CONTROL PROGRAMS FOR MATURE HORSES

Get Your Veterinarian Involved in Deworming

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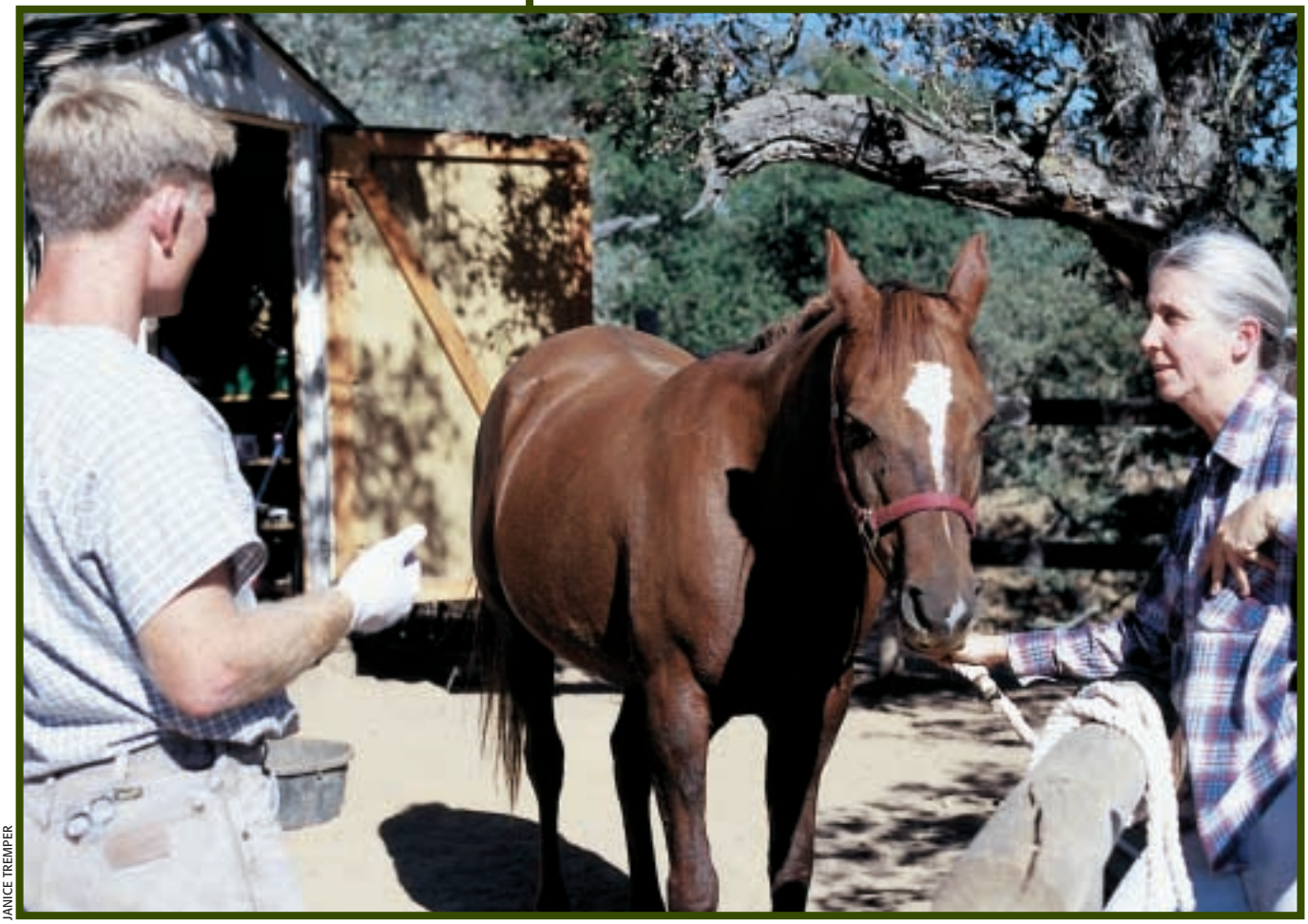
PARASITE PRIMER—PART 12

In last month's article, we discussed certain parasites that are found almost exclusively in horses less than two years of age—roundworms, threadworms, and other nasties that target the naïve immune systems of youngsters. After equines reach their second birthday, however, the picture changes dramatically, as large and small strongyles become the major focus of our parasite control programs. There are other parasites that are a concern in adult horses—bots and tapeworms, to name only two—but their impact is fairly minor in comparison to strongyles (see "Major Parasites Affecting Adult Horses" on the page 2).

Knowing how dangerous strongyles are, we want to be able to keep our horses strongyle-free as much as possible. But are our current parasite-control programs doing the job?

In far too many herds, parasite control for adult horses can be characterized as compliance with a recipe. It is still common practice at many farms to



JANICE TREMPPER

Getting your veterinarian involved in the proper deworming procedures of your horses is the first step to healthier animals.

Major Parasites Affecting Adult Horses

COMMON NAME	SCIENTIFIC NAME
Large Strongyles	*Strongylus spp.*
Cyathostomes (small strongyles)	*Cylicocyclus, Cyathostomum, Cylicostephanus, Coronocyclus, Cylicodontophorus, Poteriostomum, Petrovinema spp.*
Bots	*Gasterophilus intestinalis* and *G. nasalis*
Tapeworms	*Anoplocephala perfoliata*

deworm all horses with Drug A, then wait a stereotypic interval before all are treated with Drug B. After another period of identical duration, horses are treated yet a third time, perhaps with Drug C, or maybe another dose of A or B, and the pattern is repeated throughout the entire calendar year, according to a rotation recipe that is now decades old.

Such rote approaches to parasite control for mature horses are long overdue for major revision for several reasons. First, recipes cannot determine whether dewormers A, B, or C are still effective in a particular herd. Second, a standard rotation formula also fails to exploit the unique characteristics of dewormers A, B, and C, such as differing durations of egg count suppression following treatment. Third, rote programs usually don't attempt to discriminate between horses pastured in Florida and those stabled in Saskatchewan. Finally, recipes do not acknowledge that individual horses vary widely in their susceptibility to parasites, that their contributions to environmental contamination are distinct, and that their respective parasite control needs might differ from the rest of the herd.

With resistance patterns to anthelmintics changing, and an ever-shrinking spectrum of effective drugs to choose from, there's an element of urgency to implement some important changes in parasite control practices for mature horses. You might find some of the suggestions in this article radical, even heretical, but we contend that adoption of these methods will simultaneously provide superior parasite control and decrease selection for anthelmintic resistance, and it could probably accomplish both at a lower cost than current practices.

Target Parasites

The biology of the major parasites affecting adult horses was discussed in earlier installments of this series, but let's review the important details.

Tapeworms—As we've noted previously, tapeworms (*Anoplocephala perfoliata*, the only major variety of cestode, or flatworm, to infect horses) were long thought to be very minor players in the equine parasite game. Recent studies have given us a clearer picture of their significance and the harm they do.

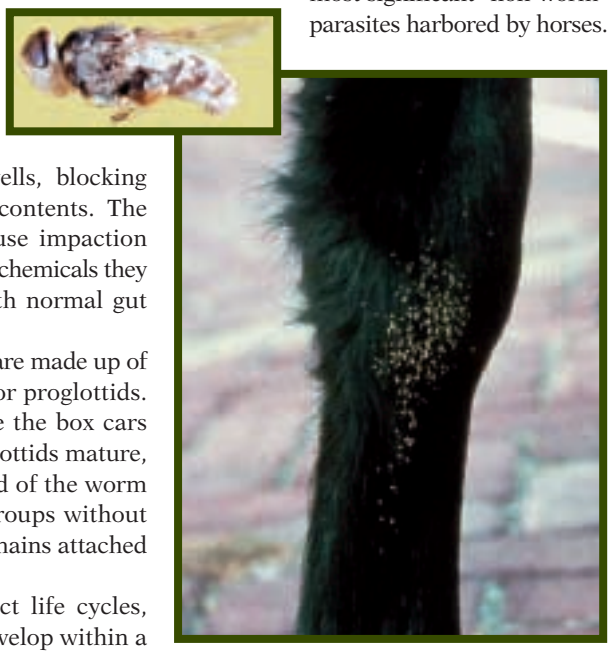
Tapeworms attach fiercely to the intestinal wall, which can cause severe inflammation at the attachment site. They're associated with several types of severe colic, especially ileocecal intussusceptions. In an intussusception, the last one foot of the small intestine (ileum) telescopes into the first section of the large intestine (cecum) and swells, blocking passage of the intestinal contents. The worms can sometimes cause impaction colic, and it's suspected that chemicals they release might interfere with normal gut motility.

Structurally, tapeworms are made up of egg-containing segments, or proglottids. The separate units are like the box cars making up a train. As proglottids mature, they break off from the end of the worm either singly or in small groups without killing the worm, which remains attached to the intestinal wall.

Tapeworms have indirect life cycles, meaning that they must develop within a different animal before they can be transmitted to their final host. Horses acquire tapeworms when they swallow tiny oribatid mites, which live in vast quantities on many pastures. The worms then grow and mature in the equine digestive tract over a six- to 10-week period.

Evidence-based recommendations for tapeworm control have not been generated to date, but many experts recommend at least one annual treatment with a dewormer containing praziquantel during spring or autumn, for horses from weaning age on up. Where there is no evidence of tapeworms causing health problems, one treatment each year might be enough to keep tapeworms at a low level. A second or third treatment might be advisable on properties where tapeworm eggs are frequently seen on fecal egg counts, or where there is a history of tapeworm problems.

Bots—The larvae of the bot fly are the most significant "non-worm" parasites harbored by horses.



MARIANNE SLOET; INSET—LEE TOWNSEND

The bot fly lays its eggs on the hairs under the jaw and on the hairs of the horse's forelegs and shoulders. The eggs hatch when horses rub their warm muzzles on their legs. (Inset) Bot flies are common everywhere horses are kept and their larvae can do significant damage in the oral cavity and stomach.

Interval After Deworming with Various Anthelmintics To Perform Fecal Egg Counts for Determining the Strongyle Contaminative Potential of Individual Horses

ANTHELMINTIC	EXPECTED EGG REAPPEARANCE PERIOD	STRONGYLE CONTAMINATIVE PERIOD
Benzimidazoles (fenbendazole, oxfendazole, oxibendazole)	4 weeks	8 weeks
Pyrantel salts	4 weeks	8 weeks
Ivermectin	8 weeks	12 weeks
Moxidectin	12 weeks	16 weeks

CONTROL BY THE MONTH

Parasite Control for Adult Horses in the United States

It is best to think of worm control as a yearly cycle, starting at the time of year when worm transmission to horses changes from negligible to probable. In the South, this is in late summer/early autumn as temperatures begin to drop. Intestinal strongyles of horses simply do not survive and develop on pasture to any significant level during the hot summers in the South. The goals of the program are to: Keep fecal egg counts (FEC) low, thereby reducing future worm transmission; kill all important parasites at the correct time of the year; and reduce the development of drug resistance.

This is one of many possible programs, and there is room for different opinions. Ultimately, each farm (with veterinary guidance) should develop a program tailored to its needs. Before a rational program can be developed, one must know which drugs work. The only means to learn this information is to perform a fecal egg count reduction test (FECRT; see "Diagnosis: Examining the Evidence" in the June 2004 issue, www.TheHorse.com/emag.aspx?ID=5193, for how to perform one).

This suggested program is only valid in a hot southern climate. For a northern climate, the ideas behind the program (and most of the recommendations) will be the same, but the cycle is different. The first treatment should be given in April and the last treatment can be given in October or November.

SEPTEMBER

In southern climates, September starts the worm control cycle. Treat all horses regardless of FEC with ivermectin or moxidectin. These drugs kill bots acquired since spring, the stomach worms *Habronema* and *Draschia* (which are transmitted by flies and cause summer sores), and sterilize *Onchocerca* females. These drugs also kill migrating large strongyles and any strongyles (large and small) in the intestinal lumen.

Is there a reason to use one over the other?

Moxidectin has the advantage of also killing large numbers of the encysted small strongyles, and it prevents worm eggs from reappearing in the feces for four weeks longer than ivermectin. However, at that time of the year, there are few cyathostome larvae on pasture. Therefore, some parasitologists are concerned that using moxidectin at that time of the year might place more pressure on drug resistance. If FEC are performed ahead of treatment, use moxidectin only in horses with FEC greater than 500 or in horses known to have chronically high FEC, and use ivermectin on the remainder.

Should I perform FEC?

Yes, on all horses. This is probably the single most important FEC performed all year (assuming that you follow this program and have not dewormed in the past few months). The reason is that by not deworming for several months, the FEC seen will be a strong indicator of each horse's innate immunity of small strongyles. Based on this FEC, you can categorize your horses as low (less than 150 epg), moderate (150-500 epg), and high (greater than 500 epg) worm egg shedders. This characteristic of individual horses has been shown to be repeatable between years.

NOVEMBER/DECEMBER

In November/December, treat all horses with FEC greater than 150 epg based on the September fecal check. If your horses were treated with ivermectin in September, treat again in November. If moxidectin was used, wait until December to treat.

Use oxibendazole and/or pyrantel (if effective on your farm). Choose these drugs to reduce the amount of ivermectin and moxidectin used, thereby helping slow the development of resistance to ivermectin and moxidectin. However, there is resistance to oxibendazole and pyrantel, so if using these drugs, before and 10-14 days after treatment a FEC should be performed. Recent data suggests that using oxibendazole and pyrantel together improves the effectiveness of treatment over treatment with the individual drugs.

Is there a reason to use one over the other?

Not unless resistance to one of these drugs is detected.

Should I perform FEC?

Yes, but only on the treated horses (FEC greater than 150 in September). If you haven't performed FECRT previously, FEC should be checked again 10-14 days after treatment.

DECEMBER

Treat all horses regardless of FEC with ivermectin/praziquantel or moxidectin/praziquantel. Tapeworm transmission peaks in autumn, so treatment with praziquantel at this time will remove all the tapeworms acquired over the summer and autumn. Praziquantel is the only FDA-approved drug for tapeworms in horses and is only available in combination with ivermectin or moxidectin. Other reasons to choose one of these combination products are: First, bot transmission will have ended (except in Florida), so treatment with ivermectin or moxidectin will remove the bots acquired since September, and no new bots will infect horses until spring, when the bot flies become active; second, any of the worms targeted in the September treatment that are picked up in the intervening months will be killed.

Is there a reason to use one over the other?

By December, small numbers of strongyle eggs have been deposited on pasture, so there is larval buildup. Therefore, resistance is less of a concern and moxidectin and ivermectin are both reasonable choices.

Should I perform FEC?

Yes, on all horses. It is important to know if the horses with low FEC in September still have low FEC, and if you have been successful in keeping FEC low in the horses that had high FEC in September.

FEBRUARY

If you treated with moxidectin/praziquantel in December, wait until March. If you treated with ivermectin/praziquantel in December, treat again. Only treat horses with FEC greater than 150 epg unless the horse is known to be a chronically high egg shedder. Use moxidectin for all horses that consistently have had the highest FEC (only if moxidectin was not already administered in December; if moxidectin was administered in December, then wait until March to decide what to do). Instead of moxidectin, oxibendazole and/or pyrantel can be used on the horses that have FEC greater than 150, but have not shown high FEC through the year.

Is there a reason to use one over the other?

Horses with chronically high FEC likely also have many encysted small strongyles, and moxidectin has the greatest efficacy against

(continued on page 5)

IS YOUR HORSE AN OFFENDER?

Determing a Horse's Strongyle Contaminative Potential

Individual horses differ widely in their contributions to pasture contamination. The relative magnitude of contamination, as measured directly by quantitative fecal egg counts, is a repeatable characteristic of individual animals. In herds that have not been dewormed recently, certain horses (approximately 20-30% of the herd) have high egg counts, another proportion will have low egg counts (30-50%), and the remainder cluster around the average.

Horses with egg counts less than 150 eggs per gram (EPG) are classified as Low Contaminators, and those with EPGs greater than 500 EPG are classified as High Contaminators. The remainder of horses, with EPGs between 150 and 500 EPG, are classified as Moderate Contaminators.

The contaminative potential of a horse can be determined by examining a fecal sample collected approximately four weeks after the expiration of the Egg Reappearance Period for the last effective anthelmintic it received (see table on page 2). Of course, this might require a break in scheduled deworming treatments, but no negative consequence will result if this occurs during mid-summer for southern horses or in mid-winter for those stabled in the North.—*Karen Briggs*

Bot flies (*Gasterophilus* spp.) are common virtually everywhere horses are kept, with two major species found in North America: *Gasterophilus nasalis*, which lays its eggs on the hairs of the intermandibular space (under the jaw); and *Gasterophilus intestinalis*, which lays its eggs on the hairs of the horse's forelegs and shoulders. *G. nasalis* larvae hatch spontaneously and crawl their way to their host's lips, while *G. intestinalis* eggs hatch when horses rub their warm muzzles on their legs, with the larvae quickly entering the mouth and burrowing into the tissues of the tongue.

Bots can do significant damage both in the oral cavity, where they spend their first month or so of life, and in the stomach, where they set up shop in their final larval stage. They attach to the stomach wall with mouth hooks and spend up to nine months drawing nourishment and ulcerating the tissues. Bot larvae then pass out with the manure to pupate in the soil in late spring, and adult flies emerge by mid-summer to start the cycle anew.

Larval bots must enter the host before winter so they can spend the colder months in the relatively stable habitat of the equine gastrointestinal tract. That's why bot infections are usually managed by using boticidal drugs (e.g., ivermectin or moxidectin) during autumn or early winter.

Large Strongyles—The most dangerous of the equine parasites are the large strongyles, or bloodworms. The three major species of large strongyles (*Strongylus vulgaris*, *S. edentatus*, and *S. equinus*) count among their various crimes against horses such severe symptoms as anemia, liver damage, damage to the cranial mesenteric artery from verminous aneurysms, and severe thrombo-embolic colics.

Furthermore, few worms are more prolific. Female strongyles lay eggs almost constantly, re-infecting your pastures again and again. The eggs hatch in fecal piles and the larvae go through three stages before they become infective, at which point they crawl up blades of grass so they can easily hitch a ride with a juicy mouthful. Horses can also ingest the larvae directly from the soil or from drinking contaminated water. (There can be dozens of large strongyle—and other parasite—larvae in a single drop of water or dew.)

Once inside the horse, large strongyles take an extensive tour of the equine innards, their exact route determined by their species. Regardless of their migration path, they eventually (over the course of six to 11 months) return to the gut to mature and lay eggs. The eggs pass out with the manure, and the cycle begins again.

In some ways, our battle against large strongyles has been very successful. During the past 15-20 years, most horse owners managed to eradicate large strongyles from their herds without realizing they had done so. The use of macrocyclic lactone dewormers (ivermectin or moxidectin) or the larvicidal regimen of fenbendazole (10 mg/kg daily for five days) kills virtually all adult and migrating large strongyles within a horse. Because it takes a minimum of six months to replace a population of reproducing adults, there will be no environmental contamination with large strongyle eggs if all horses on a farm are treated with one of these regimens at intervals of six months or less. Also, because the maximal survival of large strongyle infective larvae on pasture in the continental United States is approximately one year, the use of larvicidal regimens at intervals of six months or less for a total duration of 18 months or longer will effectively eradicate all large strongyles on a farm.

ANNE EBERHARDT

Contrary to popular belief, conditions from autumn through winter are very favorable for the persistence of infective larvae on pasture. Extra management precautions still need to be kept in place to prevent horses from becoming re-infected with larvae after being dewormed.

CONTROL BY THE MONTH (CONTINUED FROM PAGE 3)

these. If a larvicidal treatment is not needed, then use oxibendazole and/or pyrantel for the same reasons these drugs were recommended for the November treatment.

Perform FEC on all horses with greater than 150 epg on the December fecal exam.

MARCH

Treat only horses with FEC greater than 150 epg. The drugs used will depend largely on which drugs were used in the last few months. If tapeworm eggs are seen or the farm has a history of tapeworm problems, give a second treatment for tapeworms using one of the praziquantel products.

Should I perform FEC?

Yes, on all horses that were not treated in February.

APRIL

Treat only horses with FEC greater than 150 epg. The drugs used will depend on which drugs were used for previous treatments.

Perform an FEC on all horses. This is the last treatment of the cycle and the last time you will need to perform FEC until September. Eggs shed after April are doomed to die because temperatures will soon rise to levels that will kill them. This FEC will give you a good indicator of how well you have done controlling worms this year.

Note: *A five-day double dose of fenbendazole (marketed as the Panacur PowerPak) is a moxidectin alternative for removing encysted small strongyles in the spring. However, resistance is known to be quite common to fenbendazole at the single dose rate, and there is mounting evidence that the extended double-dose regimen often fails to provide high levels of control. If you use the PowerPak, do so no more than once a year, and only in a small percentage of your horses, to prevent severe resistance from developing.*

SUMMARY

This program is designed to target bots, tapeworms, *Habronema, Draschia, Onchocerca*, large strongyles, and small strongyles. A few lesser important parasites will also be controlled. Treatments in September and December with ivermectin or moxidectin (with or without praziquantel) will control all of the worms listed above for the entire year with the exception of small strongyles. So all that is left is to do after December is control small strongyles. Horses with naturally strong immunity to small strongyles (demonstrated with low FEC each exam) need no other treatments. In traditional deworming programs, repeated treatment of these horses accomplishes little to nothing.

Some horses will need a third treatment for small strongyles, but only a few horses (probably less than 30%) should need a fourth or fifth treatment, and only 5% or less should need more than that. Compare this protocol to what you are doing now. Many farms are treating all horses six times each year, and likely are getting results that are significantly less than what will be achieved on the program recommended here.—*Ray Kaplan, DVM, PhD*

This program works because the drugs kill all stages within the equine host, scheduled treatments prevent new arrivals from re-contaminating the environment, and time ultimately depletes any potential new infections (larvae) already on pasture.

So many horse farms have implemented deworming practices that are at least this rigorous that large strongyles are now considered a rarity in well-managed herds. It is relatively simple to maintain a large strongyle-free farm. All new animals should be confined upon arrival, treated with a larvicidal regimen, then held off pastures for a minimum of four days. This program will keep large strongyles out of the picture as long as our present dewormers keep their adulticidal and larvicidal properties against *Strongylus spp*.

Small Strongyles—The 40-odd species of cyathostomes (small strongyles) that infect horses are less driven by wanderlust than their larger cousins. Instead of taking the migratory approach, they set up housekeeping in the gut immediately and provide themselves with defenses that make it practically impossible for the horse's immune system to attack them.

Shortly after being swallowed, small strongyle larvae invade the lining (mucosa) of the large intestine, where a thin, tough capsule of scar tissue forms around each worm. These cysts simultaneously protect the larvae from the host's immune reactions and the majority of equine dewormers that are currently marketed. Once securely encysted, small strongyle larvae can enter a period of dormancy or continue to develop, depending on how many other small strongyles are already present in the environment of the horse. All eventually emerge, however, to morph into adults in the lumen (cavity) of the gastrointestinal tract. Individual worms could lay thousands of eggs in one day. An entire population of worms in the horse could produce over a million a day, which are then shed in the manure.

Although small strongyles generally cause less damage than their larger cousins, they can be responsible for intensely irritated intestinal tissues, diarrhea, weight loss, and anemia. Another danger is the risk of huge numbers of them emerging from the intestinal tissues all at once after the adult population dies off (either through "old age" or by being purged with a deworming drug). In essence, the act of deworming can trigger the next wave of larval emergence from the gut wall within a very short period of time (usually seven to 10 days).

On occasion, a severe syndrome called larval cyathostomosis occurs with the synchronous emergence of many small strongyle larvae; it can produce sudden-onset diarrhea, impaired gut motility, weakness, muscular wasting, and serious colic. Rarely, horses can suddenly die with few outward symptoms of disease, the cause being revealed only on necropsy. Larval cyathostomosis has a guarded prognosis at the best of times, and it is now considered one of the most serious parasite-related diseases in horses, making small strongyles a much more deadly foe than we once thought.

We haven't had the same success in controlling small strongyles that we have enjoyed with their larger relatives. Cyathostmes are ubiquitous in pastured horses, and they present the greatest challenge to effective parasite control for adult equines. Their life cycle within the host features extremely persistent larval stages that are not consistently susceptible to any dewormer. Drug resistance is also beginning to make certain classes of anthelmintics ineffective against some populations of small strongyles.

As a result, control recommendations for cyathostomes have to be based on a number of complex factors. Let's look at each in turn, then try to form some coherent parasite control recommendations for mature horses in various regions of North America.

1. Objectives of Control. It's an interesting exercise to ask horse owners, "Why should

Anthelmintics with Adulticidal or Larvicidal Activity Against Cyathostomes

DRUG ACTIVITY	CHEMICAL NAME
Adulticidal	Benzimidazoles, fenbendazole (5 mg/kg), oxfendazole (10 mg/kg), oxibendazole (10 mg/kg), macrocyclic lactones, ivermectin (0.2 mg/kg), moxidectin (0.4 mg/kg), tetrahydropyrimidines, pyrantel pamoate, pyrantel tartrate
Larvicidal	Moxidectin (0.4 mg/kg), fenbendazole (10 mg/kg daily for 5 days)

you control parasites?" Most will offer a response that includes some reference to improved health or enhanced performance. But the answers differ if one refines the question and asks, "What are you specifically trying to do when you give a dewormer?" The most frequent answer is, "To kill worms." However, killing worms per se is *not* the objective of a parasite control program. This is especially true for cyathostomes. It is actually the larval stages, encysted in the mucosa and impervious to most dewormers, that cause the most damage to the horse, and the worst of these effects is when the larvae emerge to repopulate the lumen. The adult worms in the intestinal lumen that are shedding the eggs are much less damaging than their immature siblings.

KIM AND KARI BAKER

The true objective of parasite control is preventing contamination of the environment with the eggs of the target parasites. Once strongyle eggs turn into infective larvae, the only factors that can diminish the risk of future infections are hot weather, time, and keeping horses off the pasture.

The true objective of parasite control is to prevent contamination of the environment with the eggs of the target parasites. Once strongyle eggs turn into infective larvae, the only factors that can diminish the risk of future infections are hot weather, time, and keeping horses off the pasture. The single practical way to decrease future infection is to limit the passage of worm eggs by killing female worms before they reproduce. So that's what we aim for with cyathostome control recommendations: Limiting the passage of large numbers of strongyle eggs onto pasture.

2. Environmental Factors. Because larvae encysted in gut tissues are not consistently susceptible to dewormers, all horses pass strongyle eggs in their manure at a predictable interval after treatment. Regardless of the anthelmintic used, it is impossible to "clean out" a horse's parasite burden by deworming.

When strongyle eggs pass into the environment, their ultimate infectivity is controlled by environmental conditions. In the southern United States, the climate is most conducive for hatching of strongyle eggs and their development into infective larvae during autumn and spring. In winter months, larvae can survive on pasture for long periods of time, but in the summer, larval development and survival are poor. In the north, environmental conditions are most conducive for hatching of strongyle eggs and their development into infective larvae during the spring, summer, and autumn. Contrary to popular opinion, conditions from autumn through winter are very favorable for the persistence of infective larvae on pasture.

During certain seasons (i.e., summer in the south) or in particular management conditions (i.e., stabling during winter in the North), strongyle eggs can't develop into future parasites. Under these circumstances, it's harmless for horses to pass large numbers of strongyle eggs in their manure, because those eggs don't turn into future parasites. At these times, anthelmintic treatments can be reduced or even discontinued.

3. Host Factors. Individual horses vary widely in their susceptibility to cyathostome infections, and fecal egg counts (FEC) will reflect those differences. The majority of the parasites in any group of animals are concentrated in a minority of the animals. Traditionally, however, all horses in a herd have been treated exactly the same when it came to parasite control. When one considers this practice critically, it should be obvious that routine deworming is unnecessary for some members of the herd; at best this practice is cost-inefficient for the animals that receive more treatment than necessary, and at worst it promotes drug resistance. It is also likely that the same programs that are excessive for some horses will prove to be suboptimal for highly susceptible members of the herd.

Fortunately, it is possible to categorize the potential of members of a herd to contaminate a pasture with strongyles. The timely determination of quantitative fecal egg counts can identify the troublemakers as well as the easy keepers (see "Determining a Horse's Strongyle Contaminative Potential" on page 4).

Quantitative fecal examination is *absolutely essential* if one intends to approach parasite control in a logical, medically based fashion. However, most equine practices probably don't offer this procedure for their clients at the present time. Let your veterinarian know that you want this service and are willing to support it (pay for it). Diagnostic testing isn't free, but the expense might be offset by money saved when eliminating some unnecessary or ineffective anthelmintic treatments.

4. Anthelmintic Issues. The first step is to determine which anthelmintics are effective in your herd. This can be accomplished by Fecal Egg Count Reduction Testing, or FECRT (see "Diagnosis: Examining the Evidence" in the June 2004 issue, www.TheHorse.com/emag.aspx?ID=5193, for

this diagnostic technique) with all of the major drug classes that are effective against cyathostomes (see "Anthelmintics with Adulticidal or Larvicidal Activity Against Cyathostomes" on page 6).

You also need to become familiar with the expected egg reappearance periods (ERPs) of the various anthelmintic products (see "Interval After Deworming with Various Anthelmintics to Perform Fecal Egg Counts for Determining the Strongyle Contaminative Potential of Individual Horses" on page 2). ERP is an extremely important concept in small strongyle control. As we've emphasized previously, most dewormers don't kill the encysted larval stages, and even those dewormers that are approved for this purpose do not completely eradicate the larvae. Therefore, when you treat a horse with an effective dewormer that removes adult worms from the intestinal cavity (lumen), encysted larvae already lurking in the intestinal wall are primed and ready to repopulate the gut lumen.

ANNE EBERHARDT; INSET–SARAH JACKSON

If we can learn to deworm horses according to the fecal egg count evidence rather than the calendar, the end result might just be less reliance on anthelmintics, which will help preserve their effectiveness and stave off those ever-looming resistance issues.

It takes several weeks for emergent worms to become sexually mature and begin egg laying. The time between treatment and when eggs reappear in feces is the ERP (egg reappearance period), and the ERP differs depending on the drug you use. If the time between treatments exceeds the ERP for the drug last given, then egg shedding onto pasture will occur, guaranteeing that horses will always be infected.

Since ERPs differ for the different dewormers, using standard intervals between treatments in a rotation will likely fail to adequately control egg shedding in many horses, and this is your primary objective. It is also important to appreciate that if there is no egg disappearance, then egg reappearance becomes a moot point. High levels of resistance to many common dewormers means that you won't achieve egg disappearance with your treatments, and thus will again fail to adequately control egg shedding.

5. Management Issues. Standard parasite control measures are always helpful. These include providing safe pastures. What's a "safe" pasture? That's one that has been left vacant for at least two months during the warm season of the year, one used recently to produce hay, or a pasture that was grazed by an alternate livestock species, such as cattle or sheep.

If possible, horses should not be fed directly off the ground. Manure collected from stalls or from paddocks should be composted for at least several weeks before it is spread on occupied pastures. Pastures should never be harrowed (dragged) while they are occupied by grazing horses, and harrowing should only be performed during the warmest months of the year.

Take-Home Message

In the past 12 months, we've taken a thorough and exhaustive look at the current state of parasitism in North American horses. If there is only one message you take home from all of the information we've presented, it should be that there is a pressing need to change our thinking about parasite control methods and recommendations.

We've gotten used to deworming our horses by rote and without much veterinary intervention; now it's time for veterinarians to become more involved again, with informed consultation and monitoring services. Horse owners also need to become more proactive about parasite control and to be willing to pay for that consultation and monitoring instead of just buying another tube of anthelmintic paste and trusting it to do the job.

Time-honored health care routines can be hard to shake. But if we look at the data and recognize the shortcomings in the traditional approach, we can become more open to the idea of deworming according to the FEC evidence rather than the calendar. The end result might just be less reliance on anthelmintics, which will help preserve their effectiveness and stave off those ever-looming resistance issues. That's a goal few could argue—especially when it also results in healthier, less parasitized horses.