Agricultural Innovations Fact Sheet

Sustainable Control of Internal Parasites in Small Ruminant Production

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Inside this fact sheet:

SARE *Agricultural Innovations* are based on knowledge gained from SARE-funded projects. Written for farmers, ranchers, and agricultural educators, these peer-reviewed fact sheets provide practical, hands-on information to integrate well-researched sustainable strategies into farming and ranching systems. The articles are written by project coordinators and published by SARE.

Geographic Applicability:

Humid areas, including the tropical regions of North America and the eastern United States.

Sheep and goat production is a growing enterprise for small and limited resource farmers. Small ruminants (sheep and goats) are adaptable to many different production systems and can be raised with relatively few inputs, but they face huge production challenges. Control of internal parasites, especially gastrointestinal nematodes including *Haemonchus contortus* (barberpole worm, stomach worm), is a primary concern for many sheep and goat producers and is particularly challenging in humid regions. Grazing animals ingest infective larvae from grass and shorter forages. The larvae develop into adults in the abomasum (true stomach) of ruminants. The adult parasites feed on blood in the abomasum and lay their eggs, which are excreted in the ruminants' feces. The life cycle continues when the eggs hatch and larvae develop on pasture, where they can be ingested by the grazing ruminants.

Internal parasites have become more difficult to manage in small ruminants because of the parasites' increasing resistance to all available chemical dewormers. Parasite problems negatively impact the animals' health, reduce productivity and increase treatment costs. Pastures with heavy stocking rates in high-rainfall regions are especially vulnerable to the buildup of parasites. The cost of internal parasite infection includes treatment expense, reduced animal weight gains and performance, and even animal death.

In response, the Southern Consortium for Small Ruminant Parasite Control (SCSRPC) has investigated several methods of sustainable gastrointestinal nematode parasite control, including Smart Drenching (including FAMACHA©), copper oxide wire particles (COWP), condensed tannin-containing plants, specifically sericea lespedeza (*Lespedeza cuneata*), selection of resistant breeds and other alternative methods. This fact sheet provides basic information on each approach and cites resources for training and further information.

Fig. 1. Bottle jaw is a sign of heavy parasitism.
Photo courtesy of Jean-Marie Luginbuhl, North Carolina State University.

Fig. 2. This goat illustrates loss of condition and a rough coat—both signs of heavy parasitism.
Photo courtesy of Jean-Marie Luginbuhl, North Carolina State University.

Smart Drenching

Smart Drenching is a method of parasite management that promotes selective use and improvement of the effectiveness of dewormers, most of which are drenches. Chemical dewormer use builds resistance within parasite populations over time, so one of the primary goals of Smart Drenching is to balance production needs with the need to preserve the efficacy of available dewormers for as long as possible.

Dewormers should only be administered to animals that actually need treatment. Identifying these animals easily and correctly can be problematic, but the FAMACHA© system (see next section) can now dramatically improve this process when *H. contortus* is the primary parasite.

The following Smart Drenching techniques should be used when administering dewormers:

- Identify which dewormers will work on your farm by performing a fecal egg count reduction test or a DrenchRite® larval development assay. These procedures evaluate the impact of different chemical dewormers on parasite eggs collected from fecal samples. Fecal egg count reduction tests can be performed by veterinarians or experienced producers. Resources to assist producers with this technique include an online manual, Diagnosis of Internal Parasitism in Goats (Langston University Agricultural Research And Extension programs, 2000) and a descriptive publication from the SCSRPC Web site (Kaplan and Miller, 2006; see the References section for more information). The DrenchRite® larval development assay is a service offered by the University of Georgia College of Veterinary Medicine as an alternative to performing fecal egg count reduction tests yourself (see the Resources section for more information).
- Deliver the proper dose to each animal. This will require knowing each animal's weight. It is important to note that sheep and goats require different dosages of dewormers. Goats need 1.5 to 2 times the dose recommended for sheep depending on the dewormer used. Consult your veterinarian and SCSRPC recommendations for more specifics.
- Withhold feed 12 to 24 hours prior to drenching with benzimidazoles (white dewormers such as fenbendazole and albendazole), ivermectin, doramectin and moxidectin. Benzimidazole efficacy may be enhanced by repeating the drench 12 hours after the first dose. Consult your veterinarian or the package label for more specifics regarding proper dosage.
- Deliver the dewormer over the tongue in the back of the throat with a drench tip or drench gun.
- Drench only the animals that need treatment, as described in the FAMACHA© section below. This reduces dewormer use and cost. Most importantly, untreated animals harbor worms that will stay more vulnerable to dewormers, prolonging dewormers' effectiveness.

Fig. 3. Dewormers can be administered with a drench gun.
Photo courtesy of Jean-Marie Luginbuhl, North Carolina State University.

Smart Drenching also includes recommendations for stopping the parasite life cycle through pasture management, a vital component of an animal management system designed to reduce parasite problems. To ensure good pasture management:

- Maintain forage height of at least 4 inches. Most parasite larvae migrate in water droplets on grass, but usually to heights no greater than 3 inches. When grazing cool-season forages, such as fescue or orchardgrass, move animals to a new paddock or section when the forage stubble height reaches 3 to 4 inches. This promotes faster regrowth. Also, maintaining grass at a greater height will provide forage above the infected zone, and thereby reduce the number of parasite larvae ingested by grazing animals.
- Remove small ruminants from pastures for 3 to 6 months to allow worm larvae on pasture to die off. This recommendation may not be feasible or practical under certain circumstances, and will have to be balanced against available resources and forage quality.
- Hay heavily contaminated pastures to reduce the parasite population in the pasture.
- Plant winter and summer annual forages in a prepared (tilled or disked) seedbed to break the worm cycle and drastically reduce the worms' population on the pasture.
- Alternate or co-graze pastures with horses or adult cattle, as these are not affected by sheep and goat parasites. They can serve as dead-end hosts for the parasites, lowering the parasite population on the pasture.
- Maintain appropriate stocking rates for the pasture. High stocking rates will ultimately increase parasite loads on the pasture.
- Avoid over-grazing, which forces animals to feed close to the soil, where worm larvae live.
- Allow goats to browse upright plants rather than grasses, as goats are especially vulnerable to re-infection through close-to-the-ground grazing.

Fig. 4. Goats browsing shrubs.
Photo courtesy of Margo Hale, NCAT.

Many other pasture management techniques can be used to reduce parasite problems. For more information on the Smart Drenching system see http://scsrpc.org/SCSRPC/Files/Files/Misc/DRENSHIN.PDF.

FAMACHA©

FAMACHA© was developed in South Africa as a method of identifying sheep and goats heavily infected with *Haemonchus contortus* (barberpole worm), a blood feeder that causes anemia. FAMACHA© involves examining the color of the inside of the lower eyelid, which can indicate anemia and thus presence of *H. contortus*.

FAMACHA© uses a color chart that shows five consecutive grades of goat or sheep eyelid pallor, ranging from 1 (red color; not anemic) to 5 (very pale; anemic). The eyelid is compared with the chart and the animal is scored. Only animals in the palest categories are treated with dewormers. This color-coding system was 92 percent accurate in assessing anemia levels in small ruminants.

Fig. 5. The animal's inner eyelid is compared with the FAMACHA® color chart to assess level of anemia.
Photo courtesy of Margo Hale, NCAT.

Only animals that are anemic should be dewormed. Records should be kept to identify chronically wormy animals, which should be culled from the herd. Research has shown that 80 percent of a herd's parasites are carried by 20 percent of the animals. Culling the heavily infested 20 percent will greatly reduce a herd's parasite problem.

Use of FAMACHA© requires training, but ultimately decreases the use of dewormers and allows the producer to identify animals that need frequent deworming. Studies in South Africa showed the use of FAMACHA© reduced the number of dewormer treatments by up to 90 percent. The

FAMACHA© system has been used to select rams that are parasite resistant and/or resilient, which in turn produce offspring who are also more resistant and resilient.

More than 16,000 FAMACHA© kits have been distributed to date. FAMACHA© kits are sold to producers only through veterinarians and other trained animal health specialists. Sheep and goat producers may obtain a card when they attend formal FAMACHA© training workshops. For information on how to obtain training and materials for the system, see http://www.scsrpc.org/SCSRPC/FAMACHA/famacha.htm.

Using FAMACHA© and culling problem animals:

- strengthens the flock/herd through selection of the most infection-resistant animals for breeding;
- reduces parasite levels on the pasture by culling heavily infected animals;
- slows development of resistance to dewormers by reducing the number of internal parasites exposed to dewormers;
- and saves money by reducing drug expenditures.

For more information, veterinarians and extension agents can send a message to famacha@uga.edu or visit www.scsrpc.org.

Copper Oxide Wire Particles

The SCSRPC has investigated the use of copper oxide wire particles (COWP) as a deworming agent for *Haemonchus contortus*. The goats and sheep on many southeastern U.S. farms have experienced complete resistance to other chemical dewormers, and COWP offers an alternative control method. Another benefit is cost savings—COWP costs 20 percent or less than chemical dewormers. In addition, there may be less fecal egg contamination on pasture. The exact mechanisms by which COWP works are not currently understood and further research on this topic is underway.

Administration of COWP in small ruminants requires preparation of copper boluses in smaller doses than are currently commercially available. Copper boluses (Copasure®) are currently sold for use in cattle by veterinary and animal health suppliers in 12.5-gram and 25-gram doses. Sheep and goats should be given much smaller doses. The minimum dose is 0.5 grams, but as much as 2 grams may be necessary for mature animals. Multiple doses can be given in 4 to 6-week intervals when pasture contamination is high. Animals should receive no more than four (if doses of 0.5 grams or 1 gram are used) or two (if doses of 2 grams are given) COWP boluses in a worm season.

Smaller gel capsules should be purchased at a local pharmacy, health food store or veterinary supply house, and repackaged to make boluses with the proper dose for your goats or sheep. The prepared boluses can be administered to the animals with a pill gun. COWP can also be mixed in the feed, but care must be exercised to ensure that no more than 2 grams are administered to mature animals and 1 gram to growing animals.

Sheep are particularly susceptible to copper toxicity and misuse or overdosing may lead to sudden death. Safety of the COWP method is dependent on the amount of copper already in the animals' diet. While the type of copper used in COWP boluses is poorly absorbed, and the risk it will contribute to copper toxicity is low, one must account for other copper sources. Cattle minerals used to supplement diets contain copper, for example. And higher concentrations of copper can be found in some legumes, especially in the midwestern United States and where soil is molybdenum deficient. Check with your local Cooperative Extension office for information on copper levels in your area.

As a rule of thumb, sheep may suffer toxicity at levels above 25 ppm copper in the diet; but the interactions of other minerals will influence this. Goats, on the other hand, require copper levels ranging from 15 to 25 ppm, depending on the class of goat. In addition, goats can safely have access to a free-choice loose mineral containing 1,000 ppm copper. For more information on using COWP, see *Tools for Managing Internal Parasites in Small Ruminants: Copper Wire Particles* (http://attra.ncat.org/attra-pub/copper_wire.html).

Fig. 6. Gelatin capsules, Size 3 and Size 1, filled with 0.5 g (500 mg) of COWP.
Photo courtesy of Joan Burke, Agricultural Research Service.

With regards to copper administration, the SCSRPC found:

- Low doses of COWP (0.5 grams and 1 gram) are effective treatments in lambs or kids.
- COWP is safe to use in late-pregnant and lactating ewes. A 2 gram dose is recommended. The dose is not weight dependent.
- While multiple doses of COWP given to lambs in a summer worm season increased their level of copper, no copper toxicity was observed. Untreated lambs were actually somewhat copper deficient.
- COWP administered in a gel capsule and loose or pelleted in supplemental feed were both effective in controlling barberpole worm in sheep and goats.

Results have varied across studies, and researchers believe that a disturbance in rumen function somehow interferes with the COWP action. COWP is not always effective, perhaps because problems with digestion interfere with its action as indicated by the fact that COWP works against abomasal barber pole, but not intestinal worms. Research results in this area have varied and COWP action is not fully understood.

Sericea Lespedeza

Sericea lespedeza (*Lespedeza cuneata*) is a perennial summer legume with a relatively high condensed-tannin content that can be used as part of an integrated parasite control system. The SCSRPC has investigated several forms of the forage, including sericea hay, ground hay and pelletized sericea hay. Including these in the diet of sheep and goats reduces parasite loads, specifically *H. contortus*, although how this occurs is not completely understood. The same results were observed with grazed sericea lespedeza.

Fig. 7. A goat forages on sericea.
Photo courtesy of Jean-Marie Luginbuhl, North Carolina State University.

Sericea lespedeza grows well in low fertility and acidic soils, and has been widely used in site rehabilitation, including road banks and other disturbed areas. Sericea is listed as a noxious weed in some states, and can be unwanted in some ecosystems, such as native grasslands in the Plains States. Sheep and goats need to adjust to grazing sericea but will quickly learn to feed on this forage. Sericea should be planted in the spring after the last frost date (Ball and Mosjidis, 2007). Contact your local Cooperative Extension office to ensure sericea is not listed as a noxious weed in your state and for assistance with selecting the best variety for your purposes and area, seed sources and advice on cultivation.

The SCSRPC found that:

- Grazing sericea lespedeza and feeding sericea hay effectively reduced fecal egg counts (FEC) in goats and sheep, most likely due to the condensed-tannin content of the plant.
- Loose and pelletized sericea hay were effective in reducing FEC in goats and sheep in some, but not all, studies.
- Grazing kids on sericea caused a decrease in FEC, which stayed lower while kids grazed sericea.
- Giving grazing kids free access to both sericea and millet at the same time caused a decrease in FEC, which stayed lower while the kids were grazing.
- In animals consuming sericea, the percentage of parasite eggs developing into larvae was reduced, as was the overall number of adult worms.

Farmers should not use sericea as their only method for controlling internal parasites but combine it with other methods.

Researchers continue to investigate sericea to learn more about its optimal use. For more information on using sericea lespedeza see *Tools for Managing Internal Parasites in Small Ruminants: Sericea Lespedeza* (http://attra.ncat.org/attra-pub/sericea_lespedeza.html).

Resistant Breeds for Parasite Control

Internal parasites are the top health concern for sheep and goats. The long-term solution is the selection of resistant animals. Sheep breeds that have demonstrated some level of resistance to internal parasite infection include St. Croix, Barbados Blackbelly, Gulf Coast or Florida Native, and Katahdin. Less is known about resistant goat breeds, though preliminary research indicates Spanish, Kiko and Myotonic breeds may offer some genetic resistance to parasite infections.

Fig. 8. St. Croix and Katahdin sheep are breeds known to be resistant to infection by internal parasites. Photo courtesy of Joan Burke, Agricultural Research Service.

Most importantly, more work is needed to develop selection methods for improving overall resistance within herds and flocks. Better selection methods would lead to less frequent deworming, lower production costs and reduce parasites' resistance to dewormers. There is generally more variation within any given breed than between breeds. Every breed can be improved by a) culling the animals that require an excessive number of deworming treatments and b) breeding those animals that produce well with the least amount of drenching.

Other Methods

Organic farms and farms with animals resistant to chemical dewormers must rely on alternatives to chemical dewormers. The SCSRPC has investigated other methods, such as commercially available non-drug treatments and traditional remedies. For example, some plants with high tannin content other than sericea traditionally have been useful in treating internal parasites. However, at this date and under the conditions of our experiments, the methods researched did not successfully control internal parasites. Research did show that:

- Garlic (fresh juice, bulbs, and Garlic Barrier®—a commercial insecticide prepared from liquid garlic extract) used as a drench was not effective in control of gastrointestinal parasites.
- Other plants traditionally thought to be useful, including black locust and curly dock, failed to control barberpole worm but did provide improved nutrition for goats, compared with goats feeding only on grass pastures.
- High-tannin grain sorghum was not consistently effective in reducing internal parasite fecal egg counts in goats and did not influence the number of animals that required deworming.
- Quebracho tannin powder was not effective in controlling parasites.

Rotational grazing of summer grasses did lead to less frequent deworming of lambs. Rotational grazing combined with COWP was effective in management of barberpole worm. Nevertheless, the intervals between the rotations are

crucial to the success of this approach. While a minimum 28-day interval should be used before an animal regrazes a pasture, local climate and season should be taken into account as they affect pasture regrowth and quality, and the parasite life cycle. Contact your nearest Cooperative Extension office or Natural Resources Conservation Service (NRCS) office for advice on grazing management.

While the SCSRPC has not conducted research on the following methods, they are also useful for reducing parasitism in sheep and goats:

- Zero grazing: Put the animals in dry lot and provide cut forage for them, such as hay or other harvested forage. This gives the pasture rest and prevents the animals from infecting it and re-infecting themselves by ingesting larvae.
- Protein supplementation: Research has shown that increasing protein in the diet helps animals resist parasites. For example, when pasture is low in protein, feeding one-quarter pound of soybean meal per lamb per day improved resistance (Ross, 1989). Other forms of protein can also help increase tolerance to parasites.

Continuing Research

The SCSRPC continues to research new parasite control methods, including such topics as:

- Liquid nitrogen fertilizer to reduce worms on pasture.
- Alternative sources of condensed tannins to reduce internal parasites, including native forb and browse species.
- The nematode-trapping fungus, *Duddingtonia flagrans*, for reducing parasite numbers on pasture.
- Comparing the worm susceptibility of breeds, such as Spanish and Boer goats.
- Locating the genetics of parasite-resistant flocks that have never been dewormed, with a focus on identifying genetic markers.
- Using buck/ram information (EPDs) to breed for parasite resistance.

Decreasing the negative impacts of internal parasites on flocks and herds will improve the economic bottom line for any farm operation. Preliminary economic analyses suggest that producers implementing FAMACHA© reduce their drug costs by 70 percent or more while slowing resistance to dewormers. Exact dollar amounts are difficult to assess because costs of chemical dewormers vary widely. However, one example can illustrate the potential for savings: Cydectin® drench costs about $1 per treatment per animal (goat dose). If a producer with 100 breeding does normally deworms four times per year, drug costs for the doe herd alone will be $400 per year. Our analysis indicates that use of the FAMACHA© system would reduce these costs by at least $280 per year.

SARE Research Synopsis

Consortium members have conducted numerous research projects focusing on sustainable control methods for internal parasites. These projects have been supported by a number of grants, including ones from SARE, USDA Capacity Building, and the USDA Organic Research Initiative. For more in-depth information on the SARE-funded projects, search the SARE Project Database www.sare.org for projects LS01-124, LS02-143, LS04-164, GS05-047, LS05-175, LS05-177, LNE05-232, ES06-084, GS07-059, LS08-204, LS08-212, and LNE08-269.

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About The Southern Consortium for Small Ruminant Parasite Control (SCSRPC)

The Southern Consortium for Small Ruminant Parasite Control (SCSRPC) was formed in 1999 to address the internal parasite (anthelmintic) resistance problem facing grazed small ruminants, especially in the southeastern United States. This research group got its start thanks to a SARE Planning Grant and has greatly expanded over the years. The Consortium's mission is development of new methods of sustainable control of internal parasites in sheep and goats, and education of people involved in the small ruminant industry. The Consortium now includes researchers, veterinarians, and extension educators from Alabama, Arkansas, Delaware, Georgia, Louisiana, Maryland, North Carolina, Oklahoma, Texas, Virginia, Puerto Rico, the U.S. Virgin Islands, and South Africa. The group has generated a Web site to disseminate research information (http://www.scsrpc.org).

Further Resources

The Southern Consortium for Small Ruminant Parasite Control

www.scsrpc.org

The Consortium's mission is to develop new methods for sustainable control of internal parasites in sheep and goats and to educate those involved in the small ruminant industry. Members of SCSRPC meet regularly and are in close communication, continuously updating recommendations for parasite control.

The SCSRPC website contains research articles, recommendations for producers, presentations, list of events, and contact information for Consortium members. The website is updated when new information and research results become available.

ATTRA-The National Sustainable Agriculture Information Service

www.attra.org

ATTRA has information on a variety of agricultural topics, including small ruminant parasite management. The publications *Managing Internal Parasites in Sheep and Goats*, *Tools for Managing Internal Parasites in Small Ruminants: Copper Wire Particles*, and *Tools for Managing Internal Parasites in Small Ruminants: Sericea Lespedeza* are available on the ATTRA site.

FAMACHA©

http://www.scsrpc.org/SCSRPC/FAMACHA/famachainfo-guide.htm

For more information, veterinarians or extension agents can send a message to famacha@uga.edu. See also www.scsrpc.org.

Smart Drenching

http://scsrpc.org/SCSRPC/Files/Files/Misc/DRENSHIN.PDF

Drench Rite® Larval Development Assay

http://www.scsrpc.org/SCSRPC/Files/Files/D%27Rite%20Scsrpc11-05.pdf

or contact Dept. of Infectious Diseases, College of Veterinary Medicine, University of Georgia (ph. 706-542-0742).

COWP

Tools For Managing Internal Parasites in Small Ruminants: Copper Wire Particles (http://attra.ncat.org/attra-pub/copper_wire.html)

Sericea lespedeza

Tools for Managing Internal Parasites in Small Ruminants: Sericea Lespedeza (http://attra.ncat.org/attra-pub/sericea_lespedeza.html).

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SARE Sustainable Agriculture Research & Education

This fact sheet is based on multiple SARE-funded projects. For more information, please visit sare.org and search for LS01-124. For further information on related projects, please go to sare.org > Project Reports > Search the Database and search for "internal parasites".

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