New Strategies in Worm Control

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All horses have worms. It is well known that infestation with 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 which species 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 risk of development of resistance by Small Strongyle worms to even the most recent worming compounds, the 'mectin' group, has highlighted the need for a more complete and co-ordinated 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 Assoc. Equine Practitioners Convention in Dec 2009.
The take home message was that we must act now to ensure greater sustainability of worm control, as there are no new compounds available in the near future. He advocates 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)

Over the last 30 years, many parasitologists have been concerned about the targeted control of Large Strongyle worms (predominately Strongylus vulgaris – the 'Bloodworm') by worming at regular 6 – 8 week intervals. 30 years ago, 90% of colic cases in horses were due to migratory Bloodworm larvae damaging the arteries (forming 'aneurysms') which supply blood to the gastro-intestinal tract. This targeted control has been very effective to prevent migratory Bloodworm larvae, which return to the large bowel and develop to egg laying mature forms in 6 – 8 weeks, spreading eggs into a horse's environment. However, although targeted control has reduced the incidence of colic related to Bloodworm larvae to less than 5% and 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.

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 out 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) and within 6-8 weeks after worming, high levels of recontamination with Small Redworm eggs and infective larvae can build-up on grazing pasture under ideal temperate seasonal conditions.

HANDY HINT 1

Target Immature Worms

The majority of the harmful and long term health problems are caused by 'pre-adult' or developing adult forms of Strongyle and Large Roundworms as migratory immature larvae, take months or even years before signs of damage are 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 2

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. Most of the 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.

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. 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 2 ½ 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 worming increases the risk of the development of wormer resistance.

3 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, under-estimate 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.

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)

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, less frequent 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-infestation 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 the increase in Manure Egg Counts , to allow some resistance to develop to naturally limit worm activity. **Refer to Handy Hint 4.**

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.

4 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.

5 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 rigorous 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.

New Strategies for Worm Control

The use of set 6-8 week worming intervals is now out of date due to the shift 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.**

HANDY HINT 6

Aim to Control Worm Reproduction by Worming

Complete eradication of worms is not possible or desirable because it reduces natural immunity against worms. Using wormers to control migratory or 'resting' stages of Small Strongyles before they develop into adults, is a more effective approach to overall control of worms. Worming should be targeted at controlling immature stages in the gut wall and bowels, rather than waiting to kill the adults already laying eggs which may have already increased pasture contamination.

HANDY HINT 7

Treat All New Arrivals and Quarantine for 4 days

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 to pass all killed worm eggs should greatly reduce the risk of increasing worm populations.

Facts and Stats

- Studies have shown that 99% of Strongyle spp worms are in the pasture phase of their lifecycle, with only 1% of the worm population internally infecting a horse, at any one time.
- Pasture contamination with infective mobile L3 stage larvae increases by 300% after rain on a contaminated pasture.
- Studies have also shown that egg hatching and larval development of Strongyle eggs is hampered by temperatures below 10^{o}C and above 35^{o}C, with hatching within 24 hours of the manure being passed at between 20-30^{o}C in spring and autumn seasonal conditions. Highest infective larval populations on pasture thus occur during temperate seasonal conditions in spring and autumn.
- Infective L3 stage Strongyle larvae develop in the manure heap within 7 days under temperate conditions. They then become mobile and migrate onto pasture up to 30 cms from each manure heap/ball. Collection of manure at least once weekly in small paddocks and yards removes developing L3 stages before they become infective to the grazing horse.
- Infective Strongyle spp larvae can remain viable for 6 months in the protected micro-environment of the pasture base during damp, warm conditions and for up to 5 weeks under snow! Roundworm eggs can remain viable for up to 5 years in manure sheltered areas, such as trees and in shaded, frost free moist areas - a place where young foals often congregate to rest.
- A combined pasture hygiene program to limit egg and larval contamination with strategic worming based on seasonal conditions, is from 5 to 10 times more effective in controlling worms than worming alone with anthelmintic compounds.

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 in high numbers.

HANDY HINT 8

Identify Problem Horses in a Group

Ideally each horse in a small group of horses should be evaluated by FECR tests, but in large groups, such as on studs, then 6 – 10 horses with symptoms related to worm burdens (eg. loss of condition, poor coats) can be checked by manure egg counts. Young and very old horses should be targeted as well.

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.

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

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. Rotate to an effective compound or combination.

2. Monitoring Individual Horses

It is common that 20% of the horses in a group carry 80% of the worm burdens. 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 weight tapes are available, but really only estimate body weight accurately in horses in moderate condition – heavy weight horses are commonly under dosed by up to 10-15%.

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 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.

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.

9 **HANDY HINT**

Rotate 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.

10 **HANDY HINT**

Avoid Under Dosing a Combination Wormer

There is concern that under-dosing a 3 compound combination wormer is likely to develop resistance against each of the compounds in the wormer. These wormers are presently highly effective, but over-use at every worming, combined with under-dosage or wastage at worming, as well as disregard for basic environmental hygiene in pastured young horses and aged horses in particular, is likely to increase resistance pressure against all compounds. It is important to maintain a routine rotation program using a single compound for at least 5 – 6 wormings and monitoring FECR before changing to a new compound, or on a strategic seasonal program.

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.
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

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.

Summary of New Worm Control Strategies for 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 Uptake
De-worming 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. Worm horses in stables on introduction and then every 3 – 4 months if removal of manure is rigorous.

4. Identify and Treat Horses relative to their Risk of Contaminating Pastures
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%.

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.