

Case Study: Influence of Climatic Condition on the Seasonal Trends of Gastrointestinal Nematode Infections in Sheep

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INTRODUCTION

Gastrointestinal nematodes (GINs) represent a major health challenge in grazing ruminants, significantly affecting animal productivity and farm sustainability [1]. The epidemiology of GIN infections is influenced by multiple factors, including farm management system, breed susceptibility, and climatic conditions [2]. The latter play a crucial role in the survival and transmission of GIN infective larvae in pastures, affecting the seasonal dynamics of infestations [3].

OBJECTIVES

This study investigates the epidemiology of gastrointestinal nematodes (GIN) infections in a semi-extensive dairy sheep farm located in the Campania region (Southern Italy), where two breeds, Lacaune and Bagnolese, are raised under identical management conditions. The Lacaune, a high-yielding cosmopolitan French dairy breed, and the Bagnolese, a hardy Italian native breed, differ in morphology, productivity, and adaptability to pasture environments factors that may influence their susceptibility to helminth infections. The study aims to evaluate breed and category related differences in parasitic load (EPG – eggs per gram of faeces) over time using a mixed-effects modeling. Furthermore, it explores the association between climatic trends and parasite dynamics, with a specific focus on assessing whether temperature and humidity are significant predictors of parasitic load.

METHODS

This observational study was conducted from April 2024 to March 2025 on a group of 44 selected sheep (22 animals per breed). Animals were stratified by physiological category to assess helminth burden across different life stages. Monthly faecal sampling was performed, and individual copromicroscopic analyses were carried out at the laboratories of the Regional Center for Monitoring Parasitic Infections (CREMOPAR) using the Mini-FLOTAC technique. To investigate the influence of climatic conditions on the epidemiology of GINs, temperature and relative humidity were continuously recorded in two distinct grazing areas (shaded perimeter and fully sun-exposed field) using dataloggers. A mixed-design repeated measures ANOVA was performed to evaluate the effects of breed (Bagnolese vs. Lacaune), physiological category, and time (monthly sampling) on parasite load. The dependent variable was the logarithmically transformed egg count per gram of faeces (log EPG) to meet the assumptions of normality and homogeneity of variance. Normality of residuals was tested using the Shapiro–Wilk test, while Levene’s and Mauchly’s tests were used to assess homogeneity of variance and sphericity, respectively. When sphericity was violated, Greenhouse–Geisser or Huynh–Feldt corrections were applied. To investigate the influence of climatic conditions, a lagged linear regression model was applied to monthly aggregated parasitic load and environmental variables (temperature and humidity in shaded and sun-exposed areas). The model accounted for the temporal structure of the data

using one-month lags for each predictor ($t-1$), implemented with the `dynlm()` function. All analyses were performed using RStudio (version 2024.12.0, Build 467).

RESULTS

Preliminary results showed that the average parasitic load followed a seasonal trend, with the lowest values in spring and a sharp increase in summer (Bagnolese: 310 EPG, Lacaune: 214 EPG, difference: 96.5). Bagnolese sheep consistently showed higher values than Lacaune sheep, particularly in summer, when the average load reached 262 EPG. The greatest differences were observed in the warmest months, suggesting a breed-related variation in susceptibility to gastrointestinal parasites. Parasitic load also varied across animal categories. Lambs had generally lower values, though some individuals showed high values in summer. Primiparous ewes exhibited a gradual increase, with peaks during the warm season. Adult sheep had the highest helminth infections, suggesting greater long-term exposure or reduced parasite resistance with age. These patterns were statistically confirmed by the mixed ANOVA, which revealed a highly significant effect of season on parasitic load ($p < 0.05$), indicating substantial intra-annual variation. A significant Group \times Season interaction ($p < 0.05$) suggested that seasonal patterns differed across experimental groups. In contrast, the main effects of Group ($p > 0.05$) and Breed ($p > 0.05$) were not significant. However, the Breed \times Group interaction approached significance ($p = 0.082$), pointing to a possible differential breed response depending on group conditions. Additionally, the dynamic regression analysis showed a significant effect of temperature in the previous period (lag 1) on parasitic load. A temperature increase was associated with a significant rise in the average EPG ($p < 0.05$), while humidity had no significant effect ($p \approx 1$). The model explained 64.5% of the variance in parasitic load (adjusted $R^2 = 0.556$), reinforcing the role of temperature as a key environmental driver and aligning with the observed seasonal peak.

CONCLUSIONS

The mixed ANOVA and dynamic regression analyses together demonstrated that temperature is a key environmental driver influencing parasitic load, with significant seasonal variations and differential responses among groups. The study aims to provide insights into the adaptation of different sheep breeds to helminth infections and environmental conditions, supporting the implementation of targeted helminth management programs in extensive and semi-extensive farming systems. This allowed for the evaluation of climatic influences on larval survival and helminth transmission risk. Understanding how climate and management strategies interact with breed-specific resistance to GINs is essential for developing predictive models and sustainable helminth control strategies.

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