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Managing Internal Parasites in Arkansas Horses, Donkeys and Mules

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Introduction

Parasite control strategies used in horses, donkeys and mules ("equines", "equids") are typically based on concepts and protocols that were developed more than four decades ago. Proper management of internal parasites in equids involves implementing control strategies that reflect the current recommendations. If not sufficiently surveilled and maintained, heavy internal parasite burdens in horses can lead to significant health problems, such as weight loss, diarrhea, founder and colic. These parasites reside in the internal organs, body cavities and tissues, and rob nutrients via 1. directly feeding on the equid (blood and tissue), 2. absorbing the intestinal contents meant for the host animal, or 3. creating considerable areas of malfunctioning organ. It is important for equine producers to conduct routine surveillance of parasitisms and be familiar with current recommendations for control.

Equine Internal Parasites

Equids can harbor parasitic worms and fly larvae ("bots") from ~40 different parasite species in their intestinal tracts. Dismissing some of the lesser important parasites, and grouping many of the others, equine parasites can be sorted into eight distinct categories shown in Table 1, which account for more than 95% of the parasite presence. Each group of parasites has the potential to be severely pathogenic in equines, but typically are not. Most parasites are subclinical in their detriment, meaning that the producer does not visibly see what damage is being done to the animal. Additionally, most of the parasites listed in Table 1 do not occur in every animal, of every age, on every farm, in every geographic region. Having said that, the group of parasites called the 'small strongyles' are most deserving of discussion because they can be found in every animal, of every age, on every farm, and are generally regarded as the most important group of equine parasites. Another important internal parasite is the "horse roundworm", which mostly affects foals and yearlings. Heavy roundworm infections require a killing method that is slow in its nature to try to avoid large masses of dead worms blocking the intestines, which can result in the foal's death.

Equids will readily play host to parasites due to several factors. Adult equids do not develop an immune system that is 100% effective in preventing or eliminating most parasite populations, though a healthy immune system (re: well-fed, stress-free, illness-free, "happy" animals) can provide some degree of protection. Young and older equids are most at-risk for heavy, clinical parasitic infections due to their underdeveloped immune system. Equids are also constantly exposed to new parasites, as horse, donkey and mule pastures are a reservoir for infective stages and are acquired when the animals consume forages. Equids tend to be housed on permanent pastures or paddocks and are not often rotated onto different areas to graze, which can lead to pastures becoming heavily contaminated with infective larvae. Additionally, no dewormer available is completely effective at killing 100% of the parasites, nor are they effective at providing preventative protection. Ideally, dewormer effectiveness should be evaluated with every use via fecal egg count (FEC), and failed products should not be considered for administration.

Table 1. Common Internal Parasites Found in Arkansas Equine

Scientific Name	Common Name	Parasite Location	Comments
Strongylus spp 40-50 spp of small strongyles	Large Strongyles (LS) Small Strongyles (SS)	Large Intestine Cecum	-SS most important group of parasites in equines -LS less of a concern compared to SS -Aim for spring and summer treatments using a larvicide dewormer -SS display resistance to all dewormer classes
Parascaris equorum	Horse Roundworm	Small Intestines	-Mainly foal disease -Heavy infections require careful treatments using benzimidazoles
Anoplocephala spp	Horse Tapeworms	Small Intestines Large Intestine Cecum	-Can be a concern -Praziquantel, Pyrantel or Combination to treat -Late Fall/Early Winter Treatments
Gasterophilus spp	Horse/Stomach Bots	Mouth Gums Tongue Stomach	-100% incidence -Macrocyclic lactones to treat after 2nd killing frost
Strongyloides westeri	Intestinal Threadworm	Small Intestines	-Primarily in foals -Skin penetration and "milk larvae" infection routes -Environmental contamination, typically in stalls and barns
Oxyuris equi	Horse Pinworm	Rectum	-Not very common -Excessive rear-end rubbing can lead to "rat tail" -Susceptible to dewormers
Habronema spp *Draschia megastoma* *Trichostrongylus axei*	Horse Stomach Worms	Stomach	-Cause of "summer sores" -Trichostrongylus shared with cattle
Onchocerca cervicalis *Setaria equina* *Thelazia lacrymalis*	Filarial Nematodes	Neck Ligament Abdominal Cavity Eye	-Not usually a problem -Skin/Eye lesions -Avermectins effective -Vectored by flies

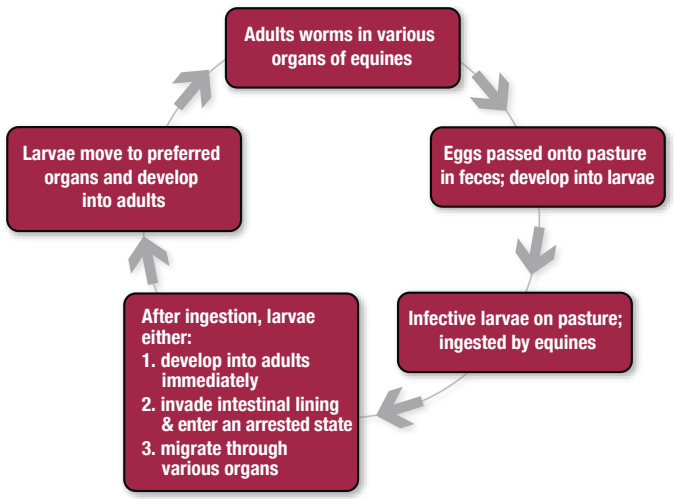
Proper parasite surveillance and implementation prevention strategies are essential for effective equine parasite control.

General Life Cycles of Equine Parasites

The aim of any parasite control program is to interrupt the life cycle of the parasite to prevent initial infections/reinfections. To effectively implement the life cycle disruption, producers must familiarize themselves with the life cycles of the target parasites. The generalized life cycle for equine parasitic worms can be found in Figure 1. The adult parasites are found in the various organs of the equid (depending on the parasite species) and pass their eggs onto the pasture with the feces, which contaminants the environment. Once the larval stages become infective, the equines consume them from the pasture along with forages, each bite resulting in potentially thousands of larvae entering the animal. Once inside the host animal, the parasite larvae will move to the preferred organ and develop into an adult, restarting the life cycle. It should be noted that the horse roundworm (*Parascaris equorum*) undergoes a larval migration through the liver and lungs as a part of the life cycle requirement; this migration is achieved before the larvae move to the small intestines and develop into adults.

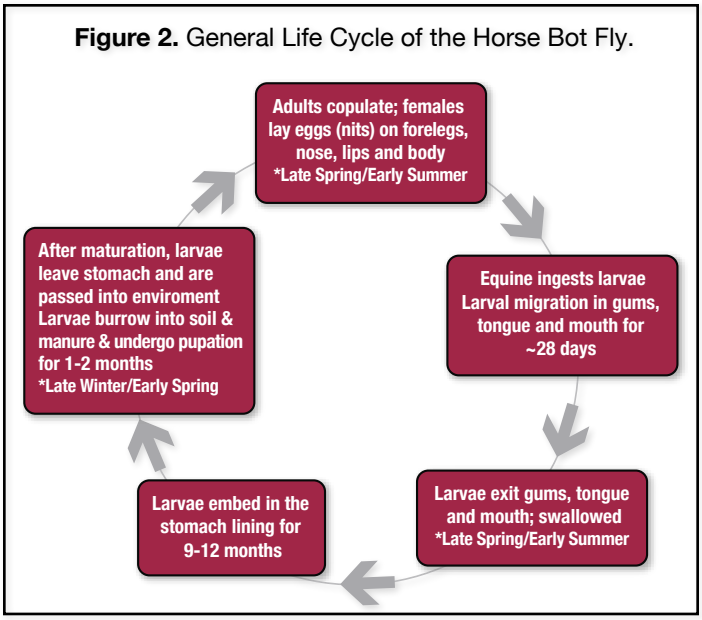
The life cycle of small strongyles ("cyathostomes"), employed to some extent by all 40-50 cyathostomin species, is presented in Figure 1. Six different life cycle stages are completed by each species, with all stages completed in 70 days to 2 ½ years. Several factors are involved in dictating the speed of the parasite's rate of development. The life cycle can be divided into three segments: the environmental phase (eggs and larvae on pasture), the luminal phase (adults in the intestinal contents), and the tissue phase (larvae encysted in the intestinal wall— total numbers can range from hundreds to millions). Given the many stages, phases and reservoir populations involved in the life cycle of cyathostomes, it is obvious that this parasitic burden is impossible to completely remove from equines. Rather, one must reduce parasitisms to a level that allows for optimal horse health, the goal being to create a type of equilibrium for the horse and its population of small strongyles.

Figure 1. General Life Cycle for Equine Parasitic Worms.



The life cycle of horse bot flies (*Gasterophilus* spp.) is displayed in Figure 2. Briefly, adult female bot flies lay their eggs in the late spring and early summer months, depositing the nits (eggs) on single hairs of the equine's front legs, abdomen, flanks and shoulders. The nits develop into larvae inside the eggshell within 7-10 days of being laid. Larvae are stimulated to emerge by being exposed to warmth, moisture and friction (re: when an animal licks or bites at the fully developed larvae). The larvae either crawl into the equine's mouth or are

Figure 2. General Life Cycle of the Horse Bot Fly.



ingested and subsequently invade the tongue, gums or lining of the mouth, where they migrate in the tissues for ~28 days. After the oral tissue migration, the larvae move to the stomach and attach to the lining near the esophageal ("top") and pyloric ("bottom") regions using hooked mouthparts and spines that line their body. The larvae will remain in the stomach lining for 9-12 months. After maturation, the larvae are passed out of the body with the feces where they burrow in the soil or dried manure and pupate; this process will last 1-2 months and typically occurs in the late winter and early spring. After a 3-10 week pupation period, the adult fly emerges and seeks out a mate, restarting the life cycle. The adult bot flies live 7-10 days.

Injury and Harm Caused by Internal Parasites

For adult horses, far and away, the most important group of intestinal parasites are the small strongyles; infections with these parasites can lead to intestinal hemorrhage, diarrhea, weight loss, anemia (blood loss) and protein loss. Another important danger that can arise from cyathostome infections is the risk of large numbers of larvae (ranging from hundreds to millions), all at once, emerging from the intestinal tissues when the adult population dies after using an effective dewormer that only kills adults. The act of deworming can trigger the "next wave" of larval emergence from the gut wall (called "larval cyathostomiasis") within a short period of time (~7-10 days). This mass emergence can produce sudden onset diarrhea, impaired gut motility/colic, severe dehydration, weakness, muscular wasting, abnormal body temperature (elevated or decreased) or even death.

The horse roundworm (*Parascaris equorum*) tends to be the most important internal parasite of foals under 3-4 months of age, though infections can occur in debilitated horses of all ages. The larval migration through the liver and lungs can result in cirrhosis, jaundice and pulmonary illnesses. The large size of the adult parasites (4-8") can lead to intestinal obstruction and perforation, which can result in fatal peritonitis (inflammation of the abdominal cavity). Most equines develop immunity by the time that they are 5 years old, with the majority of heavy infections confined to foals and yearlings, so FEC are especially important in foals and young horses.

High levels of the common horse tapeworm, *Anoplocephala perfoliata*, can result in several different types of colic, as they prefer to cluster at the ileocecal valve (sphincter that joins the small and large intestines) and block the end of the small intestine, disrupting normal movement of intestinal contents.

The horse bot fly can cause direct damage to the gums, mouths and gastrointestinal tracts of equines. The larval migration into the gums and mouth can lead to severe irritation, loss of appetite, the development of abscesses and loosened/lost teeth. Heavy infections of bot fly larvae in the stomach lining can result in colic, stomach ulcers, stomach valve disruption/blockage, chronic gastritis, esophageal paralysis, stomach rupture, stomach tumors and anemia.

Farm Management as Parasite Control

Parasite control programs attempt to achieve success by implementing two broad tactics: minimizing the level of exposure to parasites and minimizing the level of parasites maintained in the horse. These objectives can be accomplished in many ways, as each operation is unique in how it is managed (and its management limitations), the populations of parasites present, and the level of dewormer resistance displayed by said parasite populations. Generalized procedures for accomplishing the above goals include both managerial and chemical means of control and are laid out below:

- Conducting "frequent" FEC both throughout the year and prior to administering a dewormer will help producers monitor internal parasite burdens and potentially save money by eliminating unnecessary treatments. Ideally, producers should aim to conduct FEC monthly or, at the very least, once per season of the year, in order to develop a deeper understanding of the individual animal's parasitic burdens and susceptibility, parasite species that populate the operation's pastures and the seasonal fluctuations associated with said parasite species.

- Collecting and composting as much fresh horse manure as possible prior to its dispersal onto the pastures (i.e., manure in stalls, barns and exercise lots) can help to reduce the parasite pressure from pasture. It is also important to prevent fecal contamination in feed and water troughs.

- Keeping pastures healthy and lush will also help to reduce parasite pressure from pasture, as the closer horses graze to the ground and old stool piles, the

more infective larvae they ingest. Rotating pastures based on forage height (above 3-4") also can be an effective management tool since the highest concentration of infective larvae are found in the bottom 3" of forages.

- Alternating different species of herbivore (cattle, sheep, goats, etc.) behind equines will help to reduce the parasite pressure from pasture by removing infective larvae.
- Keeping stocking rates low will help to reduce animal stress and infective larvae concentrations on limited pasture. Overstocked pastures or paddocks can lead to higher parasite burdens.

Table 2. Dewormer Classes (Pioneer Products) Indicated for Equines.

Chemical Class	Drug Name	Trade Name	Comments
Macrocyclic Lactone/ Avermectin	Ivermectin	Zimectrin Eqvalan Equimectrin	-Effective against bots -Widespread resistance displayed by Parascaris -Early indications of resistance displayed by small strongyles
Macrocyclic Lactone/ Milbemycin	Moxidectin	Quest	-Effective against bots -Widespread resistance displayed by Parascaris -Early indications of resistance displayed by small strongyles -Indicated for arrested small strongyle larvae
Benzimidazole	Fenbendazole Oxibendazole	Panacur Safe-Guard Anthelcide EQ	-Widespread resistance displayed by small strongyles -Early indications of resistance displayed by Parascaris -Limited action against tapeworms
Tetrahydropyrimidine	Pyrantel Pamoate Pyrantel Tartrate	Strongid	-Common resistance displayed by small strongyles -Early indications of resistance displayed by Parascaris -Effective for tapeworms
Isoquinoline-Pyrozine + Avermectin	Praziquantel + Ivermectin	Zimectrin Gold Equimax	-Effective for tapeworms

- During fly season, remove bot eggs daily from leg and body hairs using a warm, wet sponge, which mimics the horse biting at the bot fly nits. This action will stimulate the emergence of the fly larvae onto the sponge and lead to the death of the fly.
- Feeding hay in bins off the ground will help prevent infections/reinfections from infective larvae. It is important to keep fallen hay cleaned from the ground surrounding the hay bin.
- Keeping horses, donkeys and mules healthy and stress-free will provide some degree of protection against internal parasites. Although immune responses aren't adequate to completely protect horses from parasite burdens, a healthy horse will ward off more parasites than an un-healthy horse. Additionally, healthy horses are more efficient at repairing tissue damage caused by parasites.
- Implementing an effective and strategic parasite treatment program that encompasses many different strategies will allow for a parasite control program that is tailored to individual operations and animals.

Chemical Parasite Controls and Limitations

Traditionally, parasite control programs involved rotating different dewormers on a schedule, typically once-a-month treatments, in the absence of using FEC for treatment conformations. This scheduled treatment protocol has led to the overuse of anthelmintics, and the subsequent resistance demonstrated by parasites. The rapid increase in the incidence of dewormer resistance ("anthelmintic resistance") displayed by equine parasites has created a situation where producers can no longer confidently administer dewormers without justifying their usage and evaluating their effectiveness. The objective is not to eliminate all parasites from a particular individual—this is impossible—but to develop a parasite control program designed to limit parasitic infections, so the animals remain healthy and do not develop clinical illness.

The pioneer dewormers ("first generation") indicated for equines can be found in Table 2. It is important for producers to confirm the necessity of individual deworming treatments using a FEC in an effort to slow the rate of resistance. It is also important for producers to evaluate the effectiveness of dewormers that are administered. This can also be achieved using a practice called a "fecal egg count reduction test" (FECRT). In short, a FEC is conducted prior to treatment, then again 14 days later (from the same animal), and the reduction in fecal egg output is measured. Using a FECRT, a producer can identify when a dewormer fails and remove it from use. For operations with large herds, selecting 10-20% of the entire population and conducting a FECRT on those animals will give a producer a good idea as to the level of resistance on the operation.

It is also important for producers to obtain an accurate weight prior to administering a dewormer. In the absence of weight scales, a weight tape can be purchased and utilized. Equine producers should always refer to and follow the label instructions of a dewormer for dosages and storing the dewormer.

Due to the widespread drug resistance displayed by equine parasites, it is essential for producers to evaluate the effectiveness of dewormers on a regular basis using FEC to effectively "rotate dewormers". Different

dewormers are labeled for different parasites, and treatments should be applied at different times throughout the year, targeting specific parasite populations. It is important to note that dewormers should NOT be given on a set schedule (re: once-a-month or every-other-month treatments based on convenience rather than diagnosis) and should only be administered AFTER a confirmation of parasite burdens have been established via FEC. This "rule" does not apply to bot fly larvae populations, which SHOULD be treated for on a set schedule—in late fall, after adult fly populations have dispersed. Over and indiscriminate use of dewormers, can lead to total drug failure in a short amount of time, leaving producers in a very undesirable situation.

Collecting manure samples for fecal egg counts should be done with care, and a person should never attempt to pull a sample directly from the anus. Instead, simply secure your equine to a fence or a post for a ~1 hour or until the animal defecates, after which carefully moving the animal away from the manure pile and collecting the top 2-3 "apples". Another collection method is if the animals are stalled overnight, a producer can choose the freshest manure pile and collect the top few "apples". It is important that the fecal sample be as fresh as possible, as well as clean and free of debris (dirt, hay, grass, bedding, etc.).

Developing an Effective Parasite Control Program in Summary

Maintaining and managing parasitisms in equines is no longer 'easy' and requires producers to develop new or revise current management practices. FEC can provide insight to the existence and magnitude of parasitic burdens, as well as determine targeted treatments and evaluate the effectiveness of dewormers. Implementing rotational grazing based on forage height and removing feces from pastures can decrease the parasite pressure from pasture, which can lead to fewer animals that require deworming. Removing bot fly nits from the animal can reduce the pressure from bot flies. Strategically using dewormers can help to delay the level of resistance on an operation by only treating animals that require treatment instead of the entire population. Developing a comprehensive, multifaceted approach to parasite control will help to provide a comfortable life for your equine and reduce the overall pressure and complications from parasites.

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