Chapter 29. Internal Parasite Control

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Objectives

- Realize potential negative impacts of internal parasites.
- Understand the biology of internal parasites and deworming programs.
- Present types of medications used to control internal parasites.
- Develop an understanding of the goals of a strategic deworming program.
- Recommend deworming programs for adult and young cattle.

Veterinarians and producers realize the potential negative impact that internal parasites can have on performance, health, and economic return of cattle. Producers want and need answers to the following questions:

- What is the best dewormer to use on their cattle?
- When is the best time of the year to deworm their cattle?
- What kind of return should they expect if they implement a strategic deworming program in their herd?

Because there are so many myths and misunderstandings regarding internal parasite control, basic background information will be provided in this chapter to assist the producer in understanding the biology of internal parasites and deworming programs. This information is a must before one can begin to develop a strategic deworming program. There are many different species of parasites, and they vary considerably in their economic importance and life cycle. The focus will be primarily on gastrointestinal parasites (commonly referred to as stomach worms, intestinal worms, or gut worms) involving the abomasum and the small and large intestines, and the components to develop a strategic deworming program. This will begin a discussion of the biology and life cycle of the internal parasite.

INTERNAL PARASITE LIFE CYCLE

There are several stages in the life cycle of gastrointestinal worms (Figure 29.1). Part of the parasite's life is spent living inside the host animal and another part in the environment outside the host. The life cycle can be grouped or divided into three general stages: the developmental stage, the pre-patent stage, and the patent stage. The patent stage is also commonly referred to as the adult stage of the parasite's life cycle. It is important to understand how these stages of the parasite interact with the environment, which stages can cause damage to the animal, and the length of time that the parasite spends in certain stages of its development. The developmental stage occurs outside the host while the pre-patent and patent stages live inside the host animal.

In the adult stage of the parasite, there are gender distinctions with gastrointestinal worms, male and female. The adults have a finite life span and they spend their entire life in the digestive tract of the animal. After the female worm matures, she mates with the male to produce fertilized eggs (ova). A fertilized egg is passed into the environment from the animal through the manure. The developmental stage of the parasite's life cycle begins once the egg exits the animal and is deposited in the environment.

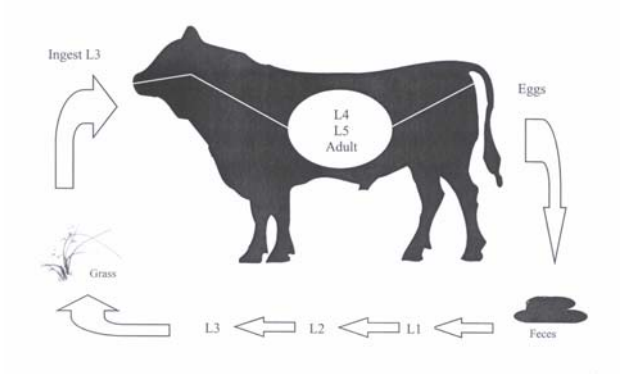

Figure 29.1 – Adult stage of parasites.

Once in the environment, the egg develops into the larval stage. The manure pat provides the necessary nutrients and a suitable environment for its development. Three larval stages of the parasite during the developmental period in the environment are designated as L1, L2, and L3, which correspond respectively to the 1st stage larvae, 2nd stage larvae, and 3rd stage larvae. The 1st and 2nd stage larvae are not infective to the animal. The 3rd stage larvae (L3) can infect cattle and is frequently referred to as the infective larval stage or infective L3. Larvae can build up in the environment to a potentially large infective dose for the animal.

The parasite has adapted some unique characteristics that allow it to take advantage of the environment and cattle behavior during the

developmental stage. These unique characteristics equip the parasite to survive and complete its life cycle by infecting animals. One of the parasite's unique characteristics takes advantage of the grazing behavior of cattle and involves the movement of the larvae away from the manure pat. Cattle do not graze adjacent to a fresh pile of manure. It can be reasoned that the fresh "smell" might be offensive to the animal's sense of smell. As the natural decay and breakdown of the manure pat occurs, nutrients are dispersed into the soil. The plants adjacent to the manure pat take up the nutrients and with adequate moisture, become more succulent and nutritious for the grazing animal to consume. The plants are more appealing to cattle, and the cattle begin to graze closer to the manure pat. The L3 stage of the parasite can migrate away from its original location in the manure pat, migrate onto a blade of grass, and hence, increase its chance to be consumed by a grazing animal. The transmission of the L3 larvae normally does not occur in dry lot production situations.

During the period outside the host, warm moist environmental conditions favor development of the larval stages. Larval stages are vulnerable to desiccation (drying out). Survival of the larvae is dependent upon moisture, as is its ability to migrate onto forage to be consumed by a grazing animal. The moisture can be in the form of rain or dewdrops. In the continental United States, springtime generally equates to warm moist conditions. Thus, the spring season favors development of the parasite. The optimal temperature range for development of the parasite is 45 to 85° F.

Another adaptive characteristic the parasite has developed is that the egg and larval stage can survive over the winter until the following spring. The L3 can survive freezing conditions. Dry, drought conditions will destroy the larval stages, but will not destroy the eggs. The eggs can survive for long periods of time in the fecal pat or the vegetative mat of the pasture. When springtime arrives, the infective larvae that have survived the winter are available for consumption by cattle and the egg will progress through its stages of development to become infective L3. During the spring, the numbers of infective larvae tend to increase rapidly. This increase in potential infectivity is commonly referred to as the "spring rise."

Once consumed by the grazing animal, the infective L3 larvae are transported to an area of the digestive tract where further growth and development occurs. Every species of internal parasite has a particular area of the digestive tract that is most ideal for survival and further development. This area in the digestive tract is known as the predilection site. Upon arrival to the parasite's predilection site, larval development continues into a 4th stage or L4 larvae. At this stage, the larvae can follow one of two different paths of development.

First, if the environmental conditions outside and/or inside the host animal are not conducive for potential reproduction, and thus perpetuation of the species, further development of the L4 is inhibited. If the larvae become inhibited or arrested in their development, they are said to be in a hypobiotic or arrested or inhibited state. Some species (Brown Stomach Worm) may enter the gut wall and become "encycsted" within the wall of the intestinal tract. Further development and maturation is halted until the environmental conditions are favorable. Once conditions become more conducive and the parasite's offspring have a better chance of reaching maturity, development continues and the encycsted larvae re-enter the gastointestinal tract. The hypobiotic larvae then mature into a L5 or young adult. Damage to the animal's digestive tract may occur. This damage may be permanent and affect future production. The decrease in production is generally caused by local inflammation of the stomach or intestinal tract or to hypersensitivity (allergic like) reactions with continued exposure to these internal parasites. This often occurs when large numbers of encycsted larvae re-enter the gastrointestinal tract over a short period of time.

The season for this arrested development of L4 varies in the continental U.S. It is dependent on where the cattle are raised. Winter in the northern latitudes of the continental U.S. is a harsh season with cold temperatures and no lush growth of forages. This type of environment is not conducive to survival of the internal parasite. Therefore, L4 will potentially go into a hypobiotic state during the winter season in northern climates. In contrast, summer in the southern latitudes of the continental U.S. is a harsh season with very hot temperatures, very dry to drought conditions and no lush forage growth. Thus, L4 will potentially arrest its development in cattle during the summer season in the south. If cattle are raised in middle latitudes of the U.S., hypobiosis can occur in either the summer or the winter season.

If the environmental conditions are conducive for the parasite's life cycle to continue, hypobiosis

often does not occur and the parasite's life cycle continues from the ingested L3 to L4, and then L5 or young adult stage. The young adults mature into adult parasites capable of producing fertile eggs. Male and female adults mate and produce fertile, potentially viable eggs. Thus, the cycle continues.

The period of development from ingestion of infective L3 until the adult parasites mature and are able to produce viable eggs or ova is referred to as the pre-patent period. It is extremely important for anyone involved in developing a strategic deworming program to understand the length of time for this period in the development of the parasite. It is the pre-patent period along with the mechanism or mode of action of dewormer medications that determine the appropriate time to deworm cattle. The length of time the parasite spends during the pre-patent period is dependent upon the species of parasites and age of the host animal. For young cattle, the pre-patent period is generally 3 to 4 weeks. For adult cattle, the pre-patent period is generally 4 to 6 weeks. The reason for a shorter duration to maturity for the parasite in younger animals is because the younger stock have not been exposed to the parasites to the extent of adult cattle, and thus, have not developed any appreciable degree of immunity. A rule of thumb commonly used when designing internal parasite control programs is the pre-patent period for young stock is 3 to 4 weeks and for adult stock is 4 to 6 weeks.

CATTLE IMMUNITY AND PREVENTIVE HEALTH PROGRAMS

Although immunity develops to internal parasites, adult cattle still develop internal parasite infections. Veterinarians have done an excellent job of communicating to producers the importance of a protective immune response in farm animals against certain diseases caused by viruses and bacteria. Thus, most producers understand the importance of animals developing an adequate immune response to certain disease causing agents. Vaccines are administered prior to exposure to these agents so that animals can develop a memory immune response.

As discussed earlier, internal parasites have adapted unique characteristics that survive harsh conditions and thus allow them to perpetuate their species. Under normal conditions as an animal grows and matures, it is continually exposed to a certain level of parasitism. This continual exposure to the parasite causes an immune response in a normal individual animal with a competent immune system. The type of immunity that develops will not necessarily eliminate the worms from the animal's digestive tract, but will suppress the reproductive capability of the internal parasite. The adult animal can still have internal parasite infections. The internal parasites can still reproduce; however, they will produce fewer eggs than parasites that infect younger nonimmune cattle. Therefore, adult cattle can still be a major source of pasture contamination for younger animals. Most parasitologists and veterinarians consider young cattle to be less than 2 years of age and adult cattle to be over 2 years of age.

In the U.S., dewormer medications can be grouped into one of four primary classes of compounds, depending upon their mode or mechanism of action. The four classes of dewormers include the benzimidazoles, the imidazothiazoles, the macrocyclic lactones (MCL), and the tetrahydropyrimidines. Examples of the active ingredients in each class of compounds are provided in Table 29.1. Within each class of drugs, there are several different active ingredients (or individual chemicals). In general, the different active ingredients may possess unique characteristics compared to other actives within each class of compound. But within a class of drugs, the modes or mechanisms of action will be the same.

Table 29.1 – Examples of active ingredients in the different classes of dewormer medications.

Benzimidazoles:	**Imidazothiazoles:**
Albendazole	Levamisole
Fenbendazole	
Oxfendazole	
Macrocylic Lactones:	**Tetrahydropyrimidines:**
Doramectin	Morantel
Eprinomectin	
Ivermectin	
Moxidectin	

One of the distinguishing characteristics between the different active ingredients that is important when developing a strategic deworming program is the residual killing activity. The residual killing activity refers to the period of time after a product has been administered that it will still kill the parasite if infective larvae are ingested. The residual killing activity may or may not be beneficial in all management situations. Therefore, producers must work closely with their veterinarians to develop a preventive health program that meets their individual needs (Williams).

Three Types of Deworming Programs

There are three different types of deworming programs: therapeutic deworming, tactical deworming, and strategic deworming. The type of deworming program that is utilized in a group of cattle is dependent upon management or lack of management. A therapeutic program approach is used when an animal or group of animals are suffering from clinical parasitism. Clinical parasitism is defined as an animal that exhibits obvious signs of infection, such as depression, decreased appetite, weight loss, rough hair coat, fluid under the jaw (commonly referred to as bottle jaw) and ventral abdomen, anemia, and diarrhea. Death may result in some cases of clinical disease if appropriate treatment is not instituted.

The diagnosis of clinical parasitism should be confirmed. Fecal egg counts (eggs per gram/EPGs) can be used to show infestation levels. However, fecal counts only confirm that at least one female is present and laying eggs. Inhibited or hypobiotic worms and immatures will not shed eggs. Fecal egg counts will not necessarily indicate what species are present. Correct identification of eggs of most species is very difficult. Larval cultures (collecting a given number of eggs and incubating them so the larvae can be identified after they hatch) is the most accurate procedure to determine what is present in a fecal sample. It should also be obvious that if an animal is suffering from clinical disease, an appropriate medication must be chosen to treat the animal's condition. The next step is to determine why the animal was suffering from clinical disease, and what management changes are needed to prevent the condition in the future. From a modern production standpoint, using dewormer medications is a very inefficient use of resources.

Many U.S. producers utilize a tactical deworming program, administering a dewormer at convenient times. The program does not focus on the effects of pasture contamination or the most appropriate time to administer the products. Because production animal agriculture is faced with a shortage of qualified reliable labor, it is often necessary to process cattle when help is available. Generally, using a tactical approach to deworming cattle is not the most cost effective.

The third type of deworming program is called a strategic deworming program. This type of program frequently is not the most convenient program for a producer; however, it is the preferred program from a cost-benefit and production point of view. A goal of a strategic deworming program is to allow younger cattle to graze "parasite-safe" pastures for approximately 90 days in the early grazing period (turn-out). It must be recognized that these are "parasite-safe" pastures, not "parasite-free" pastures. Parasites cannot be completely eliminated from the environment and cattle. Available products must be utilized to develop health programs that will minimize the negative effects of internal parasitism and optimize production. This scenario can occur if an environment is developed that will allow younger cattle to graze "parasite-safe" pastures in the early grazing period.

Another aspect that is controversial among parasitologists and veterinarians is whether or not to rotate classes of dewormer medications. One school of thought is that beef cattle in the U.S. are processed so infrequently that resistance build up to the drugs is very unlikely. However, in some parts of the world, resistance has developed especially in small ruminants and has resulted in severe economic and production losses in livestock. In this case, alternating classes of drugs on an annual basis to prevent or minimize potential resistance is appropriate. This type of program utilizes one class of dewormer for one complete 12-month cycle and then switches to another class for the next 12-month cycle. If this procedure is followed, care should be taken to ensure that the class of chemical is changed, not just the product name.

Every producer along with his or her veterinarian must include factors unique to their individual operation when choosing a particular medication. Factors such as type of cattle, working facilities, labor availability, route of product administration, residual killing activity of the product, and cost benefit are just a few of the factors that need to be considered.

The above discussion has provided a basic foundation of information necessary to develop a strategic parasite control program. No one program fits all situations. Therefore, this chapter focuses on the general considerations. An operation may require some unique modifications to these general recommendations to achieve the most beneficial results in production and return.

Adult Cattle Deworming Recommendations

The recommendations for adult cattle over 2 years of age, including breeding or herd bulls, assumes that the purpose of the adult cattle in a herd is to produce offspring for replacements and/or marketing beef and that the production of the offspring should be as efficient as possible. Controlled studies documenting a direct performance benefit of deworming adult cattle have produced inconsistent and varied results. Under normal conditions, it is difficult to justify the practice of deworming adult cattle strictly from a performance benefit to the individual animal. However, pasture contamination should be of prime concern. Even though adult cattle develop a degree of immunity, they can be a significant source of pasture contamination for young stock. An untreated cow and her untreated calf may deposit millions of eggs onto a pasture in a grazing season. Even if only a small percentage of eggs hatch and the larvae survive, infective L3 larvae on the pasture are able to reinfest the donor or other animals in the pasture.

The goal of strategic deworming is to allow cattle to graze "parasite-safe" pastures for approximately 90 days. When adult and young cattle graze pastures simultaneously, producers should consider deworming the adult animals to minimize pasture contamination with parasite eggs. If the adult cattle have been dewormed the previous late fall or winter and the likelihood of acquiring an infection is minimal, the adult cattle should contribute very little to the initial contamination of the pasture at spring turnout. The pasture however, would still have some eggs and larvae that would have survived over winter. Therefore, the adult cattle would acquire L3 larvae when they start to graze. As the pre-patent period for the adult animals is 4 to 6 weeks, the adult cattle would then start to contribute to pasture contamination after 6 weeks from turn out. In situations where adult and young cattle graze together, the adult cattle should be dewormed at 4 to 6 weeks after turn out to decrease the level of pasture contamination. If the medication has no residual killing activity, it will be another 4 to 6 weeks (pre-patent period is 4 to 6 weeks) until cattle will start to shed fertile eggs and contribute to pasture contamination. The time interval of 6 weeks plus another 6 weeks will be approximately 90 days of allowing the younger stock to graze "parasite-safe" pastures. If the dewormer medication has a longer residual killing activity such as 2 to 4 weeks, then it would be 8 to 10 weeks after the administration before the adult animals would start to contaminate the pastures and the younger stock would be allowed "parasite-safe" grazing.

If the deworming history of the adult cattle is unknown or they were not dewormed after summer/fall grazing, then they would be considered infected and could contribute to early pasture contamination. Here, producers should administer a deworming medication at turn out for spring grazing to eliminate the adult population as a source of early pasture contamination. If the dewormer medication did not have any residual killing activity, then the adults would start to contribute to pasture contamination 4 to 6 weeks after turn out. If the dewormer medication has a longer residual killing activity, the amount of time would be added to the 6 weeks period after turn out to determine when the adult animals would start to contribute to pasture contamination.

As alluded to above, another situation that would indicate the need for deworming adult cattle occurs during the winter season, after the period of summer/fall grazing. During the winter in most of the continental U.S., adult cattle are provided hay and possibly a supplement. Feed expense generally accounts for the largest percent in the cost of raising or maintaining cattle, and producers want the most benefit for their cattle possible from the feedstuffs. Therefore, it is frequently recommended to administer a dewormer to the adult herd after the fall grazing period. This also will allow the adult animals to be considered fairly free of internal parasites at spring turn out onto summer grazing pastures.

Young Cattle Deworming Recommendations

Young cattle (less than 2 years of age) are the next group to consider when developing a deworming program. Milk is the primary source of nutrition for neonatal calves. The young calves learn grazing behavior from their dams starting at a few weeks of age. A rule of thumb to use regarding the time or age when young calves might benefit from the administration of a deworming medication is approximately 2 months of age or approximately 200 lb body weight. Studies have shown that deworming the cow and her calf at this time provides a significant economic return. Calves less than 2 months of age or 200 lb generally do not need to be treated for internal parasites. However, in certain

conditions, such as severe drought or lack of milk production from the dam, young calves will start to graze earlier and thus can potentially develop internal parasite infections that affect their growth and production. In instances such as these, the diagnosis of parasitism must be confirmed by the veterinarian and appropriate medications administered to treat the problem. If conditions are such that a change in management would promote improved health and well being of the animals, changes should be implemented.

If young calves are over 2 months of age or over 200 lb body weight at spring grazing turn out, assume they will start to acquire internal parasite infections on day one of grazing. They will start to contribute to pasture contamination 4 weeks after turn out (pre-patent period is 4 weeks). The young cattle need to receive a dewormer medication at that time. If the dewormer medication does not have any residual killing activity, then the calves can start to acquire infective L3, and start to contaminate the pasture in another 4 weeks. Therefore, the young calves will need to be administered another dose of dewormer medication at that time. With this dose, the calves will not contribute to the contamination for another 3 to 4 weeks. Thus, a total of 9 to 12 weeks, which is approximately 60 to 90 days, will be allowed for the calves to graze "parasite-safe" pastures. If the dewormer medication has a residual killing activity of 2 to 4 weeks, then the pasture contamination from these calves will be 6 to 8 weeks after their initial treatment. Consult your veterinarian and refer to product labels to determine the residual killing activity of the various products.

WEANED CATTLE DEWORMING RECOMMENDATIONS

In a recent scientifically controlled study, beef steers were evaluated during the grazing period (118 days) through the finishing period (average 121 days) to harvest (Smith). The steers were purchased from various auction markets, grazed in southeastern Oklahoma, and finished at a feedlot in Colorado. During the grazing trial, steers were grouped into an untreated control group and a strategically dewormed group. At the conclusion of the grazing period, the strategically dewormed steers were 48 lb heavier than control untreated steers. With most stocker programs, deworming at turnout provides a good economic return.

During the finishing phase of production, both pasture treatment groups were randomly assigned to groups that either received a treatment of dewormer medication or were assigned to untreated control groups. The group that was strategically dewormed during the grazing period and dewormed in the feedlot gained 103 lb more than steers that never received a dewormer medication. Steers that were strategically dewormed on pasture but did not receive any further treatments were 83 lb heavier than the control group. Steers that were not administered a dewormer medication during the grazing period but were administered a medication during the finishing phase were 63 lb heavier than the control group. Additionally, the steers that were treated during the grazing and finishing phases of production produced the heaviest hot carcass weights, larger ribeye area, and the highest marbling scores of the groups involved in the trial (Taylor). The internal parasite control program for weaned cattle less than 2 years of age (weaned calves, yearlings, replacement seed stock) is straightforward because the pre-patent period will be the same, 3 to 4 weeks, for all of the animals.

OTHER RECOMMENDATIONS

Besides the administration of dewormer medications, other control measures have been investigated and utilized throughout the world with promising results. One method is to use rotational grazing where cattle are rotated from one pasture to another during the period of time that the animals will consume minimal numbers of parasites, and hence graze "parasite-safe" pastures. The use of rotational grazing can also increase the amount of forage harvested from a pasture and generally increase production efficiency. Some drawbacks to using rotational grazing systems include an increase in the amount of labor involved in moving the animals frequently, an increase in fencing costs and sometimes an increase cost of supplying water to the herd. Due to some parasites ability to survive for long periods of time, permanent pastures may have to be vacated for extended periods of time to prevent reinfestation.

Another control method that has been used in other parts of the world with beneficial results to control internal parasites is the rotation of species that are allowed to graze the pastures. The species are rotated on a seasonal or annual basis. Small ruminants such as sheep, goats, and horses are commonly used in a rotational sequence in this type of control system. In the U.S., most producers would not be able or willing to utilize this type of control

method. However, in parts of the world where internal parasites prevent certain species from surviving on some pastures, this type of production system allows the producer to utilize available pastures.

CONCLUSION

Modern beef cattle production must be considered a business. In general, optimal health is required for efficient production of cattle. Thus, recommendations about deworming programs must be justified from a cost-benefit viewpoint.

Cow-calf producers are frequently challenged to develop a parasite control program that includes both the adult cows and their young calves. Theoretically, the cows should be dewormed based on the pre-patent period of 4 to 6 weeks and the calves on the pre-patent period of 3 to 4 weeks. However, in practice, the cows are administered a dewormer medication at the same time as the calves so that pasture contamination is minimized.

Because of the various factors involved in developing a practical strategic control program, it is strongly recommended that producers work closely with their veterinarian to develop a customized control program that will be most beneficial. A cheaper product may not necessarily equate to more profit. Livestock parasite control products have large amounts of advertising directed toward them. Select a dewormer that meets your needs and is backed by sound research data.

Under most production systems for fall born calves, the chance of acquiring infective L3 during the winter months is minimal. From a practical standpoint, the calves will be weaned in early spring. A deworming program as described for weaned cattle less than 2 years of age will generally work best for those calves.

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