CFAES
Factsheet # AS-H-2-22

Equine Parasite Control Methods

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Control of internal equine parasites involves implementing best practices for pasture and manure management, deworming individual horses according to the number of parasite eggs found in manure, and identifying which dewormers are effective at your farm. It is also helpful to have some background information on common types of equine parasites; this information can be found in Factsheet # AS-H-1-22.

Pasture Management

Many horses spend a substantial amount of time on pasture. Pasture is beneficial for equine health, but pasture is also a habitat for infective stage larvae and free-living stages of equine parasites. Best management practices for pasture can reduce both parasite presence, and subsequently load, within the horse. Practices that reduce parasite burden are those that interrupt life cycles or reduce favorable habitats for the parasites.

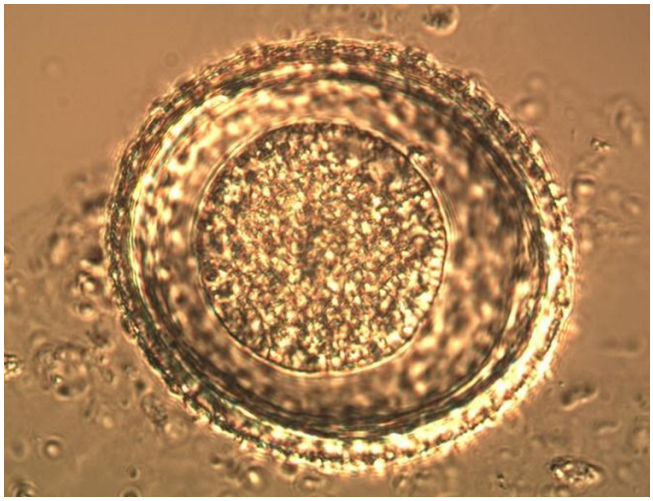

Figure 1. *Ascarid egg under a microscope. Photo by Steffanie Burk.*

Manure is a source of internal parasite eggs and larvae, and 98% of infective larvae are found less than 1 meter (3 ft) from a manure pile (Fleurance et al., 2007). Manure also attracts and supports flies (external parasites). When feasible, remove manure from pastures, as this strategy has the potential to remove internal parasite eggs/larvae from the horse's environment. Subsequently, properly composting the manure will allow it to heat to temperatures upwards of 50°C (122°F), and ascarid eggs (Figure 1) become non-viable within 8 days at such temperatures (Gould et al., 2013).

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Reducing the stocking rate or number of animals in an area also reduces the amount of manure. Fewer manure piles allow horses to choose to graze farther from manure piles from which larvae emerge. When manure removal is not an option, farm owners can drag pastures to break up manure piles. Intact fecal balls are protective of larvae and dragging or harrowing can help break them apart (Nielsen et al., 2007). A study conducted in Ohio in 1983 revealed the lowest numbers of L3 cyathostome larvae migrating from manure piles to pasture in midsummer, with higher numbers found during wetter, cooler months (Herd and Willardson, 1985). Dragging the pasture during the hottest summer months will break apart the fecal balls at the time larvae are most susceptible.

Rotational grazing has many benefits for pasture health. If rotations are long enough, they may help to break the life cycle of some parasites. However, many internal parasite eggs can subsist in the environment for a long time, waiting for a host. Rotating other non-equid livestock species with horses in pasture or co-grazing different species (Figures 2 and 3) may be more effective for parasite reduction because internal parasites may be consumed by an incompatible host. Young horses that grazed in mixed pastures with cattle shed 50% fewer strongyle eggs when compared with those grazing in equine-only pastures (Forteau et al., 2020).

Other equid species can carry parasites that are compatible with horses and ponies. Donkeys can tolerate relatively high infestations of lungworm (*Dictyocaulus arnfieldi*) and can pass those worms to horses via shared pasture space. Lungworms cause severe coughing, bronchitis, and pneumonia in horses (Ballweber, 2019).

Mowing and keeping tree lines and brush trimmed back from fence lines helps to reduce tick habitat.

Fecal Egg Counts

Guidelines for treatment of equine parasites have shifted from rotational deworming practices, where horses were dewormed every two months. Now veterinarians and researchers recommend that owners conduct fecal egg counts (FEC) and deworm only the horses shedding high levels of parasite eggs in their manure. FEC are conducted by taking a manure sample and using a microscope to count the number of parasite eggs. Your veterinarian can perform FEC, or you can do them yourself if you have the correct equipment.

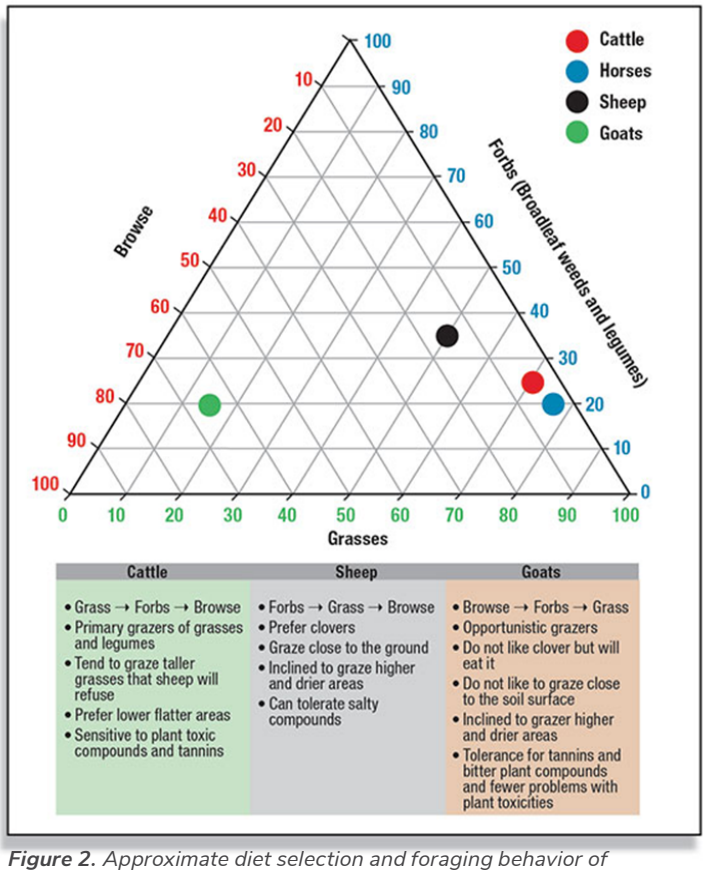

Figure 2. *Approximate diet selection and foraging behavior of livestock when offered a mixed pasture. Created by Rocky Lemus for Progressive Forage (2013).*

Figure 3. *Cattle grazing pastures typically used for horses at the Ohio State ATI Equine Center. Photo from the ATI Equine media library.*

Why perform FEC and FEC reduction tests (FECRT)?

The US horse industry contains over 7 million horses, with Ohio ranking in the top 10 states for horse population. In a 2015 survey of horse owners in the northeastern US, 17.5% performed a fecal test for parasites in the previous 12 months. Only 37.1% of horse owners had a veterinarian consult on deworming (USDA APHIS, 2015). Horse owners often state that the cost for FEC/FECRT are more expensive than purchasing a dewormer, and it is cheaper to deworm without the tests. However, several other factors must be considered in addition to the cost of the test versus the cost of the dewormer. FEC are essential for assessment of horse health and in the long-term, FEC may be more cost-effective than rotationally deworming. Horse owners are often unaware that the dewormers they are administering may be ineffective due to drug resistance. Additionally, dewormers are often needlessly administered to horses that have naturally low parasite burdens.

Rotational deworming practices were recommended in the 1960's following the release of benzimidazoles for horses. The purpose of rotational deworming was to control *Strongylus vulgaris*, a large strongyle species known for causing severe clinical signs of infestation, like colic (Drudge and Lyons,1966; Kaplan, 2002). Rotational deworming programs were successful in eradicating *Strongylus vulgaris* on most well-managed equine facilities (Kaplan, 2002). However, the frequency of treatment has led to increased drug resistance by small strongyles and ascarids. In a large multi-state study, Kaplan et al. (2004) showed that the percentages of equine facilities that had drug resistant cyathostomins were: 97.7% (fenbendazole), 53.5% (oxibendazole), 40.5% (pyrantel pamoate) and 0% (ivermectin). Nielsen et al. (2108a) found that moxidectin and ivermectin were effective at 88.7% of equine facilities, while other drug classes were effective at only 21.4% of operations The cost of worsening drug resistance due to overtreatment is daunting as there have not been any new anthelmintic drugs presented in decades, and there is now evidence of reduced efficacy for ivermectin and moxidectin, the most recently developed deworming drugs.

FEC helps horse owners to determine which horses in the herd need to be dewormed and can reduce the amount of dewormer used each year. Treatment of horses that are shedding higher numbers of parasite eggs (Figures 4-7) in their manure can slow the spread of drug resistance and promote refugia. Refugia is the preservation of parasites within a population that are

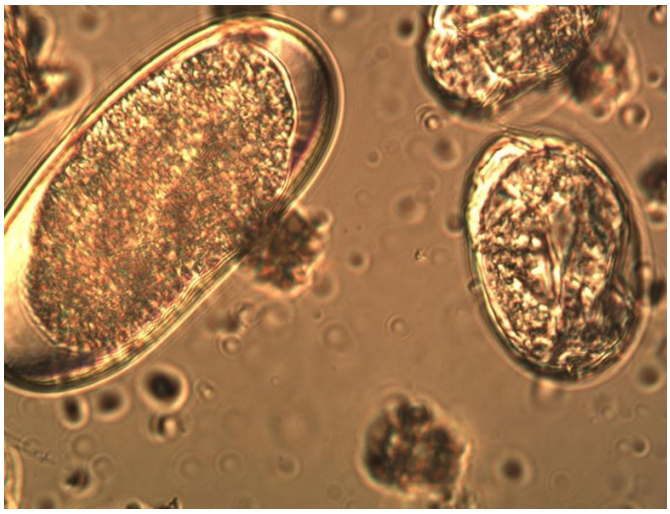

Figure 4. *Strongyle egg (left) and Strongyloides westeri egg (right) under a microscope. Photo by Steffanie Burk.*

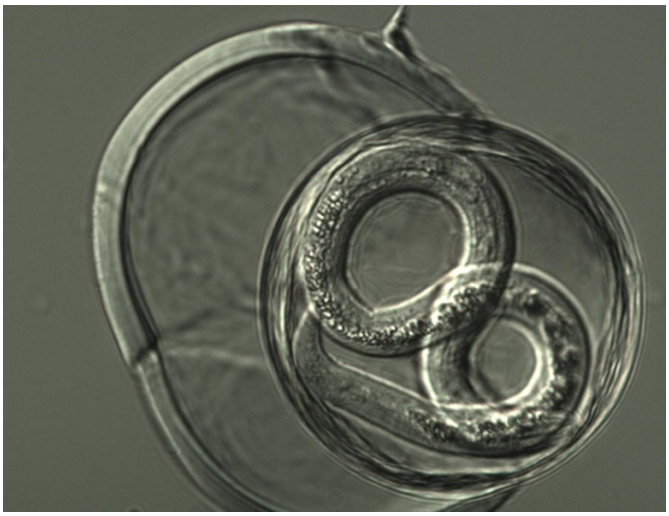

Figure 5. *Embryonated ascarid egg with chitinous layer removed (under a microscope). Photo by Steffanie Burk.*

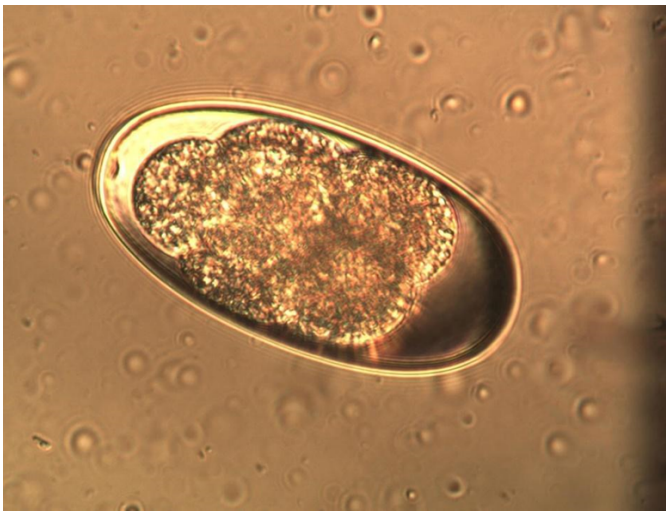

Figure 6. *Strongyle egg under a microscope. Photo by Steffanie Burk.*

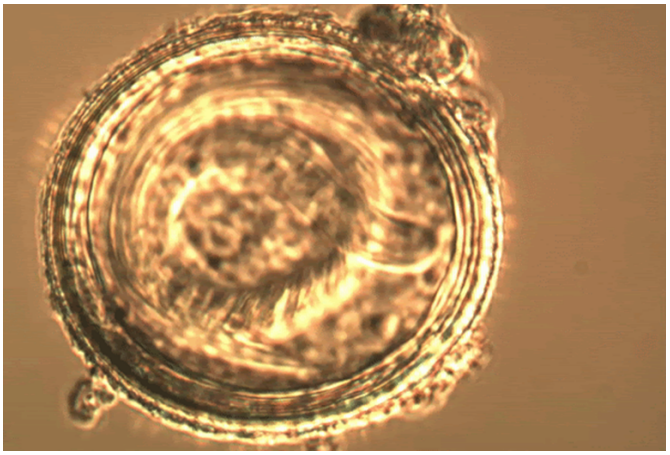

Figure 7. *An active, embryonated ascarid egg under a microscope. Video by Steffanie Burk.*

susceptible to dewormers. To preserve refugia while maintaining the health of individual horses, it is now recommended that horse owners deworm the horses shedding high numbers of eggs (called "high shedders") several times annually. The majority of adult horses ("low shedders") only require deworming once or twice a year. In a project evaluating nearly 4,000 equine facilities across 28 states, Nielsen et al. (2018b) found that 27% of horses shed 80% of the total strongyle eggs. Performing FEC on individual horses allows owners to determine which horses are high shedders, and which are low shedders. Young horses are more likely to be high shedders (Nielsen et al. 2018b) and may become low shedders as they mature. Adult horses are relatively consistent in their shedding status (Nielsen et al. 2006). So, once an owner has performed several FEC on a horse, they will have a better idea if the horse is a high or low shedder and can reduce the frequency of FEC testing. If the horse is a low-shedder, the horse may only need to be dewormed 1 to 2 times per year. This could save 2 to 5 doses of dewormer per horse per year when compared to rotational schedules, more than covering the costs of FEC.

On many farms, the dewormer that horse owners are administering may not be effective. Available drug classes, deworming drugs, brand names, and efficacy of each toward different types of equine parasites are provided in Table 1 (AAEP, 2019). Overtreating horses with dewormers not only promotes drug resistance and wastes money, but it also does not allow horse owners to gauge if the current regimen of dewormers is effective at reducing parasite load. The only way to know if parasites are resistant to a drug clas on your farm is to perform FECRT.

How is FEC performed?

Your veterinarian can analyze a manure sample collected from your horse. It is important to ensure the sample is fresh (collected within 12 hours of being passed), that you can identify which horse the sample came from, and that you label the sampling container appropriately. For a FEC, you should also wait at least 8 weeks after the horse's last deworming date (AAEP, 2019). The easiest way to collect a sample is to invert a sandwich bag, fill the bag by picking manure from a few locations in a relatively intact pile, flip the bag right-side out, squeeze out any excess air, and seal the bag. Write the date, horse name, and your name on the bag using a permanent marker. Alternatively, your veterinarian may have a sampling container for you to use. Store the sample in a barn refrigerator (not freezer) if you are not testing it immediately.

If you would like to perform your own FEC, the modified McMaster method (adapted from Gordon et al., 1939) is the most practical to use at home (see steps described below). There are other methods that are more sensitive, like the modified Stoll or Wisconsin sugar flotation technique, but these methods

Table 1. Efficacy of equine dewormers against various types of equine internal parasites (AAEP, 2019).

Drug	Brand Names	Small Strongyles	Large Strongyles	Ascarids	Bots	Tapeworms
Benzimidazoles		Widespread resistance	Effective	Early indications of resistance developing	Not effective	Not effective
Fenbendazole	Panacur Safe-guard					
Oxibendazole	Anthelcide EQ					
Tetrahydropyrimidines						
Pyrantel pamoate	Equistrength Exodus Strongid	Resistance common	Effective	Early indications of resistance developing	Not effective	2-3x dose effective
Pyrantel tartrate	PyrantelCare Strongid C	Resistance common. For prevention of infestation, not treatment for existing parasites	Effective. For prevention of infestation, not treatment for existing parasites	Early indications of resistance developing. For prevention of infestation, not treatment		Not approved for control of tapeworms
Macrocyclic lactones						
Ivermectin	Bimectin Duramectin Eqvalen IverCare Zimectrin	Early indications of resistance developing	Effective	Widespread resistance	Effective	Not effective
Moxidectin	Quest					
Praziquantel + Ivermectin	Equimax Eqvalen Gold Zimectrin Gold					Effective
Praziquantel + Moxidectin	Quest Plus					

require centrifugation and other methods that require purchasing additional equipment. The mini-FLOTAC system uses a specialized plastic device, and does not require centrifugation (ACSRPC, 2021). Parasight is a system that involves the addition of chemicals to a sample to fluoresce eggs (Parasight Systems Inc., 2021). The system then analyzes the number of eggs in an image and provides the EPG (eggs per gram of manure).

The modified McMaster method has a detection limit of 25 EPG, which means that samples containing low numbers of parasite eggs may appear as a 0 EPG result (false negative). This is adequate for performing FEC tests, but more sensitive methods such as modified Stoll, Wisconsin, mini-FLOTAC, or Parasight are recommended for FECRT.

Flotation solution is required for FEC. Fecasol® or Sheather's sucrose solution can be purchased online, or you can make your own Sheather's sucrose solution. To make Sheather's sucrose solution, gradually add 1 lb of table sugar to 12 oz of hot water while stirring over low heat. Do not let the mixture boil. Stir until all of the crystals are dissolved. You should test the specific gravity using a hydrometer (Figure 8) to ensure it is 1.27, which will make the parasite eggs float in solution. A hydrometer that measures at 1.27 specific gravity can be purchased from Amazon.com for approximately $15. First, allow the liquid to cool, pour it into the case of the hydrometer, and place the hydrometer into the liquid. Then, read the number on the hydrometer corresponding to the level of the liquid. If specific gravity is too low, add more sugar. If too high, add more water. Allow to cool to room temperature before using. Use within one week to prevent mold growth.

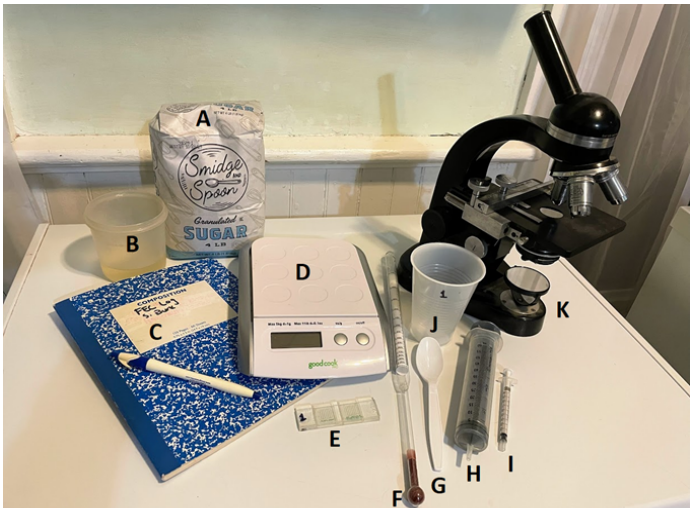

Figure 8. *Supplies needed for a modified McMaster FEC. A) Sugar, B) Sheather's sucrose solution, C) Paper and pen, D) scale, E) McMaster's slide, F) hydrometer, F) disposable spoon, H) large syringe, I) small syringe, K) microscope. You will also need a stovetop, pot, and large spoon to make the Sheather's sucrose solution, and the manure sample in a Ziploc bag. Photo by Steffanie Burk.*

To perform a modified McMaster FEC, you will need the following supplies (Figure 8):

- A kitchen scale that can weigh in grams
- Sheather's sucrose solution or other flotation solution (you will use 26 ml of solution per manure sample)
- A graduated cylinder or large syringe that can measure 26 ml
- A small syringe or transfer pipet that can measure 1 ml (1 per manure sample)
- A disposable spoon (1 per manure sample)
- A disposable paper or plastic cup (1 per manure sample)
- A McMaster slide (1 per manure sample if testing multiple samples concurrently). Can be purchased on Amazon for approximately $20.
- A microscope with a 10x lens
- A pen and paper to tally the eggs.
- A tally counter is also helpful but optional. Can be purchased on Amazon for approximately $5.

Instructions for performing FEC:

1. Turn the scale on. Place the cup on the scale and tare the scale.
2. Use a spoon to scoop manure from the bag into the cup. Weigh out 4 g of manure.
3. Measure 26 ml of flotation solution using the graduated cylinder or large syringe and add it to the manure in the cup.
4. Use the spoon to mix the solution for 1 to 2 minutes.
5. Immediately after mixing, use the small syringe or transfer pipet to draw out the solution (if you let the solution sit, eggs will not be evenly distributed in the solution). Place the syringe or pipet at the corner of one grid of the McMaster slide and slowly add solution. Be careful not to tilt the slide too much to ensure the solution remains in the slide. Fill the first chamber completely so the grid is filled with solution. If you make a bubble, try to remove the bubble using the syringe, or rinse the slide and start over.
6. Mix the solution and immediately pipet out another subsample, filling the second chamber of the McMaster slide.
7. Allow the slide to sit for 20 minutes before reading to allow eggs to float within the solution.
8. Put the slide under the microscope with a 10X lens and focus the microscope on one of the outer corners of the grid of the first chamber (Figure 9).
9. Count the eggs within each column, and then move over to count the next column. Count the eggs only on the inside of the gridlines. If an egg is partially inside of the gridline, only count it if more than 50% of the egg is within the line.
10. Record each egg by putting a tally mark on your paper. Or, you can hold a tally counter in your hand and click each time you find an egg. There are also tally counter apps that you can download on your phone. If you see both ascarid and strongyle eggs, count them separately.
11. Repeat the process for the second chamber of the slide.
12. Calculate the EPG by adding the eggs from the two chambers together and multiplying by 25. For example, if you saw 4 eggs in the left chamber and 6 eggs in the right chamber, your calcuation would be: (4+6) x 25 = 100 EPG.

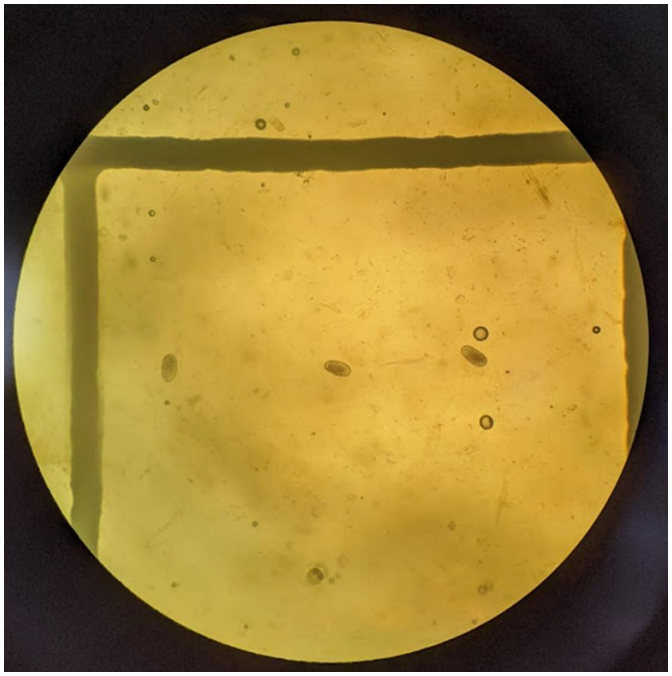

Figure 9. *View of a McMaster slide under a microscope containing strongyle eggs. Photo by Steffanie Burk.*

Which horses should be dewormed?

Talk to your veterinarian about your horse's FEC results. Your veterinarian may recommend a cutoff level of anywhere from >0 to 500 EPG (AAEP, 2019). Most commonly, deworming is recommended for adult horses with FEC results of 200 EPG or higher. Using a cutoff of 200 strongyle EPG or higher leads to a 96% reduction in overall egg shedding, but only requires treatment of 55% of horses (Kaplan and Nielsen, 2010).

When should horses be dewormed or FEC tested?

It is important to work with a veterinarian regarding treatment decisions. Treatment decisions should be based on the horse's age, types of parasite eggs detected, and efficacy of each type of dewormer on your farm. For additional reference, Colorado State University's Veterinary Teaching Hospital outlines a yearly schedule regarding when to deworm or perform FEC for foals or adult horses: https://vetmedbiosci.colostate.edu/vth/services/equine-field-service/equine-recommended-deworming-schedule/.

How should horses be dewormed?

The first step in deworming your horse is obtaining a weight estimate. This is outlined in the Factsheet: "Evaluating Body Composition of Horses". Once you have purchased the appropriate dewormer, twist the dial to set the dewormer syringe at the appropriate weight for your horse and remove the cap. Halter your horse and remove any excess hay or debris from your horse's mouth. Insert the end of the syringe into the corner of the horse's mouth. Push the plunger to empty the contents of the syringe into the horse's mouth. Elevate the horse's head to avoid dropping any of the dewormer onto the ground. To avoid issues with other pets consuming the dewormer, dispose of the dewormer in a secure trash container and clean up any dewormer that has fallen on the floor. Record the date of deworming and type of dewormer used on your calendar. If your horse is resistant to being dewormed, you can work on desensitization and counterconditioning your horse to accept oral medications by practicing ahead of time with a syringe filled with something your horse enjoys eating (like unsweetened applesauce).

How are fecal egg count reduction tests performed?

FECRT is used to determine if a dewormer is effective on your farm. To perform a FECRT (adapted from AAEP, 2019):

1. Wait at least 8 weeks since the last deworming date.
2. Collect feces and perform a FEC for each horse. The method you use should have a detection limit of less than 25 EPG (modified Stoll, Wisconsin, mini-FLOTAC, or Parasight).
3. Deworm each horse with the same type of dewormer.
4. At 10 to 14 days post-deworming, collect feces and do a FEC for each horse using a method with a detection limit of less than 25 EPG.

5. Ideally, use at least 6 horses with the highest pre-treatment FEC results in your calculation. Add up the strongyle eggs for their overall pre-treatment EPG and post-treatment EPG to come up with overall pre-treatment and post-treatment EPG. Perform the following calculation to obtain the FECRT result:

   ((Pre EPG - Post EPG) / (Pre EPG)) x 100

6. Drug resistance is present if your FECRT result is <90% for fenbendazole or oxibendazole, <85% for pyrantel pamoate, and <95% for ivermectin or moxidectin.

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