Parasites

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Parasites in horses: are you playing your part?

Denmark's approach to parasites in horses should have owners around the world thinking about how well they manage the worm burden in their animals.

Horse owners in Western countries largely take for granted the fact they can walk into any saddlery or veterinary clinic and buy a drench. There are unlikely to be questions about what parasites you intend targeting or whether the active ingredients in that particular brand will do the job you intend.

Denmark changed all that in 1999.

Over-the-counter sales went out the window and sales of drenches, more properly called anthelmintics, became prescription only. It placed worm control firmly back under the control of veterinarians, who have to be satisfied a horse's worm burden is such that it requires dosing. Many horse owners would see this as a bad idea and only adding to the cost of worm control in their animals.

However, Denmark may not be the last Western country to tighten controls over drenches, as concern grows worldwide over parasite resistance.

The unfortunate reality is that many horse owners use drenches inappropriately and, in doing so, are fuelling the growth of parasite resistance to drenches.

There are many brands of drenches available around the world, but there are relatively few active ingredients. In others words, there are only a handful of chemicals that are proven to be safe and effective in worm control.

With no new families of drenches waiting to be launched on the market, it is every horse owner's responsibility to use drenches wisely and effectively while at the same time ensuring they are doing their bit to minimize the growth of worm resistance.

Horse owners also need to employ other measures around their property to minimize drench use.

For decades, horse owners have relied on regular dosing with drenches every six or eight weeks to keep worms under control. They do so without any particular evidence that the drench being used is effective, or even that the horse needs to be drenched at all.

Parasitologists are now largely of the view that horse owners need to be smarter in their drench use. They need to monitor whether the drench they are using is effective and determine whether the horse needs the dose in the first place. Both of these can be achieved through fecal egg counts.

Eliminating parasites from horses is not realistically achievable. Horse owners need to implement a worm control program that makes responsible use of drenches, as well as sound pasture management, to keep their horse's worm burdens at sufficiently low levels to avoid health problems and disease.

Denmark's move to tighter drench control some 10 years ago was an acknowledgement of just how serious growing parasite resistance has become, especially in relation to the most troublesome of parasites, the nematodes known as strongyles.

While the jury is still out over the success or otherwise of Denmark's move, it is a clear and present reminder to horse owners that, as long as drenches

can be bought over-the-counter, the responsibility to control the growth of worm resistance rests in their hands - and no one else's.

The life and crimes of equine parasites

How the worm turns

Life would seem to be pretty rosy as an equine parasite. Living inside a horse offers a warm and comparatively stable environment, with the necessary nutrients immediately to hand.

Parasites in horses have been around a long time. Their prevalence has ebbed and flowed with the fortunes of the horse over millions of years.

During that time they have developed specialized niches and have caused horses varying degrees of grief.

Some are comparatively harmless but others can cause complications and disease severe enough to kill the host horse.

In short, you ignore equine parasites at your peril.

Mankind has developed drenches, more properly called anthelmintics, to tackle the worm burden of horses.

They have proved effective but the raft of parasites that affect horses haven't survived millions of years without learning a trick or two.

Drench resistance is becoming a growing problem and concern.

Some drenches have become relatively ineffective against resistant varieties. This is bad news for horse owners, as this is a battle they cannot afford to lose.

Strongyles are a common horse parasite that pose a major threat if burdens are not properly managed.

This series will explore the whole issue of equine parasites. It will do so in simple terms and will provide practical guidance for horse owners.

Unfortunately, in this war, there are no simple answers. There is no "one size fits all" solution. Each horse owner must assess their own situation and apply the knowledge to their own worm-control program to best effect.

Parasites are not without their problems.

For one, they need to find their way from one host to another to ensure the long-term survival of the species. To do this, most have developed life cycles that see them exiting one host in the hope of infecting another.

The horse owner's aim is to break this life cycle and keep parasite numbers within their horses within acceptable limits.

This series will look at the life cycles of each of the common parasites and the strategies they use for survival. This is important as horse owners can use this knowledge to their advantage, exploiting weakness in the parasites' "game".

It will explore the variety of drenches available and their known strengths and weaknesses. It will look at management practices that will help your deworming program and will explain how to conduct your own fecal egg counts.

While fecal worm counts have their limitations, it will give horse owners a valuable opportunity to tailor worm management programs to each of their horses.

This is a sound option as research has shown that some horses harbor very few parasites while others quite quickly develop heavy worm burdens. The majority, of course, occupy the middle ground.

If horse owners know the susceptibility of each of their horses to parasites, they can develop strategies and dosing regimes that reflect this.

Regular fecal egg counts also mean you avoid dosing horses when their worm

Doing your own fecal eggs counts should be a key part of your worming strategy.

burden is low. For horses that quickly develop heavy burdens, you may end up dosing more regularly.
Effective worming strategies mean you are playing your part in minimizing the advance of drench resistance.
It is important to bear in mind that effective parasite control is not a straightforward business, even though it is nice to think that regular drenching with any one of the brands available off the shelf will do the trick.
Your ultimate goal should to be to maintain parasite levels at low levels in your horses. You want to achieve this using sensible farm management practices and using drenches only when necessary and to maximum effect.
This two-pronged strategy will ensure you're playing your part in reducing the growth of resistance in parasites.
The numbers game

Equine parasites come in many sizes and shapes. Some commonly grow to 20cm in length and can even reach 50cm. In sufficient numbers, they can cause a potentially fatal intestinal blockage.
Many are very tiny indeed and can be present in their millions.
Some develop into highly efficient egg-laying machines. Infected horses can be passing out millions of eggs a day in their feces, supporting a parasitic life cycle that will see other horses infected.

Most parasites take up residence in a horse's gut. It's not difficult to see why. There's a plentiful supply of nutrients and access is pretty easy, via the horse's mouth.
Exiting presents few problems, either. Their eggs simply pass out in the feces, or, in some cases, the mature parasite simply lets go of the gut wall and journeys out through the intestine and into the pasture.
We refer to most of these gut-based parasites as worms. It's a good general term, but scientists have more precise scientifically accurate terms for them. For example, the different roundworms that infect a range of animals, including horses, are more properly called nematodes.
What exactly is a parasite? In its simplest terms, it is an animal that lives in another host animal. It draws sustenance from the host and will nearly always cause some harm in doing so. If enough parasites are present, their collective "harm" can cause disease. Scientists who study these worms are called parasitologists.
You'll notice our simple definition of a parasite uses the term "animal".
There are many organisms - some are actually too simple to even be called an organism - that fit neatly within the definition of a parasite, such as prions, viruses, bacteria, and some fungi.
Parasitologists are concerned with those organ-

Easy exit: Most parasites lay eggs which exit your horse in its dung and then develop to an infective stage.

isms that fit into the definition of animals - albeit simple ones. These include the likes of nematodes, flatworms and protozoa.
They also include a bunch of arthropods - lice, fleas, ticks and the like - which have very different life cycles from those we generally refer to as worms.
About 150 different internal parasites are known to affect horses.
Obviously, organisms of interest to parasitologists are far more complex than the likes of bacteria or viruses, but there are other important differences.
A virus, for example, is a tiny bundle of genetic material which can multiply only within a host cell. Bacteria are a step up the evolutionary chain, being single-celled organisms but without a nucleus housed within a membrane.
Viruses and bacteria infect their subject and, if conditions are to their liking, multiply rapidly within that host, resulting in illness or disease once their numbers reach a high enough level.
Internal parasites, on the other hand, generally do not multiply within their host.
They may, once established, produce millions of eggs for returning to the pasture but, with only a few exceptions, the arrival of one parasite egg inside your horse's gut will result in one case of infection.
One swallowed roundworm egg, for example, will result in one roundworm within your horse's gut. If they ingest more parasites, numbers will naturally rise.
This is an important consideration. While viruses or bacteria will multiply rapidly within their hosts, the level of parasites found in any particular horse will be related directly to its exposure to the eggs of infective larvae in the paddock.
Like viruses or bacteria, once numbers reach a certain level, they will start to affect the health of the host animal, with symptoms ranging from coughing, ill-thrift and malnutrition to colic.
The aim of your parasite control program is to keep these parasite numbers at a level where they cause no health issues.
You will not eliminate all parasites from your horse's gut and maintain that glorious state of affairs. Some can be so plentiful (small strongyles) that horses may re-infect themselves from virtually their first mouthful in a paddock.
That said, horse owners can employ several important strategies to minimize horses' exposure in its environment.
Horse owners will be familiar with the brands of drenches available to them. These products will contain one, or a combination of different worming agents, to tackle your horse's worm burden. They will be agents such as ivermectin or fenbendazole.
The various worming agents - and it has to be said that mankind does not have a vast array at its disposal - are not necessarily effective against all worm varieties, or indeed at all stages of each worm's lifecycle.
While proprietary worming agents will clearly identify which parasites they target, horse owners are well-advised to be familiar with the different worming chemicals available to them. Why? Because worm resistance is a greater problem in some drenches than others, and part of your strategy will be to change drenches from time to time to boost the effectiveness of your worming

Infective larvae lie in wait on grass in the hope of being ingested by grazing horses.

program.
This means you'll be reading the fine-print on the drench containers so you understand what you're buying.
Regular fecal eggs counts will also allow you to monitor whether a particular drench is proving effective against the key worm varieties.
However, your drenching program will be only one part of your worm control program.
If you can minimize a horse's exposure to eggs in a paddock environment, the horse is likely to maintain a lower worm burden for longer, thus reducing your need for drenching.
However, none of this should be a matter of guesswork. That is why fecal egg counts should be a part of your worming strategy, as we'll discuss later.
Unfortunately, in the world of parasites, there are exceptions to the general rule. There exist several protozoal parasites which can cause your horse grief and these behave in a different way to the major non-amplifying parasite.
These tiny single-celled organisms are able to multiply within their host and, once numbers reach a critical level, cause disease. But even protozoas must eventually leave their host to complete their life cycle.
And, yes, there is a common parasite that can hang out on one host and reproduce generation after generation without the need to return to the environment. It is the humble louse. More on them later.
The take-home message for control is pretty simple. Drenches will play an important part in parasite control, but your management of your horses and their environment is just as important.
Not all worming agents are created equal and how you use them will have a major bearing on their effectiveness.

How tough will the battle be?

Parasites can cause horses serious problems, and with around 150 internal parasites able to wreak havoc, that can add up to a whole heap of trouble.
Most horse owners realize that heavy worm burdens can cause ill thrift. Horses may develop a dull or rough coat, have little energy and lose weight.
However, they can also be responsible for colics, intestinal ruptures, gut irritation, lung problems, damage to internal organs and a host of other maladies.
The biggest troublemakers are large strongyles (bloodworms), small strongyles, ascarids (more commonly called roundworms), pinworms, bots, tapeworms, threadworms and lungworms.
Each has a different lifecycle involving adult and larval stages. A horse can be infected with different kinds of parasites, all at different stages in their life cycles.
Mature parasites will be laying eggs furiously - potentially hundreds of thousands of eggs can be passing out in an infected horse's dung. Often, within a matter of days, if conditions are right, these will be able to infect other horses grazing the pasture.
The prevalence of parasites varies from country to country and region to region, the most likely key influence being climate.
Next, we'll look at the drenches available to us in the battle against equine parasites.
All horse owners need a knowledge of drenches and their effectiveness. Not all drenches work against all parasites and it is the responsibly of horse owners to do their bit in reducing the chances of drench resistance developing.
However, drenching is only part of a worm-management strategy As we'll discover later, how you manage your horses and the pasture they graze will have a major bearing on your ability to keep worm counts in check.
A is for anthelmintics

It's time to take a closer look at the agents available to us in the war against worms.
Drenches, which are more formally known as anthelmintics, are available un-

der an array of brand names, but what's important is the active ingredient - or ingredients.

There are, in fact, only a comparatively modest number of drench families available to us. Each has its strengths and weaknesses and it is useful to understand them.

Strongyles: The biggest troublemakers.

Most drenches work by paralyzing the parasite. This generally has one of two effects. Some will let go their grip on the gut and pass out of the animal. If this isn't the case, the paralyzed parasite will be unable to feed, runs out of energy, and dies.

Parasites have no fat reserves so if they're unable to feed they quickly die.

The reason we need to be familiar with the drenches at our disposal is that not all have equal effectiveness. Some target only certain larval stages of some parasites and may not even be able to kill some at all.

Let's start with the stars in the line-up, the so-called macrocyclic lactones which we know better as ivermectin and moxidectin. They are highly effective against gut parasites and also deliver a killer blow to lice and other skin-based parasites.

Parasite control would much trickier without this family batting for our side.

The benzimidazoles are made up of fenbendazole, oxfendazole and oxibendazole. They are effective agents but tend to be at their best in courses delivered over several days.

The tetrahydropyrimidines comprise pyrantel pamoate and pyrantel tartrate. They are fast-acting but kill only adult parasites, meaning worm populations recover rather more quickly than other drenches, given that the maturing larvae survive the dosing.

Piperazine is not commonly used in horses these days and would normally be administered by a vet using a tube into the horse's stomach. In some part of the world it may be available to be administered as a feed supplement.

The last drenching agent is praziquantel, which is an important player because it is the only agent horse owners have in their arsenal which is effective against tapeworms. It is normally sold as part of a combination drench with ivermectin or moxidectin.

It you want to get a hit against tapeworms, you need to be reading the label to ensure the product contains praziquantel.

Mankind's worming arsenal

Mankind has known about worms in horses for centuries, but have had effective strategies to deal with them for a much shorter time.

Blood-letting was once considered an effective cure, as was making a horse drink its own blood. In fact, blood-letting would cure just about anything in what was clearly a triumph of marketing over substance.

People were on a better track when they decided that dosing a horse with certain things by mouth would overcome a worming problem.

Without doubt, literally hundreds of different agents have been tried over the centuries and most shared a number of attributes. At best they were ineffective and harmless, but many were poisonous and caused terrible health problems in horses, even death.

History tells us that animal offal was given as a worming agent and even highly toxic mercury.

Some of these remedies would undoubtedly have delivered a killer blow to the parasites in a horse's gut, but unfortunately harmed the horse in the process. What proved toxic to the parasites proved similarly toxic to the horse.

The key to identifying drenching agents has focused on identifying substanc-

es that are toxic to the parasites but do little or no harm to the horse.
Herbal remedies rose in popularity but many proved toxic to horses.
By the early 1900s horses were regularly being dosed with either carbon disulfide or carbon tetrachloride.
They both killed parasites but, like so many of the drenches that had gone before, both proved toxic.
Another worming agent from the period included tobacco (apparently a variety called Virginian shag was considered very effective). It was given internally for parasites, and a plug of tobacco in the anus was considered effective against pinworms.
Horse owners were delivered what could rightly be called the first dewormer of the modern era in the 1940s. It was called phenothiazine.
It was an effective treatment against strongyles although its toxicity to horses remained a concern. It remained popular for a good 20 years and scientists noted what would become the bette noire of all drenches - growing worm resistance to the chemical.
Resistance to phenothiazine was first recorded in the late 1950s.
But by this time horse owners suddenly had a choice. They could use piperazine and it was promoted as being effective against a range of parasite types. Unfortunately, it couldn't work its magic against large strongyles.
Later still, some organophosphates were used but proved very toxic, and not just for horses.
Some of these early wormers were marketed in combination and proved quite effective. The combination also meant the active agents could be given in lower doses, which was better for horses.
One of the biggest breakthroughs in worming came in the 1960s and 70s when the benzimidazoles came on the scene. They were highly effective against a wide range of parasites and the dose rate required was so low that they were considered very safe.
First out of the starting blocks was thiabendazole. This chemical not only delivered never-before-seen levels of effectiveness, it delivered another important change.
It truly brought deworming to the masses. Before then, drenches were largely given by veterinarians. The margin of safety was such with the benzimidazole family that they could be sold over-the-counter in easy-to-use pastes.
Other members of the family quickly followed: cambendazole, oxfendazole, fenbendazole, oxibendazole and mebendazole. Some of these can still be found in modern drench formulations.
These were grim times for your average equine parasite. The war, it seemed, was won.
Horse owners took to these safe and effective drenches in their droves. The parasites, never before exposed to such an effective agent, died in countless numbers.
What could possibly go wrong?
Scientists had already seen worm resistance in phenothiazine, and the benzimidazole family was to be no exception.
Parasites had not lived for millions of years without learning a trick or two.
Worms began developing a resistance and the effectiveness of these agents began to decline.
By the 1970s resistance was well documented, but the show was far from over.

Drenches are available under many different brand names, but the number of active ingredients used are relatively few.

Next up was pyrantel, which was new, effective and, like the benzimidazoles, safe to use. Parasites proving resistant to the benzimidazoles were dispatched with this new weapon in the war against worms.
But this was proving very much like a game of cat of mouse. Horse owners had a range of deworming agents available to them but the worms kept developing resistance.
Could the cycle be broken?
The real star in the Deworming Hall of Fame arrived in the early 1980s. Ivermectin was effective to an almost unbelievable extent. It worked on a wide range of parasites and proved very safe.
Once on the market in paste form, it quickly became a market leader.
For a time, it seemed parasites were not developing resistance to ivermectin, but it was not to be. Resistance may not have been as quick to develop against ivermectin as it was against other deworming agents, but develop it did, although admittedly not to the same extent as other drench families.
Next on the world stage was moxidectin, which, like ivermectin, is a member of the drench family called the macrocyclic lactones. It is broad spectrum like ivermectin, but, crucially, proved effective against small strongyles in their encysted larval stage. More on this later.
Today, a range of deworming chemicals is available to horse owners but all have fallen victim - at least in part - to worm resistance.
Perhaps scientists will develop new drenches in the fight against parasites. Perhaps these drenches will work on parasites in a way that reduces or even eliminates the development of resistance.
It would be dangerous for the horse community to assume that something bigger or better is just around the corner.
Prudent horse owners need to work with the cards they have been dealt and, today, that comprises a quite limited range of deworming chemicals with a range of properties.
Some are effective against some parasites, but not all, and others are effective only against parasites at certain life stages. All have seen worm resistance develop against them, some more than others.
The battle, on the evidence so far, is not about to be won.
Horse owners must therefore use all the tools available to them, using horse and paddock management techniques that minimize exposure to parasites, as well as rotating the drenches available to them to reduce the chances of resistance.

Rotation, rotation, rotation

You might think that the principle of rotating horse drenches has been with us for as long as we've had drenches. Not so.
For a start, we were heading into the 1960s before we had much in the way of drenches that could be considered suitable for rotation.
Rotating drenches as a sound management practice became established during this period, but not for the reasons you might think.
Drenches were not effective against all parasites so the sensible course was to rotate them. Drench resistance was not then the problem it is today, but finding drenches capable of doing the whole job was.
Scientists began learning more and more about the resistance problem, but strategies for the most effective use of wormers were not really taking shape until the mid-60s.
Until then, most horse owners would drench their horses when they felt they needed it. Perhaps it was the pot-belly appearance or a dull coat or tail-rubbing that persuaded them it was time to invest in a tube of drench.
Of course, by the time such signs were showing in the horse the worm burden would already have been significant.
The recommendation that we drench horses every six to eight weeks came to us in 1966 when parasitologists Gene Lyons and Harold Drudge published a paper on the subject.
They looked long and hard at the life cycles of parasites and saw that, with

drenches, horse owners could not only kill the parasites inside their horses but, with correct timing, could reduce the number of eggs being deposited in pastures when a horse passes dung.
Pastures with fewer eggs meant a slower rate of re-infection among the horses grazing it.
They recommended drenching horses with a particular drench combination at six to eight-week intervals. Their principles were adopted widely. Tubes of drench began carrying their dosing recommendations and horse owners began marking their calendars and dosing their horses regularly.
It made a huge difference. Horses that once carried major worm burdens had their parasite problem dealt with and it was kept under control long-term.
The principle of drench rotation remains important but times have, to a considerable extent, moved on. Drench resistance is now a much bigger problem than it was 40 years ago.
Rotation is still important and some horse owners rotate through a different family of drench every six or eight weeks. This is unlikely to be a sound strategy.
Firstly, researchers have yet to be convinced that rotating drenches for **every** drench cycle delivers any particular benefit and, secondly, it can make it much harder to establish the effectiveness of any particular drench.
Rotation is important, but not every cycle. Horse owners are best to use drenches they can show to be effective on their property, that target the right parasites, with very occasional rotation to slow the advance of worm resistance.
It is quite possible that an entire round or two of drenching is effectively a waste of time and money, due to resistance.
That is where fecal egg counts can prove so valuable. By monitoring the fecal egg count of horses, owners can over a period of weeks build a picture of the worm problem on their particular property.
Worm resistance is on the one hand a universal problem, but its prevalence across different countries and regions and worm species is variable.
Many factors will feed into the parasite picture on your property, including the pattern of drench use in preceding years and the comings and goings of horses and the parasites that they carry. Past management practices of the pasture will also have a big bearing.

The rotation of drenches needs to be managed carefully.

Fecal eggs counts will also prove invaluable for those who choose to use natural or herbal worming agents. Egg counts will allow you to determine once and for all whether a particular worming strategy is successful - whether you're using a recognized family of drenches or a herbal concoction.
No matter what you use, if the egg counts are high or fail to drop adequately after drenching, it's time to change your tactics.
We've discussed the issue of resistance, which is a parasite's ability to tolerate the chemical agent employed to kill it. If the resistant parasite gets to reproduce, it is likely that trait will be passed on to future generations.
Can horses themselves deliver a killer blow to parasites? A healthy immune system can overcome a raft of viral and bacterial infections. Why doesn't the immune system do the same with parasites?
Partial immunity does appear to develop in horses against some parasites. In fact, in the case of two parasites, horses seem to be particularly effective in developing a high level of immunity.
Strongyloides westeri (threadworms) can be a major problem in horses up to six months of age but then are rarely present. Parascaris equorum (ascarids or roundworms) pose their biggest threat in animals up to two years of age, then largely disappear from a horse's gut.
Unfortunately, immunity is no get-out-of-jail-free card.

No horse owner should assume that a horse's immune system will deal with its worm burden. Nor should they think that supplements to boost a horse's immune system will in turn deal with the animal's parasite problem.

The following strategies will help in the fight against worm resistance:
* Never under-dose a horse, except on veterinary advice. A vet may recommend such a course to ride a young horse of a heavy ascarid burden. For accurate dosing, you will need an accurate estimate of your horses weight.
* Use your fecal egg counts to monitor the effectiveness of your drenching program.
* Don't drench unnecessarily.
* Use pasture management techniques to minimize the re-infection rate.
* Quarantine new horses on your property and dose them with a good, broad -spectrum drench. The last thing you want to do is introduce drench-resistant worms to your property.

That said, individual horses will vary in their ability to handle worm infestation, and the effectiveness of their immune system will play a part in this.
We already know that some horses develop high levels of parasite infestation quite quickly while others tend to consistently return low fecal egg counts.
Clearly, some horses are more susceptible than others to worm infestation.
Evidence also suggests some horses are better at coping with a worm burden than others. In other words, two horses with similar levels of infestation may present in quite different ways. One may have a pot belly and dull coat, the other still appear quite healthy.
Using fecal egg counts, we can identify the more susceptible animals and tailor their worm-management program accordingly.
So immunity is important in the worm-fighting equation, but it doesn't mean you can leave your drench in its packet.
Many drenching experts appear to agree that ensuring the drench you're using is proving effective is just as important - or possibly more so - than routine rotation of drenches. It is a sensible argument.
The introduction of broad-spectrum drenches containing a number of active anthelmintics has not only improved the efficiency of drenches, but arguably reduced the need for regular rotation.
The key is ensuring that the drench you're employing is doing the job. If you cannot establish that, you may not only be failing to deal with worm burdens adequately but you're potentially helping to grow worm resistance.

Meet the nematodes

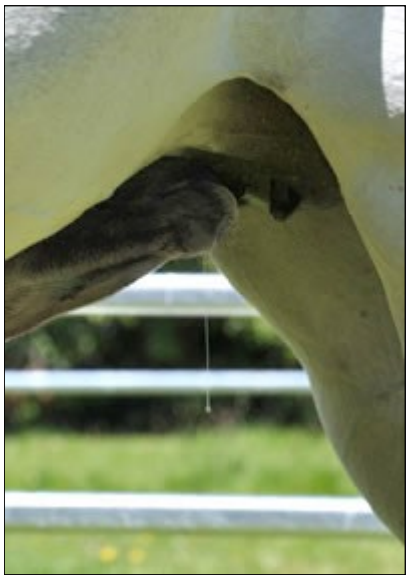
Nematodes are the parasitic equivalent of the Addams family, but without the funny side. Most of your deworming campaign will focus on keeping nematodes under control.
The main nematodes that affect horses are large strongyles, small strongyles, large roundworms, threadworms and pinworms.

We'll be dealing with each of these nematodes in greater detail later, but essentially nematodes follow similar life cycles.
The eggs laid by adult nematodes generally pass out of the horse in dung.
Several larval stages will generally follow either in the dung or the soil, or both.
Their last molting in the environment will produce an infective larvae with the aim of being eaten by a passing horse as it browses its paddock or snuffles in its bedding.
With some kinds of nematodes, infection can occur by licking a contaminated coat and some can even be passed to foals through contaminated mare's milk.
In the case of large roundworms or pinworms, the parasite relies on the ingestion of the eggs directly, not larvae.
Each kind of nematode will have a different effect on a horse's health, with much depending upon the level of infection.
Suffice to say that nematodes are public enemy number one - top of the equine "Ten most unwanted" list.
If you deworming program manages to knock nematodes out of the park, there's a very good chance you'll have the other key parasites under control, too, except, perhaps, tapeworms.
Let's now look at each of these parasites in detail.

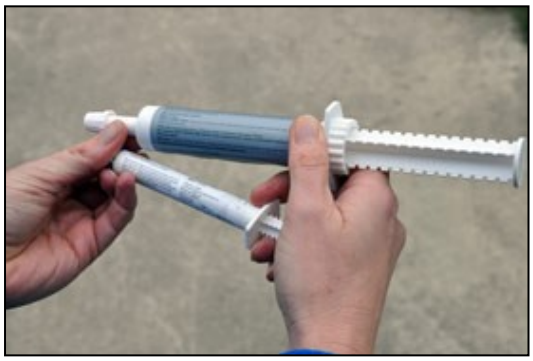
Strong-arm tactics against strongyles

Strongyles are the really bad kids on the block. They top the most-unwanted list on pretty much any list of equine parasites.
They pose a serious threat to horse health.
In fact, if your horse is unwell or dies because of a parasite burden, there's a pretty good chance that strongyles will be responsible.
They are worm-like in appearance and are white or red in color, ranging from around 2mm in length up to about 50mm.
There are dozens of strongyles but they are lumped into two main categories - the large strongyles (strongylinae) and small strongyles or small redworms (Cyathostominae), of which there are about 50 different kinds that affect horses. About 10 of these are considered common.
While the large strongyles are the monsters of the family, small strongyles are still visible to the naked eye.
Large strongyles comprise bloodworms (Strongylus vulgaris) and large redworms (Strongylus equines and Strongylus edantatus).
They are all members of the wider nematode family. There are males and females, with the females capable of producing vast numbers of egg.
A horse infected with strongyles can be passing millions of eggs a day in their dung, laying the foundation for the next life cycle.
While hanging out in a horse's insides is a pretty pleasant place to be if you're a strongyle, very significant stages of their life cycle must occur outside the horse.
Let's follow one of those strongyle eggs: Once produced by the female adult strongyle in the horse's gut, it has a one-way ticket out of the horse's gut, eventually ending up in a pile of dung with countless thousands of its mates.
Life outside a horse is a very different place and temperature will be play a very big part in the rate at which the egg can hatch and develop.
The temperature must be in the range of 7 deg Celsius to 30 deg Celsius in order for the eggs to hatch. In most temperate areas, that pretty much rules out winter.
If temperatures are to their liking, the eggs will hatch quite quickly into first-stage (L1) larvae and get sustenance from the manure. They molt into second-stage (L2) larvae and finally the L3 stage. They are then - and only then - capable of re-infecting a horse.
In ideal conditions, a strongyle egg can go through the three larval stages in three days. If conditions are more marginal, the process could take several weeks.

The third-stage larvae are very different from the first two stages. They are tightly enveloped in a tough membrane and don't even have a mouth. These larvae are intent on just one thing: surviving long enough to infect another horse.
Without the ability to feed, third-stage strongyle larvae are literally in a race against time and the vagaries of weather. The warmer the temperatures, the faster their metabolism and the quicker they use up their energy store and die.
However, in wintry or freezing conditions they use hardly any energy and can hang on for months. So while a good frost might kill some of the less resilient strongyle eggs in a pasture, those same conditions are providing the infective third-stage larvae with that most valuable of commodities - time - to infect a horse.

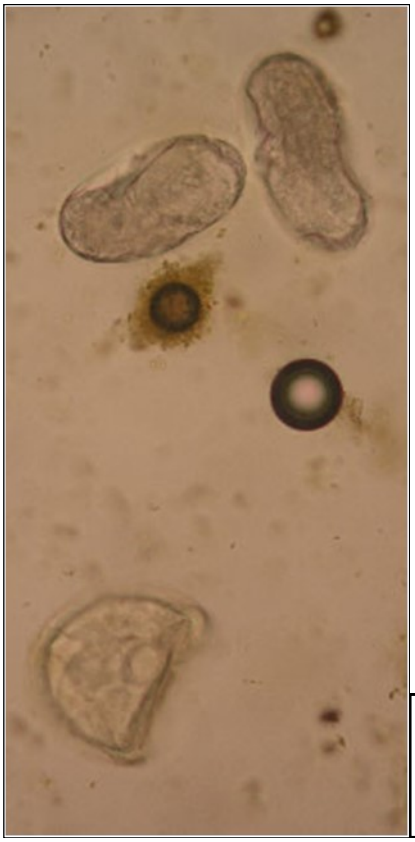


Some nematodes can even infect foals through contaminated mare's milk.



After a king hit against strongyles? Not all drenches are effective against all stages of small strongyles.

The tough membrane will also protect the strongyle from drying out, although, as mentioned above, heat will see them use up their energy reserves and die considerably quicker.
They hang out on blades of grass in the hope that a passing horse will ingest it.
What does this mean for horse owners? Strongyle eggs rapidly turn into infective larvae during warm summers, but the larvae have a shorter lifespan. However, larvae which reach their final infective stage on the cusp of winter can hang in for months.
Both large and small strongyles follow a similar life cycle in pasture, but their behaviors inside a horse are very different.
If you think that large strongyles spend all their time hanging out in the gut, you'd be very wrong. In fact, they can spend months migrating through parts of the horse, including important organs such as the liver.
Take Strongylus vulgaris, for example, which home in on the arteries that feed the gut, causing damage to the artery walls. Or Strongylus edentatus, which targets the liver. Yet another kind - Strongylus equines - has a liking for the pancreas as well as the liver.



Two strongyle-type eggs, at top, with a D-shaped tapeworm egg (Anoplocephala perfoliata).

This image of a horse's caecum - the first portion of the large bowel - shows the damage that can be caused by encysted strongyles, also known as cyathostomins. Encysted strongyles are very resilient.
© Martin Krarup Nielsen

All roads, as they say, lead to Rome - or in the case of large strongyles, back to the gut.
Their journey over, they mature and set about producing eggs which take that familiar exit route through the intestine to begin the life cycle all over again.
You don't have to be a parasitologist to realize that the migrating habits of large strongyles can do serious damage. Firstly, there are classic symptoms of worm infestation: weight loss, a dull coat, poor appetite, digestive upsets - either diarrhea or constipation - and a tell-tale pot belly.
They can cause internal bleeding and inflammation in a variety of places and even rupture the mesenteric artery, usually with fatal consequences.
They can cause blood clots, called a thrombus, which have the potential to break loose and cause damage by blocking off blood supply to tissues, most often a section of the large intestine.
They can cause anemia, damage artery walls, trigger liver problems and even colic. In short, your horse can do without large strongyles.
Small strongyles are focused on the gut and leave the other major organs pretty much alone. This means they are classified as non-migratory worms. However, they do have some very nasty habits that can make them difficult to control.
Strongyles tends to head for the large intestine and burrow into the intestinal lining. The horse's body retaliates by forming scar tissue which envelops each larvae. Behind such a protective barrier, these so-called encysted strongyles are remarkably resilient.

Adult Strongylus vulgaris, or bloodworms.
© Martin Krarup Nielsen

These little nodules are usually filled with blood and it is probable that the larvae feed on the blood.
Until comparatively recently, drenches struggled to make a dent in the population of encysted strongyles.
Safely entombed, they go through several larval stages before finally maturing into adults and producing vast numbers of eggs, which pass out of infected horses in their dung.
Encysted strongyles do not all develop at the same rate and this appears dependent upon the degree of infestation.
In heavily infected horses, encysted strongyles are capable of waiting for more than two years before finally maturing.
Small strongyles can cause serious problems. There might be some local inflammation when infection first occurs, but horses show virtually no signs of infection once the larvae are encysted in the intestinal lining.

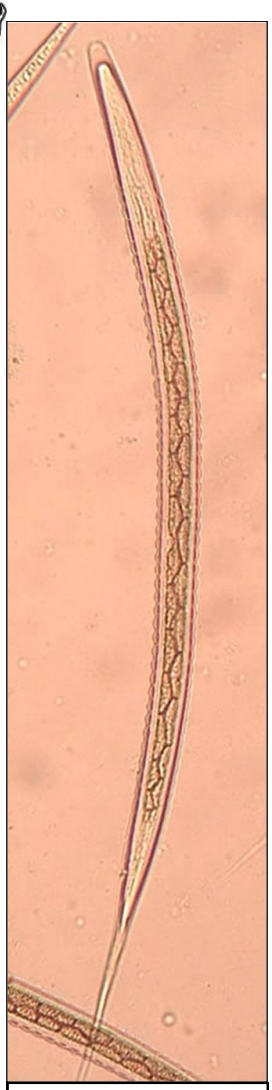
However, when the larvae mature and emerge from the cyst the localized inflammation can be quite severe. A horse can lose its appetite and suffer from diarrhea.
Bleeding from the areas of inflammation can lead to anemia and there is a very serious complication from the emergence of large numbers of encysted strongyles called larval cyathostomosis, resulting in severe irritation of the gut and a serious reduction in normal gut action, which can lead to colic and death.
With small strongyles, it is the larval stages which do most harm to a horse, not the adults.
Strongyles, we have learned, hardly play fair. It's enough to get us heading straight for the drench. But controlling strongyle infestation is not that clear cut.
While drenches may proclaim their broad-spectrum properties and claim to be effective against "strongyles", what does that really mean?
In some cases, the effectiveness the label talks of will relate only to the adult egg-laying stage.
It is entirely possible that a particular drench will be ineffective against encysted small strongyles, or large strongyles during their meandering through your horse's liver or pancreas.

Let's deal with these wandering large strongyles first. Ivermectin given at a single dose of 0.2 milligrams per kilogram of horse will deal them a killer blow, as will moxidectin at a single dose of 0.4 milligrams per kilogram of horse. Fenbendazole will also work, but a horse requires 10 milligrams per kilogram of body weight for five days in a row.
Encysted small strongyles present a special challenge and will survive most drenches, including even ivermectin.
Only two drenches are known to do the trick against these encysted larvae - moxidectin at the above-mentioned dose rate of 0.4 milligrams per kilogram of horse; and the five-day course of fenbendazole at the rate of 10 milligrams per kilogram of body weight each day. However, fenbendazole can be expected to work against these encysted larvae only if there is no resistance against it - and resistance is everywhere.
It should be noted that moxidectin is not effective against encysted small strongyles when they first enter the intestinal lining, known as the early third -stage larva (EL3), but is effective against the later encysted stages.
Strongyles clearly are a formidable foe. We need to be on our game if we want to keep the upper hand.
We can take away a few important lessons from our knowledge of strongyles. We know that we can check the feces of horses for eggs which can indicate the presence of adult, egg-laying strongyles.
While the life cycles of different strongyles vary considerably within the horse, their life cycles in pasture are remarkably similar.
It is here we get our first insights into how pasture management strategies can impact directly on the rate at which horses become infected. Clearly, prompt removal of manure from the pasture will have a real impact in containing strongyles. If conditions are warm, this needs to be done within three days to prevent the larvae reaching an infective stage.
We also know that horses are at greatest risk of infection during the winter months, when the infective third-stage larvae are able to survive longest. This means we can be strategic in the timing of our use of drench.
Strongyles are a formidable enemy and in their encysted stage can be difficult to kill. It's just as well that every other equine parasite isn't as resilient.

What's so scary about ascarids?

Foals are cute and adorable. It seems such a shame to be dosing them regularly with a chemical drench. How bad can worm infestations be in young horses?

The antics of the ascarid alone should be enough to convince you that a careful and ongoing drenching of foals and young horses is a very good idea. Ascarids, also known as roundworms, pose a considerable threat to young horses and their developing immune systems, and they have to potential to kill by triggering colic.
Even if a young horse escapes that fate, a whipper-snapper with a heavy ascarid burden will likely appear depressed and its normal growth will be affected.
The most common ascarid to infect horses is Parascaris equorum. Horses needn't feel they have been singled out for special attention. Other species of roundworms target plenty of other species, even humans.
Most ascarids are specific to a particular species. They tend to be quite large and the equine varieties are easily visible to the naked eye. In fact, P. equorum is quite enormous. Think of something the width of a ballpoint pen and up to 35cm in length.
The bigger specimens of any given species will almost certainly be female and they spend their days laying eggs furiously, which are destined for your pasture.
Ascarids on their own sound scary enough but their eggs are beautifully adapted for life in the pasture. They pass out into pasture protected by a tough shell which equips them well for survival in this tough new world.
They can withstand drying conditions and even freezing, waiting for that moment when a passing horse ingests them with grass.
Their outer layer is sticky, meaning they stick well to blades of grass, thus increasing their chances of a free one-way ticket into a horse's gut.
The larvae that develop in ascarid eggs take from 10 days to six weeks to develop to an infective stage, depending upon conditions. If conditions are just right, they can survive outside the horses for a remarkable 10 years or more, although two years would be more typical.



The third infective larval stage of the large strongyle Strongylus vulgaris, which are commonly called bloodworms.

The common P. equorum will naturally be very pleased to find itself a meal. It catches a lift to the small intestine where the larvae is released and burrows into the gut wall. Being sticky, the eggs can stick to a horse's leg and even the mare's udder. A foal will usually be exposed pretty early in its life.

Unfortunately, this is the only the beginning of the trouble. The larvae have one destination in their sights: the liver. They catch a lift in the bloodstream or perhaps the lymphatic system. Once in the liver, it hangs out for a week or so, developing into the next larval stage before catching another lift in the bloodstream to the lungs. It breaks out the capillaries in the tiny air sacs and begins migrating up the airways.

The irritation they cause can trigger coughing in their host - a very handy helping hand to keep the ascarid larvae on the move to its next destination: the upper airways.

Finally, the ascarid larvae will find itself at the back of the throat and, kind of like a pinball that's scored maximum points, it then begins to fall back - but this time into the gut.

Once swallowed, the ascarid cruises back to the small intestine, clutches on to the lining, and matures into an egg-laying machine.

A drench is starting to look a pretty good alternative for a young horse to a bad-ass bunch of ascarids.

It goes without saying that the migratory habits of ascarids cause damage. How this shows in the horse will depend upon the degree of infection and the whether the larvae are in their migratory phase.

When migrating, a horse may well show signs of respiratory problems. It may have a nasal discharge or a cough and possibly a fever. Antibiotics will make no difference as they don't kill ascarids.

A heavy burden in the gut will likely show in the classic signs of a poor coat, a loss of weight, a pot-bellied appearance and sluggishness.

Ascarids present one other notable danger. Their size is such that collectively they have the ability to block the intestinal tract of a young horse and trigger a potentially fatal bout of colic.

Ironically, this colic can be triggered by a dose of drench. The worms are killed, fall away from the intestinal lining and cause a blockage. This is the primary reason that you not only need to drench young horses, but do so regularly to ensure there is no potentially fatal build-up of mature ascarids in the gut.

There is one good piece of news about ascarids.

Horses appear to develop quite effective immunity against infection as they grow older. Ascarids are at their most dangerous in horses up to about 15 months of age. Undrenched younger horses can end up with hundreds of ascarids, triggering serious health problems.

Older horses undoubtedly continue to ingest ascarid eggs, but they rarely result in a rate of infection that is likely to cause the animal any particular problems. You will rarely see ascarid eggs when doing a fecal egg count on a mature horse.

Horses older than about 15 months will generally have developed good resistance to ascarid infection.
© Horsetalk.co.nz

It's a different story when doing fecal egg counts of younger horses. It's possible to find extremely high egg counts but, conversely, it's important to remember that only mature ascarids will be laying eggs. A horse may be harboring ascarids in their migratory phase and no eggs will show in the dung sample.
Fortunately, there are several drenches that are effective against ascarids, but the dose rate is quite high.
Drenches which contain benzimidazoles at a rate of 10mg per kilogram of horse will be effective against ascarids. The label will likely show the active ingredient as fenbendazole, oxfendazole or oxibendazole.
The 10mg dose rate for fenbendazole applies only to younger horses, as this level is needed to kill the commonest ascarid, P. equorum. As older horses should have good immunity to P. equorum, they can be dosed at half this rate to mop up other members of the family.
Drenches that contain tetrahydropyrimidines will also do the trick: either pyrantel pamoate at a rate of 6.6mg per kilogram of horse; or you could opt for a pyrantel tartrate, which is used as a daily wormer at a dose rate of 2.64mg per kilogram. At this dose, pyrantel tartrate will kill ascarid larvae emerging from recently swallowed eggs before they cause damage during their migration to the liver and lungs.
These worming agents will not kill larvae migrating through a horse's liver or lungs.
That being the case, the real stars in this particular fight are ivermectin and moxidectin. Ivermectin is effective against ascarids at a comparatively modest dose a rate of 0.2mg per kilogram of body weight. Its stablemate, moxidectin, is likewise effective, but at 0.4mg per kilogram of body weight.
Ivermectin will deal with ascarids in all their intestinal forms and delivers an effective killer blow against larvae which have migrated to the lungs or liver.
Not all drenches are recommended for use with foals. For example, at least some drench formulations containing moxidectin are not recommended for horses under six months of age, so check the label carefully.
Unfortunately, there are very real risks in drenching young horses with a heavy burden of ascarids. The last thing a horse owner wants to do is trigger an impaction colic resulting from a mass kill of ascarids.
The safest option, especially is a young horse is showing signs of heavy ascarid infestation, is to consult a veterinarian. Some may opt for a double course of fenbendazole for young horses, but with a half-strength first dose at 5mg per kilogram of body weight.
This has been shown to kill a proportion of the worms, reducing the worm burden only partially.
A follow-up higher dose can be given at a later stage - perhaps a week later - to mop up the remainder. Such youngsters will need to be monitored closely for any early signs of colic.
The safest longer-term course is to implement a regular deworming program in youngsters aimed at ensuring ascarids do not reach dangerous levels. If numbers are kept in check, the risk of an impaction colic is reduced markedly.
Like strongyles, the life cycle of ascarids present several strategies to mini-

mize exposure.
In fact, these become very much a recurring theme in your efforts to manage your horse's exposure to parasite. Picking up dung is important because the more dung you pick up, the few infective eggs will remain to be ingested by horses.
A good compost heap that generates enough heat will kill the eggs.
Feeding horses off the ground, either with feed buckets or through hay nets or a free-standing hay feeder, will similarly reduce exposure.
Ascarids present a particular challenge. Their sticky eggs means horses can actually become infected without putting their mouth anywhere near pasture. A mare which enjoys a roll in its paddock can easily end up with ascarid eggs clinging to its coat. A foal which then snuffles its mother's cost can end up ingesting eggs.
Eggs can similarly transfer from a horse's coat to the likes of a stable wall or a fence post.
These eggs are not only sticky customers, they're tricky customers. And let's not forget they can hang out for 10 years or more and still manage to infect a horse.
Mature ascarids are major eggs factories, so a crucial strategy centers on ensuring your young horses do not harbor ascarids long enough to reproduce. If your worming program is timed correctly, you can kill them off before they collectively start laying literally millions of eggs to provide you with a decade-long problem.
The magic number in the battle against ascarids is 70: that's the minimum number of days that an ingested ascarid would take within a horse to mature and begin to generate eggs.
And remember, you're not counting from when your foal first begins nibbling grass. There is every chance they may have picked up ascarids from nuzzling their mother or just snuffling about in the grass.
The first worming should take place at 60 days after birth to give you a safe 10-day margin. Any of the wormers described above will be suitable, but check the label to ensure they are suitable for use on foals.
The timing of the next dose will depend on which drench you use. It's important to remember that the benzimidazole or pyrantel drenches will not kill migrating larvae - only those in the gut.
So if we assume that a migrating larvae returns to a horse's gut just after drenching, how much time do you have before it matures and begins producing eggs? You've got eight weeks maximum, so be sure to leave follow-up doses no later than this.
Ivermectin and moxidectin put up a better showing, and are effective against migrating ascarids. This means there is more time to play with between drenching. Aim for 60 days but on no account leave it later than 70.
Ascarids continue to pose a threat until young horses are about 15 months of age, after which they should be capable of dealing with them on their own.
You'll still be deworming, of course, it's just that you'll have other enemies in your sights, safe in the knowledge that you've seen off the biggest threat from ascarids.
Even though your foal can quite easily pick up ascarid eggs, you should still minimize their exposure. It is good practice to drench a pregnant mare a fortnight or three weeks before foaling (check the label to ensure it's safe for pregnant mares) and a day or two before the birth wash the mare's underbelly and udder with soapy water to remove any ascarid eggs.

What's so bad about bots?

Computer geeks know bots as the web robots that crawl the internet indexing websites. For horses owners, they're an annoying pest that can cause a lot of grief for their equine friends.

It hardly seems fair that horses not only have to endure the nematodes and cestodes lurking in their paddock, but an aerial invasion as well.

The life cycle of the botfly is designed, as with any parasite, to ensure survival of the species. Part of that life cycle involves living as a parasite off horses. In fact, most of the life cycle of the bot is spent holed up inside your horse.

As with any pest, the first step is to understand the enemy. We'll begin with the botfly on the wing, which looks a little like a small honeybee.

You're unlikely to see these little flies that grow to about a centimeter in length, but with a sharp eye you'll easily pick up their calling card.

They fly in on a pleasant, warm day, and lay their eggs on the horse's coat. If you look closely you'll see you the pale yellow eggs clinging on. The location of the eggs will give a strong clue as to which botfly has come calling.

The eggs of gasterophilus intestinalis are most likely found on the horse's legs, shoulders, and possibly the mane. The eggs of gasterophilus nasalis will be seen around the mouth. Both are found in New Zealand.

In both cases, the bot eggs are headed for the horse's gut, but each has a different strategy for getting there.

The eggs of gasterophilus intestinalis are playing a waiting game. They're waiting for the horse to attend to an itch by nibbling it or rubbing it with their mouth - or, of course, another horse kindly doing the scratching for them.

This rubbing means the horse will pick up a few eggs in its mouth and this is all that's needed to prompt immediate action. The eggs, spurred on by the moisture and warmth of the mouth, immediately hatch a pinhead-sized larva which sets about burrowing into the gums, or beneath the tongue.

Inflammation and ulcers in the mouth which are not attributable to teeth problems could potentially be caused by botfly larvae.

Gasterophilus nasalis has the same destination in mind, but adopts a different strategy. A week after being laid, they hatch of their own accord and crawl into the mouth, again burrowing into the gums and beneath the tongue.

These larvae are known as first instars.

They take up residence for about three weeks and grow, emerging as second instars about 5mm to 6mm long. They head down the throat to the stomach and burrow into the wall.

Interestingly, G. intestinalis prefers the top part of the stomach, while G. nasalis heads for the lower part, around the duodenum. Three weeks to a month later they molt again to become third instars, and may then stay in the horse's stomach from two to 10 months, feeding off the swirling contents of the horse's stomach.

A really severe infestation will impact on a horse's ability to digest its food, and result in a decline in condition. Bots can also damage the stomach lining. Their burrowing can cause ulceration and abscesses, and these can trigger colic. The ulceration is aggravated by the digestive juices and can get worse, potentially causing a breach of the stomach lining, which can prove fatal

through peritonitis. Fortunately, this is extremely rare.
Stomach ulcers are a big enough issue for horses without botflies helping the problem along. That said, bots are down the list when it comes to the most dangerous parasites, and only in rare or extreme cases will disease or discomfort occur.
Isolated bots can even burrow through the stomach wall and cause havoc elsewhere.
Pleasant as the stomach environment may be for the third instar larvae, there's the small matter of completing the life cycle.
They finally release their grip and take a ride through the intestines, emerging in the feces. The larvae burrow into the ground for three to nine weeks, depending on the temperature, to pupate, the end result being a botfly ready to begin the cycle again.
The flies are active only during the warmer months, and typically only one generation will "roll over" in a year. Needless to say, the aim of the cycle is to have the larvae ride out the winter months inside the warm stomach of the horse.
Bot infection can be hard to detect. You'll be lucky to spot the third instars in your horse's dung, and you'd never want to wait until a lack of thrift or colic before suspecting the bot as a cause.
Research has shown that horses develop only limited resistance to bot infections. It's up to owners to lead the charge.


Using a bot knife to scrape bot eggs off the horse's hair will help destroy many bot eggs.

Horses appear to be able to tolerate quite a heavy burden of bots in their stomach and upper duodenum, but their burrowing into the gums and tongue can cause nasty and painful ulceration.
So what are your options?
Insect repellents may be more effective indoors, but are likely to have a limited effect in the outdoors.
Scrubbing a horse's legs with warm water was a common strategy in years gone by. The logic went that the warm water and moisture tricked the eggs into hatching. Yes, you'll get some, but plenty won't be fooled. As a strategy for keeping your horse's legs clean, it's great. For controlling bots, it's pretty much considered a waste of time.
Scraping or sanding the coat, or using a bot knife, is a technique that has been used for a good many years. You can certainly destroy a lot of bot eggs, but the problem is that you'll always miss some which the horse may well ingest.
Also, you're unlikely to be on hand to get all the eggs all the time. By the time you take to the little blighters, there's every chance your horse may already be infected. It's an excellent strategy, but it won't remove the need for a de-worming agent.
Dealing with internal bot infection was once a problem for horse owners.
Then, the macrocyclic lactones came on the scene - that's the likes of ivermectin, moxidectin and abamectin.
This is the winner by a long shot. Earlier worming agents had a limited effect on bots, but now, thanks to ivermectin-based drenches, mankind certainly has the upper hand. Ivermectin will kill bots in all larval stages, including when burrowed into the gums.
The life cycle of the bot poses opportunities for horse owners.
In New Zealand, with a winter running from June to August, the use of an ivermectin, moxidectin or abamectin-based drench in late-May/early-June and again in early August will be particularly effective.
Be sure that the dose rate on your selected drench is sufficient to kill bot larvae. It is possible the drench you select may have the right active ingredient but not at a sufficient dose rate to kill all bot larvae. The label should be it

clear whether a particular drench is effective against bots.

Getting the measure of tapeworms

The eggs of gasterophilus intestinalis are most likely found on the horse's legs, shoulders, and possibly the mane. The eggs of gasterophilus nasalis will be seen around the mouth.

Nematodes have long been considered the bad boys on the equine block. Tapeworms - so named because of the segmented nature of their bodies - appeared to be sissies by comparison.
While the king-hitters of the drenching arsenal were being developed, tapeworms managed to keep below the radar.
When you're a parasite, that's a good place to be. The health issues caused by tapeworm infection paled against the nasty nematodes and the havoc they created.
These days, we have a much better measure of tapeworms and the news is not altogether good. It transpires they are common and do, indeed, cause their fair share of grief.
Tapeworms - the common form is Anoplocephala perfolita - spend their day latched on to a horse's intestinal wall with a mouth-like structure of four specialized suckers, called a scolex.
Each segment of their body is a self contained unit called a proglottid and they soak up the nutrients they need through their skin. They are typically about 5cm long and 15mm wide, and their preferred real estate in the gut is where the small intestine joins the large intestine.
Tapeworms have a couple of interesting plays in their game plan. For a start, each contains both male and female reproductive organs.
Mature tapeworms don't produce eggs continuously as with most parasites, instead releasing them in occasional packets from their tail region which then pass out of the horse in its feces.

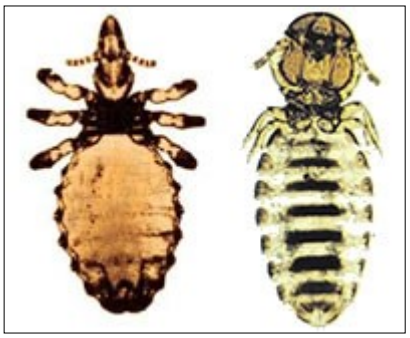
This means a fecal egg count is not a reliable way to assess whether a horse is carrying tapeworms, as there is no guarantee that a dung sample will necessarily contain eggs.
Even if a packet of eggs is present in a pile of feces, evidence suggest that the eggs are unlikely to be even distributed, meaning that coming across them in a dung sample under a microscope could well be a matter of chance.
But the life cycle of the tapeworm gets even more interesting once it exits the horse.
It actually replies on another animal besides the horse as its host. These are oribatid mites, which are common in pasture. Needless to say, these mites find plenty of edible organic material in horse feces and this plays into the hands of the tapeworm eggs.
The mites ingest the eggs as part of their diet which, over two to four months, develop in a way that enables them to infect a horse. In something akin from a scene from the movie, Alien, the ingested egg develops into a larva which busts out of the mite's tiny intestinal tract and parks up in the body cavity to continue their months of development.
Horses eat the tiny mites as they graze and, with them, the infective larvae, called cystircercoids, which in six to 10 weeks mature into a tapeworm.
There's an element of irony here. Oribatid mites and their eating of organic matter play an important role in maintaining healthy soil and pasture. If you pride yourself on the quality of your pasture, there's a pretty good chance you've got an excellent population of mites.
They're very tiny and even an average pasture is likely to have a population in the hundreds of thousands per square meter. In short, you're never going to avoid them, or eliminate them - nor indeed would you want to.
The three commonest tapeworms are Anoplocephala perfoliata (found in New Zealand), which grow to about 2.5cm in length. Paranoplocephala mamillana is about half that size, but the giant of the clan is Anoplocephala magma which can grow to 75cm in length.


Mature tapeworms (Anoplocephala perfoliata) in the cecum of a horse. The largest member of the tapeworm family can reach 75cm in length.
© Martin Krarup Nielsen

The presence of tapeworms vary from region to region and country to country, and the commonest form may likewise vary. Climatic factors undoubtedly play a significant part in this uneven distribution.
Because faecal egg counts are unreliable for detecting the presence of tapeworms, most horse owners should assume their horse is infected. It doesn't require a major leap of faith. Post mortem examinations in several of studies have consistently shown infection rates in adult horses of more than 50 per cent.
Tapeworms for many years escaped the wrath of parasitologists trying to develop effective drenches, with strongyles being the primary target.
Today, we know better. Tapeworms can cause localized inflammation which is likely to be factor in a colic episode if the burden is heavy enough.
Signs of ill-thrift through tapeworm infestation are unlikely, which is part of the reason that tapeworms didn't get such a bad rap from scientists. However, the risk of colic is reason enough to tackle tapeworms head-on.
In fact, tapeworms are considered to be the primary cause of a very dangerous colic where the lower part of the small intestine folds inside the part of the large intestine where it joins, which requires surgery to correct.
For a long while, there were no approved products on the market for tackling tapeworms, with many vets recommending high doses of drenches effective against other worms in a bid to kill them.

The first effective weapon was praziquantel, which has proved virtually 100 per cent effective against tapeworms. It is considered safe and is effective at a dose as low as 1 milligram per kilogram of horse.
Praziquantel is nearly always an ingredient in drenches targeting several different kinds of parasites. It is most commonly combined with ivermectin, moxidectin or abamectin. The precise combination will vary from brand to brand, depending upon how the manufacturer is targeting the drench.
However, to be effective against tapeworms the formulation should contain praziquantel in levels to deliver the minimum above-mentioned dose.
Again, picking up paddock dung will help minimize horse exposure to the infected mites. However, long-term strategies should centre on keeping tapeworm infestation to a level where it is unlikely to pose a danger to the horse.
Orabatid mites are likely to be most active in the warmer months, so there is some sense in drenching against tapeworms going into winter, when the re-infection rate over the cooler months is likely to be lower.
Similarly, a drench in late winter before the weather warms up is likely to play a major part in minimizing the number of eggs being deposited in the pasture. After all, the ingestion of orabatid mites is only a problem if the mite is infected.
The segmented nature of tapeworms poses another interesting problem when dealing with them by drench. Some drenches will, bizarrely, deal only to the tail of a tapeworm.
The head, still firmly attached to the gut by its scolex, will simply re-grow a few segments and start reproducing against quite quickly.
The tapeworm is proof that the battle against equine parasites is difficult. If it wasn't for praziquantel - a comparative newcomer to the drenching arsenal in horses - it's entirely possible that vets would still be doubling or tripling doses of other drenches to deal with these pests.

Putting the bite on lice, ticks and mites



A horse's coat does a pretty good job of keeping it warm. Little wonder that some critters find hanging out on a horse's skin much to their liking.
Among them are lice, which are wingless insects. The females lay eggs which stick to the hairs in a horse's coat.
The young hatchlings are called nymphs and, after two moltings are fully fledged adult lice. Adulthood is reached in only a few weeks.
Unlike most other parasites, they never have to depart a horse to complete their life cycle.
There are two common forms in New Zealand. The smaller biting louse, *Damalinia equi*, grows to about 2mm in length and is so-named because it feeds on shedding skin and other secretions.
The so-called sucking louse is more properly called *Haematopinus asini* and, as both its names suggest, it survives by piercing the skin and sucking out blood.
They can occupy any part of a horse but tend to prefer where the coat is thicker, such as along the back, where the tail joins the body, or around the mane.
Lice infestation is usually at its peak in the winter.

It goes without saying that lice can cause skin irritation, leading to rubbing and scratching by the horse.
Insecticides are available to deal with lice, but fortunately the macrocyclic lactones - that's the family that includes ivermectin and moxidectin - deal with them effectively.
A drenching late in autumn with one of this family should provide your horse with a comfortable winter and the early spring drenching should similarly set your horse up for a good summer.
It's wise to check your horse from time to time for lice. If they prove to be a problem on your property, make sure you don't spread them from horse to horse with grooming equipment and treat the linings of your horse covers with a product marketed for the purpose.

Ticks

The distinctive D-shaped egg of the tapeworm (Anoplocephala perfoliata). The dark circles in the picture are air bubbles.
© Martin Krarup Nielsen

Ticks are eight-legged blood-sucking arthropods, which sounds more like an insult than a parasite. In New Zealand, they are most common in the North Island because the climate is more to its liking.
There is only one variety found in New Zealand and, once again, its liking for blood is reflected in its name: Haemaphysalis longicornis.
The adult female tick lays eggs in vegetation and the infective larvae are ready to infect a horse two or three months later. They gather on plants in the hope of catching a ride as a suitable host brushes past.
Once on horse's coat, they will gorge on blood for about five days before dropping off and, fuelled by all the blood, moult into the next stage. It again sets itself up on vegetation with the intention of catching another ride.
It feasts again, growing to about 6mm in length and at this stage looks to the naked eye like little black beads. The adults will most likely be found during the summer months.
Once brimming with blood, they drop off to lay eggs and begin the life cycle again.
Ticks are likely to be a problem only where climate and vegetation are to their liking. They generally cause little in the way of skin irritation although some horses do have a severe local reaction to bites.
It's worth making a visual check of the ears of horses as this is prime real estate for ticks. The most likely spots for tick infestation centre on areas must likely to brush past vegetation - the legs and underside are most vulnerable.
An insecticidal spray or wish is usually only necessarily in the unlikely event a horse has a heavy infestation. Otherwise, if you see them, squeeze the skin around them and pull them out - mouth and all - with a pair or tweezers or even your fingernails. Get your nails or the tweezers underneath them and pull, to ensure you get the mouth parts out.

Mites

Mites are like tiny ticks - you need a microscope to see these little arthropods - and can live out their entire life on one animal and reproduce to their heart's content, making the occasional transfer to a new host by direct contact.
The mite known as Chorioptes tends to hang out in the lower legs and cause what horse owners cause mange: irritated areas of skin that can become inflamed and scabby.
This mange can spread up the legs and even on to the belly.
Secondary bacterial infection is an ever-present risk with mange.
It's best to consult a veterinarian as there are several causes of mange-like symptoms. A vet needs to identify the correct cause so proper treatment can be implemented.

If the vet confirms mange caused by chorioptes, treatment is likely to involve regular washes with an approved insecticidal wash until the condition improves.
Another mite that can cause problems is Psoroptes, which hang out in ears. Most horses show only very mild symptoms but in more severe cases there may be swelling at the base of the ears. A horse may rub its ears in an effort to gain relief from the irritation or carry them in an unusual way.
Again, a vet's attention is required as there are several potential causes of ear irritation, including potentially serious bacterial infections.
If the vet finds the problem is caused by Psoroptes, they are likely to prescribe insecticidal ear drops.
In all cases, only use insecticidal preparations approved for use on horses.

Here's the rub about pinworms

Pinworms (Oxyuris equi) are not a formidable foe like strongyles.
Mature pinworms, sometimes called itchworms, have a long, tapering tail and hang out in the large intestine, where the females lay eggs in masses that they deposit around the horse's anus.
The eggs develop into an infective stage in just four to five days - sometime as quickly as two days - and the sticky agent the females use to stick them there in the first place begins to break up, causing the horse some irritation.
The larvae drop into the paddock, or stable floor, and are capable of re-infecting another horse for up to four months.
Your typical infected horse will go in search of a suitable fence or post to rub their bottom in an effort to relieve the itching.
A pinworm infection can also result in mild diarrhea.
This itching may well be a sign that your worming program needs adjusting, as pinworms usually fall victim to just about any drench. That said, recent research has shown signs of pinworms developing drench resistance.
Basically, if you have an effective worming program in place to deal with the bigger equine threats, pinworms should not be a problem.
Thankfully, we have moved on from the days of 120 years ago when a small plug of tobacco up the bottom was recommended as a means of dealing with pinworms.
Interestingly, a close relative of the pinworm is not uncommon in children.

What about lungworms?

You don't need to be a rocket scientist to work out that lungworms hang out in the respiratory tract.
They're actually a major parasite that affects donkeys.
Horses can host them, too, but they are highly unlikely to reproduce. That, however, does not stop them causing in infected horse some grief.
That said, unless your horses enjoy the company of donkeys they are unlikely to be a problem.
Lungworms, or Dictyocaulus arnfieldi, are quite a large parasite, able to grow to about 8cm in length. It is therefore hardly surprising that they're able to cause some problems in the lungs.
Horses eat infective larvae in pasture. The larvae migrates to the lungs in less than a week and will be laying eggs within a month.
The irritating cough they generate helps the eggs up the windpipe. They're not looking for an exit out the mouth, however.
From the throat, they aim to get swallowed and take a quick tour of the intestinal tract before exiting on to pasture. They're able to re-infect horses in as little as five days if conditions are right.

The two forms of lice common in New Zealand: (L-R) *Haematopinus asini* and *Damalinia equi* (© Instituto de Ciências Biomédicas)

As with most parasites, serious problems are possible once the burden gets heavy, but this would be very rare in horses.
A horse suffering from a recurring cough or chest problem could be suffering from any one of a number of problems. If you can establish a link with donkeys, a lungworm infestation is worth exploring by your veterinarian.
However, you could list two dozen causes of a cough in your horse that would far more likely a lungworm problem.
Lungworms easily fall victim to the macrocyclic lactones, which include ivermectin and moxidectin.

A hairy little customer

Parasites usually target a specific species, but not so Trichostrongylus axei, or the stomach hair worm.
Trichostrongylus can infect sheep, cattle, goats and horses.
In fact, Trichostrongylus is the only worm that horses have in common with these species.
The adult worm is small - only about half a centimeter long - and they generally don't cause horses major problems.
Horses become infected with this nematode by eating grass infected with eggs. The ingested eggs hatch and the larvae take up residence in the stomach where they mature and lay more eggs, which are passed out in the manure to continue the life cycle.
The adult worms can cause irritation to the finger-like villi that line the gut and damage the tiny blood vessels. Heavy infestations can trigger dark, foul-smelling diarrhea and can limit the ability of the horse to gain nutrients from its food due to damage to the gut lining.
Foals are more likely to suffer heavy infestations than adults.
It would be tempting to think that rotational grazing horses with cattle, sheep or goats is not a good idea.
This is not the case. The risk of Trichostrongylus infection is far outweighed by the benefits of sheep, cattle and goats eating - and killing - the infective larvae and eggs of much tougher foes, such as strongyles.
Trichostrongylus are far less of a problem in mature livestock, so if you can rotate older sheep and cattle through your paddocks, the chances of a major problem are small.
Trichostrongylus can be killed with several drenches, including the tried and trusted macrocyclic lactones, which include ivermectin and moxidectin.
If you have an effective worm-management program in place, the stomach hair worm is unlikely to have you pulling your own hair out.

Employing the right worming strategies

There are drawbacks in having a drenching program that simply runs on a pre-set six- or eight-weekly cycle, together with some rotation of the active ingredient.
Certainly, any drenching program is better than no drenching program at all.
The label on the drench will no doubt spell out the active ingredients and which parasites they are effective against, together with recommended dosing intervals.
However, it's important to understand the weak spots in this game plan.
Ideally, you want to be using drenches to get the best control, using no more than is necessary to achieve that aim.

A standard de-worming program - let's say a drenching every eight weeks for adult horses - leaves a couple of important questions unanswered.
Firstly, are the drenches you're employing proving effective against the parasites you're targeting or has worm resistance rendered some of them ineffective?
Secondly, are you potentially drenching horses for worm burdens they simply don't have?
It is equally possible that, at any given time, some of your horses require a drenching and others don't. It has long been proven that some horses quickly develop heavy worm burdens while others enjoy long periods with low burdens, perhaps because of a more effective immune system.
Worming at set intervals has another drawback: some drenches are effective for longer periods than others.
A whole raft of other factors - from your pasture management practices to the local climate - may impact substantially on the infective risk to which your horses are exposed.
Worm resistance is well and truly here. It has been a problem for decades.
That is further incentive to take your parasite control program to a new level; to monitor worm burdens and apply some smarts to the way you use drenches, and when.
Central to all this is fecal egg counts. They will help you determine which horses are most susceptible to parasite infestation and which drenches are proving effective.
Egg counts will also provide you with the information needed to determine whether the time is right to drench.
Perhaps you are using a natural deworming agent without any particular evidence as to whether it's effective against all or any of the worm varieties affecting your horses. A fecal egg count can ensure your natural worming program is working.
The prudent horse owner will work with the local climate and take advantage of vulnerable spots in parasite life cycles to get the best result.
Before we turn to egg counts, let's look at climatic factors.
One important factor is whether summer temperatures reach a level capable of killing eggs and larvae in pasture.
In a country such as New Zealand, crossing temperature and sub-tropical zones, this is unlikely.
It is sensible to consult your equine vet, who will be familiar with local conditions and provide some advice.

Pinworm can cause horses to rub their rear end to relieve the itching.
© Horsetalk.co.nz

The program outlined below should not be considered set in stone, but it demonstrates how you can work with the climate and fecal eggs counts to get maximum effectiveness out of your de-worming program without using drenches unnecessarily.
Let's start in autumn and aim for a good clean-out. Let's assume you haven't drenched your horses in a while. It's possible some might be carrying a heavy burden.
First, either carry out a fecal egg count on your horses yourself or collect the samples and send them away to be done. This will hopefully provide some indication of each horse's susceptibility to worm infestation and a broad measure of their natural resistance.
Some of your horses may return a low egg count - that's anything under 100 eggs per gram of feces (epg). Others may be moderate (100 epg to 500 epg) and some may be high (above 500 epg).
If all your horses return low counts, you should be pleased. Either your drenching and pasture management program is working, or perhaps your horses all have good natural immunity.
If the eggs counts are variable across your horses, it is likely this pattern will repeat. In other words, horses with a heavy burden will tend to return to that state if your drenching program is inadequate.
Let's send the biggest star into bat for the first round. Moxidectin is a great

broad-spectrum performer and will deal with encysted small strongyles, which are otherwise difficult to kill. Moxidectin will result in a good clean-out across all your horses.
Ivermectin is a good alternative, although it won't deliver a killer blow to encysted strongyles. However, a low egg count would certainly make ivermectin a good option.
Don't forget to keep a detailed written record of which drench you've used and when.

Heading into winter, some eight weeks later, perform an egg count and see what the results show. Moxidectin is effective for up to a month longer than ivermectin, so those treated with the former should be returning low counts.
Initially at least, you might want to perform an egg count in as little as four weeks, as research in Kentucky by Gene Lyons has unearthed several farms where the egg reappearance period has dropped to four weeks for ivermectin and five weeks for moxidectin. Drench resistance is here, and you need to establish just how resilient the parasites are on your property to the biggest hitters in the worming arsenal.
Those horses returning a moderate count (more than 150 epg) should be drenched again.
Part of your worming strategy is to minimize drench resistance, so it wouldn't be unreasonable to use a different drench with an active ingredient such as oxibendazole or pyrantel, or even both.
A couple of weeks later you would be wise to do a fecal egg count on the recently drenched horses as resistance to both these drenches is possible.

Lungworms can cause coughing in horses, although they would normally only be suspected if the horse had been spending time with don-


Regular fecal egg counts will not only tell you whether your deworming program is effective, but whether your horses require drenching.
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It's important you measure whether your drenching program and the drenches you use are proving effective.
Next up will be a winter drench, when we want to deal with tapeworms. Remember, fecal egg counts do not give a reliable indication of tapeworm infection.
Mature tapeworms drop eggs off in packets from their tail so it's entirely possible you won't find any evidence of tapeworms in the tiny sample measured in an egg count.
Tapeworms are most likely to infect horses in autumn so this is the drenching cycle where we are going to assume all horses are infected. The drench you need to do this must contain praziquantel and you're only likely to find it in combination with either ivermectin or moxidectin.
This will deliver another good, broad-spectrum hit and will also deal with any bot larvae which infected the horses before the egg-laying insects found conditions too cold. This should allow horses to remain bot-free zones until the botflies find conditions warm enough again.
Again, you should perform an egg count on your horses to see how effective you have been in keeping worm burdens low. It is all part of building up a picture on how each of your horses cope with parasites, and the effectiveness of the drenches you are using.
Don't think that winter necessarily provides a holiday from the burden of worm control.

Winter conditions can allow infective larvae to remain viable for quite long periods in pasture. That said, the cold conditions may stop or eggs or larvae developing to an infective stage - at least until the weather warms up. For strongyles, freezing conditions can easily kill early-stage larvae but the later infective stages are well protected against such trying conditions and can lay in wait for months waiting to infect a horse.

Let's look at early-spring drenching. Perform a count and see how egg numbers are looking. Horses with high egg counts may well be an indication of encysted strongyles that haven't been killed (did you use ivermectin last time?), so moxidectin is the best course.

Bear in mind that if you used moxidectin in your drench in winter as opposed to ivermectin, you'll be getting four weeks of added protection, so you can afford to wait a little longer.

Horses with a low count - below 150 epg - could potentially skip this drench cycle.

Going into summer, you should continue to monitor egg counts and aim for a further drenching with a drench containing praziquantel to have another crack at tapeworms, especially if your property has any history of a tapeworm problem.

What do cattle and sheep have in common? It's a parasite called Trichostrongylus axei, sometimes called the stomach hair worm.
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The rise in egg counts during the summer months will, to a degree, depend upon the fierceness of your summer and whether strongyle eggs can survive the conditions.

Strongyles are your big target during the warmer months and their consistent - and persistent - shedding of eggs means your regular fecal egg counts will enable you to monitor each of your horse' worm burden.

If your summer is hot enough, you may be well pleased at the slow rate of increase in the worm burden of your horses over summer. If conditions are to the liking of strongyles, additional summer drenchings will prove necessary.

If you're concerned about the potential of resistance developing to moxidectin (which you're using primarily because it performs well against encysted strongyles), your vet might be able to recommend a course of fenbendazole at a higher rate as an alternative.

By the end of the first year, a horse owner should have a clear picture of how each of their horses handle parasites. Some will be destined to require more drenching than others to keep their worm burden within acceptable limits.

It is important not to lose sight of the purpose of your drenching program. Your aim is to maintain a consistently low worm burden across all your horses by using drenches to their maximum effectiveness.

You will not achieve an egg count of zero. A "good cleanout" of your horse's gut will not be a complete one. Hence the problem of drench resistance.

Aside from keeping your horses healthy, your program needs to minimize the shedding of eggs into the pasture. If this can be kept to a minimum, it means the rate of re-infection will be lower and you will use less drench.

It is also vital that you recognize how long each drench type is likely to keep eggs out of the feces. Drenches in the benzimidazole family - that's fenbendazole, oxfendazole and oxibendazole - will typically give four weeks, as will the pyrantel salts. Ivermectin will give eight weeks and moxidectin hits 12 weeks. If you waited another four weeks beyond each of these periods, it's likely that a horse prone to higher worm burdens will be shedding significant numbers of eggs, perhaps millions a day.

These time periods are important, especially in the management of small strongyles. Most drenches will do little more than give encysted strongyles. Thus, for surviving encysted strongyles, it is only a matter of time before they mature and begin producing eggs in industrial quantities. Your worm control program will be most effective if you can get back and hit them again before they get that opportunity.

The above-mentioned program is a general guide only and is no substitute

for advice from a veterinarian familiar with local conditions.
There are other drench families and combinations that can prove effective for at least some of your drenchings and these should not be ignored.
The above drenching program would suit more intensively grazed horse properties. However, if you have the opportunity to rotate stock, rest paddocks, and are religious in picking up manure, it's possible you may be able to drench even less.
The next article discusses such strategies and explains how drenching at certain times of the year can deliver long-lasting benefits.
It's important to realize that no battle was ever won by chemical warfare alone. There is much we can do in the field to help with the fight.

Employing the right farming strategies

Horses are kept in a wide range of conditions. The might share pasture with other farm livestock or might be living in a single paddock they have grazed for years.
They might be grazing on their own or have a few other equine paddock mates. They might come indoors at night, be stabled throughout the winter, or spend all year round at pasture.
If plenty of land is available, the opportunities for pasture rotation exist in a way they don't in more intensive operations, such as racing stables.
In short, the way in which your horse or horses are kept will have a major bearing on your worm management program.
If you have only a few horses and enough grazing for some rotation, it's likely you can manage with only limited use of drenches, provided you monitor fecal egg counts to ensure the worm burden is within acceptable limits.
With pasture rotation and dung collection every two or three days, a horse owner could get down to using chemical drenches two or three times a year, but egg counts must be undertaken.
More intensively grazed properties will likely involve more use of drenches to keep the worm burden low.
It's essential to understand precisely what you're trying to achieve in your worm control program.
Worm eggs and larvae are not an occasional visitor to your pasture. A horse pasture will likely have parasites in their various stages of development waiting to infect a horse, unless the pasture has been shut up and free of horses for years.
In the case of ascarids, infective larvae can typically survive within their protective coating for two years and, if conditions are to their liking, up to 10

years.
The aim of your management program is therefore to knock your horse's worm burden on the head and then do everything you can to minimize the rate of re-infection - that is, the rate at which it picks up infective larvae or eggs from the environment.
The single most important strategy is dung collection. Key parasites all make their exit from horses in their dung, so by collecting the manure you reduce the worm larvae in the pasture waiting to be ingested by grazing horses.
It has been demonstrated that this strategy alone will reduce the larvae count in pasture by 80% or more. There is also the added benefit that horses will graze more of the paddock, given their preference to eat grass well away from horse droppings.
Unfortunately, you can't leave the dung in the paddock for too long. Some eggs turn to infective larvae in under a week during warm weather. There is the further risk that rain or horses knocking the dung on the way past will help the infective larvae either into the soil or on to nearby grass to re-infect horses.
Dung should be routinely collected every two or three days and composted. If composting is done properly, the heat generated should be enough to kill eggs and larvae - and provide you with a lovely end-product for use on your garden.
Dung collection will not provide instant results as millions of infective larvae or eggs are likely to infest an established horse pasture. However, through regular dung collection and a regular drenching program, over a period of months the numbers in the pasture will dwindle and you should be able to reduce the frequency of your drenching.
The results of your dung collection should eventually be apparent in fecal egg counts, but you will need to be patient.
The use of harrows to break up the dung and distribute it around the paddock has been discussed earlier, but it's worth revisiting the pitfalls.

Dung should be routinely collected every two or three days and composted.
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Certainly, if done in hot and dry conditions, a good number are larvae and eggs are likely to die. However, a good many more will survive and still be able to infect your horses.
Generally, in temperate climates, harrowing is unlikely to be effective in controlling parasites, and is likely to distribute the infective larvae to all corners of the paddock. This is far from desirable.
Those with bigger acreages and other stock have a powerful advantage.
One of the biggest enemies of parasites is time. Once a parasite reaches an infective stage in a paddock, it must then play a waiting game to find a new host in the form of a grazing horse.
While ascarids are able to lie in wait for two years or more, your major nemesis, the small strongyle, can hang on for only a few weeks if conditions are warm and dry.
Drenching will prove more effective at certain times of the year. For example, a drench in early spring is crucial as you can deal with small strongyles that have wintered over in your horse. If you can take out the adult strongyles and those encysted in the intestine wall, you will go a long way towards minimizing the number of eggs being dropped on the pasture during the warmer months.
Two agents are effective against the toughest nut - encysted strongyles. They are moxidectin at 0.4 milligrams per kilogram of horse, and the five-day course of fenbendazole at the rate of 10 milligrams per kilogram of body weight each day, although the latter is likely to prove effective only if resistance is not present.
A late-summer drench will knock back the burden picked up over summer and an autumn drench, just on the cusp of winter, should keep levels within check over the winter months, again targeting small strongyles.
A wise horse owner might look for a broad spectrum drench for the late-autumn and early-spring drenches containing praziquantal, which will deal with tapeworms. The way in which tapeworms release their eggs means you may not see them during an egg count. It is best to assume a horse is infected and drench accordingly.
The timing of these same two drenching cycles will also prove particularly effective against bots.
It's essential to realize that reducing drench use must be based not on a whim, but on evidence through fecal eggs counts that your program is effective.

If paddocks are heavily infested through inadequate management practices in the past, it may take a couple of years of dung collection and egg-count monitoring before a reduced drenching program is effective in keeping parasites under control in your horses.
Remember, too, that your drenching program is aimed not only at reducing the burden in your horses, but reducing the re-infection rate as much as possible. That is why timing is important.

It doesn't just have to be chemical warfare

Composting: The heat in a well managed compost heap is more than enough to kill parasite eggs and larvae. © Horsetalk.co.nz

Harrowing is a pretty convenient way to deal with all that horse dung. It's likely your equine friends are each leaving 15 or more deposits in your paddock each day and no horse owner needs telling that it builds up at an unholy rate.
Unfortunately, the humble harrow is generally part of the worm problem, not the solution.
Harrowing smashes up the dung and distributes it evenly about the paddock. Unfortunately, it distributes the parasites equally well.
In very hot climates, the breaking up of dung in this way can prove effective. It exposes eggs and larvae to the fierce heat and sun which can kill them. But in a country such as New Zealand, with its temperate and sub-tropical climate, the summers may not be hot enough to do the job.
If you feel that harrowing is the only viable solution to your "dung burden", then do it on the hottest and sunniest day your local weather can muster.
Keep the horses off the paddock for at least three weeks - longer if you can manage it - to give the warm weather an opportunity to kill off as many larvae as possible (remember, infective strongyle larvae can only survive in pasture for a few weeks in warm and dry weather).
Never harrow a paddock when horses are still in it.
Harrowing is an even worse strategy in the cooler months as the strongyle larvae will be able to survive for several months, and, thanks to your harrowing, will be evenly distributed about the paddock waiting to infect horses.
In terms of parasite control, the best course is picking up the dung and composting it. A well maintained compost heat should generate enough heat for long enough to kill parasite eggs and larvae.
Normal composting temperatures are well above those needed to deal with your arch nemesis, strongyle larvae.
Composting is not just about heaping your collected dung in an unsightly pile. A few simple steps will ensure a healthy, odor-free compost heap that produces great material to return to your garden or even pasture
Picking up dung helps by removing the dung containing the eggs and larvae from the pasture. Getting it off when it's fresh is best - wait no more than three days - as some larvae while wriggle their way from the dung and take up residence in the soil.
Horses are averse to eating grass near their droppings, so picking up the manure will also ultimately improve the percentage of a paddock where horses are happy to graze.
Your dung-removal program will be even more effective if you can manage to pick it up before falls of rain, which help larvae move from dung piles into the soil or on to forage. Birds that tear apart dung pile in search of partly digested grain are also playing a part in egg and larvae distribution.
There is also a benefit in being able to shut up pastures for a time over the warmer months, when the metabolism of infective strongyle larvae will be using up their stored energy. Once they used it up, they die. If you've got the acreage and the time, it's a sensible strategy.
Given that strongyles can hold out for only a few weeks in warmer weather, you can sensibly employ this strategy with your hay paddock.
Horse owners that graze cattle and sheep have another weapon in their arsenal.
Parasites are adapted to their target species, so for a cow or sheep to eat the infective larvae that affect horses is a death sentence for the parasite. Horses, of course, return the favor to sheep and cattle as they graze the same pasture.
This is particularly effective against strongyles, but you can employ a couple of extra strategies for maximum effect.

Your dung-removal programme will be even more effective if you can manage to pick it up before falls of rain.
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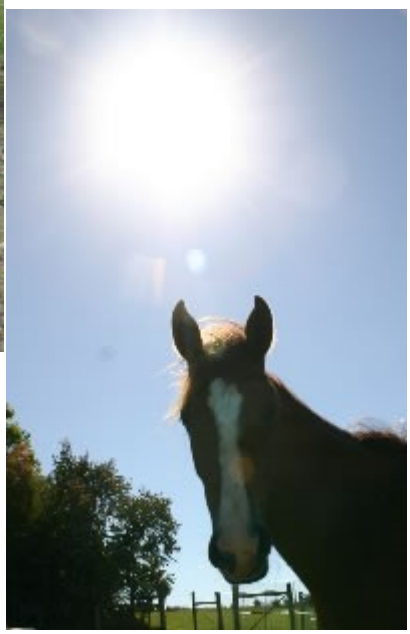
It is wise to leave the pasture unoccupied for a couple of weeks while the eggs mature (the time varies, depending upon the ambient temperature). After a couple of weeks of favorable weather, the grass will have come away and infective strongyle larvae will be parked on the grass waiting by the ingested. At this point you introduce the cattle or sheep, who will ingest them and kill them.
The larvae will continue to emerge and the cattle and sheep will continue to eat them, so graze the paddock for as long as possible.
If possible, use mature stock for this clean-up work, as they are far less likely to carry a heavy burden of Trichostrongylus, a parasite capable of infecting horse, sheep and cattle.
Once again, any strategies that reduce the number of infective larvae in a pasture will affect the re-infection rate of horses.
It is also advisable to feed horses off the ground, using buckets for hard-feed and hay nets or hay feeders for forage. The more a horse eats off the ground, the less its exposure to ground-based larvae.
What about the weather?



Climatic conditions play a major part in parasite life cycle. It's important to understand how your local weather affects their development.
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These infective third-stage larvae are much tougher, and are sealed in a protective membrane, which means they can survive only on stored energy. They are well able to withstand frost and icy temperatures. Summer temperatures increase their metabolism and they can exhaust their stored energy in a matter of two or three weeks.
In winter temperatures, they are using up little or none of their energy stores. They can ride out the winter chill for months or until ingested by a horse, where the warm internal temperatures spark them into action.
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Its chances will be much better if it can get into the pasture proper, and to this end it relies on rain, birds pulling apart the manure piles and any other mechanical means of distribution, such as a passing horse clipping a pile with its hoof or a horse owner out with harrows.
Infective larvae tend to prefer the vegetative layer close to the soil, so it's in your interests to prevent horses grazing grass too short.
Leaving the grass longer has added benefits: it will come away faster and will prove more drought-resistant if conditions are beginning to dry out.

Get rid of that dung: Dung collection and composting is a key strategy in parasite management.

Ascarid eggs are even tougher and can survive in a pasture environment for up to 10 years, with development again triggered by warmth.
Tapeworm eggs, as we learned earlier, rely on the orabatid mite as a vector. Frost can kill tapeworm eggs, but there will be plenty of infected mites to see the species through the colder months.

Moisture is another necessary element in the development of parasite larvae in pasture. Several factors come into play here. Generally, the moisture in the horse manure will linger long enough to allow parasites to complete their pasture development, perhaps topped up with the occasional shower.
However, hot and dry conditions can result in a moisture deficit which will slow, or even halt, development.
For most people in temperate and sub tropical areas, spring and autumn will generally provide great conditions for parasite development in pasture. Summers will be somewhat more variable, depending upon how hot they get and how much moisture is available.
Doing a fecal egg count
Why do fecal egg counts? Isn't it simply good enough to have a regular drenching program and take it as read that the strategy is working?
There is no doubt that a well-structured drenching program is a must, but what fecal egg counts will do is provide you with much-needed information on the effectiveness of your program, and suggest important tweaks that might make it even more effective - perhaps even using less drench at the same time.
It is well known that some horses harbor quite high parasite numbers while others consistently maintain a low burden.
By conducting fecal egg counts we can build a picture of each horse's susceptibility to parasites and gauge the effectiveness of our program.
It is possible, for example, that worms resistant to a particular drench are to be found on your property. In that case, the particular drench you're delivering may be largely ineffective. Conversely, you may be drenching horses that have a low parasite burden.
The ultimate aim of any horse owner is to use as little drench as possible to obtain maximum, effective control.
What exactly is a fecal egg count? It's a process whereby you take a sample of fresh dung and carefully take a precise amount of the material. To this we add a simple solution which we can make at home and mix it up thoroughly.
Once mixed, we strain it and place a tiny portion of the discolored liquid into a special slide which holds a specific volume of this fluid.
We place this slide in a microscope and, at quite low magnifications, we can count the eggs. Armed with this count, we can then do a simple calculation to find discover the number of eggs per gram (EPG) in the feces.
This eggs-per-gram number is a standard measure and, depending on the number, we know whether the horse in question is carrying a low, moderate or high worm burden, and can then act accordingly.
The reason we want to quantify the level of infestation is that most horses exposed to pasture are infected by strongyles, and nearly all the eggs you are likely to see under the microscope will be strongyle eggs - probably 95% or more.
The fact your horse has strongyle eggs in its feces is hardly front-page news. However, because strongyles are prolific egg producers, we can quantify the eggs and get a clear indication of just how heavy a burden each horse has.
Your main targets will be strongyle and ascarid eggs. It is your measure of these parasite eggs that will ultimately sway your drenching decisions.
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You will need to get some equipment to do the counts and will have to spend a few dollars. However, in the overall scheme of keeping horses, the cost is pretty modest.
The fact you are doing fecal egg counts also means you'll probably save money through using less drench, or at the very least use drenches that are proving the most effective.

Certainly, if done in hot and dry conditions, a good number are larvae and eggs are likely to die. However, a good many more will survive and still be able to infect your horses.

Dung should be routinely collected every two or three days and composted.
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Generally, in temperate climates, harrowing is unlikely to be effective in controlling parasites, and is likely to distribute the infective larvae to all corners of the paddock. This is far from desirable.

Those with bigger acreages and other stock have a powerful advantage.

One of the biggest enemies of parasites is time. Once a parasite reaches an infective stage in a paddock, it must then play a waiting game to find a new host in the form of a grazing horse.

While ascarids are able to lie in wait for two years or more, your major nemesis, the small strongyle, can hang on for only a few weeks if conditions are warm and dry.

Drenching will prove more effective at certain times of the year. For example, a drench in early spring is crucial as you can deal with small strongyles that have wintered over in your horse.

If you can take out the adult strongyles and those encysted in the intestine wall, you will go a long way towards minimizing the number of eggs being dropped on the pasture during the warmer months.

Two agents are effective against the toughest nut - encysted strongyles. They are moxidectin at 0.4 milligrams per kilogram of horse, and the five-day course of fenbendazole at the rate of 10 milligrams per kilogram of body weight each day, although the latter is likely to prove effective only if resistance is not present.

A late-summer drench will knock back the burden picked up over summer and an autumn drench, just on the cusp of winter, should keep levels within check over the winter months, again targeting small strongyles.

A wise horse owner might look for a broad spectrum drench for the late-autumn and early-spring drenches containing praziquantal, which will deal with tapeworms.

The way in which tapeworms release their eggs means you may not see them during an egg count. It is best to assume a horse is infected and drench accordingly.

The timing of these same two drenching cycles will also prove particularly effective against bots.

It's essential to realize that reducing drench use must be based not on a whim, but on evidence through fecal eggs counts that your program is effective.

If paddocks are heavily infested through inadequate management practices in the past, it may take a couple of years of dung collection and egg-count monitoring before a reduced drenching program is effective in keeping parasites under control in your horses.

Remember, too, that your drenching program is aimed not only at reducing the burden in your horses, but reducing the re-infection rate as much as possible. That is why timing is important.

It doesn't just have to be chemical warfare

Composting: The heat in a well managed compost heap is more than enough to kill parasite eggs and larvae.
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Harrowing is a pretty convenient way to deal with all that horse dung. It's likely your equine friends are each leaving 15 or more deposits in your paddock each day and no horse owner needs telling that it builds up at an unholy rate.
Unfortunately, the humble harrow is generally part of the worm problem, not the solution.
Harrowing smashes up the dung and distributes it evenly about the paddock. Unfortunately, it distributes the parasites equally well.
In very hot climates, the breaking up of dung in this way can prove effective. It exposes eggs and larvae to the fierce heat and sun which can kill them. But in a country such as New Zealand, with its temperate and sub-tropical climate, the summers may not be hot enough to do the job.
If you feel that harrowing is the only viable solution to your "dung burden", then do it on the hottest and sunniest day your local weather can muster.
Keep the horses off the paddock for at least three weeks - longer if you can manage it - to give the warm weather an opportunity to kill off as many larvae as possible (remember, infective strongyle larvae can only survive in pasture for a few weeks in warm and dry weather).
Never harrow a paddock when horses are still in it.
Harrowing is an even worse strategy in the cooler months as the strongyle larvae will be able to survive for several months, and, thanks to your harrowing, will be evenly distributed about the paddock waiting to infect horses.
In terms of parasite control, the best course is picking up the dung and composting it. A well maintained compost heat should generate enough heat for long enough to kill parasite eggs and larvae.
Normal composting temperatures are well above those needed to deal with your arch nemesis, strongyle larvae.
Composting is not just about heaping your collected dung in an unsightly pile. A few simple steps will ensure a healthy, odor-free compost heap that produces great material to return to your garden or even pasture
Picking up dung helps by removing the dung containing the eggs and larvae from the pasture. Getting it off when it's fresh is best - wait no more than three days - as some larvae while wriggle their way from the dung and take up residence in the soil.

Horses are averse to eating grass near their droppings, so picking up the manure will also ultimately improve the percentage of a paddock where horses are happy to graze.
Your dung-removal program will be even more effective if you can manage to pick it up before falls of rain, which help larvae move from dung piles into the soil or on to forage. Birds that tear apart dung pile in search of partly digested grain are also playing a part in egg and larvae distribution.
There is also a benefit in being able to shut up pastures for a time over the warmer months, when the metabolism of infective strongyle larvae will be using up their stored energy. Once they used it up, they die. If you've got the acreage and the time, it's a sensible strategy.
Given that strongyles can hold out for only a few weeks in warmer weather, you can sensibly employ this strategy with your hay paddock.
Horse owners that graze cattle and sheep have another weapon in their arsenal.
Parasites are adapted to their target species, so for a cow or sheep to eat the infective larvae that affect horses is a death sentence for the parasite. Horses, of course, return the favor to sheep and cattle as they graze the same pasture.
This is particularly effective against strongyles, but you can employ a couple of extra strategies for maximum effect.


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It is wise to leave the pasture unoccupied for a couple of weeks while the eggs mature (the time varies, depending upon the ambient temperature). After a couple of weeks of favorable weather, the grass will have come away and infective strongyle larvae will be parked on the grass waiting by the ingested. At this point you introduce the cattle or sheep, who will ingest them and kill them.
The larvae will continue to emerge and the cattle and sheep will continue to eat them, so graze the paddock for as long as possible.
If possible, use mature stock for this clean-up work, as they are far less likely to carry a heavy burden of Trichostrongylus, a parasite capable of infecting horse, sheep and cattle.
Once again, any strategies that reduce the number of infective larvae in a pasture will affect the re-infection rate of horses.
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The equipment you need is as follows:

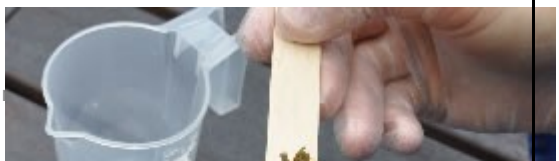
- A microscope. This is the most expensive item on the list, but the good news is that you certainly don't need a top-line model. In fact, you'll need a magnification of only 100, which is right at the lower end of most microscopes. Even modestly priced microscopes can easily magnify to 400 times or more. You could easily find a scope to do the job for under $NZ100 and would be looking at a good one for about twice that. There are a couple of considerations in buying microscopes. Microscopes are lit by either a bulb (powered by the mains or by batteries) or a mirror which directs the available ambient light through the slide. If you intend doing your fecal egg counts in an outbuilding without power, ensure the microscope you choose runs on either batteries or is fitted with a mirror. Some are mains-powered only.
- A McMaster slide. These are slides developed specially for doing eggs counts. They have two chambers that hold liquid and each chamber has a grid to help in your egg count. McMaster slides are readily available and cost around $NZ40. Your local rural stockist may carry them or you can source them through internet retailers. In New Zealand, they can be found in the Shoof catalogue.
- Two beakers, graduated in milliliters. Those capable of holding about 100ml should do nicely. It would be great if you bought a measuring cylinder as this would allow you measure quantities even more accurately.
- A pipette or eye dropper which you can use to transfer your sample into the slide. These can be sourced from your local pharmacy. A small syringe tube without the needle will likewise do fine.
- Something suitable for picking up the dung sample. You could set aside old spoons for this purpose or buy a packet of large wooden ice-block sticks, which you can dispose of after use. A $2 shop or your equivalent would be a good source.
- While there, grab a few small plastic containers with lids, which will be handy for holding your dung samples, and some stick-on labels so you can write the name of the horse on each sample bottle. Alternatively, you can use small sealable plastic bags.

The minimum equipment needed to conduct an egg count. An extra measuring beaker and a small set of scales capable of accurately measuring 4 grams would be an advantage.

The fresh sample is collected. Don't forget to wear gloves.

Accurately measure the amount of flotation solution required for the test.

The liquid measured and ready to go. In this particular test, 56mm of flotation and 4 grams of dung will be mixed.



- A flotation solution. This is something you add to the dung sample to dilute it. However, it serves another important purpose. The solution is of a specific density so that the eggs in the liquid float to the top, allowing you to count them in the slide. You must not use water, as the eggs will sink and you won't see them. You can buy these solutions, but it's cheaper to make them at home. See the side panel on how to make a suitable solution.
- Disposable gloves. Dung contains bacteria and you don't want to expose yourself to unnecessary risk. Wear these gloves when working with manure.
- A wee set of scales for measuring your dung sample. You'll be measuring only a few grams of dung, so the scales need to be reasonably accurate, perhaps to a tenth of a gram. I bought a new set of scales from an auction website for around $30. If you don't want to spend this money, there is another way we can measure the sample, which we'll discuss later.

A fine sieve or some cheesecloth. Your standard kitchen sieves vary considerably in the fineness of the mesh, so shop around until you find a fine one. Some people even use a tea strainer.

We're now ready to roll.

The first step is to collect your dung sample. You need to find a very fresh sample, particularly in warmer weather, as some eggs can hatch in a matter of hours and will therefore not show up to be counted. If too many hatch, it will make your count less accurate.

Collect a modest ball of dung, place it in your container, and label it with the horse's name. If you can't conduct the test immediately, store the sample in a refrigerator to prevent any eggs hatching. If you're collecting the sample from pasture, ensure it's not contaminated by soil or older dung deposits.

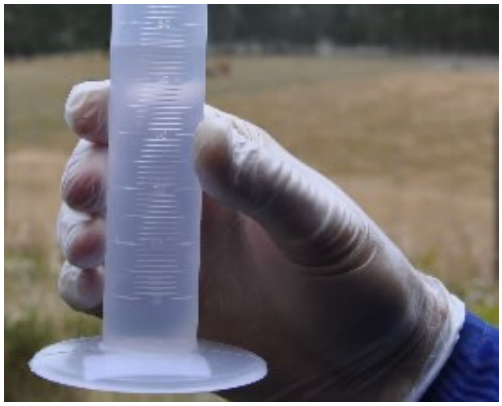
Be systematic in the way you move the slide beneath the microscope, so you cover all the grids in each chamber.

Don't forget to wear your gloves when handling dung.

Place in your beaker 26ml of flotation solution.

Using one of your wooden ice-cream sticks, thoroughly mix the dung you collected and then weigh out precisely 4 grams. Add this to the 26ml of flotation solution and stir thoroughly. These precise quantities are important.

If you don't have scales capable of measuring 4 grams, add small amounts of



The liquid measured and ready to go. In this particular test, 56mm of flotation and 4 grams of dung will be mixed.

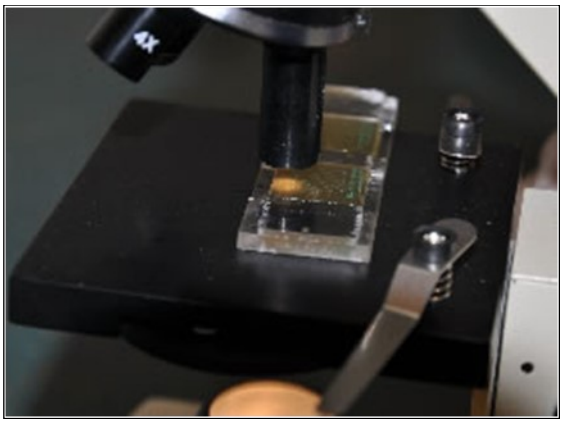
Mix the dung thoroughly first before adding it to the solution to bring the fluid level up to the 60ml mark. Even better, weight 4 grams and add it to the solution.

It's essential to mix the dung and flotation solution thoroughly.

It's not essential, but running the mixed fluid through a fine sieve will make your egg counting through the microscope easier.

Mix vigorously then draw up a small quantity into a pipette or syringe.

Fill one chamber of the slide, then mix the solution again, draw a fresh quantity, and fill the second chamber.



Under the microscope and ready for examination.

dung to the solution until the level comes up to the 30ml mark. The solution weighs roughly 1 gram per

To make a suitable **flotation solution**, we take water and dissolve another substance in it. This increases its specific gravity and provides the liquid density required to ensure the eggs we want to count float to the top.

There are a whole raft of readily available chemicals we can dissolve in water for this purpose. Some behave in certain ways, by distorting eggs or in some cases the resulting fluid isn't dense enough for certain kinds of eggs to float to the surface.

We'll therefore stick to a handful of general purpose solutions, which will be fine for our purposes.

The commonest solution used by laboratories is sodium nitrate. Take 1000ml (one litre) of water and dissolve 400 grams of sodium nitrate in it. Stir to dissolve the chemical. This will give you a flotation solution with a specific gravity of 1.18. It can distort eggs if left mixed with the dung for more than 20 minutes, but that should provide you with plenty of time to conduct your test. It's a perfect solution for strongyles.

While sodium nitrate is quite cheap, it may be difficult to source - at least in the modest quantities that you require. Another common flotation solution is a saturated salt solution, which will give us a fluid with a specific gravity of 1.18 to 1.20. Warm a litre of water and stir in 400 grams of salt (sodium chloride) until dissolved. Allow to cool. A small amount may settle at the bottom once it cools, but this is no cause for concern. This solution works fine but may distort the eggs. Another good general purpose solution is a mix of salt and sugar with water. Mix as for the saturated salt solution above (400 grams of salt in a litre of water), but also add 500g of sugar. This provides a solution with the highest specific gravity of these three examples, at 1.28.

mil, so once the liquid is displaced up to the 30ml mark, you'll be close enough to your 4 grams of feces.
Stir this thoroughly so the manure breaks up and is even distributed. Run this liquid through your fine sieve or several layers of cheese cloth into your second beaker to get rid of larger remaining particles. This is not an essential step, but it will certainly give you a much cleaner sample and will make your work under the microscope much easier.
Mix the strained solution well once again and immediately use your syringe or eye dropper (pipette) to draw up some of the mixture. Don't leave the solution standing for any more than a moment before drawing up the fluid, as the eggs will begin floating to the top as soon as the mixture is left undisturbed.
Use your syringe or eye dropper to fill on chamber of the slide. Don't allow large air bubbles to form in the chambers. If they do, suck some of the fluid out and refill.
When one chamber is filled. Empty the pipette back into the beaker and mix again, before drawing up some more of the mix to fill the second chamber.
Allow the slide to sit for five or so minutes to allow the eggs to float to the surface. Leaving the slide sitting will also provide time for some of the heavier debris in the sample to sink to the bottom of the slide, away from where you'll be conducting your count. You can leave the slide for 30 minutes or more if you wish, although some flotation solutions will begin to distort some eggs after a time.
Place the slide gently under your microscope for examination. Don't lock the slide into position as you will want to move it around to conduct your egg count.
Set the microscope at a magnification of 100. For most, the eyepiece will be at a fixed magnification of 10X, so all you need do to get your 100-times magnification is select the 10X lens immediately above the slide.
Be careful, especially with your initial use of the slide. It is much thicker than a standard microscope slide, and you don't want the bottom lens to crunch into the slide and break it. You should be OK with the 10X bottom lens but be careful, just in case.
Using the higher magnification lenses on your microscope is not only unnecessary, but will likely result in a "collision".
The grid in each of the slide chambers is at the same focal plane as the top of the fluid where the eggs will be accumulating. In other words, when you have the grid in sharp focus, you will also have the eggs in focus. You should see some dark circles, which are air bubbles that have also floated to top layer.
At the 100 magnification, your view should encompass the width of a grid.
Start in one corner and count the eggs by gently moving the slide so your view proceeds down the first of the six grid areas on each chamber. At the bottom, gently move the slide across and count the next grid going up. Proceed in this zigzag fashion until you've counted all 12 chambers.
Take a note of the tally of each chamber and remember which one you are counting so you don't lose your way.
To be consistent, count only eggs where more than half fall within each grid. This ensures that an egg sitting on a line between a grid is not accidentally

The method described here involved 4 grams of faeces mixed with 26ml of our flotation solution. Now that we know the maths involved, we can choose to alter the quantities if we like, as long as we do the calculation correctly.

For example, we could take our 4 grams of faeces and mix it with 56ml of flotation solution. We know that we will count the number of eggs seen in .3 of a millilitter in our McMaster slide, meaning we have counted the eggs seen in one-two-hundredths of the total dung-solution mix.

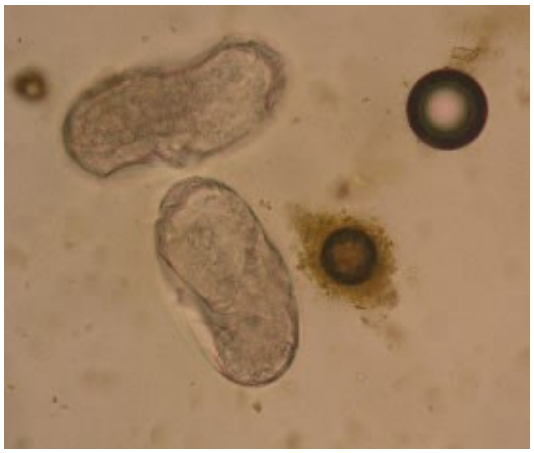
But, remember, we started with 4 grams of dung, which means we have to divide our four into the 200, to give us a factor of 50.

This means, using the quantities here, every egg we see indicates 50 eggs per gram in the feces.

counted twice.
Once finished, tally up the number of eggs you've collected. You're now ready make the simple calculation to arrive at an eggs per gram figure.
All you need do is multiple the number of eggs seen by 25 and this will give you the eggs per gram figure.
How does this work? It's simple mathematics. Each chamber holds exactly 0.15 milliliters of fluid under the grid. Across both grids that's 0.3 milliliters, which just happens to be 1 per cent of the total amount of feces/fluid mixture that we started with.
However, you may recall we started with a 4 gram dung sample, not 1 gram, so to get an accurate result we multiple the egg count not by 100, but by 25. So, if, for example, your total egg count for the slide was 10, you multiple it by 25 to get a "moderate" worm burden of 250 eggs per gram of feces.
Essentially, each egg you see under the grid on the slide represents 25 eggs per gram in the feces. It's a broad measure with a considerable margin for error. If, for example, you see no eggs, it doesn't mean the horse has no worms. It means its egg count is probably below 25 eggs per gram.
For your purposes, all you need understand is that the horse's count is obviously low and it does not require drenching.
While your counting may not match the performance of the experts, the information you glean will help you paint a more accurate picture of the worm burden among your horses and the effectiveness or otherwise of your drenching program.
Keep a careful written record and, by continuing to do egg counts, you'll be able to keep a tight rein on the worms silly enough to hang around your property.

What does my egg count mean?
You can classify your worm count as either low, moderate, or high. A fecal egg count of fewer than 100 eggs per gram of feces is considered low. A count of between of 100 and 500 is considered in the moderate range and anything above 500 is considered high.

Identifying parasites under the microscope
A picture is worth a thousands words, so study the images closely to help you identify what you're looking for through the microscope.



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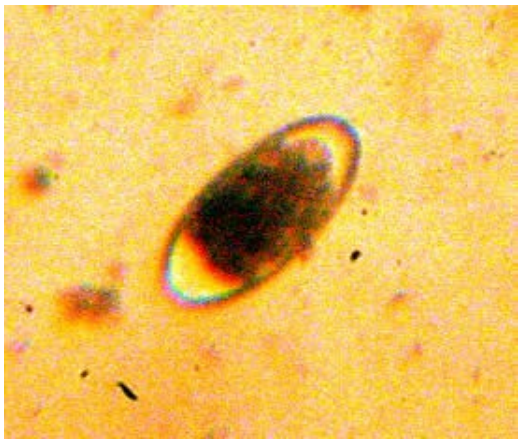


The two images above are examples of strongyle eggs, which will make up the vast majority of the eggs you'll count. The dark sphere is air bubble.

The familiar D-shape of a tapeworm egg. The sporadic way in which tapeworms release their eggs means fecal eggs counts are not a reliable means of determining whether a horse is infected. Should you sight any, a drench with praziquantal is in order.
© Martin Krarup Nielsen

The eggs are more likely to see are those of strongyles and ascarids. More than likely, it will be strongyle egg count that will persuade you it's time to drench a horse. Remember, strongyle eggs are ubiquitous in pasture, meaning your horse's re-infection by this parasite is likely to begin in its first few mouthfuls.

It is important to realize the limitation of a fecal egg count - and your own limitations. You might be lucky enough to know a friendly veterinarian or laboratory technician who will help explain what you see through your microscope. If you don't, you're relying on pictures and your identifying skills should gradually improve.

Given the DIY nature of your egg count, what particular value is it? Firstly, if you perform the test properly and your count indicates a high worm burden, that's as much as you need to know. The next step is to organize a drenching for the horse or horses in question.

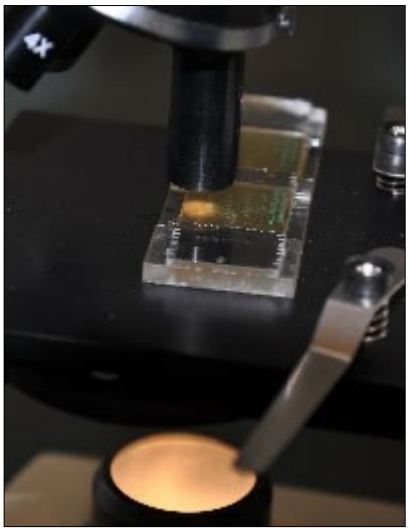
Once your testing program is under way, it has great value as a means of assessing your deworming program. Are you seeing lower egg counts in subsequent tests? Are some parasites coming back faster than you might expect, which indicates the parasite might have some resistance to the particular drench you're using? Which of your horses tend to have higher eggs counts and which ones enjoy lower numbers? With every test - or every round of tests - you build a clearer picture and can work even smarter.

Other limitations exist. For example, the above test is not an effective way of detecting tapeworms. Mature tapeworms do not release a consistent flood of eggs as strongyles do. Tapeworms release little packets of eggs from their tail section only at intermittent times, so there is a good chance you won't find them in the dung sample. Even if tapeworm eggs are present, they will be distributed unevenly and there is every chance you will not see any in the small sample you selected for testing. Naturally, the more tests you undertake the greater the likelihood of finding a tapeworm egg or two. You're best to assume your horse is infected with tapeworms and drench when appropriate. Studies involving post mortems on adult horses have pointed to an infection rate of up to 50%.

It is also important to realize that while

an egg count will provide you with some guidance as to worm burden, it provides only part of the answer. Only mature worms will be producing eggs. An egg count will, for example, provide you with no data on the numbers of encysted strongyles or immature ascarids.
Another limitation relates to the mathematics. We already know that every eggs we see under the microscope equates to 25 eggs per gram in the feces. Given this equation, just because you don't see any eggs in your test does not mean the horse is free from worms. It simply means that the horse's egg count is under 25 eggs per gram - certainly at a level that should cause you no concern.

Fighting against worm resistance



A fecal egg count reduction test can indicate whether resistant strongyles are present on your property.

Life on earth didn't get to where it is without learning a trick or two along the way.
Nature provides plenty of evidence showing that the ability to adapt is a valuable evolutionary trait.
Most of us will be aware of concerns about the resistance of bacteria to antibiotics and the conscious effort of doctors to prescribe them only when absolutely necessary.
It should therefore come as no surprise that parasites have not taken the arrival of drenches lying down.
They, too, have been gradually adapting in this long-running battle, not just in horses but in all manner of species where drenches are used, such as sheep and cattle.
Resistance is simple enough to understand.
Organisms enjoy genetic diversity. Among the countless billions of any one particular species of equine parasite, there will be a small number whose genes make them more resilient to a particular drench that the others.
If they survive a drenching they get to breed and pass on that genetic advantage. The numbers of those with this advantage grow while those with no special resistance diminish.
Eventually, the drenches we use become less effective because more resistant worms are surviving. We know that we can slow this process by using different drench families, which means that we can kill some of the resistant worms with a different chemical, but it is little more than a delaying tactic.
That said, drench rotation is important. You want to avoid the temptation of sticking solely with the likes of ivermectin or moxidectin because they prove so effective. A slow-growing worm resistance problem is much better than a fast-growing worm resistance problem.
Resistant specimens need not even exist in a given population. Mutations occur from time to time in a population and, when we talk parasites, we're talking countless billions. Most mutations in an organism are bad and usually

prove fatal.
Just occasionally, mutations occur that deliver some benefit to an organism and, if that benefit happens to be resistance to a particular drench, there is every likelihood the parasite will breed on this desirable trait (well, it's desirable from a parasite's point of view!).
Unfortunately, worm resistance is a bit like earning compound interest at the bank. Numbers grow slowly to start with, but with each generation there are more resistant offspring and finally - from a horse owner's point of view - you'll be noticing through fecal egg counts that drenching results are not as good as they once were.
Worm resistance is a global problem with a regional twist. Patterns of resistance vary from country to country, region to region, and even between properties, depending very much upon their horse history.
Fortunately, fecal egg counts can provide us with some indication of whether resistance is becoming a problem on our own property. It's most accurate in terms of strongyles because their numbers are that much greater.
We gain this measurement through what is called a fecal egg-count reduction test. This rather grand name simply describes before and after fecal egg-count tests where we compare the results to gain a measure of effectiveness.
Firstly, we need to perform an egg count before drenching to provide us with a basis for comparison. Naturally, the results are really only useful if the drench you use contains one active ingredient, otherwise how will we determine how a particular drench family is performing?
We then drench the horse and conduct a follow-up egg count around 12 days later. Then, it's a simple matter of comparing results.
The first question is: what did you drench with? Each drench family will deliver a different result so this an important part of the equation.
If you used a drench from the benzimidazole or tetrahydropyrimidine families, you would hope to see a 90% reduction in the egg count. Anything less than that and there is a reasonable chance that resistant parasites are present. If the reduction is 80 per cent or worse, you can bet your bottom dollar you have a resistance problem - at least to that particular family.
Ivermectin, moxidectin and abamectin remain highly effective drenches so you would hope to see an egg reduction of at least 98 per cent. Below that, and you would have to suspect a resistance problem. In fact, small strongyle resistance to this family of drench (the macrocyclic lactones) has only recently been shown in a study published early in 2008 based on research conducted on 250 horses on a central Kentucky farm.
In this particular case, we can come up with a collective result for all horses on your property.
While you want to record the data for each particular horse, you can add the totals across all horses tested and make the comparison. In other words, if you tested eight horses, add up the total egg count for the eight animals taken before the drenching, and add up the follow-up test results to make a direct comparison.
The more horses you test, the more accurate the result.
Remember, too, the multiplying factor involved in egg counts. If, for example, one of your horses return an egg count of 75 per gram of feces before drenching (meaning you saw three eggs within the grid on the slide) and saw just one in the follow-up (for a count of 25), the numbers are simply not statistically significant.
By way of statistical comparison, the more horses the better for a fecal egg count reduction test.

Cardinal drenching sins

We've already discussed the real star performers among equine drenches - the macrocyclic lactones, which comprise moxidectin, ivermectin and abamectin.

It is a highly effective family of drenches and resistance is, to date, limited.

It is tempting to dose only with a member of this family, but we have already discussed the importance of occasional drench rotation to slow the advance of worm resistance.

Don't use a bigger gun than you need to kill your parasitic prey.
© Martin Krarup Nielsen

But even within a family of drenches, the choice can be important. Moxidectin is more powerful and longer-lasting than ivermectin, but that is no reason to head straight for moxidectin.

By doing follow-up fecal egg counts we can determine the effectiveness of each of these drenches.

If your testing shows ivermectin to be highly effective, why use a bigger hitter?

As a general rule, don't use a bigger gun than you need to kill your parasitic prey. If ivermectin is doing the job effectively, keep using it, and keep moxidectin up your sleeve.

It's important to realize that no new drench families are on the immediate horizon. We have to make do with what we have and it's our responsibility as horse owners to use them as effectively as possible, and to minimize the growth of worm resistance.

The four key strategies for minimizing the growth of drench resistance in worms are:

- Never underdose a horse, except on veterinary advice (such as trying to gradually reduce a heavy ascarid burden in foals).
- Avoid unnecessary treatments. Drench only when circumstances (such as a new arrival) or fecal eggs counts indicate a need for drenching.
- Never use the same drench family year after year without changing.

Monitor eggs counts after drenching to ensure that the drench family you're using is proving effective, and you haven't already got a resistance problem on your property.

The perils of youth

Ascarids, or roundworms, pose the biggest threat to young stock.
© Horsetalk.co.nz

Equine age has its virtues, and one of them is an ability to fend off several of the parasites that commonly afflict horses.
We already know that ascarids (roundworms) prefer to hang out in youngsters and are rarely found in horses over 15 months of age.
Threadworms and pinworms are similarly most prevalent in young horses.
In fact, threadworms (Strongyloides westeri) can infect your newborn foals in the blink of an equine eye. This parasite can be transferred to the foal as migrating larvae are well adapted to migrating to breast tissue when hormones indicate that the time is right.
Threadworm larvae can even find their way into the mare's colostrum and thereby infect the foal.
It is for this reason that some experts recommend worming a foal within a few days of birth. Ivermectin is often used for this purpose.
Threadworms succumb quickly to ivermectin so another possible strategy is drenching the mare shortly before foaling to ensure all larvae in the breast tissue - or on their way there - are killed.
A heavy threadworm infection in a foal can cause diarrhea.
A threadworm infection is easy to identify as the eggs can be seen during a fecal egg count.
Threadworm larvae mature once they get into the digestive track and a foal, with its naive immune system, is the perfect host. The threadworm larvae will mature within a fortnight and begin producing.
The risk of infection from most other parasites increases after weaning, but even the youngest of foals will explore the pasture beneath their feet and are likely to pick up infective larvae.
When conditions are absolutely right, after rain and when temperatures are mild, threadworm larvae have been known to burrow into a horse's skin, triggering severe irritation.
The risk from another foe, ascarids, cannot be under-estimated. Youngsters are particularly prone and the build-up of mature ascarids in the gut can be so substantial that they can trigger potentially fatal colic.
Drenching foals with a heavy ascarid load has the potential to trigger colic.
When dead ascarids in heavily infected youngsters let go of the gut wall, the sheer numbers are capable of causing a blockage.
Aside from preventing this, you don't foals happily depositing ascarid eggs around the pasture. Fortunately, the ivermectin given for threadworms will work its magic on ascarids.
While several drenches will kill adult ascarids, ivermectin will also kill the mi-

grating larvae. Given the life cycle of ascarids, drenching with ivermectin at no more than 60-day intervals should ensure the ascarids do not mature and begin producing eggs.

And, come 15 months of age, your horse's immune system will be tuned to the point where ascarids should no longer be a problem.

If you suspect a foal may have a heavy burden of ascarids, consult your veterinarian. He or she is likely to recommend a reduced drenching dose which will kill only some of the ascarids. By killing off the population a bit at a time, the chance of an impaction colic is greatly reduced.

Strongyles - both large and small - will be dealt with adequately by the use of ivermectin for the other worm threats.

The lack of resistance shown by young horses is a key driving factor in implementing a drenching program early. Always check labels to ensure a drench is suitable for use in foals or youngsters.

And don't forget to calculate the weight of the youngster and drench accordingly.

Monthly, or even fortnightly, fecal egg counts will help determine whether the strategies you're employing are working.

UNO ALLA VOLTA — ONE AT A TIME

If you have read this far, you have learned a lot. Please note that this article is for your information only. You will not be tested on this material. We would like to encourage you to always question what you put in your horse in terms of chemicals.