Impact of sire selection on managing gastrointestinal worm parasites in lambs

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Introduction

It does not take long to realize animal health complications in lambs in a southeastern U.S. summer, particularly if a worm management plan was not implemented. In fact, poor lamb health can occur in almost every U.S. state if there is enough moisture in pastures used for grazing. Unfortunately, dewormer resistance has been detected in all three classes of dewormers across the U.S. which means that once a lamb succumbs to barber pole worm, a blood sucking nematode parasite that causes anemia, available dewormers may not help. Farmers need to have a solid plan to manage barber pole worm which includes good nutrition, good grazing practices, and good genetics.

What does genetics have to do with anything? Animal resistance to these worm parasites is a heritable trait. That means that a dam or sire that is resistant to parasites will pass that trait to its offspring. Resistance can be measured by counting the eggs in a fecal sample, which relates to the intensity of the worm infection. Fecal egg counts (**FEC**) can be measured in a group of lambs around the time of weaning and then again post-weaning. The National Sheep Improvement Program (**NSIP**) uses this information along with similar data on parents and relatives to give an estimated breeding value for that trait. The parasite resistance traits, weaning FEC or WFEC, and post-weaning FEC or PFEC, can be used to select the most resistant lambs in a group to be used as replacements for future generations. Over time, the farm population will become more resistant to parasites and there will be less reliance on dewormers. It was of interest to determine how important WFEC or PFEC of a sire is on offspring FEC on working farms. It was thought that sires with greater resistance (lower WFEC and PFEC EBV or more negative) would produce lambs with lower FEC.

Methods

Farm G. In each of 2022, 2023, and 2024, fecal samples were collected from ewe and ram lambs at weaning (mean age of 72 days, std. dev. of 9.2) and post-weaning (average age of 104 days, std. dev. of 9.6) to determine FEC using the McMaster's procedure. Body weight and FAMACHA score (1 = healthy and 5 = severely anemic) were also recorded on the same day. Four to five sires were used in each year representing between 12 and 31 offspring per sire each year. There were 112, 96, and 99 lambs used in each successive year. Any lamb that had been dewormed within 30 days prior to sampling was deleted.

Farm T. In 2024, lambs were born from 10 rams with a minimum of 8 offspring (offspring from 6 rams with 1 to 6 lambs each were removed from the data). Fecal samples were collected from ewe and ram lambs at weaning (n = 241; mean age of 71.5 days, std. dev. of 9.0), early post-weaning (n = 265; mean age of 104 days, std. dev. of 11.1), and post-weaning (n = 119; mean age of 154 days, std. dev. of 11.1). Body weight was recorded at weaning and post-weaning. Lambs were not dewormed before the post-weaning measurement.

Statistical analysis. For the purpose of this study, the November 2025 NSIP EBV was used for the sire's WFEC and PFEC EBV. A proc mixed (SAS) analysis was used for FEC, FAMACHA (Farm G), and body weights. FEC was log transformed because of a non-normal distribution; untransformed means are presented for clarity. For Farm G, independent variables included sex, rear type (single, twin, or multiple; rear type of 3 or more was considered multiple or triplet), year and sire with age of lamb used as a covariate. For Farm T, independent variables included sex and sire with age of lamb used as a covariate. Interactions were tested and if not significant, removed from the model. Regression analysis was used to determine the relationship between the offspring's FEC or FAMACHA score (Farm G) at each age and the sire's PFEC EBV (WFEC EBV was not used because of fewer observations or lower FEC at the WFEC collection; WFEC and PFEC are highly correlated). The shape of the curve was tested and found to be linear for FAMACHA scores and for FEC in Farm T. The curve was cubic for FEC of Farm G lambs. However, because the shape of the curve was nearly linear, for simplicity of this presentation, the linear untransformed regression equations will be presented along with the actual significant model.

Results and Discussion

Farm G. There was a sire effect on offspring's WFEC and PFEC ($P < 0.001$). Year was significant for WFEC ($P = 0.005$) and PFEC ($P = 0.05$) but there was no effect of sex or rear type. There was also a sire effect on offspring's FAMACHA score for both time points ($P < 0.001$). There was no effect of year, sex, or rear type. This means that the sire influenced the resistance (FEC) and the resilience (FAMACHA or level of anemia) of the offspring, though not uniformly among sires. There was no effect of sire on offspring's body weight, but as expected, sex ($P < 0.001$), rear type ($P < 0.001$), and year ($P < 0.001$) affected body weight at both time points.

The regression analyses showed a positive relationship between the offspring's FEC and FAMACHA score and the sire's PFEC EBV. WFEC: $y = 6.27 + 0.0068x – (3.7 \times 10^{-6})x^2$ ($P < 0.001$; $R^2 = 0.09$) where y = WFEC and x = sire's PFEC EBV (x will be the same for the following equations). More simply, for every 1 unit improvement (more negative) in the sire's PFEC EBV, the mean WFEC of offspring decreased by 9.5 eggs per gram.

PFEC: $y = 7.18 + 0.011x - (6.5 \times 10^{-6})x^2$ ($P < 0.001$; $R^2 = 0.18$) where y = PFEC. More simply, for every 1 unit improvement (more negative) in the sire's PFEC EBV, the mean PFEC of offspring decreased by 21.2 eggs per gram. **In other words, a sire with -100 PFEC EBV had lambs with 622 eggs/g at weaning and a sire with -50 PFEC EBV had lambs with 953 eggs/g. That could be a difference between lambs not becoming sick from parasites (from the -100 sire) or lambs that may become sick (from the -50 sire).**

For both weaning and post-weaning FAMACHA: $y = 1.58 + 0.0025x$ ($P < 0.001$; $R^2 = 0.07$) where y = WFEC or PFEC. Or, for every 1-unit improvement in sire PFEC EBV, the FAMACHA scores improved by 0.016. Recall that FAMACHA is a 5-point scoring system. For a sire with a PFEC EBV of -100, his offspring will have a mean FAMACHA score of 1.3 compared with a sire with a PFEC EBV of 0 whose offspring FAMACHA score would be 1.6. That means that within the sire's offspring, sires with less resistance will have more lambs that might need to be dewormed, especially if their FEC are higher and there are more worms on pasture. **Or, a sire with -100 PFEC EBV had lambs with 791 eggs/g at post-weaning and a sire with -50 PFEC EBV had lambs with 1562 eggs/g. Again, that could be a difference between lambs needing to be dewormed (from the -50 sire) or lambs that don't need to be dewormed (from the -100 sire).**

Farm T. There was no effect of sire or any variable on WFEC or PFEC. The mean WFEC for sire groups ranged from a low of 476 to 1412 eggs/g. The mean PFEC for sire groups ranged from 656 eggs/g to 3686 eggs/g but there were only 119 observations due to lambs being removed from the farm. There was an effect of sire on EPFEC ($P = 0.007$) even though the mean FEC for sires groups were low (the highest mean was 800 eggs/g and the lowest was 111 eggs/g). There tended to be an effect of sire on weaning weight ($P = 0.09$) with a significant effect of sex ($P = 0.004$) and rear type ($P < 0.001$) as expected. There was a sire effect on the offspring's post-weaning weight ($P = 0.002$); the weight was influenced by rear type ($P < 0.001$).

For the regression analyses, there was a relationship between sire PFEC EBV and offspring's WFEC: $y = 6.9 + 0.012x$ ($P = 0.003$; $R^2 = 0.03$) where y = EPFEC. Or, for every 1-unit improvement in sire PFEC EBV, the mean EPFEC improved by 6.9 eggs/g.

EPFEC: $y = 5.7 + 0.009x$ ($P = 0.03$; $R^2 = 0.03$) where y = WFEC. Or, for every 1-unit improvement in sire PFEC EBV, the mean WFEC improved by 12.8 eggs/g.

PFEC: $y = 8.0 + 0.016x$ ($P = 0.009$; $R^2 = 0.06$) where y = PFEC. Or, for every 1-unit improvement in sire PFEC EBV, the mean PFEC improved by 35.3 eggs/g.

Summary and impacts. Data was collected on NSIP lamb traits from two farms. Farm conditions (environment, management, resources) will always be different, and climate, especially rainfall, will influence lamb parasitism or FEC. Typically, wetter years will yield higher FEC and FAMACHA scores and more reliable differences among sire genetics, although if FEC are allowed to increase too much across all lambs, parasitism can overwhelm even the best genetics. Multiple year studies can yield more information than single year studies, but changes in sires among years will influence offspring production data.

The impact of the study shows clearly that sires with greater parasite resistance yield offspring better adapted to parasite exposure. Their lambs will have lower FEC and FAMACHA or anemia scores, leading to fewer cases of deworming and deaths, and lower parasite load on pasture.

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Table 1. Least squares means for offspring WFEC, PFEC (eggs/g), weaning FAMACHA (WFAM), and post-weaning FAMACHA (PFAM), and WWT and PWT (lb.) for each sire on Farm G. The "n" is the number of offspring that were sampled per sire at weaning.

		22-24 values		2025 values		Offspring Means						
Sire	**Yr**	**WFEC EBV**	**PFEC EBV**	**WFEC EBV**	**PFEC EBV**	**n**	**WFEC**	**PFEC**	**WFAM**	**PFAM**	**WWT**	**PWT**
GBR20030	22	-93	-90	-45	-63	23	1896	2424	1.49	1.71	57.7	76.8
MOF21116	22	-82	-90	-52	-53	25	939	1912	1.52	1.47	57.2	77.3
NWT18012	22	-67	6	-40	1	22	1049	1853	1.36	1.27	56.2	75.2
NWT19067	22	-98	-100	-99	-100	12	65	771	1.27	1.05	54.8	71.6
RMK20072	22			-33	-64	31	996	1419	1.64	1.24	57.7	77.9
NWT19067	23	-99	-101	-99	-100	21	0	0	1.21	1.09	66.0	88.0
NWT22037	23	-63	-83	-98	-100	24	633	662	1.16	1.54	62.0	81.7
RMK20072	23	-69	-83	-33	-64	31	1184	670	1.27	1.20	64.6	84.7
USD21365	23	-65	-67	-37	37	25	306	2156	1.28	1.54	62.4	82.5
NCS22025	24	-45	-47	163	153	23	1325	4095	2.19	2.11	52.1	70.6
NWT22037	24	-60	-97	-98	-100	16	380	63	1.12	1.17	52.3	70.7
NWT22133	24	-83	-97	-96	-100	18	424	867	1.39	1.28	49.3	68.8
RMK20072	24	-41	-80	-33	-64	24	663	1299	1.58	1.75	51.9	70.3
WRI22072	24	-74	-53	-30	-1	22	911	1967	1.60	1.65	53.7	71.3

Table 2. Least squares means for offspring WFEC and PFEC (eggs/g) and WWT and PWT (lb.) for each sire on Farm T.

			Offspring data							
Sire	**WFEC EBV**	**PFEC EBV**	**n**	**WFEC**	**n**	**EPFEC**	**n**	**PFEC**	**WWT**	**PWT**
MOF20005	-37	-57	46	951	50	227	23	1586	40.3	67.9
MSU23032	-69	-84	23	895	25	115	12	1226	37.9	58.1
NWT18041	-68	-86	11	827	9	276	1	824	39.9	70.7
NWT064	-93	-90	9	483	9	127	5	656	40.3	73.6
NWT22080	20	-28	8	1412	10	259	5	1992	43.6	63.7
NWT22091	-93	-95	20	556	19	111	7	1877	40.6	66.1

NWT22125	-85	-89	10	477	11	237	3	935	41.9	63.7
NWT22129	-53	-52	26	741	26	800	12	3685	37.2	58.9
OSF22031	-70	-97	30	823	36	112	17	1052	38.1	64.4
TLF21004	-41	-80	58	941	70	266	34	1426	36.7	61.0