PowerPoint Narrative for Integrative Parasite Management: Sheep

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Slide 1: Integrated Parasite Management: Train the Trainer

The sponsors of this three-year project:

1. Western Sustainability Agriculture Research and Education
2. National Center for Appropriate Technology
3. Montana State University
4. University of Wyoming
5. Utah State University

And for this webinar, University of Idaho State Sheep Extension!

Slide 2: Thanks to WSARE

Special thanks to Western Sustainable Agriculture Research and Education for their funding of this three-year project that included applied research by Dr. Whit Stewart and Dr. Tom Murphy concerning the incidence of the Barber Pole Worm in the Intermountain West and also the degree of resistance to anthelmintics. Today's webinar is the last of nine that have been conducted to train trainers and producers in the ways we can successfully control Barber Pole Worm infection in our flocks. There have been many ag researchers, educators, and producers that have contributed greatly to this project and we are thankful for their time, expertise, and effort.

Slide 3: Integrative Parasite Management

1. This presentation focuses on sheep parasites, particularly the Barber Pole Worm, or *Haemonchus contortus*.
2. It involves sheep, green grass pasture, and the Barber Pole Worm.

Slide 4: ATTRA Resources

NCAT's ATTRA program has more than 1,000 publications, podcasts, videos, and tutorials, available as free downloads on a wide variety of agricultural topics, such as crop production, horticulture, animal production, soils, local food production and more. Check us out at attra.ncat.org.

Slide 5: ATTRA IPM Tipsheets

This presentation is based on the following five tipsheets offered by ATTRA, which can be downloaded and printed free of charge at the provided links.

- Frequently Asked Questions About Integrated Parasite Management
  https://attra.ncat.org/attra-pub/download.php?id=602
- Why FAMACHA score?
  https://attra.ncat.org/attra-pub/download.php?id=601
- Simple Genetic Strategies to Limit the Barber Pole Worm
  https://attra.ncat.org/attra-pub/download.php?id=603
- Using Fecal Egg Counts to Control the Barber Pole Worm
  https://attra.ncat.org/attra-pub/download.php?id=605
- Grazing to Control Parasites
  https://attra.ncat.org/attra-pub/download.php?id=604

Slide 6: State Sheep Extension

Resources: State Sheep Extension Specialists

Montana Sheep Specialist

Brent Roeder
406-994-3758
roeder@montana.edu

Wyoming Sheep Specialist

Dr. Whit Stewart
307-766-5374

whit.stewart@uwyo.edu

Utah State Sheep Specialist

Dr. Chad Page435-797-2152

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Idaho Sheep Specialist

Dr. Melinda Ellison

208-756-2749 office

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Slide 7: Wormx.info

Resources:

American Consortium for Small Ruminant Parasite Control

a. Composed of researchers, extension agents, farmers, and ranchers
b. Cutting-edge research in USA
c. Many factsheets and information provided on its website, www.wormx.info
d. The only source of FAMACHA cards in the United States. These cards can only be given out after the completion of a IPM workshop given by a IPM Trainer.

Slide 8: Sheep Potential

Sheep have huge potential for profit. This is because they can wean two times the weight of the ewe. Cattle cannot come close to this. To maximize profit, multiple births must be combined with intensive grazing management, which maximizes the production of lamb per acre.

Slide 9: Roadblocks to Success

A Major Challenge: Parasites on Irrigated Pasture

1. You will most likely run into BP problems eventually if you:
    a. Continually graze at stocking rate of one ewe per/ acre
    b. Rotationally graze with than seven-day (or more) paddock periods with two ewes /acre

    c. Intensively graze with paddock grazing periods of less than four days and three ewes /acre
2. It is only a matter of time!
    a. Example: it took one producer 20 years to have BP problems with continuous grazing at one ewe per acre. Others may run into significant problems in several years.
    b. It took another producer with intensive grazing management three years to have problems.

Slide 10: Internal Parasites

Internal parasites are the number one health problem for small ruminants.

Why?

1. If unmanaged, they will naturally graze close to the ground, ingesting parasite larvae.
2. Unlike cattle, they will graze close to their own fecal pellets.
3. They are slow to develop immunity.

We can no longer count on new anthelmintics or dewormers being developed. This is just not going to happen with the cost of getting them approved by the FDA. Thus, we must manage the use of dewormers carefully and learn other ways to control them, such as grazing and breeding for resistant sheep.

Slide 11 *Haemonchus contortus* = Barber Pole Worm

The most common sheep parasite in the Intermountain West.

Adult Barber Pole Worms live in sheep abomasum, sucking blood. You may have a 100 adult worms in an animal. The adult lifespan is seven to eight months. The worms cause anemia, which can lead to death of the sheep. The Barber Pole Worm is so named because of the curling red and white stripes—the red is blood and the white are thousands of eggs. You can see how it attaches to the abomasal wall.

Slide 12: Barber Pole Worm

Symptoms: The BP does <u>not</u> typically cause diarrhea. Lush pasture and coccidia cause diarrhea. Symptoms are pale mucous membranes, bottle jaw (advanced state of infection), sudden death. FAMACHA scoring the lower eyelid is the ONLY true diagnosis. You can have animals doing poorly that FAMACHA score a F1. omething else is wrong here. On the other hand, you can have a healthy-looking FAMACHA score 5 animal and she can suddenly die.

To make things worse, the Barber Pole Worm can readily develop resistance to dewormers, or anthelmintics.

Slide 13: Other Round Worms

These parasites do not cause anemia. They are not nearly as common as the Barber Pole on irrigated pasture.

Slide 14: Coccida = Protozoa

Coccidia are a protozoon, not a roundworm. Coccidia do not cause anemia. They often cause scouring and pooey butts. The symptoms occur two to three weeks after infection, when it is too late to prevent damage. It is best to use a coccidiostat when you know you will have problems. You can use a fecal egg culture to find out, and assume it will happen each year unless there is a change in management.

Fecal egg counts may or may not describe the virility of the infection.

Slide 15: Coccidia

Treatment of coccidia: Amprolium or Corrid (Trade Name)

Slide 16: How Do Sheep Get Infected with BP?

Important to realize: the BP population exits as 80% larvae out on the pasture, 20% as adults inside the sheep.

Slide 17: Consider Host Resistance

The most susceptible flock animals are lactating ewes and weaned lambs because they are under physiological stress. The least susceptible are dry ewes, rams, and old wethers.

Slide 18: BP Life Cycle- Key Points

1. From fecal deposit on pasture, it takes four days for eggs to develop into L.3 larvae and for the larvae to crawl up onto the grass leaf. It only crawls up three to four inches from ground. Why does it not crawl higher? It likes coolness. Heat will desiccate and shorten larvae life.

2. L3 larvae can live for 40 to 200 days in the pasture, depending on the temp. They do not eat. They exist on stored fat cells. They are perpetually wiggling and only have a set amount of wiggles. The hotter it is, the faster they wiggle, shortening their lifespan.
3. After ingestion, L3 larvae will turn into L4. If they do not go into an arrested state, L4 larvae will become adult worms in 18 days. If there is a large population of adult worms in the abomasum, L4 larvae go into an arrested state in the summer and do not become adults until adult population decreases. L4 larvae also go into hypobiosis in the fall, and they can remain in that state all winter and then become adults in the spring, sucking blood and laying eggs at that time.
4. We can use this life cycle to combat the BP. That is what IPM is all about! For example, 7 days plus 18 days = an average of 25 days from egg to adult. This is why 35 to 40 days of pasture rest is so effective. Also why three weeks of pasture rest is terrible!

Slide 19: Periparturient Rise

1. Increasing protein in the ration helps combat periparturient rise. This is very easy with alfalfa hay during late gestation.
2. Managing for periparturient rise:
   a. FAMACHA score and deworm with Ivermectin or Cydectin F3, F4, F5 ewes in the jug at lambing
      Or:
   b. FAMACHA score and deworm Ivermectin or Cydectin F3, F4, F5 ewes when lambs are C&D vaccinated three to four weeks post-lambing.

Slide 20: How We Get into Trouble

Here is what we are up against.

Adult *Haemonchus* worms can lay 5,000 to 10,000 eggs per day.

Example:

A ewe shedding 200 eggs per gram

1,800 grams of feces per day

->360,000 eggs per day

Put 100 ewes on one acre

➔ 36 million eggs or 700 eggs per square foot!

Fortunately, not all of these eggs are viable. At any rate, you can see the tremendous capacity that the Barber Pole Worm has to infect our flocks.

Slide 21: How Do We get the Barber Pole Worm?

1. They are just there—that is the easy explanation
2. We can buy them
    a. Ewes or lambs that we buy or comingle on pastures
    b. What we buy:
        i. The animal
        ii. The parasites within the animal
        iii. Anthelmintic management of those parasites
            1. Dewormer use - best practices or incorrect practices
                a. Selective deworming practice/FAMACHA
                b. Underdosing
                c. Alternating use of dewormer classes
        iv. Management: Genetics of the animal
            1. Selection for parasite resistance
            2. No selection for parasite resistance
3. Dryland range: sub-irrigated pastures or irrigated pastures at the ranch headquarters
4. Irrigated pastures—watch out

Slide 22: Genetics and Worms

Resistance

1. Ability of host to limit infection
2. Assessed by FEC

Resilience

1. Ability of host to withstand the infection and stay healthy and productive
    a. Increase red blood cell production
    b. Sloughing off of worms??

Resilience explains why two different sheep can have the same FEC and very different FAMACHA scores

Ewe #1 3000 FEC FAMACHA F2 high resilience

Ewe #2 200 FEC FAMACHA 4 low resilience

In highly infected flocks, and where resilience is low, resilience approaches FEC. Selection for resistance can easily be done by FAMACHA scoring.

Slide 23: How do You Know What Parasites You Have?

Fecal egg coproculture identifies the types of roundworms present in your flock. The most common in the Intermountain West are:

1. Barber Pole Worm—by far the most prevalent
2. Nematodirus
3. Teladorsargia

Coprocultures must be performed by a lab. Since Barber Pole Worm is by far the most common strongyle in this region, we count all round worms in a Mc Masters FEC and assume that they are Haemonchus, or Barber Pole Worm.

Slide 24 Fecal Egg Counts

1. Differentiates between roundworms and coccidia—enables treatment
2. FECRT
3. In flock selection for parasite resistance
4. NSIP ebv's for parasite resistance
5. DrenchRite Test

For more information on FEC, see the ATTRA Publication, *How Fecal Egg Counts Can Help You Fight Internal Parasites*https://attra.ncat.org/product/how-fecal-egg-counts-can-help-you-fight-parasites/

Slide 25: FEC—What You See

A McMasters fecal egg count determines basically the amount of and coccidia present in each fecal sample. In our region, we assume all roundworms to be *Haemonchus*. Roundworm eggs are differentiated between coccidia eggs by size. They are three to four times larger than coccidia eggs. You can learn how to do your own fecal egg counting by taking the online University of Rhode Island FEC course.

https://www.youtube.com/watch?v=ZZQymZKe_hs&feature=youtu.be

Slide 26: Integrated Parasite Management (IPM)

It is not our goal, nor is it possible, to have parasite-free animals. Our goal is limit parasites so that they do not limit our sheep production. We will use several strategic tools to accomplish this.

Slide 27: Tool #1: Deworming Strategy Tips

1. Use one dewormer until it stops working.
2. Use correct dose! Under-dosing is common and leads to parasite resistance.
3. Combination dewormers are useful when all three classes of dewormers are ineffective.

Should I use LongRange dewormer in my flock?

No!

Why:

1. It is extra label—needs a veterinary prescription.
2. Provides 100-plus days of exposure of BP to the drug—this will hasten parasite resistance to both Ivermectin and Cydectin. No refugia!
3. What is refugia?

Slide 28: Refugia

Refugia is the means to limit the exposure of parasites to a dewormer. How?

Two facts:

1. 70-80% of the parasite infection comes from 20-30% of the worm population. This means that there are some really infectious worms and some not-so-infectious worms. Selective deworming aims to kill the really bad worms and keep the ones that are not damaging sheep production.
2. The other piece of the puzzle: the best dewormer can only kill 98% of the worm population.

So, if we deworm all sheep and turn them out to a clean pasture, the only eggs out there will be those from *Haemonchu*s that are really infective. <u>This is what we don't want.</u>

However, if we only deworm the sheep that are infected (20-30%), we allow a refugia of poor worms to interbreed with highly virile worms, thus diluting the genetic base of the worm population in regard to infection. <u>This is what we want.</u>

How can we selectively deworm?

Slide 29: The Answer: FAMACHA

We can selectively determine which worms are effective and which are not by screening individual sheep and their response to worm infection. This is done with FAMACHA scoring of eyelids. The anemic condition resulting from Barber Pole Worm infection can be seen by "popping" the lower eyelid and comparing its color with a FAMACHA score card. The FAMACHA card has a color range of bright red to white, mimicking the range of anemia we see in sheep. Healthy eye mucosal membranes exhibit a bright red color (F1). F5 is a creamy white color, indicating the severe anemia of animal that is about to die. We can then identify sheep with acute anemia and those without. The acutely anemic sheep can be dewormed and all others left alone. This will result in the refugia we desire and will greatly prolong the effective life of a dewormer.

FAMACHA cards are only effective against *Haemonchus* because it is basically the only common parasite that causes anemia in small ruminants.

FAMACHA cards are distributed by the University of Georgia under the auspices of the American Consortium for Small Ruminant Control and can only be obtained by attending an IPM training session, like this one!

Slide 30: Deworm F3, F4 ,F5 and Leave the Rest

It is that easy. FAMACHA score each sheep in your flock. Deworm the F3, F4, F5 sheep and leave the rest. By doing so, you will treat those sheep who need it and also prolong the effective life of you dewormer. That is what refugia does.

Slide 31: But FAMACHA Takes Longer

No!

Why? Because instead of drenching all of your sheep, you will probably only have to drench 20-30%. That saves a ton of time and dewormer. Cydectin costs about $1.00 per 150-lb. ewe. If you don't have to deworm 80 sheep out of 100, you save $80 for every 100 sheep you have. To make things worse, anthelmintics have doubled in price in the last 10 years. Do we want to keep doing things like deworming everyone indiscriminately when there are better methods that are more profitable?

With a tub and a race, you can easily score and deworm 125 ewes an hour. That is about 40 ewes more per hour than we could do when we drenched every single sheep. Here is a video illustrating this.

FAMACHA Scoring Out West

www.youtube.com/watch?v=qk9vtCnbhz4

FAMACHA first and then deworm!

Slide 32: Precautions

Of course, your selective deworming will fail if your dewormer does not work. To find out if it still is effective, you must either do a FECRT or a DrenchRite test. Waiting a few years to get a sense of whether your dewormer is working or not is probably not too profitable. How many lambs or ewes will

you lose? A Drenchrite assay costs about $450. It will tell you the parasitic resistance to all dewormers you have available to use. It is worth it.

One question always comes up: how often do I need to FAMACHA score? It depends. If you are running ewes and lambs on irrigated pasture, the most susceptible time for the ewes is 45 days after you turn out in the spring, provided you make allowances for periparturient rise. You probably should FAMACHA score ewes then and again at weaning if your infection rate is high.

Lambs tend to become infected post weaning. With low infection rates, you can get by with FAMACHA scoring three to four weeks post-weaning and then repeating in another three to four weeks. On the other hand, high infection rates demand checking eyes at least every two weeks. In some cases, weekly FAMACHA scoring is necessary. You will be able to tell how often you must check eyes by the amount of F4s and F5s you have when you score and, unfortunately, by mortality. Remember that once the lambs come off of pasture in the fall, the Barber Pole worm still is at work for at least six to eight weeks. Generally speaking, you should continue to FAMACHA score until you have less than 3% F4s and F5s.

When you are done using the FAMACHA card, store it in a dark place. The colors can fade if kept out in direct sunlight, such as a pickup truck dashboard!

Slide 33: Drugs

The two most important things concerning dewormers are that we must treat them as a limited resource and that dosing is critical.

All dewormers will eventually become ineffective. If we use them incorrectly without refugia, one class of dewormer may only last several years. Incorporating other tools into your management, such as grazing and genetic selection for resistant sheep, is essential in order to be sustainable.

Do weigh your animals often enough to have a good idea of the correct dosage of dewormer. Overdosing costs money and, in the case of Prohibit, it can be deadly. Underdosing only decreases the effective lifespan of a dewormer.

Slide 34: Three Drug Families

Dewormers kill parasites by starving or paralyzing them. They actual manner in which they do this is called the *mode of action*. We currently have three drug classes each with different modes of action to kill the parasite.

The three classes labeled for sheep, goats, and camelids are:

1. White wormers: Valbazen, Safeguard, Panacure. The chemical name is Benzimidazoles.
2. Ivermectin, Cydectin. Chemical name is Macrolytic lactones.
3. Prohibit. The chemical name is Nicontinics or Levamisoles.

Before going into each specific class, there are two important things to remember:

1. Once one dewormer is no longer effective, all dewormers in that class are not effective. For example, if you have determined by dead reckoning that Valbazen has quit you, don't switch to Safeguard. It will not work either.
2. Do not alternate between dewormers! This only hastens the resistance of parasites to all classes.

So, unless you plan to use combination dewormers (at double the cost per animal), you only have three dewormers to work with. This is why creating refugia with FAMACHA scoring is so important.

Slide 35: Albendazole

Common name is Valbazen. This is the first dewormer we usually start with because it is in nearly all feed stores and is less expensive. It is also widely ineffective in flocks in the Intermountain West, as Dr. Whit Stewart's research has uncovered. If you have been using Valbazen for a long time and it seems that you are no longer killing the worms, you are probably correct! But, don't switch to Safeguard!

Valbazen will kill liver flukes and tapeworms. The other dewormers will not.

Can abort fetuses in the first 50 days of pregnancy.

Widespread resistance.

As with all dewormers, a 12-hour fast before treatment can improve efficacy.

Slide 36: Fenbendazole

Very similar to Valbazen. One difference is that the dose must be doubled to kill tape worms. Also, Safeguard will kill Meningeal Worm. Do the popular Safeguard blocks create refugia? NO.

Slide 37: Avermectins: Ivermectin

Developed in the 1980s, this drug is the dewormer of choice to kill the meningeal worm. It is also very effective on hypobiotic larvae in late gestation and during lambing/early lactation.

In the West, it has little resistance yet; however, in the Southeast, it is virtually useless.

Effective on ectoparasites such as lice.

Ivermectin is extremely hard on dung beetles in your soil.

Slide 38: Moxidectin: Cydectin

Very similar to Ivermectin, although it uses a slightly different mode of action. If your parasites are resistant to Ivermectin, it will not be long until they are resistant to Cydectin. Soil health: much less harmful to dung beetles.

Slide 39: Levamisoles: Prohibit

Probably the least used of all three dewormer classes because of ease of use. You have to rehydrate before using. Because of less use, it is probably the most effective of all dewormers in the sheep industry.

*** Can kill the animal if overdosed. Be sure you know the body weights of the sheep you are treating.

Questionable effectiveness on hypobiotic larvae.

Slide 40: Extra Label Drug Use

The only dewormers labeled for sheep are drench-type. Any other dewormer is off-label and must be obtained with a prescription from a veterinarian.

The sheep industry has a very good reputation amongst consumers for high-quality meat untainted by antibiotics and anthelmintics. We need to keep that confidence alive. Our increasing markets depend on it.

Slide 41: Does My Dewormer Still Work?

How do you tell if your dewormer still works? Gut feeling? You can take out the guesswork by conducting a Fecal Egg Count Reduction Test. This involves taking fresh fecal samples, counting the Barber Pole Worm eggs under a microscope before deworming and then again seven to 10 days after you deworm your sheep. If your dewormer is still effective, you will observe at least a 95% reduction in fecal egg count. You will have to do this for all three classes of dewormers. Laborious!

Unless you have the equipment and know McMasters fecal egg counting procedure, you will need your veterinarian do this for you.

Another, and easier, method is using the DrenchRite test, available at the University of Georgia. This test requires sending in a composite fecal sample of 10 animals before deworming. The analysis will tell you which parasite species you have in your flock and which dewormers the Barber Pole Worm is resistant or susceptible to. It eliminates performing a FECRT test for multiple dewormers. For more information and pricing, contact Leonor Sicalo Gianechini, leonor@uga.edu.

Slide 42: Combination Dewormers

The concept of combination dewormers has been developed in the Southeast, basically out of desperation. Many sheep and goat operations have disbanded because of the Barber Pole Worm becoming resistant to all three classes of dewormers. This is largely due to lack of knowledge of the importance of creating refugias while deworming and also because the Southeast is prime habitat for *Haemonchus*.

Research has found that the additive effect of two dewormers that are ineffective by themselves, when used in conjunction, greatly increases efficacy. As this slide shows, for example, if Valbazen and Ivermectin were only 80% effective in your flock, by using them both at the same time, the efficacy increases to 95%, which is the minimum kill rate to be considered effective.

You can also see that if you're unfortunate enough to have resistance to all three classes of dewormers, you can improve the efficacy by deworming with all three simultaneously.

Please note that you cannot combine the dewormers into one shot. They have to be administered separately and simultaneously.

Of course, the cost of the anthelmintic treatment goes up proportionately.

Slide 43: Non-chemical "Anthelmintics"

There are several natural dewormers on the market. Garlic is perhaps the most popular, followed by diatomaceous earth. Research has not supported that they are effective. So, if you wish to use these, be sure to have a way to monitor whether they work and a backup plan to put into effect if they do not. Don't subject your flock to try and make a point.

The most effective non-chemical dewormers are two schemes we can all put into play: grazing strategies and genetic selection for parasite resistant sheep.

Slide 44: Tool #2: Grazing Strategy

The second tool we can use is grazing to limit Barber Pole survival and ingestion. We need to remember that 80% of the Barber Pole worm population is in the form of larvae out in our pasture. It is a big target that we can capitalize on!

For grazing to be effectively limit ingestion of L3 larvae, three rules must be followed: allow a parasite-killing pasture rest, graze for short-duration periods, and leave behind sufficient residual. It is that simple!

Let's look at each component of a well-designed grazing strategy that limits Barber Pole infection.

Slide 45: 35 to 45 Days of Pasture Rest

These two pictures demonstrate how much more grass you can have in a paddock with just 10 days more pasture rest. In this case, it is about 1,000 lbs. of dry matter per acre. This extra dry matter enables you to not graze so close to the ground. The Barber Pole worm larvae are three to four inches above the soil surface, perched on the leaves of the grass leaves.

Tall grass grazing also promotes soil health. In our case, it has enabled us to grow six to seven tons of dry matter per acre per year without using any fertilizer. Isn't it neat that long rest periods and trampled grass limit parasite infection and also enable you to graze more profitably? For more details, see the ATTRA publication *Building Healthy Pasture Soils*, which you can access free from NCAT's ATTRA website. https://attra.ncat.org/product/building-healthy-pasture-soils/

Slide 46: Larval Survival

Infective L3 larvae move by wiggling through moisture. They don't eat, but rely on fat deposits to survive. Thus, each larva only has a set number of wiggles. One more thing we can capitalize on: the hotter the outside temperature, the faster they wiggle. Research data from WormBoss in Australia indicates that 90% of the L3 larvae die 40 days after being deposited on the pasture when daytime highs are in the 90s. How about letting them wiggle to death before we graze a paddock with our sheep?

It's easy! If we set our pasture rest at 35 to 40 days or more, we have avoided 75 to 85% of the BP because they are no longer there.

Fifteen years ago, Montana Highland Lamb grazed sheep on 22 days of pasture rest all season long. We had a huge problem with the Barber Pole. We shifted to 32 days rest in 2009 and reduced our parasite infection rate in the lambs by 75%. Boom! Just like that. Less dewormer, less dinky lambs, less death.

Slide 47: Hay

Haying a pasture gobbles up larvae and dries them out. It also dries out any larvae that remain in the hayed field. It is usually 40 days until you come back to graze. It is a double whammy. I have met several sheep producers that use this strategy. It works very well if you are producing grass/ legume hay and have the land to pasture and hay both.

Slide 48: Four Day (or less) Paddock Grazing Periods

Here is the poo pellet to stem sprint facts. The infective larvae can't move without water. However, it does not take too much water to do it. Rainfall and irrigation are a super highway. Dew will do it. If you leave your sheep on a paddock for longer than four to nine days, be prepared for a shoot-out with parasites. It is much easier in the long run to just get out of Dodge.

In a way, this is deceitful. Here I am urging you to go from normal one- to two-week paddock grazing periods to four-day periods. I am also encouraging you to leave a minimum of six to eight inches behind. Yet from our own grazing experience, I think that there is a pretty good chance that once you see the results of changing every three to four days, you are going to want to try changing every one to two days. You just have so much more control over your residual length and, thus, over parasites. You will also double your grass production. How can you lose?

Slide 49: Exit with A Six-Inch Residual

L3 larvae generally only climb up the first three to four inches of the grass stem or leaf. You can further avoid them by grazing down only to six to eight inches and then exiting the grazing paddock. This slide shows what six to eight inches of paddock residual looks like.

This picture was taken with the grazing set at 32 days of pasture rest and 70% utilization of the pasture. Daily moves and stocking densities were in the 60,000 to 70,000 lb per acre range.

Six- to eight-inch residual simply reduces the number of infective larvae your sheep ingest. Big time. So, if you only graze down to six to eight inches, you again have dodged the bullet.

Slide 50: Six-inch Residual

This is another picture of what I consider 6-inch residual. Yes, if you took a ruler out there and measured, you would find some grass at a foot long, and some less than six inches. A big part of the grazing art is setting visual monitoring targets in your mind that are action cues. This visual is when I change the ewes and lambs to another paddock. If I were to leave the 200 ewes and 300 lambs in this paddock for 12 more hours, the next slide is what the paddock would look like.

Slide 51: Too Little Residual

OOPS! Twelve hours can make a huge difference. Now with two- to four-inch residual, you have Barber Pole Worm infective larvae being gobbled up, big time. A few years of this and you will be spending time and money deworming sheep. If you are organic, you will be really sorry. The motto I try to observe is "When in doubt, MOVE 'EM."

Slide 52: Fenceline Weaning

By the way, fence-line weaning is a very effective in reducing lamb stress. Here lambs are on the left, ewes on the right of a woven-wire fence. This picture was taken four hours after separation. Notice there's no baaing, just peaceful eating! Stress can predispose lambs to worm infection. Try it!

Slide 53: Graze Multiple Species

Sheep, goats, and camelids share the same internal parasites. Cows and horses are a dead end for small ruminant parasites. The reverse is also true. You can use cattle to vacuum up Barber Pole Worm infective larvae and never have them be returned alive to your pastures. Nice!

Slide 54: Condensed Tannin Forages

Condensed tannins do not "kill" Barber Pole Worm L4 larvae and adults, but they severely limit blood sucking and egg production. They also severely reduce the bloat potential for <u>any</u> legumes in the pasture. Grazing legumes such as Sanfoin(2 to 5% tannins) and Birdsfoot Trefoil (1 to 2% tannins) will virtually make your parasite problems go away. The same applies to hay made from these plants.

Tannins are marvelous compounds that we are just beginning to learn about. Research out ofby Utah State University (Provenza and Villalba) indicates that they alter bacterial nitrogen and carbohydrate metabolism in the rumen and, in so doing, can increase ADG significantly. They may be the future of forage grazing.

The problem is that they are hard to grow in the windswept, cold landscape of Montana. In Utah and Idaho, they are much hardier. They need at least 45 days of rest between grazing's, maybe longer.

Keep these two legumes in the back of your mind for future use.

Slide 55: Tool #3: Cull!

The third tool is to use your FAMACHA skills and cull ewes that rank 4 or 5. By doing so, you are selecting for genetics in your flock that are resilient to the Barber Pole Worm.

Why keep a ewe that cannot survive your flock management unless she is dewormed multiple times during a year? She is only holding your genetics back, while shedding millions of harmful parasite eggs onto your pasture. At the very minimum, do not keep offspring from her.

You can improve your flock genetics to resist BP infection in two to three generations. More on this.

Slide 56: Tool # 4: Select!

The fourth tool to fight Barber Pole infection is selecting replacement breeding ewes and rams that are resistant to parasites. You can select for ewes by using FAMACHA scoring or fecal egg counts. Rams can be grazed on your pastures and then selected with FAMACHA scores and egg counts also. Better yet, if you have access to rams that have low Estimated Breeding Values (EBVs) for parasite infection, consider using them. They may cost more to purchase, but they will pay for themselves in the long run. Rams have a tremendous influence on the genetics in your flock.

Slide 57: Select!

Slide 58: Building Parasite Resistance

There are essentially two distinct traits that you can select for genetically that will help your flock fight parasites: resistance and resilience. As was mentioned earlier, with resilience, you essentially are identifying the animal's ability to tolerate the parasites, whereas with resistance, you are identifying the animal's ability to fight the parasites. Both are important for a system challenged by parasites, but they accomplish different outcomes.

So, why should one select for resilience? Well, there are many reasons, but I think the most important is that it helps improve the bottom line by reducing negative impacts on animal performance. Remember that resilience is the ability of the animal to handle the parasites and tolerate them, so an animal that can do so is likely going to keep producing much better than one that cannot handle the parasites. Another important aspect of resilience is that it creates what I describe as a cushion or a buffer. In different years, environmental factors change, and as Dave described earlier, some of those factors from a management side to have a substantial effect on animal performance and health due to parasites. Well, if your animals end up one year in a scenario where you have higher levels of parasites, having resilience in your flock will help to give you a sort of a buffer for management errors created by the animal's genetics. That is a key to making sure you don't run into a train wreck at some point due to weak animal performance caused by weak animal resilience which leads to, yep, you guessed it, weak animal production. Additionally, for those of you out there like myself that raise and select seed stock to be able to produce for commercial producers, this is important to select for because this is what commercial producers need. Some larger-scale producers don't want to or can't run every animal through a chute every couple weeks to watch FAMACHA, so by selecting rams that are more prone genetically to pass on resilience will reduce their input in the form of time and will help their bottom line.

The good news is that resilience is moderately heritable. Research by the USDA ARS Booneville seems to indicate that the heritability factor of FAMACHA scores is relatively possible to facilitate genetic improvement somewhat quickly for this trait. The other nice factor about selecting for resilience to parasites is the fact that it is an option that doesn't require economic inputs for testing, but just requires FAMACHA scoring. This allows a broader swath of producers to utilize it for selection.

However, it does have its shortcomings.

One of those shortcomings is that it finds which animals are not affected by the problem, rather than identifying those that are contributing to the problem, thus seeking to minimize the symptoms while not necessarily solving the root problem. That said, selecting for FAMACHA will gradually increase resistance, but the correlation is certainly not direct. By selecting for resistance, you are selecting the animals that have higher immune responses to the parasites and that kill them rather than tolerating them. Resistance is measured through quantitative fecal egg counts, thus giving an indicator of the number of parasites within the animal. This allows for genetic selection, which we'll talk about in a minute.

Perhaps the most major reason for selecting for resistance is that it helps to reduce pasture contamination. By selecting animals that have reduced fecal egg counts, you are selecting animals that are thus releasing fewer parasitic eggs, which can dramatically reduce the contamination of a field.

Considering the majority of parasites on a pasture in the spring come through the ewes or does over winter, by selecting ewes or does that can reduce those parasites, over time the parasitic load on pastures can be steadily reduced, thus reducing the infection level possibilities for lambs and kids.

Also, because selecting for this resistance provides the sheep with the genetics to fight the parasites themselves, by selecting on this industry-wide, we can begin to see a solution to the problem from the genetics side rather than chemical solutions. Of course, this would take decades, but it is a goal that the U.S. sheep industry can strive for.

Fortunately, much research and work has been done to demonstrate how to select for parasite resistance. So how should you go about selecting for parasite resistance? Glad you asked!

Slide 59: Selecting for Parasite Resistance

As referenced earlier, this occurs through quantitative fecal egg counts. This occurs through a sample of sheep manure analyzed under a microscope where the eggs of the Barber Pole Worm are counted. These can be done yourself. I do many myself and they are very easy to do. A demonstration and explanation video can be found on YouTube that was produced by Dr. Zajac with the University of Rhode Island. This video is very helpful and provides a link to a factsheet with the resources needed to process and analyze these oneself. The ability to do these yourself is something that is helpful for quick analysis and developing the results in a cost-effective manner. However, note that deworming should not occur based upon FEC but rather based upon FAMACHA, as this is a better indicator of the need for deworming of the animal due to the discrepancy that can occur between FEC and resilience. These can also be done at some labs for fees ranging from $5/sample to $25/sample, depending on the number submitted and the lab used.

The main benefit to using FEC for selection is that it provides a quantitative value often with a large range of numbers, which is important for ranking the lamb within its contemporaries within the flock, and we'll see why it is important in a minute.

Additionally, it is most accurate to measure genetic resistance as sometimes the genetic component can be masked in FAMACHA scores by nutritional or environmental factors. (For example, a single vs. a triplet, something that is seen in FEC, too, but that is adjusted out in evaluation.)

In order to be able to use FEC for genetic selection, several parameters must be met to make the data meaningful.

First, there must be a parasitic challenge, which is defined by 500 eggs per gram at a minimum group average. I like to describe this as everyone is exposed to the parasites, not just the difference between the lambs eating the creep feed and a few lambs that go and actually eat grass. 500 epg is the level identified in the research as the minimum value for defining group exposure, although 1,000 epg is better. Now, you might be wondering, "wait, don't we want fewer parasites?" Well, the answer is yes and no… Ideally you want few enough parasites to not run into strongly negative impacts in performance, but from a selection standpoint, you want enough parasites out there to see a range so you can select the best ones and cull the worst. In other words, if everyone is at 500 epg, that doesn't help you select for resistance. You have to have a range to accurately select. And, of course none of this matters if the collection isn't the same process consistently. There has to be consistency to the sampling (all on the same day, etc.)

So, how should one select for resistance? The most accurate way by far is to utilize multigenerational Estimated Breeding Values developed by the National Sheep Improvement Program. This tool helps to factor out the environmental components to identify the genetic differences in individual sheep. Similar to cattle EPDs, sheep EBVs predict performance, although they represent the animal's genetic merit, rather than the expected difference in their progeny.

Slide 60: Estimating Breeding Values (EBVs)

So, how do EBVs work? Essentially, the goal of estimated breeding values is to eliminate the environmental factors that can cloud the actual reality of the animal's genetics based on performance. By comparing animals within a group, one can begin to see how it relates in performance to the other animals.

Laying out the animals in a group, one would expect their traits to form a bell curve, with the proportions of animals statistically distributed close to a normal distribution with a couple animals that really outperform the rest, with most being within one standard distribution of the average. Of course, with smaller numbers of lambs, it doesn't work out statistically perfect, but it is representative of what happens.

Slide 61: EBVs

So let's imagine for a second that this bell curve represents your flock.

Ok, well, actually, let's be honest, if you've had sheep for more than a year, your flock has gone from this, to this.

Slide 62: EBVs

So, let's imagine that this is your flock. Now let's imagine that each sheep's fecal egg count placed them vertically within this graph with the levels placed like a timeline with the highest fecal egg counts on the left and the lowest on the right.

This is much how your flock may actually look, just with real sheep rather than cartoon ones. (And honestly, they're a lot harder to take care of when they're real.)

Slide 63: EBVs

Your sheep are likely distributed like this graph. Now, when you got to select replacement ewes, without knowing an animal's fecal egg counts, you may end up selecting animals on the left side of the average and slowly moving your flock in the wrong direction. On the other hand, by taking fecal egg counts, you can select the animals on the right side of the graph and slowly move that average to the right. This is where EBVs come into practice.

Parasite resistance is moderately heritable, meaning the animal with the lowest fecal egg count is not necessarily the most resistant… Hold on a second, you say, if that's the case, then how do I know that I'm selecting the most resistant? Well, with raw data you don't. However, when that data is collected and analyzed, especially over multiple generations, the resulting EBVs can identify trends and consistency and thus begin to identify the genetics of the animals themselves. By using EBVs, you can use a tool that removes the other environmental factors and begin to make progress much more quickly.

One thing that I hear frequently from producers is that they want to use this technology, but they don't sell much breeding stock and/or can't collect all the data. In that case, selection pressure can just be put on purchased rams. Flock sires make a substantial difference in the future genetic makeup of a flock, and can contribute substantially to lamb parasite resistance due to the moderate heritability that exists. However, when selecting rams, one must be careful to not over-accelerate single traits.

Single trait selection with EBVs can be very dangerous to a sheep flock as the technology is very powerful in identifying those traits and you can increase the trait very quickly. Why is that a problem? Well, many traits have inverse correlation to other traits, or perhaps success of one trait is dependent upon another.

For example, if you were to select solely on number of lambs born, you may end up at a point where you have lots of triplets. But, if you haven't also been selecting for milk and mothering instinct, you are likely to end up with a lot of bottle lambs. None of us here want that to happen. If you do, give it a year or two; don't worry, you won't want to have lots of bottle lambs either!

This is an important consideration with parasite resistance. One must not give up production for parasite resistance in most systems. It is true that big lambs that have died from parasites don't make you any money, but neither do tiny parasite-resistant lambs. So, just like with everything, one needs a balance.

Slide 64: Using EBVs

Let me give you a quick example from my flock this year. These are EBVs on two of my ram lambs pulled from the online searchable database. The link is in the resources.

On the left, we have a ram lamb that had exceptional parasite resistance. That -98.6 reflects a 98.6 percent reduction in fecal egg count in the group. That puts him in the top 2% of the nation for parasite resistance. This ram never went above 250 eggs per gram in his group that at times averaged over 3,500 epg. He's also got good prolificacy and positive growth and milk scores. On the other side, we have a ram with poor parasite resistance. His WFEC is +76, which means you would expect his counts to be 176% of the average. That's pretty high. However, he does have higher milk and growth. That milk is in the top 10% of the nation. Now, both of them looked great their whole life. Neither looked thin from worms and both grew pretty equally. But by submitting data for the EBVs, I am able to identify the ones that have the traits that I need. If I were solely selecting on milk, I would definitely pick the ram on the right. By doing so, however, I would actually be moving parasite resistance in the wrong direction and fast. Keeping a balance is this very important.

Slide 65: EBVs: Helpful Resources

If you want to learn more about EBVs, you can explore these resources listed here or you can contact me directly. My email address is caleb@idahowoolgrowers.org and I'm happy to answer any questions that I can.

Slide 66: Summary

We have covered a lot of ground with this webinar. Keep going over the basics. Here is a summary:

- Can Barber Pole Worms overwinter? How?
  1. On our pastures (limited)
  2. In our sheep (hypobiotic L4 larvae)****
- Should I ever deworm without FAMACHA?
  NO!
- Besides FAMACHA FIRST, what are the two most important deworming rules?
  1. Use correct dose
  2. Use one dewormer until it quits
- What are the two most powerful, long-term tools to manage the Barber Pole Worm?
  1. Grazing strategies
  2. Genetic selection

The ATTRA tipsheets listed in Slide #4 were written with the advice and practical experience of many sheep producers and educators that have first-hand experience with the production-robbing effects of the Barber Pole Worm. Please refer to them!

Slide 67
If you have any questions on Barber Pole Worm management, please give Dave or Caleb a call. We are here to help!
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406-490-7596

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FAMACHA video
Here are two videos that demonstrate the FAMACHA eye scoring technique.

https://www.youtube.com/watch?v=mMNopmAKQkQ&list=PLDu0ElBiEy9z52pGxdJDT1zTchJUVrm4U&index=5

https://attra.ncat.org/famacha-in-a-nutshell/

Good luck at beating the Barber Pole Worm in in your flock!