AUSTRALIAN VETERINARY JOURNAL
AUSTRALIA'S PREMIER VETERINARY SCIENCE TEXT
EQUINE

Check for updates

INVITED REVIEW

Australian guidelines for equine internal parasite management

A Beasley,[a] G Abbas,[b] K Hughes,[c] C El-Hage,[b] C Jacobson,[d] J Bauquier,[b] E Wilkes,[e] P Carrigan,[f] L Cudmore,[f] J Hurley,[g] I Beveridge,[b] M Nielsen[h] and A Jabbar[b*]

Over the past few decades, the emergence of resistance amongst intestinal parasites of horses to all available anthelmintic classes has emphasised the need for a paradigm shift in parasite control approaches within the Australian equine industry. Findings of a recent Australia-wide research project have provided new insights into intestinal parasites (i.e. strongyles and ascarids) and parasite control from the perspectives of Australian horse breeders and equine veterinarians. The published data have revealed recent trends in parasite prevalence and distribution, breeders' and veterinarians' attitudes and perspectives on controlling horse internal parasites, the efficacy of commonly used anthelmintic products and post-treatment egg reappearance periods. These studies have formed the basis of newly developed guidelines managing and treating gastrointestinal nematodes in horses. Tailored for equine veterinarians, these guidelines contain information on target parasites and risk factors for their transmission, as well as practical advice for surveillance, anthelmintic choice, timing of treatment, testing for anthelmintic resistance and managing refugia. The Australian Guidelines for Equine Internal Parasite Management (AGEIPM) will serve as a pocket companion for equine veterinarians, providing best-practice recommendations grounded in locally conducted scientific research. Dissemination and extension of the AGEIPM to industry will strengthen the client–practitioner relationship. The aim is to reduce reliance on blanket deworming in equine parasite management programs and help curb the progression of resistance to the limited anthelmintic classes available for treating horses.

Keywords anthelmintic; anthelmintic resistance; equine; guidelines; management; parasites

Aust Vet J 2025 doi: 10.1111/avj.13424

Over the last few decades, the emergence of resistance to all available anthelmintic classes has created an urgency for radical change to parasite control strategies in the Australian and other equine industries. Historically, indiscriminate and frequent timed use of a narrow range of anthelmintics has driven widespread selection for resistant cyathostomins and *Parascaris* spp. Without the adoption of better practices, many farms may find that parasite control becomes both more expensive and less effective.

Guidelines for parasite control in horses in the USA, Europe and Denmark have been produced by the American Association of Equine Practitioners in the USA,[1] the European Scientific Counsel Companion Animal Parasites[2] and the Danish Veterinary Association,[3] respectively. Many concepts presented by these groups can be logically extrapolated; however, recommendations for horses managed under Australian conditions require consideration of local grazing management practices often conducive to parasite transmission.

The guidelines presented here have been formulated by the Australian Equine Parasitology Advisory Panel (AEPAP). Strategies are based on data collected through extensive research on Australian equine farms and evidence available in the scientific literature.

The objectives of this document are to provide:

1. Evidence-based recommendations to Australian equine veterinarians for the sustainable control of internal parasites, with emphasis on cyathostomins and *Parascaris* spp.
2. Recommendations for testing for anthelmintic resistance.
3. Supporting information on the diagnosis of internal parasites in horses and nonchemical management strategies (extensive guidelines are available as a supplementary file).

Goals of parasite management in horses

The objectives of internal parasite control in horses have changed substantially since the era of emphasis on chemical intervention. The focus of advice has shifted from complete elimination of parasites and/or prevention of clinical disease through interval-based treatments, to maintaining 'manageable' levels of infection through more strategic and targeted approaches. Regardless of geography or climatic conditions, modern objectives should be overarching. These are:

1. To reduce the risk of parasitic diseases;
2. To limit parasite egg-shedding into the environment, particularly when favourable conditions for egg and larval survival prevail;
3. To decrease the frequency of anthelmintic administration and maintain a refugia population through selective use of effective anthelmintics;

*Corresponding author.
[a]School of Agriculture and Food Sustainability, The University of Queensland, Gatton, Queensland, Australia
[b]Melbourne Veterinary School, The University of Melbourne, Werribee, Victoria 3030, Australia; jabbara@unimelb.edu.au
[c]School of Agricultural, Environmental and Veterinary Sciences, Charles Sturt University, Wagga Wagga, New South Wales, Australia
[d]Centre for Animal Production and Health, Murdoch University, Murdoch, Western Australia, Australia
[e]Racing Victoria, Flemington, Victoria, Australia
[f]Scone Equine Hospital, Scone, New South Wales, Australia
[g]Swettenham Stud, Nagambie, Victoria, Australia
[h]M.H. Gluck Equine Research Center, Department of Veterinary Science, University of Kentucky, Lexington, Kentucky, USA

4 To determine effective drugs for use on individual properties through the faecal egg count reduction test (FECRT) and/or egg reappearance period (ERP); and
5 To avoid the transmission of resistant parasites between farms through implementation of effective quarantine protocols.

This final objective is relevant given the recently confirmed importation of macrocyclic lactone-resistant cyathostomins in thoroughbred yearlings from Ireland to the USA[4] and confirmation of macrocyclic lactone resistance on Australian thoroughbred farms.[5]

Finding a practical balance between these objectives can be challenging, especially in establishments with large numbers of horses, or with frequent movement of horses on and off the property. And further, a suite of tools, a bank of knowledge and some educated assumptions are required to succeed.

Targets for parasite control

Small strongyles (Cyathostomins) should be considered the primary target of any worm control strategy for mature horses, given that these parasites are present in up to 72%–100% of surveyed Australian horse properties.[6–8] *Parascaris* is the primary concern for foals and horses under 12 months of age, due to the pathogenicity of the parasite and the longevity of eggs in the environment. The tapeworm, *Anoplocephala perfoliata*, presents a risk for ileocaecal pathology; however, reports of clinical disease are anecdotally rare, most likely due to the inclusion of praziquantel in more than half of the available anthelmintic products on the Australian market. Resistance of *A. perfoliata* to praziquantel and pyrantel pamoate has recently been established overseas,[9,10] so ongoing surveillance is important.

Other parasites (bots [*Gasterophilus* spp], pinworms [*Oxyuris equi*], *Habronema* spp. *Draschia* and *Onchocerca* spp.) have the potential to become problematic given the right conditions. So, they should be included in the farm surveillance protocol. However, in most cases, these parasites are often controlled as a consequence of anthelmintic treatments for strongyles.

Diagnostic tools and tests

The faecal egg count

The foundation of practical diagnostics for equine strongylid and ascarid infections is the faecal egg count (FEC). Fewer than 40% of horse managers[11] and equine veterinarians[12] report using FECs, and fewer than 30% use FEC results to inform deworming decisions.

Although there have been many iterations of FEC methodology, the modified McMaster technique is still the most widely used in clinical settings. More recently developed techniques for faecal egg counting include the Mini-Flotac system (based on flotation and microscopy),[13] the FECPAK^{G2} system (based on flotation and remote automated counting using egg recognition software)[14] and the Parasight system (based on automated imaging and counting of eggs coated in a fluorescent chitin-binding protein).[15] These methods either require specialised equipment or a subscription for the acquisition of results. Multiple studies have compared the precision, accuracy and sensitivity of these methods,[16–18] and these are variables that are important for researchers and practitioners to consider. For monitoring egg-shedding on horse properties, the preference for the FEC method by equine veterinarians will likely depend on the number of samples routinely processed. While an automated system such as FECPAK or Parasight might be cost-effective for a lab processing large numbers of samples, the traditional McMaster technique would be adequate for those processing a smaller number of samples. A multiplication factor of 25 or less is recommended if planning to carry out a FECRT, and this can be achieved by combining 4 g faeces with 26 mL of floatation solution and counting eggs in a 0.3 mL counting chamber. While this smaller multiplication factor is not a measure of improved diagnostic performance,[19] it does reduce the requirement for larger FECRT group sizes.[20] For the purpose of general FEC surveillance, a multiplication factor of 50 would suffice.

Larval culture

Strongylid eggs, shed by both small and large strongyles, are indistinguishable by traditional microscopy. The larval culture provides suitable conditions for eggs to hatch so that third-stage larvae can be harvested and differentiated.

The prevalence of *Strongylus vulgaris* on Australian farms is low (6.9%–7.8%),[6,7] likely due to the lack of resistance of *S. vulgaris* to the available anthelmintic classes, long prepatent periods (6 months or longer) and the frequent anthelmintic treatments that are administered on most horse properties. In well-managed, healthy horse populations receiving 1–2 anthelmintic treatments per year, the risk of *S. vulgaris* establishing on the property is reduced.

Limitations of faecal egg count diagnostic method

The FEC is not an appropriate tool for diagnosing *Gasterophilus* spp. and is unreliable for the diagnosis of *Oxyuris equi* or *Harbronema/Draschia* spp. Further, the FEC has low sensitivity for quantifying *Anoplocephala* eggs (Table 1). Australian data suggest that the prevalence of tapeworm infections in horses is low (<5%),[6] which could be attributed to the low diagnostic sensitivity of common egg counting methods and the large proportion of available anthelmintic products on the Australian market containing praziquantel or pyrantel.

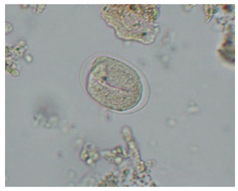
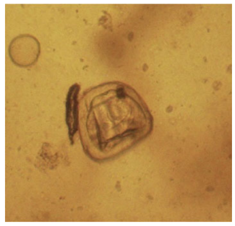
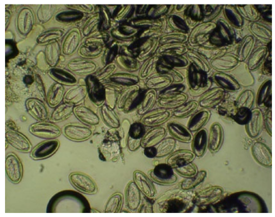
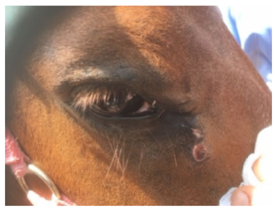
Interpretation of FEC results

The categories and thresholds typically used for classification of FEC results are presented in Table 2. These values refer only to egg-shedding and do not hold any implications for total worm burden, or clinical impacts.

Anthelmintic resistance and resistance testing

Anthelmintic resistance among cyathostomins and *Parascaris* spp. is widespread on Australian horse properties, with the magnitude and prevalence increasing among all available nematocidal drug classes (macrocyclic lactones [MLs], benzimidazoles [BZs] and tetrahydropyrimidines [THPs]). Recent work carried out by the AEPAP has captured cases of resistance on Australian Thoroughbred farms.[5,23–25] Table 3 provides an overview of the status of anthelmintic resistance both globally and within Australia.

Table 1. **Summary of diagnostic tests available for common equine parasitic infections**

Parasite	Appropriate diagnostic test	Notes	
Strongyloides westeri	Faecal egg count	Eggs are larvated, smaller and more transparent than strongylid eggs requiring thorough observation; lower density flotation media such as zinc sulphate may work better	
Gasterophilus spp.	Observation of eggs deposited on coat indicates probable infection while oral inspection and gastroscopy can confirm infection	Small, yellowish and oval-shaped eggs, easily visualised on hairs of forelimbs, shoulders or submaxillary region	
Anoplocephala perfoliata	Faecal egg count (although lacks sensitivity). Improved sensitivity with centrifugation/ sedimentation method[21,22]	Qualitative diagnosis by observing eggs. False negative results are common	
Oxyuris equi	Sticky tape impression of perianal skin followed by microscopic identification of eggs	Eggs are easily identified on tape impressions. False negative results are possible	
Habronema spp/*Draschia megastoma*	Assessment of skin lesions in case of cutaneous habronemiasis. Response to treatment. Molecular tests	Difficult diagnosis. Faecal examination challenging, requiring expertise	

Images courtesy of Drs Anne Beasley and Charles El-Hage.

The faecal egg count reduction test (FECRT) is used to test the efficacy of anthelmintic products against cyathostomins and *Parascaris* spp. The following recommendations are based on those of the World Association for the Advancement of Veterinary Parasitology (WAAVP).[20]

Prior to executing a FECRT, screening samples via FEC with a multiplication factor of 25 or less should confirm that horses are shedding eggs. Horses shedding at least 200 epg (or 8 eggs within the counting chamber) should be recruited. The higher the number of eggs being shed in the manure prior to treatment, the fewer horses are required for the FECRT (Table 4).

Once a suitable group of horses has been selected, faecal samples are collected from each individual on the day of anthelmintic administration, and again from the same individuals 14 days post-treatment.

The online resource https://www.fecrt.com/ harnesses a statistical analysis method[24,27,35] to categorise results as 'resistant', 'susceptible' or 'inconclusive'. Data required for input into the site include the pretreatment and post-treatment FEC values, and the multiplication factor used in the FEC method. Refer to the supplementary file for expanded guidelines.

If resources to conduct FECRT are limited, useful information can be gleaned from post-treatment sampling alone. Collecting individual

Table 2. Thresholds used for categorising strongyle faecal egg count (FEC) results

FEC	Category
<200 epg	'Low'
200–500 epg	'Moderate'
>500 epg	'High'

Table 3. Level of resistance recorded globally and in Australia for the major drug classes among important equine parasites

Anthelmintic drug class and parasite	Status of resistance reported globally	Australian status of resistance
Benzimidazoles		
Cyathostomins	Widespread	Widespread
Parascaris spp.	Early indications	Early indications
Macrocyclic lactones		
Cyathostomins	Early indications	Early indications
Parascaris spp.	Widespread	Widespread
Tetrahydropyrimidines		*Not available for testing*
Cyathostomins	Common	No recent[26] reports
Parascaris spp.	Early indications	Early indications
Anoplocephala	Early indications for pyrantel pamoate (US)[9,10]	Not reported
Combination products	*Not registered in US or Europe*	
Cyathostomins		Early indications of treatment failure (oxfendazole and pyrantel)
Parascaris spp.		None reported
Pyrazino-isoquinoline derivative		
Anoplocephala	Emerging for praziquantel (US)[9,10]	None reported

Table 4. Required group size for a faecal egg count reduction test (FECRT) using a faecal egg count (FEC) method with a multiplication factor of 25 epg

Min 1000 epg	Min 375 epg	Min 200 epg
(40 eggs counted per horse)	(15 eggs counted per horse)	(8 eggs counted per horse)
Group size = 5	Group size = 7	Group size = 11

faecal samples from horses 14 days after anthelmintic treatment can give a quick assessment of post-treatment egg-shedding. While efficacy cannot be calculated without pretreatment samples, egg counts that persist after treatment may warrant further investigation by performing an FECRT.

Table 5. Current status of egg reappearance periods (ERPs) for equine strongylid nematodes following anthelmintic treatments[26,29]

Anthelmintic	ERP at drug registration	Australian reports of ERP
Fenbendazole/oxibendazole	6 weeks	Complete resistance reported
Ivermectin	8–10 weeks	4–6 weeks
Moxidectin	12–16 weeks	4–6 weeks

The THP (Pyrantel/Morantel) class is not represented here as there is no Australian registered product for testing. Resistance is very common to pyrantel overseas, and so, ERP is typically not measured.

When only one horse is available for resistance testing, and consequently, no confidence intervals can be formulated, a simple calculation of arithmetic mean reduction less than 95% at 14 days post-treatment is the only indicator of reduced efficacy.[1]

Egg reappearance periods

A simple definition of ERP is the time taken for eggs to reappear in faeces following anthelmintic treatment. Until the ERP is reached, egg-shedding remains negligible. The ERP is measured as an extension of the FECRT process, whereby sample collection continues from the same horses on a weekly basis. The online resource https://www.fecrt.com/ can be used to calculate 90% confidence interval (CIs), as outlined for the FECRT process, and the ERP is considered to be reached when the upper 90% confidence interval reaches 10 percentage points less than the FECR at 14 days post-treatment. For example, if the FECR at 14 days post-treatment is 98%, the ERP is reached when the upper 90% confidence interval falls below 88%.[28]

The ERP following treatment with ML drugs has shortened considerably since the introduction of these drugs to the market (Table 5); hence, monitoring ERP on a property may be very informative.

Chemical deworming strategies

Strategies for the administration of chemical dewormers have evolved since the 1960s. Each strategy is considered below.

Interval treatment

Interval treatment is the practice of regular or calendar-based deworming, often every 6–8 weeks throughout the life of the horse, and sometimes within the ERP of the chosen anthelmintics. This is no longer recommended for adult horses as frequent and indiscriminate use of anthelmintics is a major driver of resistance in parasite populations. A notable exception to this is for foals, weanlings, yearlings and potentially younger horses. While these horses may require more treatments compared with their mature counterparts, minimising the frequency should still be prioritised where possible.

Targeted or 'selective' treatment

Generally, a minority (10%–30%) of adult horses will likely be shedding high numbers of strongylid eggs onto pasture, and these horses can be targeted under a targeted or selective treatment strategy while leaving low egg-shedders to be target treated less frequently. Among 729 adult Australian thoroughbred horses sampled, 67% were classified as low strongylid egg-shedders[8]. Anthelmintic treatment would then be administered only to the horses based on their predetermined category. Whether a 'moderate' or 'high' threshold is chosen for more regular treatment should consider the prevailing risk factors for transmission. If the risk is high (e.g. stocking rate is high, pasture biomass is low, climatic conditions are highly suitable for egg hatching and larval survival [15–25°C]), theoretically the more conservative 'moderate' threshold might be advisable. If, on the contrary, risk is low, the 'high' threshold might be more appropriate. One note of caution for this approach is that low egg-shedders may consistently remain under the designated threshold. However, they should still receive at least one treatment per year to control tapeworms and bots, and minimise the risk of *S. vulgaris* becoming established on the farm. An ML product would be best administered during the spring or autumn when conditions are favourable for transmission.

An alternative way to implement targeted treatment in a closed herd, with mature, long-term resident horses, is to use FECs to establish the strongylid egg-shedding pattern of individuals. This can be determined using well-timed FECs (3–4) throughout the year: the natural strongylid egg-shedding patterns of mature horses remain relatively stable over time.[30,31] Once categorised, the frequency of monitoring can be reduced and treatments administered accordingly. Low-shedders, as previously stated, should receive at least one foundation treatment per year, while moderate- to high-shedders should receive between two and four treatments per year.

The merits of targeting mostly high egg-shedding horses are that parasites in untreated horses contribute to the refugia on the property, and the overall cost of anthelmintic treatment can be greatly reduced.

Strategic treatment

Decisions around 'strategic' treatment of horses are typically based on epidemiological factors such as temperature and rainfall, which influence the survival of parasite eggs and larvae on pasture, rather than being informed by ongoing FEC surveillance. Under this treatment approach, a customised schedule of treatment would be developed to suit the climate of the region. There are many regions of Australia where the climate allows for the year-round survival of parasites on pasture and, in most cases, offers little reprieve in comparison with European systems that operate with defined grazing and housing seasons. While there is no 'one-size-fits-all' application of epidemiological patterns across different geographical regions, there may be seasonal conditions that are either particularly favourable or unfavourable for egg development and larval survival. For example, hot, dry summer periods in south-west WA are detrimental to parasite survival, whereas the summer dominant rainfall area of south-east QLD with warm spring and autumn temperatures is highly favourable. To generalise, survival of larvae is poorer in hot, dry conditions, warm and moist conditions favour rapid egg development and hatching, while mild to cool conditions favour longevity of larvae on pasture.

Drug rotation/combinations

Drug rotation refers to the alternate use of different chemical classes and was recommended previously as a way to slow the development of anthelmintic resistance – the premise being that worms resistant to one chemical class will likely be killed by the next chosen chemical class. Despite the popularity of this strategy, it is now considered a misguided approach for sustainable worm control.

The approach that *has* been shown to slow the development of resistance in sheep nematodes is using chemical classes in *combination*,[32] rather than rotation. Australian horse owners and managers have access to a range of dual-active products, but before making assumptions about their effectiveness, each combination should be properly tested via FECRT. It should be noted that resistance of cyathostomins to a

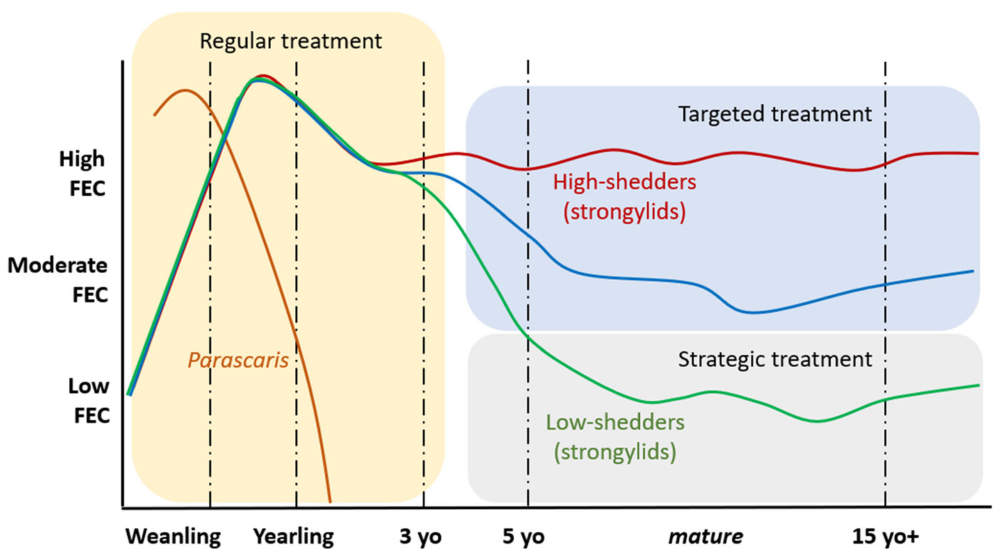


Figure 1. General indication of changes in egg-shedding of strongylids (high = red line; blue line = moderate; green line = low) and *Parascaris* (orange line) as horses age. Coloured panels indicate recommended treatment strategies.

Table 6. **Guidance for worm control in each equine age cohort (adapted from AAEP, 2024)**

Foals and weanlings • Main target for worm control in this age group is *Parascaris*. The prepatent period for *Parascaris* is 10–12 weeks • Strongylid egg-shedding will be increasing throughout this phase as immunity *to Parascaris* develops	*Interval treatment* Treat no earlier than 2 months of age – Target *Parascaris* with BZ or combination product (BZ + THP) Treat at 5 months – Target *Parascaris* again Treat at 7–8 months (postweaning) – Check for presence of *Parascaris*. If only strongylid eggs, use an ML + praziquantel product to include tapeworms Treat at ∼12 months – Target strongylids
Young (1–3 years old) and maturing (3–5 years old) horses • It should be expected that young horses will shed high numbers of strongylid eggs during this phase; therefore, targeted treatment is not recommended • Natural immunity to strongylids will become established as horses mature, with some horses being more susceptible to infection than others • Ascarids should no longer be an issue in horses >18 months	*Transition from interval to targeted/strategic treatment* • 3–4 annual treatments may be warranted for young horses – Administer during times of favourable transmission (spring/autumn) • Use ML-based product (or combination containing ML). Include praziquantel in one of these treatments • As horses mature, transition to targeted or strategic treatment strategies which utilise FECs inform frequency of treatment • Encourage FECRT on farm to establish which products are effective
Mature horses (5–15 years old) • Natural immunity established • Horses can be categorised into high/low-shedders by a series of FEC throughout the year	*Targeted/strategic treatment* • Targeted treatment recommended for moderate/high-shedders – This may include 3–4 treatments throughout the year based on FEC (1–2 treatments) • Strategic treatment recommended for low-shedders – 1–2 treatments per year during peak transmission periods (spring/autumn). Include praziquantel in one of these treatments • ML products likely to have best efficacy, but FECRT should inform all product selection
Aged horses (15+ years old) • Conditions such as Cushing's disease become more common in older horses, which predisposes them to higher egg-shedding • Other aged horses may also transition back to higher egg-shedding	*Targeted/strategic treatment* • FEC monitoring will inform targeted treatment of these horses • If high egg-shedding resumes, frequency of treatment will need to increase accordingly – Treat as mature high-shedder • Otherwise, strategic treatment can continue for low-shedders

BZs, benzimidazoles; FEC, faecal egg count; FECRT, faecal egg count reduction test; MLs, macrocyclic lactones; THPs, tetrahydropyrimidines.

combination of oxfendazole and pyrantel has been reported in Australia,[5] so it cannot be assumed that a combination product will be effective.

In conclusion, to slow the development of anthelmintic resistance, it is better to create a worm management strategy that makes use of effective products (including combination products), than to rely blindly on drug rotation *per se*.

When introducing horses to a property, it is unlikely that the resistance status of parasites from the property of origin will be known. Therefore, it should be assumed that resistant parasites *may* be harboured by the horse. Incoming horses should therefore be kept in a separate designated quarantine/biosecurity area, away from the resident herd. They should receive anthelmintic treatment containing an active from each of the three available drug classes – this could take the form of a BZ + THP combination plus an ML (moxidectin) + praziquantel product. This ensures that encysted cyathostomins and tapeworms will be targeted in addition to all other common parasites. Ideally, a FEC would be performed both before and 14 days after treatment to ensure that no eggs are being shed and the efficacy was 100%. If no pretreatment sample is collected, a post-treatment sample will still be informative. Currently, no treatment or combination thereof is known to be capable of removing all parasite stages from a horse. Manure from the quarantine yard should be collected and disposed of to avoid the dissemination of any parasites with resistant genes.

Suggested management approach for different classes of stock

As horses move through the various age brackets, worm management strategies will need to adapt. For properties where multiple classes of stock are raised and kept, a mixture of approaches may need to be implemented at any given time of the year. A very basic schematic of the dynamics of strongyle and *Parascaris* egg-shedding over the life of the horse is provided in Figure 1.

The following suggestions (Table 6) assume that the resistance status of the parasites is assessed, guiding the appropriate selection of anthelmintics.

Nonchemotherapeutic contributors to parasite control

In addition to the use of registered anthelmintics, there are nonchemotherapeutic strategies that can be woven into the worm management plan to further reduce the frequency of anthelmintic treatments required. The practicality of these strategies, however, needs to be considered on a property-by-property basis.

Products

BioWorma® (International Animal Health Products Pty Ltd, Sydney Australia) entered the commercial market in the last decade as the only registered 'nonchemical' anthelmintic product that has sufficient scientific backing. It contains a naturally occurring fungus, *Duddingtonia flagrans*, which traps and paralyses larvae emerging in faecal pellets, and consequently reduces pasture contamination and parasite transmission. The product is fed to horses daily (1.5 g/25 kg body weight which equates to 30 g for a 500 kg horse) after receiving an effective chemical dewormer and being moved to a pasture with low contamination. An initial study on the efficacy of BioWorma against equine cyathostomins showed an 84% reduction in pasture larval count over 8 weeks,[33] but further field studies are required to validate its use as part of an integrated worm management program. The economic aspects of the incorporation of BioWorma have also not yet been documented.

There is little to no scientific evidence to support the effectiveness of other nonchemical treatments, such as diatomaceous earth or herbal treatments for controlling worms in horses. Clients that use these approaches in place of chemical treatment (or BioWorma) should closely monitor FEC and test for the presence of large strongyles.

Mixed grazing

Due to the high degree of host specificity of most parasites, equine worms (and bots) will not complete their life cycles within nonequid hosts. This creates an opportunity for grazing pastures with cattle, sheep or alpacas either alternately or concurrently. There is only one study that has attempted to validate the mixed grazing theory in the field,[34] and it demonstrated that horses grazing with cattle shed 50% fewer strongyle eggs than horses grazed in equine-only pastures. This strategy is only practical for farms that have the capacity to graze additional animals and will require careful management of the pasture as a feed base.

Manure management (removal, spreading, composting)

Removing manure from the environment in a timely manner to prevent the translation of developed larvae onto pasture is perhaps the most effective way to interrupt the lifecycle of strongylid parasites. To be effective, it must take place before third-stage strongyle larvae translate to pasture which means the timing of manure removal is linked directly to climatic conditions. During the warmer months, manure should be removed 2–3 times per week where possible. During the cooler months, this timing can be extended.

Manure spreading across paddocks is not recommended in general and should be carried out with great caution. Spreading is not recommended unless climatic conditions are very unfavourable (i.e. during very hot, dry weather), exposing strongylid eggs and larvae to high temperature and desiccation, particularly when pasture mass is low. Horses should be kept off the paddock for a few weeks after manure spreading (longer if weather becomes cool and moist) to allow sufficient time for contamination to reduce to low levels. Manure spreading is believed to be less effective for the control of *Parascaris* as the eggs, which remain unhatched, are more resilient to environmental conditions. Therefore, it should not be recommended as a worm control strategy for paddocks housing foals, weanling or yearlings.

Pasture spelling

Spelling of pastures, when executed under the right conditions, can be an effective way to reduce pasture larval contamination and subsequently lower transmission risk for grazing horses. Epidemiological principles should be used to guide the length of pasture spelling required. These time frames may not be achievable in all systems due to limited land availability or lack of infrastructure, so again, the usefulness of this strategy should be considered on a property-by-property basis.

Stocking density

Overstocking can be a common occurrence on horse properties, especially in peri-urban environments where horses are kept on small acreage blocks. Pasture contamination with parasite eggs and larvae will be heavily influenced by the number of horses grazing the area. Further, determining an optimal stocking rate for any paddock will depend on factors such as the types of pastures present, the growth characteristics of those pastures and whether any supplementary feed is provided. A rough guide for unsupplemented horses would be a sliding scale from 1 horse per 2 hectares (∼5 acres) for poor quality, unfertilised, summer-dominant pasture up to 4 horses per 2 hectares for improved, fertilised and irrigated pastures. The stocking rate should be reduced when ground cover starts to decline or pasture height falls below 2.5 cm over parts of the paddock.[35]

Key recommendations

This article offers evidence-based recommendations for sustainable management of equine internal parasites. To slow further development of anthelmintic resistance, FECs should guide deworming decisions and drug class selection, while FECRTs should be conducted regularly to monitor drug efficacy. These tools, combined with nonchemical strategies to disrupt parasite life cycles, can be integrated into a comprehensive management approach.

Acknowledgments

The Australian Equine Parasitology Advisory Panel developed these guidelines based on a research project funded by AgriFutures Australia, Thoroughbred Breeders Australia and Boehringer Ingelheim, Australia. The funding partners did not have any role in the design or content of these guidelines. The authors are grateful to Boehringer Ingelheim, Australia, for paying the open-access publication charges for this manuscript. The PhD student, Ghazanfar Abbas, is a grateful recipient of the Australian Government Research Training Scholarship through the University of Melbourne.

Conflicts of interest and sources of funding

The authors declare no conflicts of interest or sources of funding for the work presented here.

Data availability statement

Data sharing not applicable to this article as no datasets were generated or analysed during the current study.

References

1. AAEP. Internal parasite control guidelines. 2024. Available at: https://aaep.org/resource/internal-parasite-control-guidelines/. Accessed September 2024.
2. ESCCAP. A guide to the treatment and control of equine gastrointestinal parasite infections. Guideline 08 second edition. 2019. Available at: https://www.esccap.org/guidelines/gl8/. Accessed September 2024.
3. Den Danske Dyrlægeforening. Parasite control in horses in Denmark. 2024. Available at: https://www.ddd.dk/faggrupper/faggruppe-heste/vejledninger-og-guidelines/parasitkontrol-hos-heste-i-danmark/. Accessed September 2024.
4. Nielsen MK, Banahan M, Kaplan RM. Importation of macrocyclic lactone resistant cyathostomins on a US Thoroughbred farm. *Int J Parasitol Drugs Drug Resist* 2020;14:99–104.
5. Abbas G, Ghafar A, Hurley J et al. Cyathostomin resistance to moxidectin and combinations of anthelmintics in Australian horses. *Parasit Vectors* 2021;14:1–10.
6. Beasley AM, Kotze AC, Barnes TS et al. Equine helminth prevalence and management practices on Australian properties as shown by coprological survey and written questionnaire. *Anim Prod Sci* 2020;60:2131–2144.
7. Abbas G, Ghafar A, Bauquier J et al. Prevalence and diversity of ascarid and strongylid nematodes in Australian Thoroughbred horses using next-generation sequencing and bioinformatic tools. *Vet Parasitol* 2023;323:110048.
8. Abbas G, Ghafar A, Beasley A et al. Understanding temporal and spatial distribution of intestinal nematodes of horses using faecal egg counts and DNA metabarcoding. *Vet Parasitol* 2024;325:110094.
9. Nielsen MK. Apparent treatment failure of praziquantel and pyrantel pamoate against anoplocephalid tapeworms. *Int J Parasitol Drugs Drug Resist* 2023;22:96–101.
10. Finnerty CA, Bonometti S, Ripley NE et al. Evidence of tapeworm treatment failure on a Central Kentucky Thoroughbred farm. *Equine Vet Educ* 2024;36:579–585.
11. Abbas G, Bauquier J, Beasley A et al. Worm control practices used by thoroughbred horse managers in Australia: a national survey. *Vet Parasitol* 2024;327:110116.
12. Abbas G, Stevenson MA, Bauquier J et al. Assessment of worm control practices recommended by equine veterinarians in Australia. *Front Vet Sci* 2023;10:10.
13. Cringoli G, Maurelli MP, Levecke B et al. The mini-FLOTAC technique for the diagnosis of helminth and protozoan infections in humans and animals. *Nat Protoc* 2017;12(9):1723–1732.
14. Tyson F, Dalesman S, Brophy PM et al. Novel equine faecal egg diagnostics: validation of the FECPAKG2. *Animals* 2020;10:1254.
15. Slusarewicz P, Pagano S, Mills C et al. Automated parasite faecal egg counting using fluorescence labelling, smartphone image capture and computational image analysis. *Int J Parasitol* 2016;46:485–493.
16. Noel ML, Scare JA, Bellaw JL et al. Accuracy and precision of mini-FLOTAC and McMaster techniques for determining equine strongyle egg counts. *J Equine Vet Sci* 2017;48:182–187.
17. Scare JA, Slusarewicz P, Noel ML et al. Evaluation of accuracy and precision of a smartphone based automated parasite egg counting system in comparison to the McMaster and Mini-FLOTAC methods. *Vet Parasitol* 2017;247:85–92.
18. Ghafar A, Abbas G, King J et al. Comparative studies on faecal egg counting techniques used for the detection of gastrointestinal parasites of equines: a systematic review. *Curr Res Parasitol Vector Borne Dis* 2021;1:100046.
19. Nielsen MK. Parasite faecal egg counts in equine veterinary practice. *Eq Vet Ed* 2022;34:584–591.
20. Kaplan RM, Denwood MJ, Nielsen MK et al. World Association for the Advancement of Veterinary Parasitology (WAAVP) guideline for diagnosing anthelmintic resistance using the faecal egg count reduction test in ruminants, horses and swine. *Vet Parasitol* 2023;109936:109936.
21. Tomczuk K, Kostro K, Grzybek M et al. Seasonal changes of diagnostic potential in the detection of *Anoplocephala perfoliata* equine infections in the climate of Central Europe. *Parasitol Res* 2015;114:767–772.
22. Nielsen MK. Equine tapeworm infections: disease, diagnosis and control. *Equine Vet Educ* 2016;28:388–395.
23. Armstrong SK, Woodgate RG, Gough S et al. The efficacy of ivermectin, pyrantel and fenbendazole against *Parascaris equorum* infection in foals on farms in Australia. *Vet Parasitol* 2014;205:575–580.
24. Beasley A, Coleman G, Kotze AC. Suspected ivermectin resistance in a south-east Queensland *Parascaris equorum* population. *Aust Vet J* 2015;93:305–307.
25. Abbas G, Ghafar A, McConnell E et al. A national survey of anthelmintic resistance in ascarid and strongylid nematodes in Australian Thoroughbred horses. *Int J Parasitol Drugs Drug Resist* 2024;24:100517.
26. Pook JF, Power ML, Sangster NC et al. Evaluation of tests for anthelmintic resistance in cyathostomes. *Vet Parasitol* 2002;106:331–343.
27. Denwood MJ, Kaplan RM, McKendrick IJ et al. A statistical framework for calculating prospective sample sizes and classifying efficacy results for faecal egg count reduction tests in ruminants, horses and swine. *Vet Parasitol* 2023;314:109867.
28. Nielsen MK, von Samson-Himmelstjerna G, Kuzmina TA, van Doorn DC, Meana A, Rehbein S, Elliott T, Reinemeyer CR. World Association for the Advancement of Veterinary Parasitology (WAAVP): Third edition of guideline for evaluating the efficacy of equine anthelmintics. *Vet Parasitol* 2022;303:109676.
29. Nielsen MK, Steuer AE, Anderson HP et al. Shortened egg reappearance periods of equine cyathostomins following ivermectin or moxidectin treatment: morphological and molecular investigation of efficacy and species composition. *Int J Parasitol* 2022;52:787–798.
30. Lester HE, Morgan ER, Hodgkinson JE et al. Analysis of strongyle egg shedding consistency in horses and factors that affect it. *J Equine Vet Sci* 2018;60:113–119.
31. Nielsen MK, Haaning N, Olsen SN. Strongyle egg shedding consistency in horses on farms using selective therapy in Denmark. *Vet Parasitol* 2006;135:333–335.
32. Bartram DJ, Leathwick DM, Taylor MA et al. The role of combination anthelmintic formulations in the sustainable control of sheep nematodes. *Vet Parasitol* 2012;186:151–158.
33. Healey K, Lawlor C, Knox MR et al. Field evaluation of *Duddingtonia flagrans* IAH 1297 for the reduction of worm burden in grazing animals: pasture larval studies in horses, cattle and goats. *Vet Parasitol* 2018;258:124–132.
34. Forteau L, Dumont B, Salle G et al. Horses grazing with cattle have reduced strongyle egg count due to the dilution effect and increased reliance on macrocyclic lactones in mixed farms. *Animal* 2020;14:1076–1082.
35. Allen H, Hoare R, Rose C. *Pastures for horses*. Vol. 525. New South Wales: Department of Primary Industries, 2007.

Supporting information

Additional Supporting Information may be found in the online version of this article at the publisher's web-site: http://onlinelibrary.wiley.com/doi/10.1111/avj.13424/suppinfo.

Data S1: Supplementary information.

(Accepted for publication 23 December 2024)