NEWS TO EWES

Stomach Worm x Breed x Management Interactions

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Introduction

Any producer can encounter a "sheep wreck". The size of the "wreck" can range from an entire flock to a small blip on the total program. Causes can be an outbreak of disease, summer sterility in rams, genetic defects in newborns, low lamb prices, poor producing ewes, and others. However, it seems the most often occurring "sheep wreck" is one that involves the ever-present stomach worm (also known as the *Haemonchus contortus*).

Wreck No. 1. One hundred hair-type ewes lambed in April and nursed twins until late June. They grazed cool season grass pasture **without any supplemental feed**. Temperatures and rainfall were normal for Kentucky. In early June, however, some ewes became really thin and lethargic. One died. Then, another died. Immediate deworming the entire flock helped a little. Eventually, the lamb crop weaned in late June looked terrible.

Wreck No. 2. One hundred hair-and wool-type lambs born in April nursed ewes on cool season grass pasture and were weaned in late June. After weaning, they were moved to "clean cool season grass pasture" **without any supplemental feed**. Weather was typical for July/August (hot and dry). Lambs seemed to be doing OK, except some were trying to eat off the ground around the waterer where there was no grass. Then, a 2-inch rain fell that was followed with 85 to 95° F temperatures and 80% humidity. One morning a lamb was found dead. Upon closer inspection, several exhibited "bottle jaw". Another died the next day. The panic button was pushed. All lambs were dewormed. Another died. All were dewormed again. The "wreck" finally calmed, but the producer was mentally and economically devastated.

The purpose of this article is to present information that may help us to **"manage stomach worms"** so we are better able to survive the onslaught of infestations like the ones just described.

The Stomach Worm

This parasite lives off its host. It lives in the sheep's abomasum and attaches to the wall of the abomasum so it can live off the blood it sucks from its host. It has been estimated that each mature female stomach worm can lay 5,000 to 10,000 eggs per day. These eggs pass out of the sheep's body in the feces, land on the grass of the pasture being grazed, and develop into larvae on the grass leaves until consumed by the grazing sheep. Once in the abomasum, these larvae develop into mature worms and the cycle begins over again unless interrupted by the shepherd. A critical deviation of this cycle is the "hypobiotic state", which is a stage of parasite larval dormancy that allows escape from harsh environmental conditions by remaining in the wall of the abomasum. These harsh conditions can be exceptionally hot, dry, or cold combinations not conducive to larval development. Once the harsh conditions pass, the larvae can "wake up", develop into mature worms and begin to suck blood and lay eggs. Soon thereafter, sheep that harbor large number of worms may become exceptionally thin (body condition score near 1.0) and lethargic. Examination of the third lower eyelid may reveal a FAMACHA score of 4 or 5. An accumulation of fluid under the skin (edema) is another major symptom of a large infestation. This edema is typically seen under the jaw; thus, it is called "bottle jaw".

World-wide, sheep diets contain 85 to 90% roughage and 10 to 15% concentrate. Sheep raised in the eastern half of the U.S. typically consume their roughage from cool season grasses like fescue, orchardgrass, and bluegrass. Figure 1 shows that dry matter production per acre peaks in May and June. Producers try to take advantage of this curve by lambing ewes in April

Figure 1

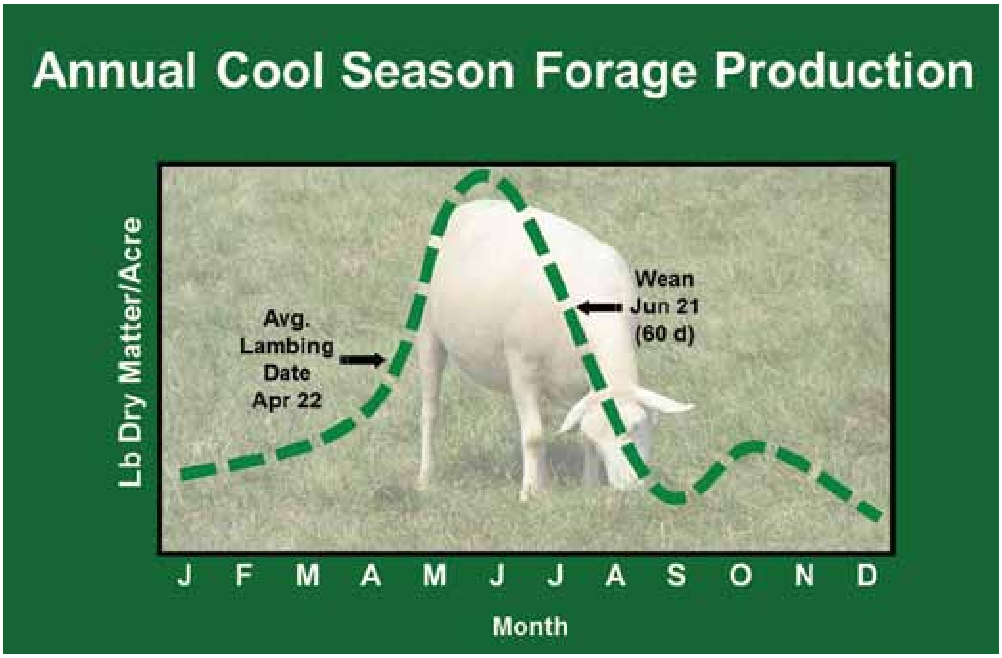
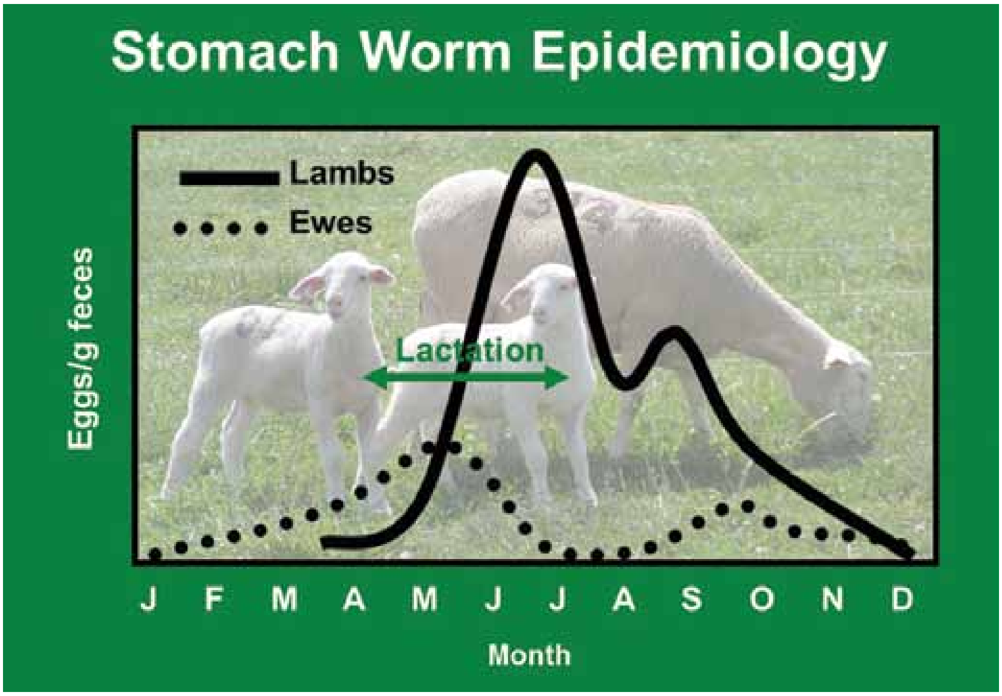


Figure 2



and weaning lambs in June to pasture or allowing ewes to continue grazing and nursing lambs to produce slaughter lambs as efficiently as possible. However, Figure 2 shows that stomach worms can interfere with some of this efficiency. Two points about this figure are: (1) Peak stomach worm infestation occurs when April lambing ewes are nursing lambs and (2) The main infestors of stomach worms in lambs are their mothers. Now, if we place Figure 2 on top of Figure 1, we will find the greatest stomach worm infestation occurs when forage production is greatest. A conclusion that can be derived from these two figures is: **If ewes lamb in April and graze, with their lambs, on cool season pasture, <u>they will have stomach worms</u>.** So, the question is: How can we manage pasture and/or sheep to control (manage) these worms?

Integrated Pasture Management

Pasture management techniques to help control stomach worm infestations have been offered as long as sheep have grazed forages. Some of these techniques have been discarded or changed as we learn more and more about the interactions of sheep x stomach worms x management. One of the current techniques is to use **Clean or Safe Pastures**. It is generally accepted that a clean or safe pasture is one that has not been grazed by sheep in the last 6 to 12 months. To do this, cattle or horses can graze these pastures during this interim because the stomach worm of the sheep does not affect cattle or horses and vice versa. Harvesting a single cutting of hay prior to grazing sheep will help to make the pasture clean or safe. Even better is taking hay from a pasture for an entire season. Fields rotated with field crops or pastures renovated by tillage can also be considered clean or safe.

From a forage standpoint, **Pasture Rest and Rotation** usually infers that rotating sheep from a grazed pasture to a fresh one means the previously grazed pasture is given a minimum of 30 days of rest before animals return. This length of rest may be okay for the forage and its nutritional value, but to control stomach worm infestations and make a pasture **Clean or Safe**, 6 to 12 months of rest may be needed. Not many producers can afford to rest a pasture this long. Rotating to “rested” pastures too soon may contribute to stomach worm problems rather than help prevent them. Therefore, use of **Pasture Rest and Rotation,** as an integrated pasture management procedure, may create a dilemma between forage and stomach worm management.

Generally, the recommendation is to not allow sheep to graze forage below 2 inches from the ground. Some even recommend not grazing below 4 inches. The thought behind this **Grazing Strategy** is that 80% of stomach worm larvae are found in the lower 2 inches of the plant growth (2 inches above ground level). Research has shown that larvae move up and down within the lower 2 to 4 inches of grass growth. If the grass is wet, from rain or dew, larvae move up and back down as the pasture dries. A sheep management recommendation is to allow daily grazing only after the forage dries out. Three problems arise from this **Grazing Strategy.** First, it is virtually impossible to estimate 2-to 4-inch forage heights of thick stands because plant growth usually falls towards the ground and lays there instead of growing upward for measurement. Secondly, techniques for forcing sheep to only consume forage that is taller than 2 to 4 inches have not been discovered. Finally, grazing only after forage dries in the middle of a summer day is liable to result in low forage intake because this is when sheep are typically in the shade.

Multi-Species Grazing is a management technique that can increase forage productivity because sheep eat weeds and short grasses while cattle prefer taller grasses. Although both sheep and cattle can become worm infested, it is generally accepted that internal parasites harbored by either of these do not infest across species. Although cattle may provide some protection from predators for the sheep, two different supplemental mineral sources should be available. If this is not an option, provision of only sheep mineral, because of its lower copper content, can be provided for both species. A way to avoid this problem is to use a “leader-follower” system, which allows the highest producing animals (ewes/lambs or cows/calves) to graze the pasture first and maintenance animals (dry ewes or cows) to follow.

Alternative Forages can contribute to integrated pasture management for stomach worm control. Lespedeza, birdsfoot trefoil, and chicory have all been shown to help manage stomach worms in different situations. Alfalfa can also serve as an **Alternate Forage** for cool season grasses because of its ability to withstand drought and still produce nutritious forage. It will not prevent or may not even decrease stomach worm

Genetic News continues on pg. 20

Genetic News continued from pg. 19

infestation, but grazing alfalfa stimulates growth of the consuming animal, which will allow them to better withstand an onslaught of stomach worms than those grazing cool season grasses.

As described, the Integrated Pasture Management techniques can be helpful in controlling stomach worm infestations in some situations. In other situations, they may not be as effective. Use of genetic resistant or resilient sheep and nutritional supplementation schemes offer us the potential to better “live with stomach worms” than we have been able to do in the past.

The Stomach Worm x Breed

The Gulf Coast Native, St. Croix, and Barbados Blackbelly are recognized as breeds that are “resistant” to stomach worms. The Katadhin also appears to have some resistance. However, none of these are totally resistant. The Dorper and White Dorper originated in South Africa and are believed to be more “resilient” to an infestation than many other breeds, especially wool breeds like the Polypay. This stimulated Aaron and co-workers to study the factors affecting indicators of *Haemonchus contortus* infestation in Polypay and White Dorper ewes.

Aaron et al. Study I.

This work, conducted from 2005 through 2008, used a grading-up mating scheme designed to remove wool from the traditional Polypay (PP) by mating PP ewes to White Dorper (WD) rams. Resulting genetic types and numbers of ewes were:

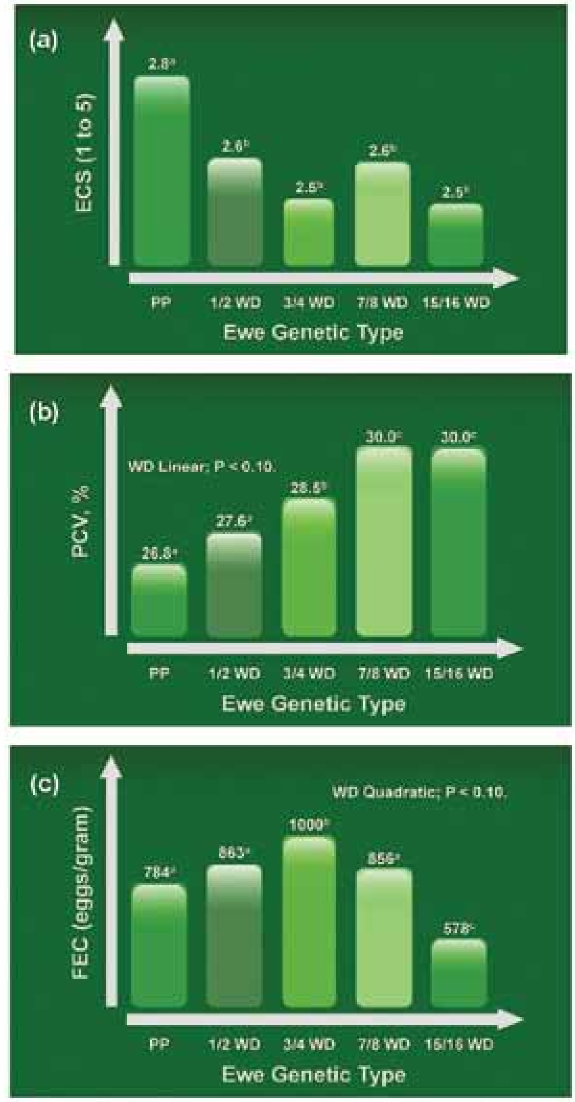
PP (83)
1/2 WD x 1/2 PP (53)
3/4 WD x 1/4 PP (53)
7/8 WD x 1/8 PP (38)
15/16 WD x 1/16 PP (25)

A total of 455 lambings resulted from 3-week breeding seasons that extended from November 15 to December 7 each year. Ewes lambed in a barn in April each year, but remained there less than 7 days before being moved to pasture. All received an anthelmintic upon leaving the lambing jug. Ewes and their lambs were maintained as a single flock and rotational grazing was practiced as ewes were supplemented with 1.0 lb shelled corn per head daily. Lambs had continued access to creep feed until weaned at 70 days of age (average). All ewes received an anthelmintic at weaning. Stomach worm indicator traits measured on each ewe at weaning (70 days) were 1) Eyelid color scores (ECS-FAMACHA®), packed red blood cell volumes (PCV, %) and fecal egg counts (FEC, eggs/gram feces).

The influence of genetic type on the ECS, PCV, and FEC at weaning (70 days) is shown in Figure 3.

Highest ECS was found in the PP and the 2.8 of a 5.0 maximum was different from all WD genetic types. The PP ewes also had the lowest PCV (Figure 3b), which tended to increase as the percentage WD increased. The FEC graph (Figure 3c) presents a somewhat different picture; that is, the 3/4 WD had the highest count, the 15/16 WD had the lowest, and the PP count was similar to the intermediate counts of the 1/2 and 7/8 WD. **Ideally, if ECS (FAMACHA®) is low (closer to 1.0), PCV should be high (greater than 28%), and FEC should be low. Conversely, if ECS (FAMACHA®) is high, PCV should be low, and FEC high.** An overall analysis of the data in Figure 3 indicates PP ewes were carrying more stomach worms, when lambs were weaned at 70 days of age, than the WD genetic types. Professional parasitologists generally agree that ECS (FAMACHA®) and PCV are more precise indicators of stomach worm infestation than is FEC. Therefore, we conclude the infestation decreased as WD genetics increased, even

Figure 3. Influence of Ewe Genetic Type on Eyelid Color Score (a), Packed Cell Volume (b), and Fecal Egg Count (c) at Weaning (70 Days).



abc Means not sharing common superscripts differ ($P < 0.05$).

though FEC did not directly line up with ECS and PCV.

Another aspect of this research was how ewe age (parity) and number of lambs nursed affected stomach worm infestation indicators. These effects, measured across ewe genetic types, are illustrated in Tables 1 and 2. Table 1 shows younger ewes have lower ECS and higher PCV although FEC did not appear to be affected by ewe age. The data in Table 2 show ewes nursing multiple lambs are more susceptible to stomach worm infestations than are ewes nursing singles, regardless of genetic type.

Overall, this experiment found that stomach worm indicators (ECS-FAMACHA®, PCV, and FEC) are affected by genetic type (PP more susceptible than percentage WD), age (older ewes more susceptible than younger ones), and number of lambs weaned (ewes than wean twins and/or triplets more susceptible than those with singles). One might also conclude that older ewes are more susceptible because they typically nurse more multiple lambs.

Aaron et al. Study II.

A second research study was conducted by Aaron and co-workers that evaluated

Table 1. Influence of Ewe Age (Parity) on Stomach Worm Indicator Traits at Weaning (70 Days).

		Trait[1]		
Ewe Age (Yr)	No. Lambings	ECS	PCV	FEC
1	183	2.4[a]	29.3[a]	793
2	117	2.6[b]	27.8[b]	786
3+	155	3.0[c]	26.5[c]	811

[1]ECS = Eyelid Color Score (FAMACHA®), 1 = optimal to 5 = fatal; PCV = Packed Cell Volume, %; FEC = Fecal Egg Count.
[abc]Means in the same column not sharing common superscripts differ (P<0.01).

Table 2. Influence of Type of Rearing on Stomach Worm Indicator Traits at Weaning (70 Days).

		Trait[1]		
No. Lambs Reared	No. Lambings	ECS**	PCV**	FEC*
Single	154	2.5	29.1	715
Multiple	301	2.8	26.7	887

[1]ECS = Eyelid Color Score (FAMACHA®); 1 = optimal to 5 = fatal; PCV = Packed Cell Volume, %; FEC = Fecal Egg Count.
**Single vs. multiple difference (P<0.01).
*Single vs. multiple difference (P<0.10).

Genetic News continues on pg. 22

Genetic News continued from pg. 21

post weaning growth and stomach worm tolerance of lambs that differed in percentage hair breeding and were raised on pasture. The lambs in this study were raised by the ewes described in Study I, resulting in the following genetic types:

PP
1/2 WD x 1/2 PP
3/4 WD x 1/4 PP
7/8 WD x 1/8 PP

Lambs were born in April in a barn where they remained for 7 days. Ewes and lambs were then moved to cool season grass pasture. All lambs were provided a corn-based creep feed, weaned at 70 days of age (~ June 20), managed on cool season pasture for 105 days post weaning and supplemented with a grain mix fed at 2 to 3% body weight daily. Data reported here were collected from a randomly selected sub-population of 44 lambs (11 of each genetic type). Traits measured were lamb weights/gains, red blood cell concentration of jugular blood (Packed Cell Volume = PCV), and fecal egg counts per gram of feces (FEC). These traits were measured at weaning (70 days of age) and at 3-week intervals post weaning (91, 112, 133, 154, and 175 days of age). However, only traits measured at 70 and 175 days are presented here.

Table 3. Summary of Lamb Weights, Gains, PCV, and FEC by Genetic Type.

	Genetic Type			
Trait	PP	1/2 WD	3/4 WD	7/8 WD
Weaning Wt., lb	53^{a}	52^{a}	45^{b}	38^{b}
Final Wt., lb	98^{a}	104^{b}	102^{ab}	82^{c}
TG, 70 to 175 d, lb	45^{a}	52^{b}	57^{b}	44^{a}
Weaning PCV, %	30.5^{ab}	33.5^{a}	28.5^{b}	28.0^{b}
Final PCV, %	33.5	34.0	33.0	32.5
PCV Change, 70 to 175 d, %	$+ 3.0^{a}$	$+ 0.5^{b}$	$+ 4.5^{a}$	$+ 4.5^{a}$
Weaning FEC, eggs/g	112	105	120	135
Final FEC, eggs/g	1050^{a}	1600^{b}	1000^{a}	1450^{ab}
FEC Change, 70 to 175 d, eggs/g	$+ 938^{a}$	$+1495^{b}$	$+ 880^{a}$	$+1315^{a}$

^{abc} Values on the same line not sharing common superscripts differ (P<0.05).

Lamb weights, gains, and stomach worm indicator traits (PCV and FEC) are summarized in Table 3. Weaning weights (70 days) of 3/4 and 7/8 WD lambs were less than those of PP and 1/2 WD. Final weights, at 175 days of age, were heaviest for 1/2 and 3/4 WD. Resultant total gains for the 105 days from weaning to 175 days of age favored the 1/2 and 3/4 WD genetic types. Increased performance of these crossbreds was most likely due to heterosis.

The PCV at weaning were highest for the PP and 1/2 WD lambs. This may indicate these lambs were carrying fewer worms,

Genetic News continues on pg. 24

Genetic News continued from pg. 22
which may have contributed to heavier weaning weights. On the contrary, 3/4 and 7/8 WD lambs had lower PCV and lighter weaning weights. No lamb genetic type differences were found for PCV measured 105 days later even though final weights and gains were affected by genetic type.

Fecal egg counts (FEC) were exceptionally low at weaning, but increased to 1000 to 1600 eggs/gram of feces after 105 days of grazing. The largest FEC change from weaning to final was found for the 1/2 and 7/8 WD lambs, but this finding did not align with the weight and PCV changes.

Overall, 1/2 and 3/4 WD lambs used forage plus supplemental concentrate to produce fastest post weaning gains. The 1/2 WD lambs were heaviest and had highest PCV at 175 days even though they had high FEC. The PP and 7/8 WD lambs gained slowest, but this was not attributable to differences in PCV or FEC.

Nutritional Supplementation

A recent 2-year study conducted at the University of Kentucky by Wood et al. compared performance of supplemented (S) and unsupplemented (US) Polypay (PP) and White Dorper (WD) lambs. These

Table 4. Total Gains of Lambs Grazing Alfalfa/Orchardgrass Pasture from June 25 to September 17.

	Gain, lb/hd
Breed	
PP	40.5
WD	38.3
Supplementation	
S	48.0
US	30.8
Breed x Supplementation	
S-PP	50.0
US-PP	31.0
S-WD	45.8
US-WD	30.6

Table 5. Log-Transformed Fecal Egg Counts of Lambs Grazing Alfalfa/ Orchardgrass Pasture from June 25 to September 17.

	Initial FEC, 6/25	Final FEC, 9/17
Breed		
PP	2.98	2.80
WD	2.46	2.25
Supplementation		
S	2.77	2.66
US	2.39	2.63
Breed x Supplementation		
S-PP	3.04	2.67
US-PP	2.92	2.93
S-WD	2.51	2.12
US-WD	2.41	2.37

lambs were born in April and were weaned at 70 days of age to alfalfa/orchardgrass pasture. One half of the lambs of each breed was supplemented, at 2% body weight daily, with a 14% crude protein concentrate from June 25 to September 17 (84 days). The other lambs of each breed were unsupplemented. The effect of breed (PP vs. WD) and supplementation on total lamb gains is summarized in Table 4. The comparison of PP and WD is made across supplementation treatments and shows PP gained 6% more than WD. A comparison of supplementation treatments, regardless of breed, shows how dramatic the effect of supplementation has on weight gains when lambs are raised on pasture during summer (48.0 vs. 30.8 lb/head; 156% greater for supplementation). The breed x supplementation gains in Table 4 show that PP lambs were more responsive to supplementation (50.0 vs. 31.0 lb/head) than WD (45.8 vs. 30.6 lb/head).

Table 5 shows initial and final FEC of PP vs. WD as well as supplemented vs. unsupplemented lambs. The interaction of breed x supplementation on FEC is also presented in this table. The numbers presented here are log-transformed rather than actual values. Comparison of these numbers is the same as if they were actual. Simply put, the larger the log-transformed number, the higher the FEC. The PP lambs had higher FEC than WD at both the beginning and end of the grazing season.

Both breeds had slightly larger FEC at the beginning of the grazing season than at the end. Supplemented lambs had higher initial FEC than unsupplemented, but they were near equal by September 17. The FEC of supplemented lambs decreased only slightly from initial to final, whereas unsupplemented FEC increased from 2.39 to 2.63. Further analysis of Table 5 (breed x supplementation) shows that PP had higher values than WD (regardless of supplementation). The benefit of supplementation becomes apparent when S-PP initial and final (3.04 vs. 2.67) values are compared with US-PP initial and final (2.92 vs. 2.93). Likewise, S-WD decreased from 2.51 (initial) to 2.12 (final) as US-WD decreased only from 2.41 (initial) to 2.37 (final).

Where Does This Leave Us?

Ewes that lamb in April "on pasture" will get stomach worms, even if they are so-called "genetically resistant breeds", are rotated through cool-season pastures, dewormed as needed, supplemented daily with a concentrate, and evaluated via FAMACHA. The question now becomes, "How do we manage ewes and lambs from April lambing?" The following is a proposed method. First, lactating ewes must be supplemented with at least 1.0 lb of concentrate daily. Provide creep feed to lambs from birth until weaning at 70 days of age. After weaning, move lambs to a clean alfalfa/orchardgrass pasture and supplement with a concentrate at 2% body weight daily. Move ewes to a low-quality "clean" pasture. Deworm ewes and lambs as needed based on FAMACHA and other characteristics (lethargy, bottle jaw, slow growth, eating off ground). Lambs can be marketed at light weights (50 to 90 lb) until October as desired or marketed in October/November at 100 to 120 lb.

Two management options are available if we want to avoid the stomach worm season. The first calls for breeding ewes in August/September and lambing in January/February. Feed ewes harvested feeds in the barn for 90 to 100 days (last 4 weeks of gestation and 60 days of lactation). Creep feed lambs from birth to weaning at 60 days of age. Move ewes to clean pasture and finish lambs in confinement (barn) to 100 to 120 lb. Market in May.

The second option is to breed ewes in May for September/October lambing. Feed harvested feeds to ewes after lambing in the barn or supplement with 1.0 lb concentrate/head/day on stockpiled fall pasture. Creep feed lambs from birth to weaning at 60 days of age. Move ewes to clean pasture plus low quality hay for winter. Finish lambs in confinement or outside to 100 to 120 lb. Market in late February/early March.

Summary

Many management techniques have been proposed to control stomach worm infestations. Even though it is virtually impossible for producers to practice all of these, this does not mean we shouldn't try. The Integrated Pasture Management practices can aid in keeping infestations under control. Use of "genetically resistant breeds" and daily supplementation with a concentrate are other practices that can help control this devastating parasite. As these practices are incorporated into the annual management of flocks, we should remember that stomach worm infestations are also affected by age of ewes and the number of lambs they nurse. Finally, recognize and accept the fact that sheep on pasture are going to have worms. It is the producer's responsibility to manage these worms to minimize their effect on the sheep. This may even require producers to breed ewes to avoid the stomach worm season.

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