New Strategies in Worm Control

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Management Fact Sheet 9

All horses have worms. It is well known that heavy burdens of internal parasites, or worms, can have a severe effect on the health and performance of all classes of horses, especially foals, working and aged horses. The side-effects of worm burdens are related to the species of worm that are present, their relative numbers and the age or use of the horse.

Over the last 3 decades, horse owners have been led to believe that complete control of worms of all types was possible with worming alone by the exclusive use of drugs at regular intervals. This has resulted in less emphasis being placed on pasture and other hygiene related measures to minimise re-infestation, allowing natural immunity to suppress worm activity and lack of strategic worming to help control seasonal worm burdens.

The increased risk of development of resistance by Small Strongyle worms to even the most recent worming compounds, the 'mectin' group, highlights the need for a more complete and coordinated approach to worm control, rather than relying on chemical or anthelmintic use alone to keep horses relatively worm free.

Dr. Craig Reinemeyer DVM, PhD of Tennessee, USA presented a review of methods to control Strongyle parasites in horses, entitled "A Mandate for Change" at the American Association of Equine Practitioners Convention in Dec 2009. The take home message was that we must act now to ensure greater sustainability of worm control, as no new compounds will be available in the near future. **He, and other leading parasitologists, advocate a less frequent, more targeted and strategic seasonal approach to worm control based on a combination of using drugs, improved hygiene and environmental control and worming only selected horses in a group which have higher than acceptable worm burdens.**

Increasing Burdens of Small Strongyles
(Cyathostomes or Cyathostomiasis)

Over the last 30 years, many parasitologists have been concerned about the targeted control of Large Strongyle worms (predominately Strongyle vulgaris - the 'Bloodworm') by worming at regular 6-8 week intervals. Thirty years ago, 90% of colic cases in horses were due to migratory Bloodworm larvae damaging the arteries (forming 'aneurysms') which supply blood to the gastrointestinal tract. Targeted control has been very effective to prevent migratory Bloodworm larvae because it breaks the 6-8 week cycle where the worms return to the large bowel and develop into egg laying mature forms, which results in eggs being spread into a horse's environment. However, although targeted control has reduced the incidence of colic related to Bloodworm larvae to less than 5% and has eradicated Bloodworms on many studs and horse properties, it has facilitated increased populations of Small Strongyles, or Small Redworms (Cyathostomes). The common types of Cyathostomes of which about 12 varieties out of 50 or more affect horses, cause internal damage, ill-thrift and impaired digestion and a risk of colic (as well as an increased risk of sand colic) in grazing and stabled horses.

Handy Hint
Target Immature Worms

Most of the harmful and long term health problems associated with internal parasites are caused by 'pre-adult' or developing adult forms of Strongyle and Large Roundworms. It can be months or even years before signs of damage by migratory immature larvae become obvious. Worming to remove adult forms in the intestines is only part of the long term control of worms. Young and very elderly horses are more likely to develop 'resting' stages of Small Strongyle larvae as 'cysts' in the hindgut lining, possibly due to lack of immunity or waning immunity as horses reach 20 years of age. It is important to target immature worms with an appropriate worming compound.

Handy Hint
Ill-thrift and Redworm Burdens

Adult Small Redworms only attach weakly to the gut wall and cause only minor damage, if any, as they mainly feed on organic matter being digested in the bowel. The main signs of a heavy adult Small Redworm burden are ill-thrift and weight loss because the worms take nutrients from the bowel. Large populations of adults do not stimulate an immune response to infestation in the bowel itself, only when the resting stages are leaving the bowel wall.

Early studies in the 1980's indicated that 99% of potential Strongyle-type worm populations existed on pasture as 'infective-larvae', with follow-up surveys in the mid 1990's suggesting that 95-100% of these are Small Redworm larvae.

There are 3 main reasons for the increase in Small Redworm infestation in horses.

1. Shorter Adult Development Phase

Small Redworm larvae returning to the large intestine can develop to mature egg laying adults in 4-5 weeks. **This leaves an egg laying 'gap' of 2-3 weeks if worming intervals are spaced every 6-8 weeks in traditional worming programs.** Although adult Small Redworms are much less prolific egg producers (100 eggs/female/day) as compared to Bloodworms (5000 eggs/female/day), within 6-8 weeks after worming high levels of recontamination with Small Redworm eggs can build-up on grazing pasture.

2. Reservoirs of 'Resting' Larvae in the Hindgut Lining

Small Redworm infective larvae taken up when grazing burrow into the wall of the large intestine for the next phase of their development, forming small 'nodules' or 'cysts' in the gut lining. This is referred to as 'Cyathostomiasis'. Depending on seasonal conditions, especially during drought and dry seasons, these 'resting' or 'hypobiotic' hibernating-like forms can remain dormant and viable for up to 2½ years in the gut wall, protected against many older worming compounds. After each worming, small numbers are released into the large intestine to develop into egg laying adults in 4-5 weeks. After rain or under ideal mild seasonal conditions with green pasture which is favourable to survival, large numbers can be released to develop to adult forms to recontaminate pastures and spread to all horses sharing the pasture.

3. Resistance Build-Up Against Worming Compounds

In the mid 1990's, it was estimated that about 10 species of Small Redworms had developed resistance against the then common Benzimidazole (B-Z) worming compounds. The build-up of resistance has been attributed to excessive frequency of worming with B-Z compounds, failure to rotate to non B-Z compounds and under-dosing or wastage of paste wormers when worming a horse.

Build-Up of Resistance against Worming Compounds – 2010 and Onwards

The latest surveys indicate that Large Roundworms (Ascarids) have developed resistance against 'mectin' compounds in the USA, and field based evidence suggests that reduced efficacy is also likely against Small Redworms and Pinworms.

If resistance is allowed to build-up against these compounds, then there are very few, if any of the current compounds which will be effective. Frequent, poorly targeted worming strongly selects for the development of wormer resistance.

Handy Hint

Worm Stabled Horses Before Returning to Pasture

Stabled horses are usually wormed regularly at 8-12 week intervals, which can be extended if rigourous stable hygiene is adopted to remove all manure prior to L3 larval stage. The risk of re-infection is minimised by daily manure collection in stables and yards. Dry bedding and dry stable/yard environment restricts the development of Small Strongyle larvae. The low populations of migratory or 'resting' stages of Small Strongyles do not stimulate natural immunity in the bowel against larval forms in the gut wall. The adult worms stimulate little, if any, immunity because they feed on organic matter within the digestive mass.

Wormer Resistance Summary

Compound	Worm Species Resistance (USA Surveys)
Benzimidazole (B-Z)	Small Strongyles > 95%
Pyrimidines (pyrantel)	Small Strongyles 50%
Macrocyclic Lactones (mectins)	Large Roundworms in foals (USA, Europe, Canada)

Handy Hint

Treat All New Arrivals and Quarantine

Treatment of horses at pasture with worming compounds, such as 'mectins' and high doses of fendbendazole at 6 month intervals will eliminate large Strongyles. Treating all new arrivals and isolating them in a yard for 96 hours (4 days) to pass all killed worm eggs should greatly reduce the risk of increasing worm populations.

The "Mandate for Change", as proposed by Dr. Reinemeyer, emphasises prevention and sustainability of control based on environmental regulation, management and maintaining natural immunity by targeted and evidence based minimal use of wormers.

Strongyle worm infective stage L3 larvae are most likely to be transmitted in grazing horses on pastures or when horses are turned out to rest on pasture. Horses turned out to rest at pasture have a high risk of almost immediate worm re-infection from L3 stage contaminated pasture once they start grazing. They should be wormed out at the time of turning out. Then adopt longer intervals, relative to Manure Egg Count increases, to allow some resistance to develop to naturally limit worm activity.

Many horse owners use particular events to worm horses, such as change of season (quarterly worming) or at the time of farrier visits - both of which do not consider the lifecycle control of worms at its most vulnerable points - the immature larvae and resting stage migratory phases.

Large Numbers of Small Redworm larvae resting in 'cysts' or nodules in the hindgut wall can result in thickening of the bowel wall and may reduce its ability to contract normally. An increased risk of sand colic in horses grazing on sandy soils or after heavy rain on short or sparse pasture when sand splashes up onto the blades of grass and is eaten by a grazing horse has been associated with heavy Small Strongyle larvae burdens (Cyathostomiasis).

Handy Hint

Regular Faecal (Manure) Egg Counts

The new strategy for worm control strongly recommends the use of faecal egg counts (worm egg manure counts) to monitor the efficiency following worming and to identify individual horses in a group which have higher egg counts due to low natural resistance, close grazing habits which increases the 'pick-up'of infective larvae from pasture, as well as resistance build-up against a specific worming compound due to over-use and under dosing. Faecal Egg Count Reduction Testing (FECRT) can be used to monitor the seasonal prevalence of worms and response to a worming compound or combination of compounds.

New strategies for worm control

The use of set 6-8 week worming intervals is now out of date due to the shift away from high populations of Large Strongyles (Bloodworms), which have been virtually eradicated. Worm populations have changed to heavy infections (99% of horses) with Small Strongyles or Small Redworms, which have a shorter development phase to maturity of 4 weeks. However, it is unwise to treat horses with burdens of Small Redworms worms at monthly intervals, as this is more likely to select for worm resistance because of too frequent use of worming compounds. Many horses are able to develop a natural or acquired immunity to limit their own worm burden and they should be identified by FECRT and not be wormed out as frequently as other horses in a group. **All chemical forms of worm control have a relatively short lifespan of 10-15 years at the most and because no new compounds are likely to be released in the next decade, it is important to preserve current compounds against resistance build-up.**

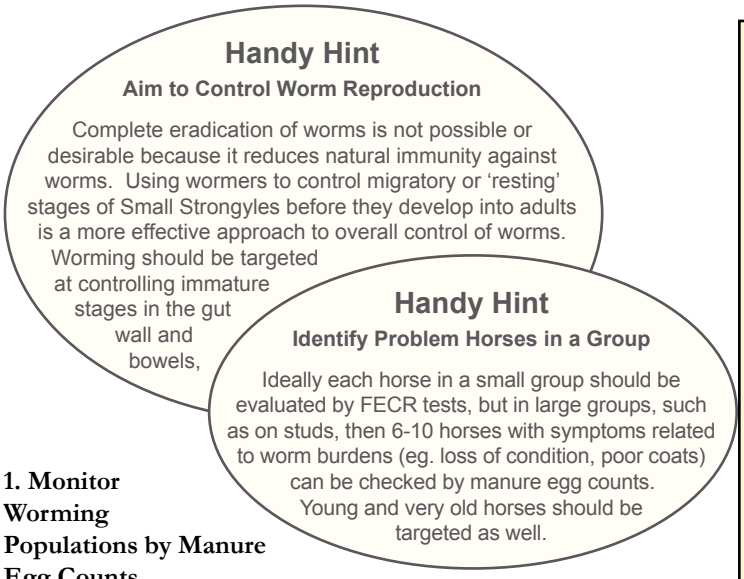
Targeted Control of Small Redworms (Cyathostomes)

These are the most populous and damaging worms to all horses, although Large Roundworms are a problem in foals up until 9 months as they gain immunity, or in horses stressed by hard training or old age when immunity is reduced. Tapeworms have been reported to cause colic and death in heavy infections and Pinworms loss of condition when in high numbers.

Handy Hint

Combination wormers

The 3 current classes of worming compounds effective against Small Strongyles are the only presently available, with no new chemical types being developed due to the high cost of R&D. The use of combination wormers based on these compounds, which in theory reduces the risk of resistance build-up, may be effective for an extended time. However, long term control is not likely under practical situations due to under-dosing as a result of poor dosing technique, wastage and inaccurate body weight estimation. Surveys have shown that 80% of horse owners and veterinarians alike underestimate the body weight of horses by up to 10-15% or 50-75kg for a 500kg horse. All three factors can contribute to build-up of resistance to the full arsenal of wormers currently available.



1. Monitor Worming Populations by Manure Egg Counts

It is helpful to identify the individual horses which have a naturally high burden of Small Strongyles despite regular worming by collecting droppings and performing Faecal Egg Counts (Manure Egg Counts). This is best carried out 6 weeks after the last worming with a B-Z wormer or morantel, and 10-12 weeks for a 'mectin', particularly the moxidectin compound, as these wormers can suppress egg reappearance for a longer period.

Horses with Strongyle egg counts above 200 eggs per gram at 6 weeks or 12 weeks after worming, depending on the wormer used, should be treated with a 'mectin' wormer.

After 10-14 days following worming, allowing time for female worms not killed to start laying eggs again, collect droppings to check if the wormer has been effective and calculate the Faecal Egg Count Reduction percentage.

$$\text{FECR\%} = \frac{\text{Initial epg - After Treatment epg}}{\text{Initial epg}} \times 100$$

If the wormer used results in a 95-100% reduction in egg count after 10-14 days, it is not likely to have a build-up of worm resistance. Ideally, an annual check should be carried out to monitor the effectiveness of the wormer against Small Strongyles. Any wormer which fails to reduce FEC by at least 90% should not be used.

2. Monitoring Individual Horses

It is common that 20% of the horses in a group carry 80% of the worm burden. Studies have shown that around 50% of horses in a group, without being wormed, will have a FEC below 200 eggs per gram. These are horses which have a natural genetic resistance or acquired immunity against Small Strongyles. They may also be less likely to graze adjacent to 'roughs' and have their own careful hygiene approach by eating only on areas free of manure contamination. **These horses should be identified and not treated as regularly with wormers to reduce their risk of wormer resistance build-up and minimise reduction of their own immune defences. Horses with FEC above 500 epg are at a high risk of contaminating pasture and must be targeted for more regular worming.**

3. Rotation of Worming Compounds

Rotation to different chemical compounds is an option to help reduce the risk of resistance build-up to worms. However, it must be programmed carefully to avoid changing to a similar chemical compound or 'family' of wormer. There is no evidence to suggest that rotating worming compounds delays or prevents resistance, but once resistance to a particular worming compound (an individual B-Z or group of compounds, eg all B-Z's or in the future, possibly 'mectins') it may take years before Strongyle populations lose their ability to resist the compound. There is evidence to indicate that a 'slow' rotation, combined with FECR tests to monitor efficacy of a compound or group of compounds, over a 12-18 month period, helps ensure each generation of worms is challenged by only one chemical group at a time.

4. Worming Technique

Many scientists believe that paste wormers have increased the risk of resistance build-up because of the potential for under-dosing due to inaccurate body weight estimation and waste of paste at worming. Low volume paste wormers are particularly at risk of under-dosing due to wastage as a loss of only relatively small amounts (1-2 mL out of 7-10 mL), significantly reduces the dose of the drug administered. Horse girth weight tapes are accurate if scales are not available. However estimates of body weight in horses in moderate condition - heavy weight horses are commonly under estimated and these horses may be under dosed by up to 10-15%. **The latest recommendations suggest to dose on estimated body weight (ie using a girth tape) and add an extra 15% in kilograms.**

Did you know that...

1. Wet soiled bedding moistened by urine, which releases ammonia in stables at floor level, actually suppresses Strongyle larval development in the bedding because ammonia is highly toxic to larvae as it is released from urine soaked bedding.
2. 'Roughs' in a pasture, which can take up 50% of the grazing area after 3-6 months, become the 'toilet' area for grazing horses and can have up to 15 times the number of Strongyle larvae as compared to 'lawns' – the areas horses select because of preferred plants as a 'dining' area. Horses appear to innately limit their exposure to worm larvae in this way.
3. Harrowing pastures to break-up and open manure to heat and dry out, can be used to control pasture L3 larvae stages, but only if it is carried out during hot, drying weather and after a heavy dew or a light rain to soften the manure balls. The pasture should be left vacant without horses for 5-6 weeks, preferably over the summer months to desiccate L3 larvae. Harrowing short pasture again before midwinter can also reduce pasture contamination due to larvae being exposed to cold conditions.
4. The infective L3 stage of Strongyle larvae are the only larvae stage which can infect horses. They are protected by an external protective sheath or 'coat' which can help them to survive for long periods of up to 6 months on well covered pasture areas under temperate conditions. However, they cannot feed to ingest nutrients and must survive on stored energy. Dehydration during hot weather can rapidly kill infective larvae, but they can survive in the pasture micro-environment under snow for up to 5 weeks or even frosts. Contary to a popular myth, frosts actually have little effect on reducing infective larvae populations on well covered pasture, but a severe frost can kill the pasture.
5. Rainfall, except flooding, helps to maintain Strongyle larvae on pasture. Larvae die quickly at temperatures above 36-37°C in the dry summer months.
6. Under temperate conditions (10-30°C), long survival periods of Small Strongyle larvae enable re-infection to continue over the whole year and with the climate warming in southern Australia, conditions are going to be more suited to longer larvae survival.

Steps to Ensure Accuracy of Paste Dosing

- Paste wormers are convenient and easy to use. However, they must be carefully administered to ensure that the animal receives the full dose.
- Ensure that the horse's mouth is empty. If necessary, wash out feed residues with a hose before worming.
- Dial-up the full recommended dose based on body weight. As all wormers have 20-25 times safety dose, giving slightly more (10%) to offset waste is sound worming practice.
- Deposit the paste over the rear of the tongue to prevent the horse spitting it out. Hold the horse's head up for 15-20 seconds to ensure that the full dose is swallowed. If the horse is slow to swallow, rub the throat latch area to stimulate swallowing.
- Avoid worming a horse within a few hours after exercise. Worm on a rest day.

5. Strategic/Seasonal Worming

Strategic worming programs have been used for sheep and cattle for many years to target seasonal populations of worms. **There is no need to use a combination wormer at each worming as they are generally more costly and under-dosing can lead to an increased risk of resistance build-up.** Strategic worming is targeted to match the vulnerable or high risk times of the year to control specific worms.

As an example…

Small Strongyles	Regular worming based on an individual animal's needs or grazing access. Worm twice, 3 weeks apart in hottest months to offload 'resting' stages and kill larvae on pasture. (Refer to Worming Recommendations)
Tapeworms	Spread by pasture mites on green pasture - decreased once pastures dry off. Worm mid April - mid Oct to break lifecycle.
Bots	Bot lifecycle most vulnerable in late May as immature bots reach stomach and late August before mature bots detach into droppings.
Pinworms/Large Roundworms	As for Strongyles, but target foals and aged horses for Large Roundworms.

Handy Hint

Regular Faecal (Manure) Egg Counts

The new strategy for worm control strongly recommends the use of faecal egg counts (worm egg manure counts) to monitor the efficiency following worming and to identify individual horses in a group which have higher egg counts due to low natural resistance, close grazing habits which increases the 'pick-up'of infective larvae from pasture, as well as resistance build-up against a specific worming compound due to over-use and under dosing. Faecal Egg Count Reduction Testing (FECRT) can be used to monitor the seasonal prevalence of worms and response to a worming compound or combination of compounds.

Handy Hint

Collect and Compost Manure

The infective L3 stage of Strongyle worms develop 7 days after droppings containing the worm eggs have been passed. Collecting droppings significantly reduces re-infection rates with L3 Strongyle larvae. If manure is not removed daily in stables and yards, it can be scattered and buried in bedding which facilitates egg hatching and L3 infective stage development. In larger yards and small paddocks, a thorough pick-up of droppings at least one per week will help reduce risk of re-infection. Collected droppings can be picked up, watered to moisten to facilitate fermentation and composting, which produces heat above 60°C which kills Strongyle eggs and larvae. The manure once composted and the worm eggs killed, can be safely spread back onto pasture to recycle organic matter. Up to 83% of the nutrients passed in a horse's droppings are returned to the soil to assist soil fertility. Studies have shown that spreading bedding containing fresh droppings onto pasture increases the contamination with viable Large Roundworm eggs - compost all bedding.

Handy Hint

Encourage Dung Beetles

Dung beetles open up the droppings and bury and recycle organic matter and other nutrients and expose the droppings to heat and drying. Dung beetles also reduce the available sites for fly breeding, reducing fly numbers in horse areas. Dung beetles are more active during spring and summer when conditions favor breeding so they can effectively reduce worm eggs and larvae during the higher risk period.

Summary of New Worm Control Strategies

Small Strongyles

1. Combine Worm Control with Environmental Hygiene.

Control of adult worms by regular worming is not as effective in the long term as compared to preventing parasite reproduction and contamination of the pasture environment - by the time mature worms have been controlled by worming, the damage they cause is already done. It is better to control environmental contamination, which is 5-10 times more effective than worming alone.

2. Focus on Seasonal Control to Minimise Larvae Up-Take

Deworming during winter under cold conditions is not normally required, but target spring and autumn periods when larvae are more active and live longer on pasture and use FECR tests to monitor wormer efficiency.

3. Avoid Excessive Use of Wormers

Regular 6-8 week worming intervals increases the risk of resistance build-up by Small Strongyles, especially if the wormer is under-dosed due to inaccurate body weight estimation or waste of the paste wormer. Worm horses in stables on introduction and then every 3-4 months if removal of manure is rigorous. Carry out FECR tests to identify horses which do not require worming at standard intervals.

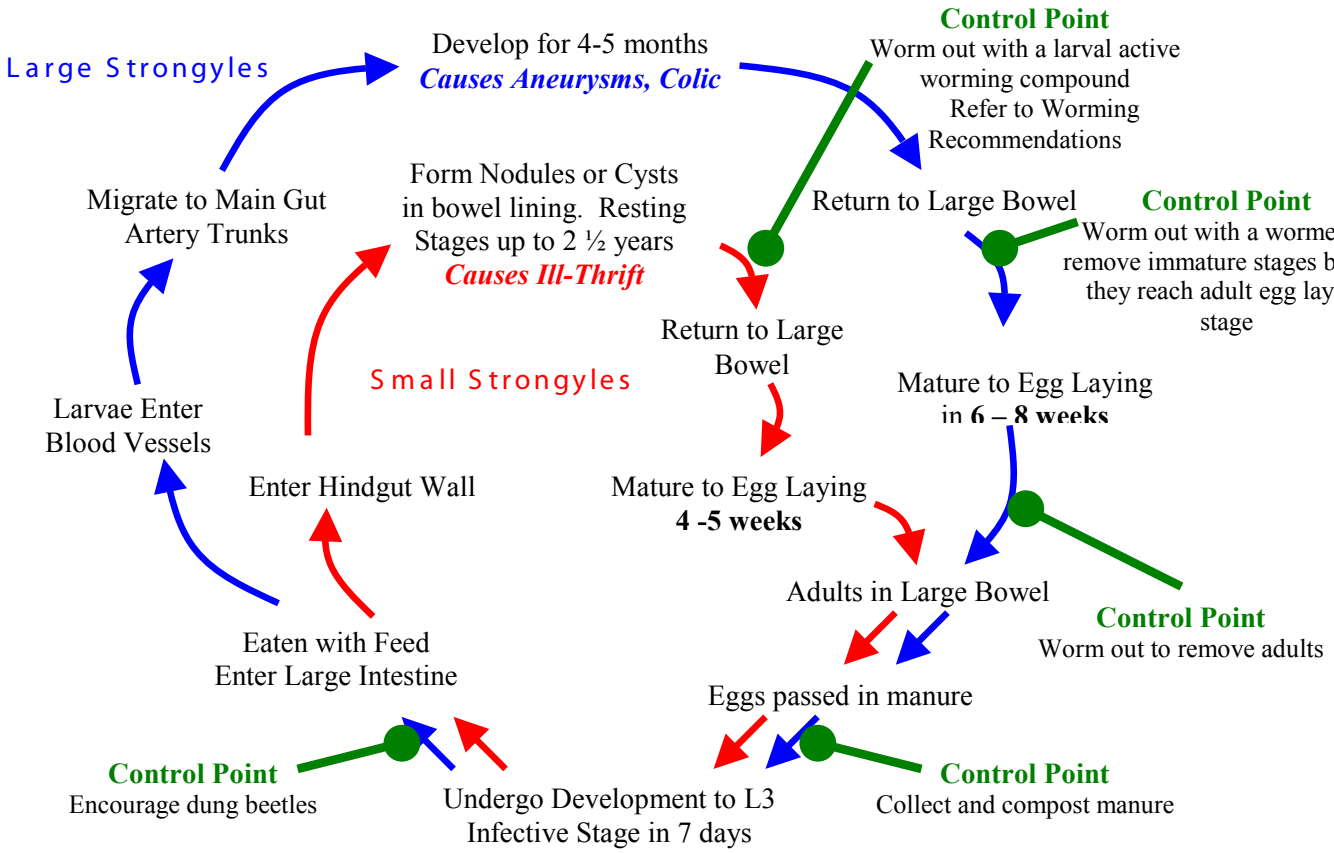
4. Treat Horses less likely to Contaminate Pasture Relative to their Worm Burden.

Some horses have natural resistance. Identify these horses by Manure Egg Counts 8-12 weeks after worming and if they are lower than 200 epg - miss them and concentrate on horses with higher manure egg counts. You can save on worming costs by up to 50%. Worm young horses and aged horses with likely lower 'worm' immunity more often.

5. Use a Manure Egg Count Reduction Test at 14 days after Worming

Identify possible wormer resistance and if a 95% reduction is not achieved, rotate to another wormer group. Only use a 'slow' wormer rotation over 12-18 months rather than change worming compounds at 2-3 worming intervals. Consult your vet for advice if you are concerned that your wormer is not as effective as it should be.

Major Differences in the Migratory Phase of Large and Small Strongyles



TOTAL LIFECYCLE

Large Strongyles 6 – 8 Months ***Small Strongyles 7 weeks – 2 ⅓ years***

Did you know that...

There are various species of dung beetle which are native or introduced to Australia. Native species are not efficient at opening up the large volumes of manure passed by horses. 26 species of exotic dung beetles have been introduced to Australia to open up, aerate and recycle horse and cattle manure. Dung beetles build nests under piles of droppings, creating an extensive maze of tunnels up to 20cm deep and lay eggs in small dung balls carried into the tunnels. Some species roll dung balls away to bury them. You can check if dung beetles are active in your pasture by looking for dropping heaps which have been opened up and spread out into little balls of manure.

Handy Hint

Liming Pastures to Control Worm Larvae

Many horse owners believe that applying powdered Limestone (Ag-Lime) to 'lime' pastures helps to destroy L3 stage infective Strongyle larvae. There is no scientific basis for this practice. Applying lime to alkalinise (increase the pH above 7.0 units) helps to neutralise horse 'sick' pastures from urine saturation in 'peeing' areas. However, increasing the pH of soil above 7.0 units over the whole pasture area can significantly reduce the uptake of trace-elements including zinc, copper, molybdenum and manganese in growing plants. This can subsequently reduce the content of these trace-minerals in plants and can increase the risk of joint disease and limb growth abnormalities in young, growing horses grazing these pastures. Supplements of these important trace-minerals, such as **Kohnke's Own Cell-Grow**, may need to be provided to ensure adequate levels for limb and joint development.

Worming and Dung Beetles

It is claimed that mectin worming compounds, which are also insecticides, do not kill dung beetles when residues are passed in the droppings for 2-5 days after worming. However, it is good practice to confine horses after worming to a yard or small paddock for 3-4 days to eliminate the worming chemical as well as collect the manure and compost it to help minimise any risk to dung beetles working in the treated droppings on pasture.

Worming Recommendations: Worm out Initially using a Larval Active Wormer

If you are unsure of the worming history of a new horse, or have a horse which is not doing well or has symptoms of cyathostomiasis such as diarrhoea, ill-thrift and low grade colic, worm out using a larval active compound, such as Moxidectin (Equest gel®) or a 5 day course of fenbendazole (Panacur 100®).

However, while Equest gel® is the most effective single dose wormer which is metabolised over an extended period to maintain lethal blood levels against 'resting' Small Strongyles in heavily infested horses, it can result in colic within 3-4 days after dosing due to the large number of dying larvae causing an allergic/toxin reaction in the gut wall.

Panacur 100®, (or a wormer with similar concentration of fenbendazole 100g/litre), when given at a dose rate of 10mL per 100kg body weight each day for 5 days in the feed or over the tongue, maintains blood levels for up to 7-10 days and kills a few worms at each dose, reducing the risk of a rapid, high larval kill in the gut wall.

Do not worm with a fenbendazole liquid as a 5 day course within 10 days of competition as metabolites can be identified in a urine swab.

It is recommended to dose horses to remove encysted larvae in January of each year because under normal seasonal conditions, most Small Redworms are in the encysted or 'resting' stage at this time of the year and parasite eggs and larvae have limited survival on pasture. A 5 day course of Panacur® is the best option for sick or debilitated horses carrying large burdens of 'resting' cyathostomes. At the present time, there is a positive benefit from dosing with fenbendazole daily for 5 days to eliminate 'resting' Small Strongyles, but if not carefully targeted or used only when necessary, this regimen may also become ineffective in the longer term. Consult your vet for specific advice.

Handy Hint

Rotate Wormers at 9-12 Month Intervals.

One 'rule of thumb' often recommended is to use one wormer for 4-5 wormings and then change to a different chemical group or a combination wormer for 2-3 wormings and then resume with the old worming compound.