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Genetic Parameter Estimates for Phenotypic Indicator Traits of Resistance to Gastrointestinal Nematode Infection in Kilakarsal Sheep

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ABSTRACT

Breeding for resistance to gastrointestinal nematode was highly effective in parasite control in sheep breeds. This study was undertaken with an aim to study the gastrointestinal nematode infection in Kilakarsal breed of sheep by measuring the FEC and PCV and to estimate the correlation for these traits along with their association with ADG. The FEC was calculated using the modified McMaster technique, PCV was estimated by the microhaematocrit centrifuge method and The relationship among log_e (FEC+100), PCV and ADG were estimated by Pearson and Spearman's Rank-Order Correlation coefficient methods using SPSS statistics program. The overall least-squares mean for loge (FEC+100), PCV and ADG in ILFC & DLF were -0.00791±0.015 & -0.02517±0.013, and 30.82±2.316% & 26.83±1.030% and 5.9319±0.531 & 7.4399±0.595 kg, respectively. The Pearson Correlation analysis showed a highly significant (P<0.01) negative correlation between FEC and ADG (-0.716) and between FEC and ADG (-0.620) at the 0.01 level and positive nonsignificant correlation between PCV ADG (0.205). Similarly Spearman's rho Correlation analysis also showed a highly significant negative associations of FEC with PCV (-0.705) and ADG (-0.629), whereas, PCV exhibited non-significant positive association with ADG (0.305). This study specified that the FEC and PCV can be a best indicator trait to assess the genetic resistance against gastrointestinal infection in sheep. The genetically resistant animals against gastrointestinal infection were found to have reduced FEC and increased PCV, increased weight gain. The results confirmed the feasibility of genetic selection of sheep for resistance to gastrointestinal nematode parasites. **KEYWORDS:** Genetic resistance; Gastrointestinal nematode; Faecal Egg Count; Packed Cell Volume; Correlation;

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INTRODUCTION

Sheep are generally known as 'Museum of Parasite' because of their close grazing practice. Gastrointestinal nematodes infection is a major constraint to the sheep farming which causes production losses, increased costs of management and treatment, and even mortality in severe cases [1]. In India, control of gastrointestinal nematodes is solely dependent on use of anthelmintics. There are several reports of parasites becoming resistant to most of the available classes of anthelmintics [2]. Selection of sheep with natural or acquired resistance to parasite infection is one such option for alternative control of parasite. Attempts have been made to identify susceptible and resistant animals based on indicator traits for parasite infection.

A number of phenotypic traits such as fecal egg count (FEC), packed cell volume (PCV), serum antibodies, peripheral eosinophilia, pepsinogen, fructosamine and plasma albumin concentration have been used to identify animals with resistance to infection [3, 4]. Both FEC and PCV are traits of value, as FEC is an indirect measure of resistance and PCV is an indicator of resilience, i.e. the ability of the animal to



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withstand the effects of infection. PCV estimate the percentage of RBC in blood which can be used as a pathological indicator of anaemia and an indication suggestive of *Haemonchus contortus* infection.

Knowledge on genetic parameters namely heritability and correlation of these indicator traits is imperative for selection of sheep for genetic resistance. However, there have not been any published reports of genetic parameter estimates for parasite resistance traits in sheep in Tamil Nadu. This study was undertaken with an aim to study the gastrointestinal nematode infection following natural infection in Kilakarsal breed of sheep by measuring the FEC and PCV and further to estimate the correlation for these traits along with their association with body weight.

MATERIALS AND METHODS

Experimental Animals: This study was carried out in Kilakarsal breed of sheep (Figure 1) maintained at Instructional Livestock Farm Complex (ILFC), Veterinary College and Research Institute, Tirunelveli and District Livestock Farm (DLF), Abishegappatti, Tirunelveli during 2014-2015. A total of 100 sheep, 50 each of Kilakarsal and Vembur breeds, aged from 6 to 18 months at the beginning of the study and of both sexes were randomly selected for this study. All the animals were maintained under semi-intensive system of management and normal natural grazing conditions.

Phenotypic indicator traits: All the animals selected for this study 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 evaluation of parasitic burden by FEC, PCV and body weight were recorded as per the standard protocol.

FEC: Susceptibility to gastrointestinal nematode infection following natural infection was evaluated. Faecal samples (5-10 g) were collected directly from the rectum of the animals. The samples were taken to the laboratory in separate plastic containers with a closed plastic bag which were labeled with breed, sex of animal, date and place of collection. Macroscopic examination of faecal samples was made for consistency, colour, presence of blood or mucus, presence of adult or larval parasites. The faecal egg counting was conducted using the modified McMaster technique [5].

Faecal cultures: 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. The pooled faecal samples were transferred to a jar and its mouth covered with gauze cloth. The faeces packed jar was kept in the dark place for seven days in the room temperature. After seven days, 150 ml of luke warm water was poured into the jar and allowed it to stand for five minutes. Thereafter, the water was transferred to a beaker and waited till all larvae had got settled in the bottom. The larvae were examined under the microscope.

PCV: Fresh blood samples were collected on the day of faecal sampling for measuring packed cell volume. Five ml of blood was collected from external jugular vein by using vacutainer with EDTA as an anticoagulant. PCV was estimated by the microhaematocrit centrifuge method [6].

Body weight/Average Daily weight gain (ADG): The body weight of all animals was measured (ESSAE weighing scale, Model: D415, Capacity: 300 kg, Accuracy: 50 g) every month and changes in the body weight. Recording was done in the morning before the animals were let out for grazing. The average daily weight gain was calculated.

Statistical Analysis: 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 [7]. The relationship 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. The Pearson product-moment correlation coefficient is a test statistics that measures the statistical relationship, or association, between two continuous variables. It is known as the best method of measuring the association between variables of interest because it is based on the method of covariance. The Spearman's correlation coefficient measures the strength and direction of association between two ranked variables. 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. Also Levene's Test for Equality of Variances, T-test for Equality of Means was performed to analyze the samples has equal variances/ homogeneity of variance.

RESULTS AND DISCUSSION

Phenotypic indicator traits of gastrointestinal nematode infection: The overall least-squares means for log-transformed FEC, PCV and ADG of Kilakarsal sheep maintained at Instructional Livestock Farm

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Complex (ILFC), Veterinary College and Research Institute, Tirunelveli and District Livestock Farm (DLF), Abishegappatti, Tirunelveli are calculated and presented in Table 1. The overall least-squares mean for loge (FEC+100) in ILFC and DLF were -0.00791±0.015 and -0.02517±0.013, respectively. The least-squares mean for PCV were 30.82±2.316% and 26.83±1.030% during the course of infection in the respective farms. The least squares mean for ADG gain in ILFC and DLF were 5.9319±0.531 and 7.4399±0.595 kg, respectively during the study period.

Correlations among indicator traits: The Figures 2, 3, 4 shows the scatter plot of bivariate data of various combination of \log_e (FEC+100) PCV and ADG. The figure 2 showed the uphill pattern i.e. move from left to right, which indicates a positive relationship between PCV and ADG. Whereas, Figures 3 and 4 showed downhill pattern i.e. move from left to right, which indicates a negative relationship between \log_e (FEC+100) & ADG and \log_e (FEC+100) & PCV as the FEC values increase the PCV and ADG values tend to decrease.

Pearson Correlations analysis: The Pearson Correlations of log-transformed fecal egg count, PCV and ADG in Kilakarsal Sheep are presented in Table 2. From this result it has been observed that there is highly significant negative correlation between FEC and ADG (-0.716) and between FEC and ADG (-0.620) at the 0.01 level. But, PCV is positively correlated with body weight gain, which is not significant (0.205). 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.

Spearman's rho Correlations analysis: The comparable kind of result is also observed in the Spearman's rho Correlations analysis (Table 3). Where the FEC had negative associations with PCV (-0.705) and ADG (-0.629) which are highly significant (P<0.01). Whereas, PCV exhibited a positive association with ADG (0.305) but it was not significant.

Breeding for resistance to gastrointestinal nematode was highly effective in decreasing the worm burden and worm egg output in sheep breeds around the world [8]. 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. Many authors stated that FEC is an important and commonly used indicator trait for selecting sheep for genetic resistance against parasites [9]. PCV is a useful parameter to describe resistance against parasites depending on the dominant species [10]. Many blood sucking parasites including *Haemonchus contortus* often lead to the lower PCV values and other haematological disturbances and this is attributed to the loss of blood through gastrointestinal tract by the injuries caused by these parasites [11]. So, haematocrit is taken as valuable tool to check the gastrointestinal tract blood sucking parasites. The average daily weight gain is also a marker in assessing resistance to gastrointestinal nematode infection [12].

In this study the FEC is negatively correlated to PCV and body weight gain, whereas, PCV is 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 moderate negative 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. In fine-wool Merino lambs which were artificially infected with Haemonchus contortus reported that faecal egg counts and PCV had a strong negative correlation [9]. In Polish Long Wool sheep, a negative genetic correlation (-0.61) was found between faecal egg count and daily weight gain [13]. In another study, phenotypic correlations between FEC and live weight in Scottish Blackface lambs were negative but closed to zero and genetic correlations were close to -1.0 (14). 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, respectively under tropical conditions [8]. There was a strong negative genetic correlation between FEC and eosinophil counts in Scottish Blackface lambs infected with Teladorsagia circumcincta (-0.78 and -0.97 respectively) [15]. Regarding the production traits, the negative correlation of FEC with body weight was reported in few studies [10].

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Table 1. Least-squares means for log_e (FEC+100), PCV and ADG

| | | Ν | Mean | Std. Deviation | Std. Error Mean |
|----------------------------|------|----|----------|----------------|-----------------|
| ADG | ILFC | 25 | -0.00791 | 0.0154 | 0.004 |
| | DLF | 25 | -0.02517 | 0.0138 | 0.0040 |
| PCV | ILFC | 25 | 30.82 | 2.316 | 0.698 |
| | DLF | 25 | 26.83 | 1.030 | 0.297 |
| log _e (FEC+100) | ILFC | 25 | 5.9319 | 0.531 | 0.160 |
| | DLF | 25 | 7.4399 | 0.595 | 0.171 |

| Table 2. Pearson Correlations of FEC, PCV and ADG in Kilakarsal Sheep |
|---|
|---|

| | | ADG | loge (FEC+100) | PCV |
|----------------------------|---------------------|----------|----------------|----------|
| ADG | Pearson Correlation | 1 | -0.716** | 0.205 |
| | Sig. (2-tailed) | | .000 | 0.337 |
| log _e (FEC+100) | Pearson Correlation | -0.716** | 1 | -0.620** |
| | Sig. (2-tailed) | 0.000 | | 0.001 |
| PCV | Pearson Correlation | 0.205 | -0.620** | 1 |
| | Sig. (2-tailed) | 0.337 | 0.001 | |

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

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| | | ADG | loge (FEC+100) | PCV |
|----------------------------|--------------------------------|----------|----------------|----------|
| ADG | Correlation Coefficient | 1.000 | -0.629** | 0.305 |
| | Sig. (2-tailed) | | 0.001 | 0.147 |
| log _e (FEC+100) | Correlation Coefficient | -0.629** | 1.000 | -0.705** |
| | Sig. (2-tailed) | 0.001 | | 0.000 |
| PCV | Correlation Coefficient | 0.305 | -0.705** | 1.000 |
| | Sig. (2-tailed) | 0.147 | 0.000 | |

Table 3. Spearman's rho Correlations of FEC, PCV and ADG in Kilakarsal Sheep

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

CONCLUSION

From this study, it is clearly indicated that the FEC can be a best indicator trait to assess the genetic resistance against gastrointestinal infection in sheep and also PCV is a useful indicator if blood sucking parasites such as *Haemonchus contortus* are major disease causing pathogens. The correlations of fecal egg counts and packed cell volume with body weights indicates that the influence of gastrointestinal infection with production parameters in sheep. The genetically resistant animals against gastrointestinal infection were found to have reduced FEC and increased PCV, increased weight gain. The results confirmed the feasibility of genetic selection of sheep for resistance to gastrointestinal nematode parasites.

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