

## **Sleepless Shepherd Midnight Musings - A Theory on the Root Cause of the “Parasite Problem” in Sheep**

Root cause analysis is an engineering and quality management process used to delve deeply into the who, what, where, when and ultimately why of a problem. It not only has value in engineering but for all businesses including farming.

So often we identify something as a problem while it is just a symptom of a deeper problem. We are frustrated when our solution does not solve the problem. A prime example in the sheep industry is a producer will identify that they have a parasite “problem”. Their solution is to deworm the flock. That solution is temporary at best or ineffective at worst. Their “problem” is still there or will return very quickly.

The reason is they have reacted to a symptom of a deeper problem and have neither identified nor fixed the real problem. That is where root cause analysis comes in.

I decided to take root cause analysis of the parasite problem to the extreme. The following is the result of that analysis. Unfortunately, there is little data and no way of proving most assumptions that I make but there is a logic to the path I take. You will be happy to know that I did not take my analysis back to the “big bang theory” and have limited myself to a period of 13,000 years.

Our modern-day domestic sheep are believed to have originated in the middle east. They were one of the first animals to be domesticated about 13,000 years ago. I warned you that this was root cause analysis taken to an extreme.

In a wild situation, flocks of sheep would have ranged over huge areas. Their movement was driven by the need for food and by packs of predators. Even at that time, they would also have been host to internal and external parasites. These parasites would have co-evolved with their hosts. Unless there were unusual circumstances, they would have been at low levels that would not have killed their host. Parasites that have a host as part of their life cycle need that host to survive if they are to survive. It makes no sense for a parasite to kill its host despite what we see in modern days. This should be our first sign that something is seriously amiss. What went wrong?

Early flock management of domestic sheep would have been very similar to the natural movement of sheep in the wild. Shepherds would move with their sheep to fresh feeding areas often not returning to their original grazing areas for extended periods of time. Sheep would have followed their natural tendency to move to fresh food and to avoid where they deposited their manure. Their diet would have been a vast mix of plants that they grazed and browsed. Their knowledge of what was safe to eat would have been passed from one generation to the next – from a ewe to her lambs. Breeding and lambing would have followed seasonal cycles corresponding to when forage supply was greatest. The species would have evolved to adapt to periods of scarcity. There is a reason that the “fat-tailed breeds originated in the middle east and Northern Africa. These sheep evolved to adapt to periods of scarcity by storing fat reserves in their hind quarters

and tail and would draw upon these reserves during periods when food resources were scarce.

Mankind also originated in the African continent and migrated throughout the world taking their domestic animals and by default their parasites with them.

This is the point where my theory gets a bit fuzzy. When the sheep migrated with their owners, they would have encountered other species, each with their own parasites, species like early cattle, deer and goats. It is possible that parasites found in one host might jump to another host during that period. That could have happened with parasites found in sheep and goats. Did *Haemonchus* originate in the middle east or did it originate elsewhere in the world? There is recent evidence of an African continent origin of *Haemonchus*. The net result is *Haemonchus* are now found in most modern-day sheep flocks throughout the world.

Flocks would probably still be maintained by shepherds moving in a nomadic or semi-nomadic way with constant movement and a varied diet for the flock.

And then came a new concept – land ownership. Though there was and continues to be common grazing lands. Early farmers and those in certain parts of the world used and still use common grazing lands and only brought their flocks to the smaller holdings for short periods of time.

Today confinement management is interpreted as meaning four walls and a roof, but confinement really started with land ownership and a fence. Flocks were “confined” to an area that was a mere fraction of their earlier range. With land ownership, sheep were grazing and spreading their manure on a smaller area. As a result, their parasites were concentrated into a smaller area increasing the likelihood of a sheep encountering infective larvae when they were grazing.

Problems with parasites really started to escalate the more we confined our sheep to single properties and we “unlearned” the importance of constant movement and long rest periods for the grazing lands. I have read flock management publications from the 18<sup>th</sup> and 19<sup>th</sup> centuries and they emphasize the importance of short periods of grazing a paddock and extended rest periods for that paddock after grazing. It is no wonder that early Britain was a patchwork of small fields fenced with stone or hedgerows.

Those publications also emphasized the importance of diversity of plants in the grazing lands. They recognized that sheep, given a choice, will feed on a greater variety of plants compared to other ruminants.

New research on bioactive phytochemicals such as condensed tannins and on proteins that bypass rumen digestion note their importance in parasite resistance. At first glance this research seems so new and innovative. Yet in reading these early publications, I wonder if we are just relearning what was known for hundreds of years? Our ancestors

didn't have fancy scientific names; they called these plants bitter herbs and other colourful names.

By limiting the variety of plants we are feeding our sheep, are we also limiting their nutrition? Like with the NPK focus on soil fertility, we tend to have a very narrow focus on livestock nutrition: protein, energy, some macro-and micro minerals and vitamins. But what if we are only touching the tip of the iceberg in sheep nutrition? By limiting our focus on the diet are we also limiting intake of a range of important plant specific phytochemicals that are essential for the health and well being of our animals?

I now want to discuss a parallel co-evolution dynamic. With animals comes manure and with manure nature evolved a process to recycle the nutrients back to the soil. A range of insects such as dung beetles, fungi and bacteria evolved around that pile of manure to break it down, return the nutrients into the soil and continue the carbon cycle.

As part of that co-evolution there are organisms that kill and consume the parasite eggs and larvae. Nematophagous fungi are part of that process. Nematophagous literally means "eats nematodes". At this point I would like to thank my Grade 11 Latin teacher. In the last year a "new" product has been released to the market. *Duddingtonia flagrans* is a nematophagous fungi that will survive passage through the digestive system of livestock, will colonize the manure on pasture and will digest the parasite larva thereby reducing the population of parasites on the pasture. It really isn't new but just one of many different fungi that are found in nature that performs this function. It does work to varying degrees, but I am not sure whether it does any better than an undisturbed, fully functional soil ecosystem.

Tillage of the land disrupts that natural system by destroying habitat and the interaction of the natural mycorrhizal organisms. Our farms have large land areas that rarely if ever encounter livestock manure. Organisms that specifically evolved to live on manure piles no longer will have their food source.

Parasites became an even bigger issue. Then came the chemical salvation that would solve the parasite problem. Producers embraced these products with a passion, overused and misused them to the point that most no longer are effective. Nature 'flipped us the finger' by evolving parasites that were resistance at what we threw at them.

Unfortunately, a significant amount of the drug passes through the sheep and is deposited in their manure in a form that will kill insects such as dung beetles. We have now damaged the system that nature evolved to get rid of the problem that we are trying to solve. I doubt that we have a healthy dung beetle on our property. Manure is now left to break down by weathering and mechanical means taking longer to continue the carbon cycle thereby leaving more infective larva on the soil surface where they can be consumed by grazing sheep.

You have started with an elegant natural system of parasite management:

- Large grazing ranges

- Constant movement
- Extended periods of rest before the sheep return
- Biodiverse diet with a complete range of nutrients and phytochemicals
- Effective manure recycling with nematode-reducing processes
- Natural selection of strong, hardy sheep that can coexist with their parasite dependents

So, what went wrong?

- Land ownership
- Fences
- Set stocking
- Exceeding the carrying capacity of the land base
- Tillage
- Reducing the diversity in the diet
- Chemicals and their overuse destroying the natural soil ecosystem and manure recycling processes
- Selective breeding with an exclusive focus on high production without regard to hardiness, high immune response, resistance to parasites, inbreeding that reduces resistance

We are now dogs chasing our tails trying to solve a problem that we have created. Chemical control is not the solution. Remember nature ‘flipping us the finger’ on that effort!

This is the end of my root cause analysis. I am sure that many of you are saying – “So What!” or “So what now?” or just denying the validity of anything that I have proposed.

For those of you saying, “So What!”, I have no response and I wish you luck in solving your parasite problem.

For those of you questioning the accuracy of everything I have proposed I say, “Prove me wrong and give me an alternative.”

I can only really respond to those of you who say, “So what now?”. Unfortunately, there is no simple or single answer. We need to look at what we have broken in a functional system for some answers. I am not proposing that we all return to nomadic life, living in isolation with our flocks ranging over hundreds of miles with our sheep, our dogs and a crook (though that life is appealing at times). The answer is dependent on your operation, your sheep and how much you are willing to change what you are doing now.

Some of you will decide to increase the level of confinement of your flock by housing your sheep at all times. This will not eliminate your parasite problems; it will just change them. You will go from a system with mainly nematode problems to one with other parasites such as coccidia. I do not underestimate the ability of nematodes to evolve and adapt to the new environment.

For others the solution will be a mix of management strategies including consideration of

- Nutrition
- Breeding
- Environmental management/pasture management
- Grazing strategies
- Plant diversity
- Regeneration of the soil and land surface biological processes for manure recycling

There is no easy nor fast fix for the problem. Remember it was 13,000 years in the making. There will be compromises and re-evaluations. It will require constant monitoring and adjustments.

It can be done. It will improve the health of your animals. And ultimately it will improve your profits. Simple fixes rarely work in the long run.

I do know one thing; parasites are expensive dependents. You need to get them off your payroll.

Now hopefully I will go to sleep.

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