Internal parasites are considered by some to be one of the most economically important constraints in raising livestock. Confinement and pasture-based animals are almost certain to be exposed to worms at some point in their life. This is certainly true for goats.

Most producers are aware of the problems that worms cause, which range from decreased productivity of their animals to death. Animals are usually routinely dewormed with different commercial chemicals by owners using a variety of deworming schedules. Every dewormer on the market has had some resistance built up to it by the internal parasites that infest livestock. This resistance means that not all the worms are killed during deworming. The surviving worms pass that genetic resistance on to offspring.

The seriousness of the issue cannot be stressed enough, especially with goats. More and more goat herds are finding they have no chemical dewormers left to use. The worms are resistant to every one of them. This has changed the strategy of dealing with internal parasites. We are no longer as interested in killing all the worms as we are in preserving the susceptible worms. This is such a different way of thinking that it takes a while to adjust the way a producer deals with worms in their herd. But it will become ever more important if we are to retain any chemical dewormers for emergency use.
As a result, this problem has caused people to look for alternatives. Much attention both in the research community and on the farm is being devoted to discovering ways to prevent and treat internal parasites without relying on heavy doses of chemical dewormers. Many people claim this treatment or that control measure works, but there are more questions than answers. There is no simple alternative way of preventing or treating worms, nor will there be. By looking at the whole farm as an interrelated system, it becomes apparent that there are parts of the system that can be managed to decrease internal parasites and their effects. These management adjustments not only postpone the day when chemical controls no longer work, but they also may decrease costs and increase the overall health of the animal.

**Parasite Life Cycle**

Goats and sheep are infested by the same species of worms. Cattle are mainly infested by other species. The barber pole worm, *Haemonchus contortus*, is a stomach worm that can severely affect goats and sheep. It is a bloodsucking worm, which can cause severe anemia and death. The cattle parasite of most concern is *Ostertagia ostertagi*, the brown stomach worm.

Both of these parasites have a simple life cycle, as illustrated here.

http://www.ext.vt.edu/pubs/sheep/410-027/figure1.html

**Nutrition**
Nutrition plays a major role in how well animals are able to overcome the detrimental effects of internal parasites. In fact, the signs of parasitism can often be used as a symptom of some other problem, usually poor nutrition. In an article in the Journal of the American Veterinary Medical Association in 1943, researchers showed that sheep placed on a high plane of nutrition were able to reduce their worm burden significantly and many of the sheep were even able to cure themselves (Whitlock et al., 1943).

By-pass Protein

Researchers in New Zealand have been studying the effects of by-pass protein on parasitized sheep (Stear et al., 1997). They have found that by increasing the amount of protein that is not degraded or broken down in the rumen, animals lose less weight than those animals that were not fed the increased level of by-pass protein. These researchers used fish meal as their source of by-pass protein. However, there are forages that also have an increased level of by-pass protein because they contain tannins. These include birdsfoot trefoil and lespedeza. The protein in native warm season grasses also has a higher level of by-pass protein.

This research is now extending into the U.S. The research done by the American Institute for Goat Research of Langston University on goats browsing sericea lespedeza has been breakthrough research (Min et al., 2004). It showed that fecal egg counts went down to zero while the goats were browsing the sericea. The egg counts rebounded when the goats were removed. The next step is to see how this information can be used to decrease egg and larval pasture contamination.

FAMACHA Testing

The FAMACHA test, imported from South Africa, is a system of testing sheep and goats for the level of anemia due to Haemonchus infestation. The eyelids are each pulled down to expose the conjunctiva or pink part of the eyelid which is then compared to an eye color chart. Goats which have a score of 3, 4 or 5 are at risk of dying from Haemonchus and should be dewormed. Those with a score of 1 or 2 should not be dewormed. Research has shown that this system is very effective in identifying those animals at highest risk from dying due to parasites (Kaplan et al. 2004). The research has also shown that about 20% of a herd will have 80% of the worm problems. It's important to identify those 20%, and cull them and their offspring from the herd.

This test should be used so that animals that show no signs of parasites are not dewormed. This keeps a level of refugia, those worms still susceptible to chemical dewormers, out on pastures, barnyards and in animals. It is also useful to help determine how well the strategies outlined in the rest of this article are working for the producer.

In many instances the only dewormer still effective is Cydectin. Therefore, do not use that dewormer at all if another dewormer is still effective on your farm.

Training on the use of the FAMACHA system is offered around the country. More information on this system, and where to find a training, can be found on the website of the Southern Consortium on Small Ruminant Parasite Control at www.scsrpc.org
Pasture Management

Management of animals, pastures and any loafing areas is the key to reducing the amount of internal parasite problems in livestock. An understanding of the life cycles of the different parasites within the whole soil-plant-animal system will help show the interrelationships between these three components. Managing internal parasites is just like managing fleas in dogs and cats. The major part of the parasite life cycle is outside of the animal. This point will help the producer to choose management strategies that reduce parasite levels on his or her farm and decrease the usage of chemical dewormers. The same principle is used in integrated pest management for vegetables and other crops.

Many farmers closely monitor their animals but pay little attention to the plants and soil. Pasture contamination by infective larvae is the primary factor to deal with. If you start with an understanding of the interrelationship between the animal, the plants it eats and the soil on which those plants grow, then it becomes clearer how parasites infect the animal and how they can be managed so as not to cause as many problems. Everything a farmer does to his or her animals, including the grazing management, has an impact on the numbers of internal parasites their animals will have.

By looking at the whole farm as an interrelated system, it becomes apparent that there are parts of the system that can be managed to decrease internal parasites and their effects. For example, animals that continuously graze a pasture eat the grass into the ground, while contaminating the soil with so many parasites that nothing outside of regular deworming with chemicals will control them. This can especially be disastrous for goats, as they quit grazing when the pasture forage height falls to a level of three to five inches. By using controlled grazing methods that allow pastures to rest and soil life to function well, contamination can be reduced. This reduction occurs because soil organisms, including earthworms, dung beetles, and nematophagous fungi will destroy or keep many of the parasite eggs and larvae from developing. Keeping the grass in a more vegetative stage, and tall enough to provide the animal with adequate forage, will provide better nutrition to keep the animal healthier, thereby strengthening the immune system to prevent the adult worms from producing eggs. Parasites do not cause as much harm to a healthy, well nourished animal. The parasites that are present will not deplete the host as much as in an animal that is malnourished. Parasite loads affecting wildlife generally do not cause the death of the host, because the parasites need the host to survive. The same principle applies to livestock.

Pasture contamination can be reduced through management. Livestock will avoid manure piles and the grass surrounding them. This behavior also helps them avoid eating larvae. The height of the pasture sward can affect parasites. The majority of worm larvae crawl only one inch from the ground onto plants, so not allowing animals to graze below that point will cut down on infestation. This is one reason sheep tend to have more problems with internal parasites. They eat much lower to the ground than cattle do, picking up higher numbers of larvae. Therefore, it is important to monitor grazing sheep closely so they don't graze too low. Larvae migrate from the manure no more than 12 inches from the manure pile. If livestock are not forced to eat close to their own manure, they will eat fewer larvae. This holds true even for goats and sheep which scatter the manure "berries" as they walk.

With sheep and goats, the most important time to control pasture contamination is during the periparturient rise, which is the sudden release of infective larvae and eggs within the ewe's intestinal tract. This occurs right after kidding, and is due to the doe's immune system becoming temporarily less
effective. By treating animals at this time, the exposure to newborn and young lambs (those most susceptible to parasites) is minimized.

Good grazing management includes the use of clean pasture to minimize re-infection. Clean pasture is pasture that has not been grazed by the host animal (in this case, goats) for 12 months, and therefore, is not contaminated with worm larvae. It may be new pasture, pasture grazed by livestock such as cattle or horses which do not share parasites with sheep (goats do share parasites with sheep), or pasture that has been hayed, renovated, or rotated with row crops. There is some killing of parasites on pasture during the winter due to freezing and thawing; however, snow cover insulates the larvae. Summer is the time in the Southern states when most larval kill will occur on pastures. Sunlight will kill them, and this occurrence can be used to determine which pastures can be used in the fall and into the winter. Grazing down to 2-4 inches from the ground allows more sunlight to get to those larvae and increases their chances of drying out and being killed.

Warmth, oxygen and moisture are the three most important things that increase the chances that larvae will survive on pasture (Barrell, 1997). Knowing when your pastures are apt to be driest and hottest will help you manage them better for parasite control.

Good sanitation is a defense against parasites. Feed troughs and water sources located where they can be contaminated with feces will increase the chances of livestock infestation. This is only one reason not to water directly from ponds, or to allow animals continuous access to water sources. Feeders should be cleaned and elevated. Kidding areas, as well as other holding areas, should be clean and dry. Prevent the transmission of infestations from new arrivals to the herd or flock by deworming them before arrival and again three weeks later.

Immunity

While it is usually neither possible nor advisable to completely eliminate internal parasites in sheep or other livestock, reduction of parasite load can be achieved. Many people have found, and research has shown, that adult animals rarely need to be wormed (Barrell, 1997). Most animals develop immunity against internal parasites, though not to the level that is developed against viruses and bacteria. This immunity keeps the parasites from reproducing but rarely kills them. An example of an effective parasite control program can be found in Tennessee. Dennis Onks, superintendent of the Highland Rim Experiment Station in Springfield, Tennessee, has not wormed the adult cattle on the farm in eight years. They are wormed at weaning and then not again. They have never shown any signs of internal parasites and their condition is excellent. These animals are on a high plane of nutrition, have a low stress level, and are strictly culled on production. All these things work together to produce an animal that shows no signs of internal parasites. This can be applied to goat herds also, selecting those animals and their offspring who rarely if ever show signs of parasitism.

It is the young animal whose immune system is not fully mature and the animal whose immune system is compromised by disease, inadequate nutrition, or other stress, which is most adversely affected by worms. Animals brought from western rangelands, for example, where the arid conditions keep parasites from surviving, have no immunity and are even more easily overwhelmed by worms.

Every farm is different. The parasite load of the animal depends on many variables - such as stocking density, time of year, the reproductive state of the animal, etc. Good nutrition plays a big part.
in how well the animal's immune system mounts the proper defenses, and in the animal's overall ability to tolerate the presence of some worms. Healthy and well-nourished animals will be able to develop resistance and resilience to worms and other parasites much better than thin animals that do not have good availability of quality feed (Barrell, 1997). Resistance is the ability of an animal to prevent the establishment and maintenance of a parasite population within the gastrointestinal tract. Some individuals and some breeds show more resistance to parasitic infection than others. Research to identify characteristics in such individuals is a hot area. Culling susceptible animals can take advantage of this. Resilience is the ability of an animal to reduce production loss during a parasite infestation. Both of these traits are being looked at as ways of selecting animals that will be less susceptible to parasite effects. Animals that possess some genetic resistance or resilience can still be infected with worms. Therefore, you must keep in mind that this is just one more measure that will help control worm problems, not a cure by itself.

**Soil Organisms**

There are several soil organisms that can have an impact on parasites. Managing pastures to favor populations of beneficial soil organisms will decrease parasite levels on pastures.

Oxygen is the primary requirement for worm eggs and larvae to survive and develop. Earthworms have been shown to ingest worm eggs and larvae, either killing them or carrying them far enough below ground to keep them from maturing. Dung beetles ingest and disperse manure, taking it to their burrows, thus keeping eggs and larvae from developing. There are also nematophagous fungi that produce "traps" that engulf and kill parasitic larvae. These fungi are more delicate than other fungi, so there are rarely great numbers of them in the soil. If the soil is depleted or out of balance, other, more dominant microorganisms will replace these fungi. Research in Louisiana at LSU has been done very successfully using nematophagous fungi. Spores were fed to sheep that passed through into manure before developing into fungi. These fungi then eliminated the eggs from those manure piles extremely well. There are hopes that this will be available to producers as a commercial product in 2006.

The amount of time that feces remain on the pasture has an effect on the number of parasite larvae that survive and mature. Anything that hastens the breakdown of the feces will lessen the number of larvae. This can include the soil organisms mentioned above, mechanical dragging of pastures, poultry or other animal disturbance and the consistency of the feces themselves.

**Effect of Ivermectin on Dung Beetles**

Resistance development by worms is not the only problem with ivermectin. There is concern today about the effects of ivermectin on soil organisms, especially dung beetles. Research has shown that the use of ivermectin kills dung beetle larvae for up to 45 days through residue in the manure (Herd, 1996; Strong, et al., 1996.). Manure from livestock treated with ivermectin does not break down as fast, either. Other dewormers, including cydectin, don't appear to have the same effect.

**Strategic Deworming**

There will be times when chemical dewormers are the best treatment. The situation, time of year and location will help determine which chemical dewormer to use. These dewormings should be strategically carried out in order to reduce the number of times needed. There are three main classes
of worms: the benzimidazoles, such as fenbendazole or Safeguard (white); the imidazothiazoles, such as levamisole (yellow); and the avermectins, of which ivermectin or cydectin (clear) is a member. Rotating these three classes yearly is an accepted rule for decreasing resistance buildup by the parasites themselves. It is critical to retreat three weeks later, especially with newly weaned animals. This kills those worms that were ingested and matured following the initial deworming. This has been shown to significantly reduce pasture contamination.

It does little good to deworm livestock and return them to the same infected pasture. Do not deworm and immediately move animals to a clean pasture. All the dead worms, with very viable eggs in them, will be passed to contaminate the pasture. Instead, deworm, hold animals in their same location for 12-24 hours, and then move them to a clean pasture.

Appropriate management minimizes re-infection. There are several ways to utilize multiple animal species to control the worm population. Many producers raise goats and cattle. One technique that appears to work well is dividing your farm in half, with cattle on one half and goats on the other half. Midway through the grazing season, switch halves of the farm. Having one species of livestock follow another one will have a benefit. Letting the goats browse where they want to, but keeping the cattle rotating through pastures with just one strand of electric fence is yet another way of using cattle and goats together. The different livestock species will break up manure of other species and will not avoid those areas of pastures. This will break the life cycles of the parasites because their natural host will not be present.

Make sure that your dewormer is effective. If you are concerned that it isn't, have a veterinarian check the egg count in the feces of about 15 animals before treatment. After 10 days, check the egg count again. There should be at least an 85 percent kill. You may need to consult your veterinarian about the most effective dewormers for your area. If parasites become resistant to a particular family of dewormers, then you will have to switch families. Alternating families of wormers is a good way of slowing resistance to the dewormer. Many people alternate every time they worm. Research does not recommend this. Instead, use the same dewormer for a whole year before switching.

To implement any type of integrated parasite control program it is essential to know when loads will be highest, such as at kidding; where the young animals stay at those highest egg production times; how pastures can be divided and how long they can be rested in order to let eggs and larvae die. In addition, grazing height for goats is crucial. Goats will quit grazing when pastures fall below 3-5 inches in height. This lowers the animal’s nutritional status and, if they have many worms in them, they will show signs of worms even more quickly. This means the producer must have plenty of forage available for the goats, or else be supplementing with some other kind of feed. It is also essential to fully identify those animals having the most clinical signs through the use of the FAMACHA test and fecal egg counts.

If the producer has some idea of how much parasite infestation exists, this will also help in determining whether, and how often, chemical deworming should be given. Some scientists and producers say that rotationally grazed pastures do not aid in parasite control, because the rest period is usually not long enough to break the life cycles of parasites. Most pastures are rested between 21-30 days during the growing season, which is also the length of time it takes for infective stage larvae to develop. The goal is to lower the number of infective larvae that are ingested by the animal. The less time that animals are on a particular pasture, the less the pasture is contaminated with manure. If even
one thing can be done to lower these parasite numbers, it will help reduce the need for chemical
dewormers. Managing the length of time animals remain on a pasture is also important to remember.
This is just one other item that has to be figured in when doing pasture planning for a season. Don't let
those pastures be grazed too short!

**Alternative Dewormers**

Most alternative dewormers have not been shown by scientific research to have any effect on
numbers of worms. Diatomaceous earth (DE) has been promoted by some for controlling internal and
external parasites in livestock. Almost pure silica, DE is the finely ground fossilized remains of
diatoms, tiny sea organisms that accumulate on the sea floor and can be mined from deposits. The
diatom remains have microscopic cutting edges that are said to pierce the outer protective layer of
parasitic worms and insects, causing dehydration and death. There is little scientific data on the
effectiveness of DE for internal parasites, but researchers have seen a decrease in flies on animals when
using DE. A report from The Leopold Center showed no statistical difference between the use of DE
and the control group. I have talked to Dan Morrical, Sheep Extension Specialist at Iowa State, who
told me that they had a hard time even getting the lambs infested with worms, which was necessary to
test to the effectiveness of DE. I bring up this point to make you aware that farmers must know if their
animals even have worms in order to know whether control measures are needed, are effective, or how
to effectively change them.

Many producers have claimed that they have had good results with DE, but their management is
usually very good. They may be giving credit to the DE when they should be giving it to themselves.
Although I have nothing to back me up, I've often wondered if it isn't the minerals in the DE that
provide the benefit. Worm egg count also naturally falls at the end of summer and the beginning of fall.
People who are doing fecal egg counts (FEC) may be thinking the DE is lowering the egg counts,
instead of realizing that it is the natural cycle. I haven't talked to any producer who uses DE without
significantly changing and then watching their management. Using DE is not just a simple substitute
for a chemical dewormer. This is another problem with the scientific research that has been done on
DE. Researchers have simply substituted DE for their conventional wormer and done everything else
exactly the same. This is component research, whereas to really prove that DE has an effect, systems
research needs to be done, using the same or similar management techniques that producers use. This
type of research is much more difficult to do. If you still want to use DE, one dosage that I've seen used
is ten to twenty pounds per ton of mineral supplement. Every animal must be fed a dose every day to
be effective.

Deworming alternatives exist in herbal and folk medicine used for centuries in other cultures. Herbs
such as garlic work not by killing the worms, but by making the intestinal tract healthier. Since worms
and other intestinal parasites have evolved to thrive in the unhealthy digestive tract, anything that will
make that environment healthier will be detrimental to their survival. Dr. Susan Wynn (1996), writing
in the Journal of American Holistic Veterinary Medical Association, discusses alternative dewormers
in great detail and points out that much more research needs to be done to determine the effectiveness
of herbs and other natural substances traditionally used as dewormers. Her article also states that many
herbs can be toxic to animals, so great care should be taken in giving them. There are veterinarians who
use herbs as part of a parasite control program. The AHVMA has a list of veterinarians practicing
complementary and alternative medicine in every state.
Herbal dewormers are being used more and more by goat producers. Some of these producers get complacent. Others are in parts of the country where worms are not as much of a problem. Still others have low numbers of goats on a large enough area of land, which is low stock density. These animals are unlikely to be exposed to enough worm eggs and larvae to have a problem. The herbal dewormers need to be researched more because there is very probably a place in a management strategy. However, they will not be a direct substitute for chemical dewormers.

Copper oxide wire particles have been fed to Katahdin hair sheep in Arkansas and found to kill *Haemonchus* worms (Burke et al., 2004). This research will be continued with goats this year. As little as 0.5 g of the wire particles have been effective in reducing worm numbers. Even though goats have a high requirement for copper, the risk of this treatment is in not knowing what, if any, the toxic level of these particles might be.

**Conditions with Signs Similar to Parasitism**

Keep in mind that there are other conditions that can mimic the signs of parasites. It is easy to assume that any unthrifty or thin animal with a rough hair coat or diarrhea is wormy. Internal parasites may be present, but the clinical signs are secondary or a symptom of some other, more insidious disease or condition. Any stressful condition, such as a weather extreme, can cause borderline clinical parasitism to become severe. If animals do not have enough forage or other feed in the fall so that they go into winter in good condition, this lack of condition will cause additional stress on the animal in other ways. This animal will be more apt to show extreme clinical signs of parasitism, including blood loss and death, than an animal which might have some internal parasites but is in good physical condition and is on a high plane of nutrition. In this case, poor nutrition is the cause of the animal's disease and worms are the symptom.

**Conclusion**

There is no one thing that can be given or done to replace chemical dewormers. It will take a combination of extremely good management techniques and possibly some alternative therapies. Do not think you can just stop deworming your animals with chemical dewormers. It is something you will need to change gradually, observing and testing animals and soil, in order to monitor your progress. Alternative parasite control is an area that is receiving a lot of interest and attention. Programs and research will continue in the pursuit of parasite control, using alternative and more management-intensive methods.

**References**


Resources

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