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FECAL EGG COUNTS EXPLAINED

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Frustrated by Fecal Egg Counts?

Simple solutions to common problems veterinarians and technicians encounter when performing FECs

Stacey Oke, DVM, MSc

Fecal egg counts (FECs) are the foundation of modern equine parasite control programs. Counting those parasite eggs reliably to obtain the information you need to make smart deworming decisions, however, can be frustrating. In this article Martin Nielsen, DVM, PhD, Dipl. ACVM, EVPC, Schlaikjer Professor of Equine Infectious Diseases in the Gluck Equine Research Center at the University of Kentucky, in Lexington, offers solutions for seven common problems equine practitioners and their technicians encounter when performing FECs.

Problem: My clients don't understand the purpose of FECs.

Solution: Review the AAEP Internal Parasite Control Guidelines to brush up on your basic internal parasite knowledge.

Nielsen co-authored the American Association of Equine Practitioner's guidelines (aaep.org/guidelines/internal-parasite-control-guidelines), which outline the main goals of FECs:

1. Performing fecal egg count reduction tests (FECRTs) to monitor anthelmintic (dewormer) resistance among both small strongyles (cyathostomins) and ascarids (*Parascaris* spp).
2. Identifying animals in need of anthel-

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Use fecal egg counts to determine which horses are moderate to high shedders and then deworm them at the appropriate times of year (e.g., spring).

mintic treatment as part of a targeted anthelmintic treatment protocol. Such surveillance-based control regimens eliminate rote deworming, with the goal of preserving effective chemical anthelmintics.

3. Identifying the presence of ascarid eggs in young stock and deworming affected animals when indicated with an appropriate anthelmintic.

Have FECs performed at least twice a year on all adult horses. This allows you to classify horses based on their egg shedding level, because not all horses shed parasite eggs to the same extent. Research shows a small percentage of horses, dubbed "high shedders," are responsible for excreting the bulk of the eggs on a farm. This is the 80/20 rule: Twenty percent of the horses on a farm shed 80% of the eggs.

Low shedders have fewer than 200 eggs per gram (EPG) of feces, whereas moderate and high shedders have more than 200 and 500-1,000 EPG, respectively.

"The main aim of the FEC is to identify the low and the high shedders," says Nielsen. "The medium shedders between 200 and 500 EPG aren't as important."

Problem: I don't know which horses to deworm based on the FEC.

Solution: Focus on moderate/high shedders at appropriate times of year.

Deworming only high shedders helps reduce selection pressure for anthelmintic resistance. Most horses typically need to be dewormed only once or twice per year, but high shedders often need more frequent deworming.

However, don't deworm simply because a horse's egg count exceeds 200 EPG. Experts such as Nielsen advocate deworming horses that have more than 200 EPG only at appropriate times of year when environmental conditions favor larval development on pasture. For example, don't deworm during the winter in cold temperate climates and during the summer in warm/hot climates when strongyle eggs are unlikely to develop into infective larvae.

While egg counts can identify heavy shedders, they cannot pinpoint animals with heavy parasite burdens or diagnose disease.

"Egg counts can never indicate any role of parasites in disease or even predict the risk of disease," says Nielsen. "Many people still believe that egg counts correlate with worm burdens, and I am correcting that misconception on a weekly basis."

Here are a few reasons we can't use egg counts to establish worm burdens:

- More than 50 strongyle parasite species produce the same strongyle-type of parasite egg. Some species make more eggs than others, so it becomes impossible to relate the number of eggs to the number of worms.
- Worms go through phases of life. When they're premature, they produce no eggs. When they're young adults, they produce more eggs than when they age. At the end of their lives, they no longer produce eggs. Given this variation across a worm's life span, egg counts don't directly relate to the number of worms present.
- The host immune system suppresses egg shedding. Two horses might have the exact same number of worms and types of species and stages present yet have vastly different egg counts.
- Large populations of female worms suppress each other's egg production.

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If a horse harbors many adult internal parasites, each individual female produces fewer eggs than when only a few individuals are present (and each worm produces a higher number of eggs).

Problem: I don't know which egg counting technique to use.

Solution: Research and understand your options.

The basic principle of a fecal float is to separate parasite ova from the bulk of fecal detritus using a dense liquid medium that permits subsequent ova counting. Veterinarians can send fecal samples to a commercial FEC laboratory to avoid performing this time-consuming task themselves, or they can run FECs in-house using a modified McMaster (the industry standard and most popular technique), Wisconsin, Mini-FLOTAC, or novel automated technique.

Factors affecting which test your practice uses include precision, accuracy, experience and training of personnel performing the test, and cost.

Problem: How do I know if my test is reliable?

Solution: Understand sources of error and variability when performing FECs.

A reliable FEC test is one that is precise, which is a measure of variation between repeated counts of the same sample. Precision is synonymous with repeatability.

"Given that the most important use of the FEC is to test for resistance, we need to be able to differentiate between normal variation of counts and a lack of dewormer efficacy," says Nielsen. "An imprecise test can lead to the wrong conclusions."

For example, an imprecise test might suggest resistance is present on a specific farm when it's not.

Factors affecting FEC precision fall into two main categories:

1. **Biological sources of variation.** These occur because egg distribution within the feces is not even, meaning samples taken from the same animal vary.
2. **Technical sources of variation.** Such variation occurs because ova get lost during processing, including the filtration, flotation, mixing, and suspending steps. The training and experience of the analyst reading the sample can also contribute to technical errors.

"The performance and reliability of a given technique are highly dependent on the person tasked with conducting it," says Nielsen.

Fecal Egg Count Cheat Sheet

	When to Perform FECs	When to Perform FEC Reduction Tests	When to Deworm
Adult Horses	Once or twice a year to determine horses' level of egg shedding	At least every three years for each drug class used	Give baseline treatments usually in spring and fall, with additional treatments for high strongyle shedders
Juveniles	Routinely to determine ascarid presence, map out egg reappearance periods, and check treatment effect	Annually until past age 2	Deworm foals for ascarids according to their age; after weaning shift focus to strongyles and tapeworms. Juveniles are more susceptible to parasites and often treated more frequently.
New Horses	Upon arrival. Check post-treatment sample for treatment effect	At least every three years for each drug class used	Same considerations as for adult horses
Old Horses	Same considerations as for adult horses, keeping in mind that old horses are more likely to be high shedders	At least every three years	Same considerations as for adult horses

Problem: How can I minimize technical sources of variation?

Solution A: Address technician training.

"Completing FECs under time pressure negatively affects both accuracy and precision," says Nielsen. "In a busy veterinary practice, a large number of samples may need to be analyzed within a specific time frame. To be efficient, technicians may abbreviate the test, taking less time to count the eggs on the slides, or only count one of the two chambers on the McMaster grid (for example) to accommodate workload."

In one study (Slusarewicz et al., 2019) Nielsen and colleagues demonstrated operator proficiency's effect on FECs by limiting technicians' counting duration by either restricting counting time or having them count one of the two McMaster grids. The results showed that technicians took, on average, 4.1 minutes to perform an FEC. With counting time restricted to one minute, the egg counts decreased by 50-60% of those counted at the technician's leisure. When the technicians had two minutes to perform the FEC, the counts were 10% lower than the at-leisure counts—still a highly significant difference. Counting only one of the two McMaster grids also reduced precision.

Solution B: Adopt automated systems into your practice.

Automated egg counting systems were designed, at least partly, to decrease inter- and intra-analyst variation during the manual counting process. With these systems the technician uses an image analysis algorithm to perform the counting.

"When developing automated systems, we wanted to eliminate human error in the counting process and therefore increase precision," explains Nielsen.

Researchers at the Gluck Center and Lincoln Memorial University, in Harrogate, Tennessee, recently compared the McMaster and Wisconsin techniques to an automated FEC system to assess technical variability and determine the tests' sensitivity and specificity (Cain et al., 2020; Nielsen was a co-author). The data showed the automated egg count algorithms significantly improve precision over manual methods for samples with egg counts above 200 EPG.

"This study also found that the Wisconsin

egg counts were substantially lower than those of the other techniques evaluated in that study—evidence of a lack of accuracy," says Nielsen.

These systems improve precision, but filtering, mixing, suspending, and, most importantly, operator error still affect FEC results. Researchers are further improving this technology.

Solution C: Collect and store samples appropriately.

Collect freshly voided fecal samples no more than 12 hours old. At 20 degrees C (68 F), eggs in the feces can hatch in one day, making FECs unreliable. Because egg hatching is an aerobic (requiring oxygen) process, storing freshly collected fecal samples in airtight zip-close bags below 6 C (42 F—so, in the refrigerator) will prevent the eggs from hatching. You can maintain samples like this for five days without affecting egg count.

Problem: I don't know what to do with the FECRT results when it appears I've detected anthelmintic resistance in a herd.

Solution: Repeat the test.

"Veterinarians should first repeat the test to confirm resistance and rule out other causes of reduced dewormer efficacy," says Nielsen. "If resistance is confirmed, affected horses should be dewormed using another anthelmintic class."

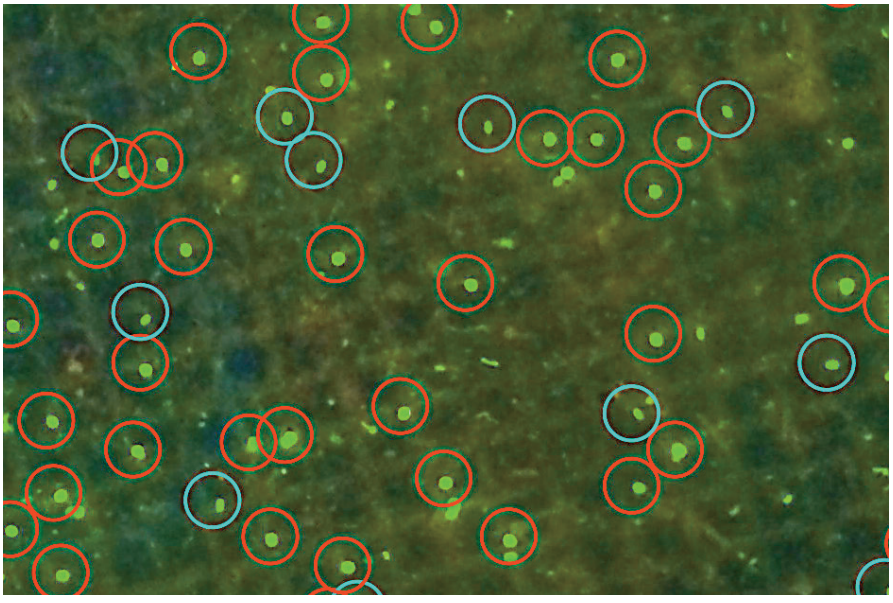
Veterinarians should test for resistance using the FECRT every year, running counts 10-14 days after anthelmintic treatment. "Deworming without routine resistance testing is irresponsible," he adds. "The FECRT is the only field test capable of evaluating anthelmintic efficacy."

Because it is a herd test, Nielsen typically recommends including a minimum of six horses on a premises.

"Fewer horses can be included in cases where six egg-count-positive horses are not available; the results just need to be interpreted with more caution," he said.

Problem: I don't understand the multiplication factor.

Solution: Calculate your multiplication factor from your protocol's instructions.



COURTESY DR. PAUL SLUSAREWICZ

Automated egg counting systems can help eliminate human error by using an image analysis algorithm to perform the counting.

For the modified McMaster technique (described in the AAEP Guidelines), the final step of the procedure involves multiplying the number of strongyle eggs counted in the chamber grid by 25. This is not a fixed number applicable to all variations of the McMaster technique.

"The multiplication factor is protocol-dependent and determined from three numbers: the weight of the sample in grams, the volume of fluid (in which) it is suspended in milliliters, and the volume of subsample examined under the microscope, also in milliliters," Nielsen says.

For example, the McMaster protocol described in the Guidelines uses 4 grams of feces suspended in 26 mL of flotation medium to make a total of 30 mL suspension medium. A 0.3 mL aliquot of that suspension is present under the grids in the two counting chambers examined under the microscope. Therefore, the multiplication factor is:

(30 mL suspension medium/4 g feces)/0.3 mL suspension = 25 EPG

But, if you use another McMaster protocol in which 4 grams of feces is suspended in 56 mL of flotation medium, yielding 60 mL of suspension, your multiplication factor changes to 50. "If you are counting one chamber instead of two, the multiplication factor changes yet again," Nielsen says. "And if you don't weigh the feces to begin with, then you cannot estimate the multiplication factor at all."

He says another issue is many people wrongly interpret the multiplication factor as a performance metric. They believe a small multiplication factor somehow correlates with a better or more sensitive technique. "The multiplication factor is just derived from the protocol," Nielsen says. "It doesn't tell us anything about performance."

Take-Home Message

Fecal egg counts have an irreplaceable role in equine internal parasite control programs (which you can learn more about in this longform feature: TheHorse.com/HorseWorms). Using an egg-counting technique correctly can yield valuable information for identifying anthelmintic resistance and deworming individual horses selectively. Understanding and controlling technical sources of variation can improve precision. **SM**

Disclosure: Dr. Martin Nielsen holds stock in Parasight Inc., a company that manufactures an automated parasite egg counting technique.