Adequate ventilation needs to be provided (to prevent humidity and decrease ammonia level), and stress must be minimized. If any bedding is consumed by an animal, it must be certified organic. Providing animals with an adequate diet (high-quality forages, vitamin E, selenium, other minerals) for their stage of production is important. Rapid fluctuation of temperatures inside the barn should be avoided. Animals should be protected from inclement weather conditions.

Animal factors

Conventionally raised animals can be transitioned to organic if pregnant does or ewes are maintained organically for the last one-third of pregnancy. Such dams cannot be marketed as organic, but lambs or kids can be sold as organic if raised certified organic after birth . Lambing and kidding areas should be cleaned before and after use. If a shelter or pens are used, they should be kept clean, dry, and well-bedded with elevated feeders and clean water tanks to avoid ingestion of fecal materials (as with any feeders/waterers on pasture). Animals may only consume organic feed, use organic certified or allowable beddings, and use approved health treatments. Use of growth hormones, feeding ionophores, urea, or mammalian byproducts are prohibited in organic production systems, but most vaccines can be used.

Regardless of housing situation (indoor or on pastures), a balanced diet with proper vitamin and mineral content is needed to develop immunity and fight against diseases, including parasites. Colostrum (the first milk after lambing/kidding) ingestion within the first 24 hours of birth is necessary for passive immunity to cover the first several weeks of the lamb or kid's life. It is recommended not to mix adults with young animals as the adults can serve as a reservoir for infection. Weaning stress should be minimized for coccidia, worm parasites, and other disease control.

Best Management Practices Fact Sheets for more detailed information

- Copper oxide wire particles (COWP)
- Genetic selection using crossbreeding and estimated breeding values
- Genomic EBVs
- Management
- Nutritional effects on parasites
- On-farm selection for resistance to parasites
- Pasture management
- Sericea lespedeza (SL)
- Understanding the biology

https://www.wormx.info/bmps

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