Northern New York Agricultural Development Program
2013 FINAL REPORT

Innovations in Parasite Management for North Country Sheep and Goat Farms

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Cooperating Producers:
Essex County:
Asgaard Farm & Goat Dairy, Rhonda Butler and David Brummer

Franklin County
Downing Acres, Katahdin Sheep, Pat, Beth, and Michael Downing

St. Lawrence County
Cornell Cooperative Extension of St. Lawrence County Learning Farm, Dorset Sheep, Betsy Hodge managed on-farm study

Background:

Northern New York is blessed with an abundance of grazing land. Pasture-based kidding and lambing help to reduce feeding costs when nutrient needs are greatest. A major limitation for birthing and the raising of offspring with their dams on pasture is control of internal parasites in young, growing animals, and lactating ewes and does. This project will help to solve this frustrating and expensive challenge to sheep and goat farming in the North Country.

Two separate studies were planned to answer specific questions about the control and treatment of two of the most serious parasites. *Haemonchus contortus* (barber pole worm, stomach worm) is a major cause of death and must be managed carefully to prevent it from developing resistance to the limited classes of dewormers that are available. Many North Country sheep and goat farmers already report *H. contortus* resistance to multiple dewormers. *Parelaphostrongylus tenuis* (meningeal worm, deer worm) has a life cycle involving white-tailed deer and the snails or slugs that ingest their feces. Most white tail deer are infected and sheep and goat farmers have observed increased numbers of affected livestock. This organism is ingested by sheep or goats from snail slime tracks on forage. It migrates to the spinal cord, causing inflammation and paralysis, particularly in young animals that have yet to develop immunity.

Methods:

1. **Copper oxide wire particles (COWP) to control *Haemonchus contortus***

Although we originally intended to test effectiveness of different levels of COWP in pastured lambs and goats on 2 farms in St. Lawrence County and 1 farm in Clinton County, an immediate need was identified to evaluate levels being used at a commercial goat dairy farm.

Goat dairy study. The commercial goat dairy farmer was unwilling to include a negative control group because control animals would likely have to have been chemically dewormed during the study and their milk discarded. Instead, 15 does were assigned to HCOWP (1 g/22 lb live weight), 15 does to MCOWP (2 g/head) and 15 does to LCOWP (1 g/head). Representative milk samples were obtained with milk meters immediately before receiving COWP (Day 0), and again 14 and 42 days later. Milk samples were analyzed for copper using inductively coupled plasma-atomic emission spectroscopy. All does were fecal sampled and FAMACHA scored on Day 0, 14, 28, and 42. FAMACHA scoring is a field method of checking for anemia (the primary symptom of barber pole worm infection) in small ruminants by comparing the color on the inside membrane of the lower eyelid to a standardized score card. Bulk fecal samples were also collected and grown out to identify larvae populations. The farmer reported on pasture management every 14 days. Blood samples were collected from all does on Day 42 to determine AST enzyme concentration, an indicator of copper toxicity.

Lamb and kid grazing study. Grazing lambs from two farms from the Northern New York region were used in this study: Downing Acres in Franklin County and the St. Lawrence County Extension Learning Farm.

Weaned lambs were assigned randomly within farm to Control, low COWP (LCOWP), or high COWP (HCOWP). Pooled fecal samples were taken from lambs and kids at weaning age prior to return to pasture to determine the distribution of worm species and extent of infection at weaning time. Based upon the extent of infection, animals in the Control group were given either no treatment or dewormed with a chemical anthelmintic known to be effective on each farm.

Animals in the LCOWP group were given 0.5 g COWP. Animals in the HCOWP group were given 1 g COWP. Individual fecal samples and FAMACHA scores were obtained on days 0, 14, and 28 after administration of the COWP. Fecal egg counts specific for *H. contortus* were measured and the lambs were weighed on days 0 and 28.

Fecal egg counts were transformed to natural log values to normalize them for analysis of variance with the effects of COWP, day of sampling, and the interaction in the statistical model.

2. **Work with farmers and their veterinarians to evaluate the effectiveness of including ivermectin in protocols to treat *P. tenuis* infections in sheep and goats.**

This study was designed to compare treatment protocols with and without ivermectin. We did not conduct a deer worm study in the North Country because the veterinarians and farmers stated that they were seeing very little deer worm infections in the areas that Betsy could easily get to for monitoring and tracking infected animals. Instead funds were used to test milk for Cu levels and blood plasma for AST enzyme levels on the lactating dairy goats studied as part of the COWP studies.

Results:

1. Copper oxide wire particles (COWP) to control *Haemonchus contortus*

Dairy goat study

There was no long-term effect of COWP dosage on *H. contortus* fecal egg counts (Table 1). However, 14 days after administering COWP, fecal worm egg counts were reduced by approximately 50 percent in goats receiving the HCOWP (1g/22 lb live weight), or MCOWP (2g/head) treatments and remained essentially the same in goats receiving the LCOWP (1g/head) treatment (Table 2). Because there was not control treatment, we are unable to estimate how much worm egg counts might have increased in animals had received no COWP.

No does were chemically dewormed during the study although FAMACHA scores remained high (score of 4) for several does (Figure 1). Protocol generally indicates deworming at a FAMACHA score of 4 but the farmer was resistant to this and observed

animals closely every day. Pasture management was excellent. Goats were moved rapidly through pastures to prevent autoinfection and the pastures had not been grazed by goats since 2012. Instead they had been harvested for hay or grazed by cattle.

Throughout the study, no does scored a "5," which would have required immediate deworming. The high levels of barber pole worm infection observed at the beginning of the study were attributed to a "barnyard effect" from the forage-filled barnyards the goats had access to prior to pasturing in mid-May. The goats were also exposed to these barnyards during the study but grazing was discouraged by keeping the forage mowed extremely short and by providing hay in the barnyards at all times.

The cheese maker was asked to observe whether the time to set curd and/or the curd consistency appeared abnormal for the four types of cheeses made during the week following COWP administration. She observed no changes. Copper levels in milk within each sampling day (Figure 2) were not significantly different between the three COWP levels nor were the changes in copper concentration from Day O to Day 42 significant. However, in a paired t test, copper concentrations increased significantly ($P < 0.0016$) from 0.105 ppm ± 0.019 to 0.171 ppm ± 0.019 from Day 0 to Day 14 for HCOWP but not for MCOWP ($P < 0.06$) or LCOWP ($P < 0.07$). But even the highest levels of copper were below maximum allowable levels.

Copper toxicity elicits AST enzyme activity values of > 300 ppm. Plasma AST concentrations on Day 42 were 118 ppm ± 6.9, 121 ppm ± 7.2 and 113 ppm ± 7.2 for HCOWP, MCOWP and LCOWP, respectively, and did not differ significantly among levels of COWP. Only two does had AST values greater than 200 (203 and 221 ppm respectively). In this study, COWP dosages of 2 g/head caused reductions in fecal egg counts similar to dosages of 1 g/22 lb live weight but only used 25% (large does) to 50% (small does) as much COWP after accounting for the live weight of the does.

Lamb grazing study

Conditions and management were quite different among the two farms involved in this study. Therefore, the data were analyzed separately for each farm.

St. Lawrence County Extension Learning Farm

There was an interaction ($P < 0.010$) for fecal egg counts, indicating that the effect of COWP depended upon sampling day (Table 3). Fecal egg counts in Control lambs (not given COWP) increased dramatically from day 0 to day 28. Haemonchus fecal egg counts from lambs given either 0.5 g COWP or 1 g COWP actually decreased from day 0 to day 14, with only a modest increase at day 28 to level of 293 eggs/g, much lower than would dictate deworming.

The box plot of FAMACHA scores (Figure 4) confirmed fecal egg count results. FAMACHA scores for Control lambs were higher 14 and 28 days after the start of the experiment.

Downing Acres
There was no interaction between level of COWP treatment and date of fecal sampling, primarily because fecal egg counts were low for all groups. With fecal egg counts so low, there was no effect of level of COWP (Table 4). There was, however, an unexpected linear decrease ($P < 0.008$) in fecal egg counts from 0 to 28 days after the start of the experiment. This indicated that pasture management was excellent and also reflected the large amount of creep feed that the lambs were consuming.

The box plot of FAMACHA scores (Figure 5) reflected fecal egg count results. Except for a high value for one lamb treated with 1 g COWP, FAMACHA scores for were low throughout the experiment..

2. Work with farmers and their veterinarians to evaluate the effectiveness of including ivermectin in protocols to treat *P. tenuis* infections in sheep and goats.

Although no farms from the northern New York region were include in the study this past year, several farmers in other parts of the state did treat *P. tenuis*-infected animals based upon the protocol. However, there were too-few observations to draw conclusions. More will be added in the next two years and we hope they will include farms in Northern New York.

Conclusions/Outcomes/Impacts:
These results indicate that 0.5 g COWP per head is effective at controlling Haemonchus contortus in growing lambs and that 2 g per doe is as effective as higher levels for lactating does.

Outreach:
A field day on the rationale for using COWP particles to control *Haemonchus contortus* was held at Asgaard Farm (Essex County) during the on-farm study. Preliminary results were reported to farmers during 4 workshops from 3 to 5 December 2013 about innovations in parasite management during the Northern NY Sheep & Goat Week (workshops were held in Clinton, Franklin, Jefferson, and St. Lawrence Counties) and at the Cornell Cooperative Extension In-Service Training on 19 November 2013 at Cornell University.

More complete results were presented at the 1) 2014 NOFA-NY Winter Conference (half-day intensive workshop) on January 24 at Saratoga Springs, NY; 2) 11th Annual Catskill Regional Agricultural Conference, Jan 16, 2014 at Delhi, NY; and 3) Northeast Pasture Consortium Annual Conference & Meeting, Feb 5, 2014 in State College, PA. Two FAMACHA certification workshops were held in Essex County and Jefferson County on Feb.8, 2014 (10 participants due to bad weather).

Next steps

These results should be considered somewhat preliminary. Data from additional farms, including those in northern New York, are needed to provide definitive results.

Acknowledgments:

- Cornell University Experiment Station Hatch and Cornell Cooperative Extension Smith-Lever Federal Formula Funds.
- Dairy One went out of their way to provide milk meters at a very modest rental fee.
- CCE of St. Lawrence County paid the salary for Betsy Hodge and provided two students, Christine Hitchman (SUNY Cobleskill) and Tristan Peterson (SUNY Morrisville), who helped with animal handling and data collection. We paid both students a small honorarium to offset some of the expenses.
- An USDA OREI grant provided additional materials for FAMACHA workshops and helped with travel expenses to present results at the Winter Conferences.
- NOFA-NY used funds from the USDA Risk Management Agency, Outreach and Assistance Program to help sponsor a field day, "Copper Oxide Wire Particle Trial for Parasite Prevention," during our study at Asgaard Farm.

Reports and/or articles in which results of this project have already been published.

We would like more data before drawing major conclusions, An article is in preparation for the April "Agricultural News" and also on the web at www.ccenny.com.

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Tables and Figures

Table 1. Effect of copper oxide wire particles (COWP) and date on fecal egg counts in lactating does[1].

	Strongyles		Haemonchus	
Item	Log_e	Antilog, eggs/g feces	Log_e	Antilog, eggs/g feces
COWP				
1 g/22 lb BW	7.22	1372	7.18	1310
1 g/doe	7.26	1418	7.17	1305
2 g/doe	7.05	1149	6.91	1005
SE	0.200		0.205	
P-value	0.717		0.580	
Date				
27 May 2013	7.32	1504	7.27	1437
10 June 2013	6.92	1009	6.85	945
24 June 2013	7.00	1099	6.91	1000
8 July 2013	7.47	1751	7.32	1518
SE	0.136		0.166	
P-value	0.013		0.092	

[1]The COWP x Date interactions were not significant.

Table 2. Effect of copper oxide wire particles (COWP) on the change in fecal egg counts after 14 days in lactating does.

COWP	Strongyles	Haemonchus
1 g/22 lb BW	-1185	-1153
1 g/doe	75	107
2 g/doe	-1191	-1226
SE	477.9	484.6
P-value for 1 g/head vs average of 1 g/22 lb and 2 g/head	0.036	0.034
P-value for 1 g/22 lb vs 2 g/head	0.993	0.914

Tables and Figures

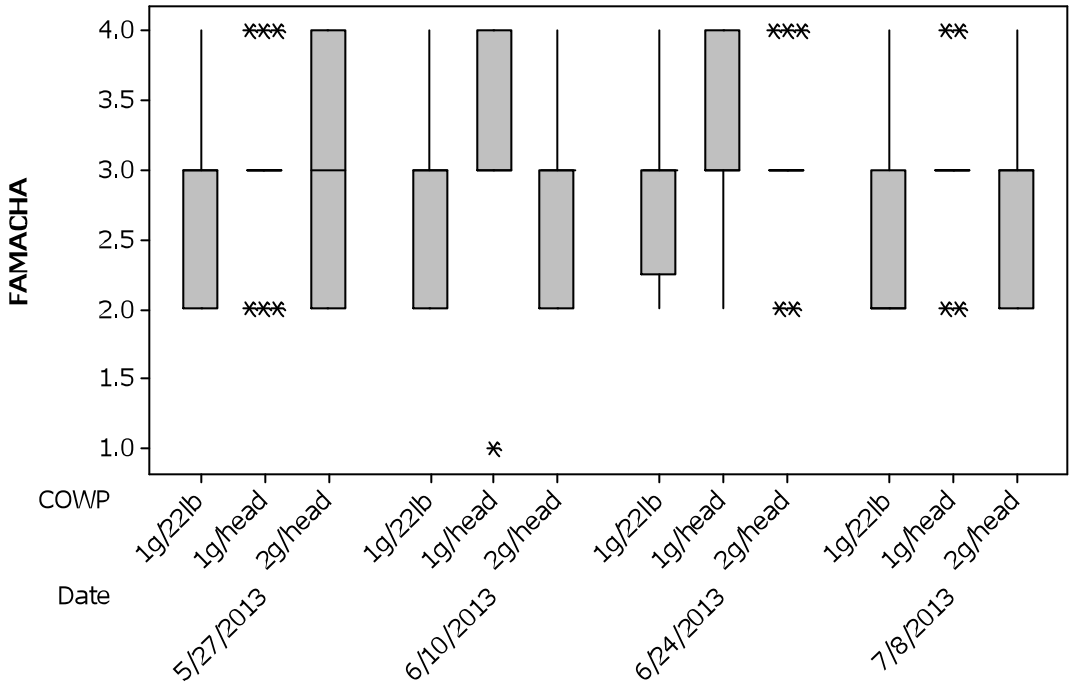

Figure 1. Effect of copper oxide wire particle (COWP) level on FAMACHA scores at the time of administering COWP on 27 May 2013 and on subsequent dates in lactating does.

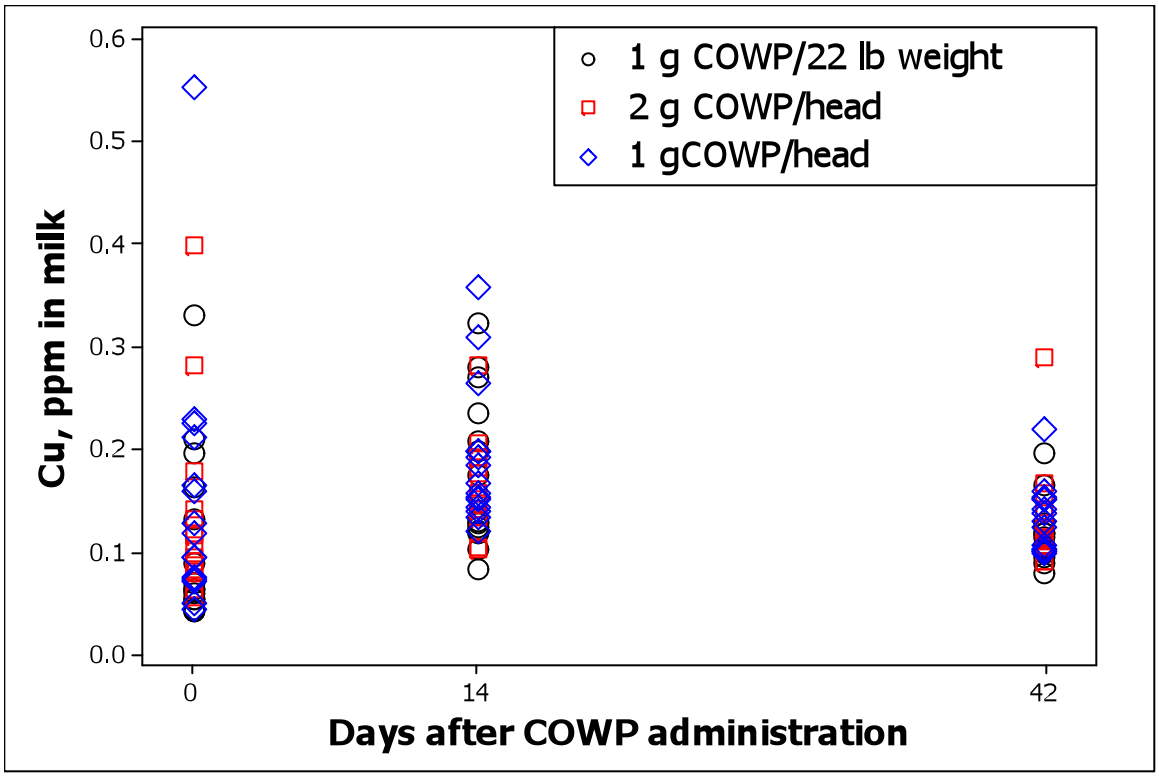

Figure 2. Effect of COWP on concentration of copper in milk of lactating does (there was no effect).

Table 3. Effect of copper oxide wire particles (COWP) and days on fecal egg counts for the St. Lawrence County Extension Learning Farm.

COWP, g	Days	Strongyles		Haemonchus	
		Log_e	Antilog, eggs/g feces	Log_e	Antilog, eggs/g feces
0 (control)	0	5.22	185	5.14	171
	14	7.39	1620	7.37	1588
	28	7.56	1920	7.38	1604
0.5	0	4.20	67	4.13	62
	14	2.66	14	2.02	8
	28	6.12	455	5.93	376
1	0	5.46	235	5.29	198
	14	3.07	22	2.63	14
	28	6.19	488	5.68	293
SE		0.728		0.736	
P-value		0.026		0.010	

Table 4. Effect of copper oxide wire particles (COWP) and date on fecal egg counts for Downing Farm [1].

Item	Strongyles		Haemonchus	
	Log_e	Antilog, eggs/g feces	Log_e	Antilog, eggs/g feces
COWP, g				
0 (control)	5.45	233	4.85	128
0.5	5.69	296	4.53	93
1	5.74	311	4.90	134
SE	0.243		0.290	
P-value for control vs COWP	0.626		0.818	
P-value for 0.5 vs 1 g	0.925		0.585	
Days after COWP				
0	6.10	446	5.30	200
14	5.54	255	4.80	122
28	5.23	187	4.18	65
SE	0.244		0.291	
P-value linear contrast	0.013		0.008	
P-value quadratic contrast	0.675		0.863	

[1]The COWP x Date interactions were not significant.

Tables and Figures

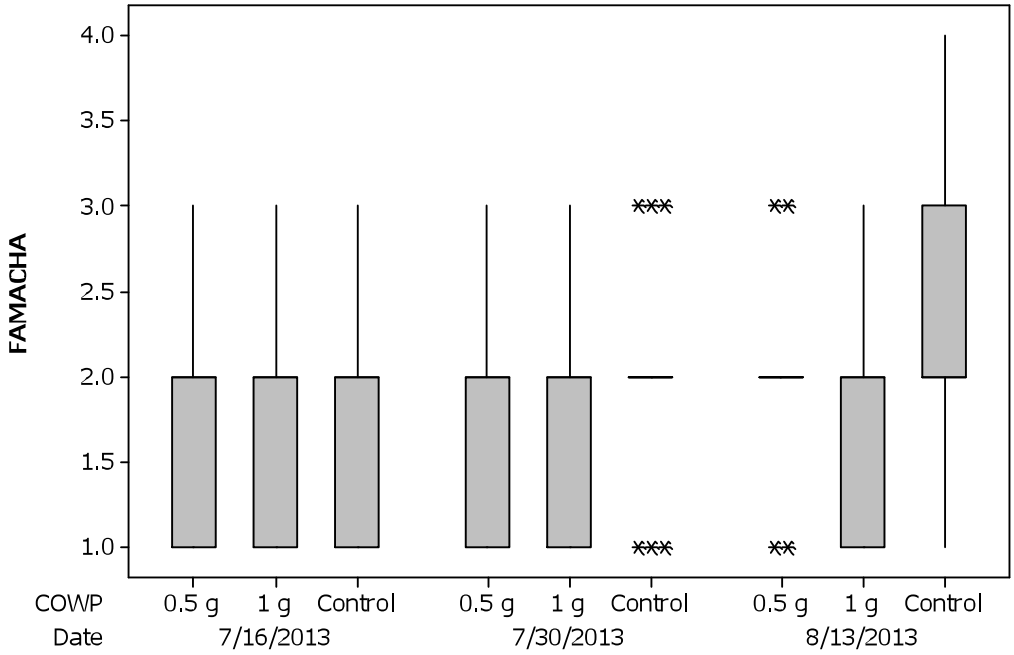

Figure 4. Box plot of FAMACHA scores for the Extension Learning Farm lambs.

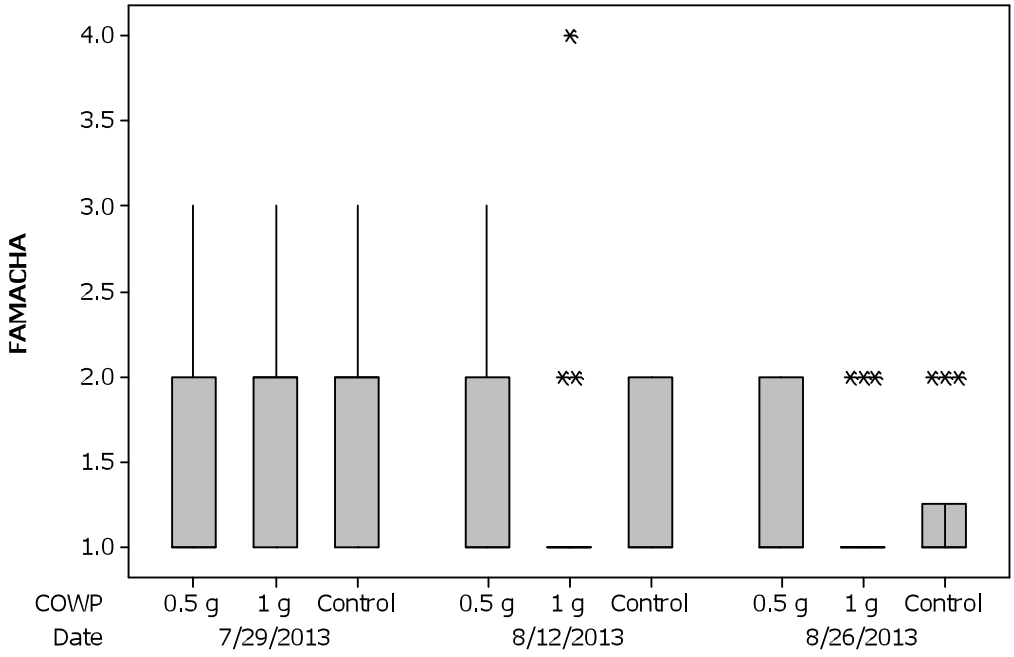

Figure 4. Box plot of FAMACHA scores for Downing Farm lambs.