Weathering the infection: How seasonal and environmental factors affect GI parasitism in sheep

S.T. Kalwaghe[1], H.Y. Palampalle[2], B.W. Narladkar[1], G.M. Chigure[1], G.N. Bhangale[1]*

[1]Department of Parasitology College of Veterinary and Animal Sciences, Parbhani; [2]Department of Parasitology, Mumbai Veterinary College, Mumbai, MAFSU, Nagpur, INDIA
* Corresponding author: gajumanu@gmail.com

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Abstract

This study investigates the seasonal variation in the prevalence of gastrointestinal (GI) parasitism in sheep and goats across various regions of Maharashtra. Significant seasonal differences were observed, with the highest prevalence during the monsoon season (87.80%), followed by winter (66.66%) and summer (68.18%). The study further examines the regional variation in the prevalence of parasitic infections, with Marathwada showing distinct trends compared to Western Maharashtra, Vidarbha, and Konkan. Environmental factors such as temperature and humidity were found to play a crucial role in the survival and development of parasitic larvae. Recommendations for deworming strategies are provided based on seasonal and regional variations in infection rates.

Keywords: Season; sheep; parasites; gastrointestinal helminthes

Introduction

Gastrointestinal (GI) parasitism is a significant concern for livestock farmers, particularly those raising sheep and goats, as it can have a profound impact on both animal health and productivity. These parasitic infections can lead to a variety of issues, including poor weight gain, reduced milk production, diarrhea, and even death in severe cases. In addition to these direct health impacts, GI parasitism also affects the economic viability of livestock farming by increasing veterinary costs, deworming expenses, and decreasing overall livestock performance. The most common GI parasites affecting sheep and goats include various species of nematodes, cestodes, and trematodes, with the majority of infections being caused by the Strongyle group of nematodes (Kalwaghe et al., 2022).

The prevalence of these parasitic infections in livestock varies significantly across different regions and seasons. One of the primary factors influencing the occurrence and intensity of GI parasitism is the local environmental conditions, which play a crucial role in the life cycle of parasitic organisms (Salehi et al., 2022). Temperature, humidity, and rainfall are key climatic variables that directly affect the survival, development, and transmission of parasitic larvae (Pavlovic et al., 2023). For instance, high humidity and moderate temperatures provide optimal conditions for the growth of parasitic eggs and larvae, leading to higher infection rates (Bhat et al., 2012; Castro et al., 2023). In contrast, extreme temperatures, either very cold or excessively hot, can hinder the development of parasites, leading to a decline in infection rates during such periods (Morgan and Dijk 2012).

Understanding the seasonal variation in the prevalence of GI parasitism is essential for developing effective control strategies, such as deworming schedules, and for predicting the risks associated with parasitic infections (Sivajothi and Reddy, 2018). In areas with distinct seasonal patterns, such as Maharashtra, environmental factors fluctuate dramatically throughout the year, creating conditions that favor or inhibit parasitic infections at different times. Maharashtra, with its diverse climatic zones, including tropical, semi-arid, and arid regions, presents a unique case for studying the interaction between climate and parasitism (Anand et al., 2009; Swami et al., 2021). The monsoon season, characterized by heavy rainfall and high humidity, typically fosters an environment conducive to parasite growth, while the summer and winter seasons bring contrasting conditions that influence the dynamics of parasitic prevalence (Shaikh and Naphade, 2021).

This present study was, therefore, conducted with an objective to evaluate the seasonal variation in the prevalence of GI parasitism in sheep and goats across different regions of Maharashtra. Additionally, the study examined the relationship between environmental factors and parasitic prevalence, with the goal of identifying patterns that can inform better management practices and targeted deworming schedules. By gaining a deeper understanding of how climate impacts the occurrence of GI parasitism, the study hopes to provide valuable insights for livestock farmers to reduce the economic burden of parasitic infections and improve the health and productivity of their stocks.

Materials and Methods

Data were collected from four regions in Maharashtra: Western Maharashtra, Marathwada, Vidarbha, and Konkan. The details on the sites of sample collections and number of samples collected at each location are given in Table No. 1. Sample sites were selected such that all the regions and climatic variations are included in the study. The prevalence of GI parasitism was assessed during three seasons: monsoon, winter, and summer. Fecal samples from sheep at each farm were collected throughout 2018. Fecal samples were collected from sheep and goats to estimate the Egg per Gram (EPG) of parasitic eggs. These samples were carefully obtained directly from the rectum of the sheep using a moistened finger to ensure aseptic collection. After collection, the samples were placed in min-zip locked polythene bags and transported to the Veterinary Parasitology Laboratory at Mumbai Veterinary College, taking care to preserve their moisture. In the laboratory, both qualitative and quantitative analyses of the samples were carried out using standard parasitological methods. The eggs and oocysts observed under the microscope were identified using the identification keys outlined by Soulsby (1982). The prevalence data of the parasitic fauna were analyzed using the chi-square test, with statistical significance evaluated at the 5% level using the online software WASP 2.0, developed by the ICAR – Central Coastal Agricultural Research Institute, Goa.

Results

Overall Prevalence of Parasitic Infections

The overall prevalence of parasitic infections varied significantly across seasons. The highest prevalence was observed during the monsoon season (80.93%), followed by winter (64.94%) and summer (37.93%). The

Table 1. Centres selected for the sample collection

No.	Name of the region	Name of centers
1	Konkan	Mumbai sub urban Area
		Private Farms at Village Dadae / Alonde, tehsil. Vikramgadh Dist. Palghar
2	Western Maharashtra	Punyashlok Ahilyadevi Maharashtra Sheepand Goat Development Corporation farm, Dahiwadi, Tehsil. Maan Dist .Satara
		Sheep and Goat Farms, M. P. K. V. Rahuri Dist. Ahmednagar
3	Marathwada	Private Farms at Golegaon, Tehsil. Sillod Dist. Aurangabad
		Private Farms at Jafrabad, Tehsil. Jafrabad Dist. Jalna
4	Vidarbha	Private Farms at Konti, Tehsil. Khamgaon Dist. Buldana
		Private Farms at Chandol, Tehsil. Buldana Dist. Buldana

Table 2: Overall and Season-wise prevalence of GI parasitism in sheep of Maharashtra state

Region	Winter			Summer			Monsoon			Overall			χ^2	Significance*
	T E	T P	%	T E	T P	%	T E	T P	%	T E	T P	%		
Western Maharashtra	76	57	75.0	50	22	44.0	55	48	87.27	181	127	70.2	7.42	S
Vidarbha	50	27	54.0	52	21	40.4	50	38	76.0	152	86	56.6	5.80	S
Marathwada	75	56	74.7	51	18	35.3	60	50	83.33	186	124	66.7	10.75	HS
Konkan	50	23	46.0	50	16	32.0	50	38	76.00	150	77	51.3	9.84	HS
Overall	251	163	64.9	203	77	37.9	215	174	80.9	669	414	61.9		

TE = Total number of sheep Examined; TP = Total Positive; HS = Highly Significant at both 5% and 1% level; S = Significant at 5% level.
*Indicates significance between the season in the particular region (between rows)

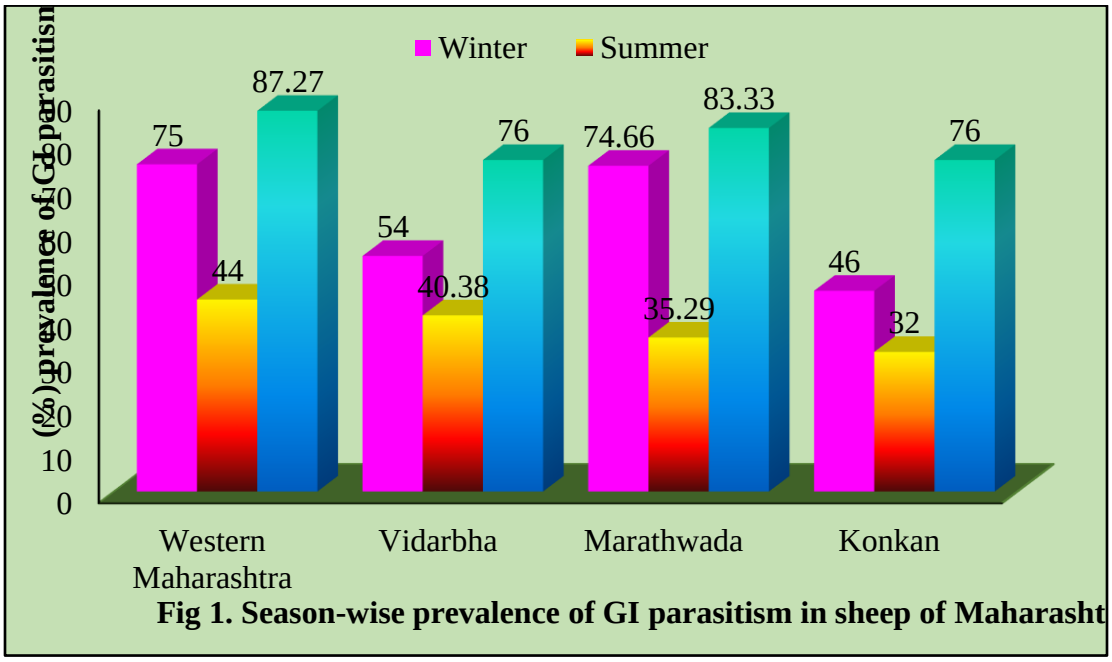

Fig 1. Season-wise prevalence of GI parasitism in sheep of Maharasht

regional variation showed that, except for Marathwada, the prevalence rates in other regions (Western Maharashtra, Vidarbha, and Konkan) were similar across all seasons.

Seasonal Prevalence of GI Parasitism in Sheep

In Western Maharashtra, the prevalence was highest during the monsoon (87.27%), followed by winter (75.00%) and lowest in summer (44.00%). In contrast, Marathwada showed a different trend, with the monsoon season having the highest prevalence (83.33%), winter slightly lower (74.66%), and summer being the lowest (35.29%). Konkan and Vidarbha regions showed similar seasonal patterns.

Environmental Factors and Prevalence

The season wise prevalence data when correlated with climatic data, it was revealed that during the monsoon season, the maximum temperature showed a significant negative correlation with EPG levels, indicating that higher temperatures were unfavorable for parasite survival. However, the minimum temperature was sufficient for larval development and survival, which contributed to the high prevalence of infections. During winter, lower temperatures and reduced grazing time led to lower infection rates. Summer, characterized by high temperatures and low humidity, showed the lowest prevalence.

Discussion

Seasonal variation in the prevalence of gastrointestinal (GI) parasitism in small ruminants is strongly influenced by environmental factors, especially temperature and humidity, which directly affect the life cycle of the parasites (Sissay et al., 2007). The monsoon season, characterized by increased rainfall and high humidity, provides favorable conditions for parasite growth, as these conditions support the development and survival of parasitic larvae. The optimal temperature range during the monsoon enhances larval hatching and the survival of infective stages on pasture, leading to a peak in infection rates during this period (Swarnkar and Singh, 2014). In contrast, the conditions during winter and summer seasons tend to hinder the development of parasites. Winter is associated with lower temperatures and reduced humidity, which can slow down the development of larvae and result in a lower prevalence of parasitic infections (Jas et al., 2022). Similarly, the summer season, characterized by high heat and low humidity, presents an unfavorable environment for the survival of larvae, leading to a sharp decline in infection rates during this period (Singh et al., 2017).

These findings are consistent with previous studies that have consistently reported the highest prevalence of GI parasitism during the monsoon season, followed by a decline during the summer months. Velusamy et al. (2015) and Singh et al. (2017) both noted that the monsoon season is the period of highest infection in sheep and goats, which is attributed to the environmental factors that favor parasite transmission. In particular, the availability of moist conditions, coupled with grazing habits during the rainy season, leads to increased exposure to infective larvae on pastures (Zajac and Garza, 2020). On the other hand, the summer season often shows the lowest prevalence due to the extreme heat and reduced humidity, which significantly lower larval survival rates (Bautista-Garfias et al., 2022).

The regional differences observed in the prevalence of GI parasitism, particularly in the Marathwada region of Maharashtra, can be attributed to variations in irrigation practices and the availability of grazing land. Regions with better irrigation facilities, such as Western Maharashtra, maintain higher humidity levels throughout the year, which supports the persistence of parasitic infections (Kalwaghe et al., 2022). In these regions, grazing lands remain fertile and humid even during the summer months, providing a suitable environment for parasite larvae to survive and continue infecting livestock (Singh et al., 2018). Conversely, areas like Marathwada, which are heavily dependent on monsoon rains and have limited irrigation infrastructure, experience a more pronounced seasonal variation. The dry conditions in the summer and the colder winter months reduce the availability of suitable habitats for parasite larvae, leading to lower infection rates during these times (Swarnkar and Singh, 2014).

Overall, these findings reinforce the idea that seasonal variation in the prevalence of GI parasitism is closely linked to the environmental factors of temperature and humidity. The ability of parasites to thrive during the monsoon season is largely driven by favorable climatic conditions, while the extremes of temperature and humidity in winter and summer serve as limiting factors that reduce the survival and transmission of parasitic larvae. Further research into region-specific deworming strategies, considering local climatic conditions, could help mitigate the economic impact of GI parasitism on livestock farming.

Conclusion

For the observations of current study it is herewith concluded the prevalence of parasitic infections in sheep exhibited significant seasonal variation, with the highest occurrence during the monsoon season, followed by winter and summer. Regional differences were observed, particularly in Marathwada, where seasonal trends deviated slightly from other regions. Based on the findings, it is recommended that deworming strategies should be tailored considering these regional and seasonal variations. Regular deworming should be planned for areas with consistent grazing land and irrigation, such as Western Maharashtra, while seasonal deworming strategies should be employed in regions like Marathwada, where grazing land is limited to the monsoon season. In areas with high summer temperatures and low humidity, regular deworming may not be necessary.

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Conflict of interest The authors declare that they have no conflict of interest.

Ethical statement The manuscript submitted does not involve any animal experimentation.

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