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**R Selvam**  
Livestock Farm Complex,  
Veterinary College and Research  
Institute, Tamil Nadu  
Veterinary and Animal Sciences  
University, Tamil Nadu, India

## Estimation of genetic parameters of traits for evaluation of resistance to gastrointestinal nematode infection in Vembur sheep

**R Selvam**

### Abstract

The faecal egg count and packed cell volume are parameters used for evaluation of natural resistance against gastrointestinal nematode infection. This study has been carried out to analysis the correlation among the indicator traits for gastrointestinal nematode infection such as FEC, PCV and gain in body weight in Vembur breed of sheep by Pearson correlation coefficient and Spearman's Rank-Order Correlation coefficient methods. The overall least-squares mean for log FEC in Livestock Farm Complex, Veterinary College and Research Institute, Tirunelveli and District Livestock Farm, Abishegappatti, Tirunelveli were  $5.0097 \pm 0.181$  and  $6.1911 \pm 0.304$ , the least-squares mean for PCV were  $32.57 \pm 0.732\%$  and  $26.90 \pm 0.623\%$  and the least squares mean for ADG gain were  $-0.69714 \pm 0.33$  and  $-1.5731 \pm 0.38$  kg, respectively. The Pearson Correlation analysis of log-transformed faecal egg count, PCV and ADG showed that there is a highly significant negative correlation between FEC and PCV (-0.787) and between PCV and ADG (-0.660) at the 0.01 level. FEC is positively correlated with body weight gain, which is not significant (0.339). Spearman's RHO Correlations analysis indicated that the FEC had negative associations with PCV (-0.796) and PCV with ADG (-0.602) which are highly significant ( $P < 0.01$ ) and FEC exhibited a positive association with ADG (0.124) but it was not significant. The result implies that if gastrointestinal nematodes egg counts increases then, PCV reduces. The correlation of PCV and FEC may assist in predicting natural resistance to gastrointestinal nematodes in sheep breeds.

**Keywords:** genetic resistance, gastrointestinal nematode, faecal egg count, packed cell volume, correlation, Vembur

### Introduction

Gastrointestinal nematode infections are one of the major constraints in livestock production. It constitutes an important contributor to economic losses due to reduced weight gain, decreased production and mortality of infected animals. Gastrointestinal nematodes such as *Haemonchus contortus*, *Teledorsagia circumcincta*, *Trichostrongyles*, *Nematodirus* sp., are major species causing infection in sheep. *Haemonchus contortus* is of high economic significance due to its high prevalence and blood sucking habit. The faecal egg count (FEC) and packed cell volume (PCV) are parameters used for evaluation of natural resistance against gastrointestinal nematode infection in animals. FEC was proposed as the only proven way of selecting sheep for parasite resistance in many breeds (Woolaston, 1992) <sup>[1]</sup>. Packed cell volume was another parameter which positively correlated with weight gain and negatively correlated with FEC (Chauhan *et al.*, 2003) <sup>[2]</sup>. FEC is an excellent parameter to describe worm load. Different studies have shown that FEC have moderate to high correlation with nematode burdens (Stear *et al.*, 1997) <sup>[3]</sup>. A measurement that is more specific to *H. contortus* is the hematocrit or packed cell volume which provides a measurement of anemia. Selection criteria to improve parasite resistance have commonly been based on both of these two measures. However, there are only limited publications in genetic parameter estimates for indicator traits for gastrointestinal nematode infection in sheep. Based on importance of gastrointestinal nematodes in sheep, this study was conducted with an aim to study the gastrointestinal nematode infection in Vembur breed of sheep by measuring the FEC and PCV and to estimate the correlation for these traits along with their association with average daily weight gain (ADG). This study has been carried out to find the feasibility of genetic selection of sheep for resistance to gastrointestinal nematodes based on the analysis of correlation among the indicator traits such as FEC, PCV and gain in body weight.

**Corresponding Author:**  
**R Selvam**  
Livestock Farm Complex,  
Veterinary College and Research  
Institute, Tamil Nadu  
Veterinary and Animal Sciences  
University, Tamil Nadu, India

## Materials and Methods

This study was carried out in Vembur breed of sheep maintained at Livestock Farm Complex (LFC), Veterinary College and Research Institute, Tirunelveli and District Livestock Farm (DLF), Abishegappatti, Tirunelveli. A total of 50 Vembur breeds, aged from 6 to 18 months and both male and female were randomly selected for this study. All the animals were maintained under semi-intensive system of management and normal natural grazing conditions and were dewormed routinely once in three months with different rotational anthelmintics as per the standard procedure. The phenotypic indicator traits for evaluating the genetic resistance to gastrointestinal nematode infection such as faecal egg count, packed cell volume and body weight were recorded as per the standard protocol. The faecal egg counting was conducted using the modified McMaster technique (Dominik, 2005) [4]. Faecal cultures were prepared from pooled faecal samples taken from a random sample to define the species composition of the nematodes that infected the flock. Fresh blood samples were collected on the day of faecal sampling for measuring packed cell volume. PCV was estimated by the microhaematocrit centrifuge method (Maff. 1977) [5]. The body weight of all animals was measured every month and changes in the body weight. The average daily weight gain was calculated. Data on FEC, PCV and ADG were used for subsequent analyses. All raw data of FEC was transformed by  $\log_e$  (FEC+100) to correct for heterogeneity of variance and to produce approximately normally distributed data. The data were analysed using a mixed model least-squares analysis for fitting constants (Preston and Allonby, 1978) [6]. The correlation among  $\log_e$  (FEC+100), PCV and ADG were estimated by Pearson correlation coefficient and Spearman's Rank-Order Correlation coefficient methods using SPSS statistics version 20.0. Before performing correlation coefficient, a scatter plot is used for bivariate data (two variables) which is a visual presentation that gives information about the extent of the relationship between the two variables.

## Results and Discussion

The overall least-squares means for log-transformed FEC, PCV and ADG of Vembur sheep maintained at Livestock Farm Complex, VCRI, Tirunelveli and District Livestock Farm, Abishegappatti, Tirunelveli are calculated and presented in Table 1. The overall least-squares mean for  $\log_e$  (FEC+100) in LFC and DLF were  $5.0097 \pm 0.181$  and  $6.1911 \pm 0.304$ , respectively. The least-squares mean for PCV were  $32.57 \pm 0.732\%$  and  $26.90 \pm 0.623\%$  during the course of infection in the respective farms. The least squares mean for ADG gain in LFC and DLF were  $-0.69714 \pm 0.33$  and  $-1.5731 \pm 0.38$  kg, respectively.

The Figures 1, shows the scatter plot of bivariate data of various combination of  $\log_e$  (FEC+100) and PCV and it showed the downhill pattern i.e. move from right to left, which indicates a negative relationship between FEC and PCV.

The Pearson Correlations of log-transformed faecal egg count, PCV and ADG in Vembur Sheep are presented in Table 2. From this result it has been observed that there is highly significant negative correlation between FEC and PCV ( $-0.787$ ) and between PCV and ADG ( $-0.660$ ) at the 0.01 level. But, FEC is positively correlated with body weight gain, which is not significant ( $0.339$ ). The Faecal egg culture results showed that the sheep were infected mostly with blood

sucking *Haemonchus contortus* which is substantiated by the higher FEC was associated with lower PCV in this study.

The similar result is also observed in the Spearman's RHO Correlations analysis (Table 3). Where the FEC had negative associations with PCV ( $-0.796$ ) and PCV with ADG ( $-0.602$ ) which are highly significant ( $P < 0.01$ ). Whereas, FEC exhibited a positive association with ADG ( $0.124$ ) but it was not significant.

In this study the FEC is negatively correlated to PCV and PCV to body weight gain and the correlation is highly significant. Whereas, FEC is non-significantly, positively correlated with body weight gain. Low PCV and High FEC correlation indicated that *Haemonchus contortus* is a major pathogen in this flock which is supported by the results of faecal egg culture. The positive correlation between FEC and ADG indicate that resistance to gastrointestinal nematode is probably an important determinant of growth rate in this environment.

Similar kind of results of was reported earlier by many studies. Roberts and Swan, 1982 [7] stated that the negative correlation of FEC and PCV confirms blood sucking parasites were dominant in the animals studied. Selvam and Venkataramanan, 2018 [8] recorded significant negative correlation in FEC with PCV ( $-0.705$ ) and ADG ( $-0.629$ ), and PCV exhibited non-significant positive association with ADG ( $0.30$ ) in Kilakarsal Sheep of Tamil Nadu. Negative correlations of FEC and PCV were observed in fine-wool Merino lambs (Baker *et al.*, 2001) [9], in Polish Long Wool sheep (Greer *et al.*, 2009) [10], in Scottish Blackface lambs (Bouix *et al.*, 1998) [11]. Similarly, highly negative genetic correlations ( $0.56-0.79$ ) and positive genetic correlations ( $0.37-0.58$ ) between FEC and PCV had been reported in Galla and Small East African goats (Harvey *et al.*, 1990) [12]. The negative correlation of FEC with body weight was reported in few studies (Woolaston and Piper 1996) [13]. The genetic correlation between FEC and live weight in lambs older than 3 months of age was close to  $-1.0$  (Bishop *et al.*, 1996) [14]. The non significant, positive correlation of FEC with body weight gain of this study indicated that sheep with high genetic merit for body weight had a higher level of natural resistance.

The result implies that when gastrointestinal nematodes egg counts increases, PCV reduces. The correlation of PCV and FEC may aid in predicting resistance to gastrointestinal nematodes. Correlation between PCV and FEC may be utilized as a selection criterion in obtaining gastrointestinal nematode resistant animals.

## Conclusion

From this study, it is clearly indicated that the correlations of faecal egg counts and packed cell volume indicates that these traits may be markers for genetic resistance to gastrointestinal nematode infection. The genetically resistant animals against gastrointestinal infection were found to have reduced FEC and increased PCV, increased weight gain. In future this study can be further extended with genomic studies to identify the molecular markers for the genetic resistance to gastrointestinal nematode infection. This study will open possibilities in the future to select and breed animals for enhanced resistance to parasitic diseases. In future this study will be helpful for the identification of molecular basis of genetic resistance to parasitic diseases for carrying out genetic selection programme for developing sheep breeds with natural resistance to gastrointestinal nematode infection

**Table 1:** Least-squares means for log<sub>e</sub> (FEC+100), PCV and ADG of Vembur Sheep

		N	Mean	Std. Deviation	Std. Error Mean
ADG	LFC	25	-.69714	1.236747	0.330535
	DLF	25	-1.57310	1.201719	0.380017
PCV	LFC	25	32.57	2.738	0.732
	DLF	25	26.90	1.969	0.623
log <sub>e</sub> (FEC+100)	LFC	25	5.0097	0.67768	0.18112
	DLF	25	6.1911	0.96188	0.30417

**Table 2:** Pearson Correlations of FEC, PCV and ADG in Vembur Sheep

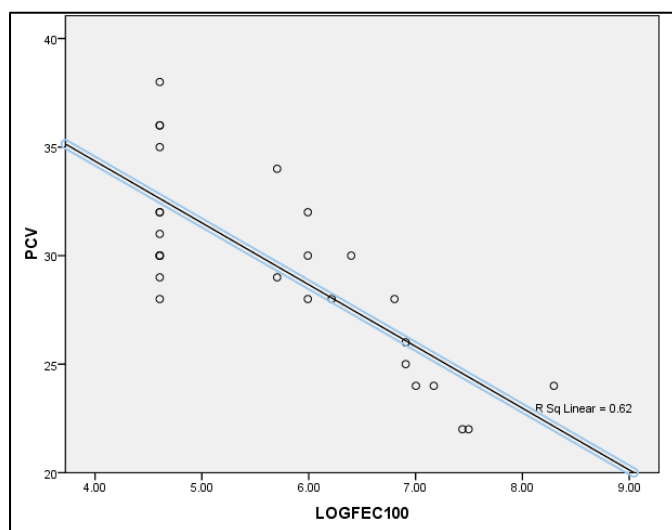
		ADG	log <sub>e</sub> (FEC+100)	PCV
ADG	Pearson Correlation	1	0.339	-0.660**
	Sig. (2-tailed)		0.083	0.000
log <sub>e</sub> (FEC+100)	Pearson Correlation	0.339	1	-0.787**
	Sig. (2-tailed)	0.083		0.000
PCV	Pearson Correlation	-0.660**	-0.787**	1
	Sig. (2-tailed)	0.000	0.000	

\*\* . Correlation is significant at the 0.01 level (2-tailed).

**Table 3:** Spearman's rho Correlations of FEC, PCV and ADG in Vembur Sheep

		ADG	log <sub>e</sub> (FEC+100)	PCV
ADG	Correlation Coefficient	1.000	0.303	-0.602**
	Sig. (2-tailed)		0.124	0.001
log <sub>e</sub> (FEC+100)	Correlation Coefficient	0.303	1.000	-0.796**
	Sig. (2-tailed)	0.124		0.000
PCV	Correlation Coefficient	-.602**	-.796**	1.000
	Sig. (2-tailed)	0.001	0.000	

\*\* . Correlation is significant at the 0.01 level (2-tailed).



**Fig 1:** Scatter Plot (BIVAR) = log<sub>e</sub>(FEC+100) with PCV

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