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Epidemiology of Trichostrongylid Nematode Infections in Sheep Under Traditional Husbandry System in Pakistan

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ABSTRACT

Some epidemiological aspects of Trichostrongylid nematodes infecting gastrointestinal tract of sheep were studied in a part of agro–ecological zone of Pakistan. Six different species of Trichostrongylid nematodes viz., *Haemonchus (H.) contortus*, *Trichostrongylus (T.) axei*, *T. colubriformis*, *Ostertagia* (*O.*) *trifurcata*, *O. circumcincta* and *Cooperia (C.) curticei* were identified from 960 gastrointestinal tracts of sheep slaughtered at local abattoir of Faisalabad. *Haemonchus contortus* was the highest in prevalence (61.5%) followed by *Trichostrongylus* species (46.1%), *Ostertagia* species (33.0%) and *C. curticei* (18.5%). A majority (94.6%) of the infected sheep harbored more than one species of nematode parasites, having minimum two and maximum three Trichostrongylid nematode species in each host. The highest prevalence was recorded in the months of July, August and September. A trend of higher prevalence was recorded in young animals and in females. An association of prevalence, worm burden, arrested larvae, availability of nematode larvae on pasture and periparturient period was observed. The results warranted development of a strategic worm control program in the area of study, which at present is not in practice anywhere in Pakistan.

Key Words: Prevalence; Larval Pasture Count; Worm Burden; Trichostrongylid Nematodes; Sheep

INTRODUCTION

Increased understanding of the biology and epidemiology of gastrointestinal parasites of sheep has led to improvement in control measures and a decrease in population losses (Michael, 1985). Numerous studies have been carried out to investigate the ecology and epidemiology of nematode parasites in countries other than Pakistan (Pandey *et al*., 1990; Garcia Romero *et al*., 1993).

The ultimate objective of the researches on helminthes is to devise effective control strategies. Multidimensional approaches are in practice for an effective control of helminths. These include periodical use of anthelmintics and epidemiological interventions coupled with improved management. It is, however, advisable to plan effective integrated control strategies based on the epidemiological findings. This paper reports for the first time some epidemiological aspects of Trichostrongylid nematodes of sheep in Pakistan.

MATERIALS AND METHODS

Study area. The district Faisalabad of agro-ecological zone was selected for the present study. Climatically, the study area is subtropical and receives an annual rainfall of about 150-350 mm. The temperature is highest in June, before the onset of monsoon season. During summer, the daily maximum temperature exceeds 40°C and seldom declines below 24°C. Relative humidity is lowest during April-May and rises during the monsoon season (Fig. 1). One year cycle is divided into four seasons viz. winter (December-February) spring (March-April) summer (May-September) and autumn (October-November). Summer also includes monsoon season (July-August).

Animal management. In the study area, sheep farmers lead a settled life in villages. They and their flocks live in mud–plastered houses in winter. Communal grazing is in practice in the area. The flocks are taken out in the morning for grazing on canal banks, roadsides, crop residues, fallow and common lands and brought back to the holding by sunset. There are two lambing seasons in the year, first in March–April and the second in October–November. Lambs are allowed to accompany their dams to pasture as soon as they are able to walk. Culling is commonly practiced in male lambs when money is needed or before the start of the breeding season. Sheep farmers have very low level of awareness about the control of worm infections, and rely on ethno–veterinary practices.

Collection of materials. A total of 960 complete gastrointestinal tracts of sheep were obtained from local abattoir of district Faisalabad and brought to the Department of Veterinary Parasitology, University of Agriculture, Faisalabad–Pakistan for examination. Only those animals were included in this study, which were brought from the study area. Random samplings were made irrespective of the age and sex of the host (s). However, a complete record of the age and sex of the animals was kept for computation of data.

Parasitological Protocols

Nematodes parasitizing the abomasums, small and large intestines. Sampling of nematodes from the abomasums, small and large intestines was carried out within four hours after the slaughter of animals. Abomasums, small and large intestines were ligated at omaso–abomasal, abomaso–duodenal and ileo–caecal junctions to prevent worms spilling from one location to another. The nematodes were recovered from the gastrointestinal tracts as described by Urquhart *et al.* (1987). Three fractions of abomasum i.e., contents, washing and digested mucosa (Roepstorff & Nansen, 1998) were examined for the inhibited larvae/immature nematodes and these were identified using standard keys (MAFF, 1979; Soulsby, 1982; Urquhart *et al*., 1987).

Pasture larval counts. The herbage samples for the recovery of larvae were collected from a selected pasture (about three acres of land) near Faisalabad through out the year at fortnightly intervals. For this purpose, the procedure described by Urquhart *et al*. (1987) was followed. The Trichostrongylid larvae/adult nematodes were examined under a microscope and identified according to the morphological characteristics given by MAFF (1979), Soulsby (1982) and Urquhart *et al*. (1987).

Parasitological data. The data recorded during this study included the following:

- Prevalence of different Trichostrongylid nematodes
- Prevalence of different combinations Trichostrongylid nematodes
- Month–wise prevalence of different Trichostrongylid nematodes
- Age–wise prevalence of different Trichostrongylid nematodes
- Sex–wise prevalence of different Trichostrongylid nematodes
- Worm burden of different Trichostrongylid nematodes
- Arrested larval development of different Trichostrongylid nematodes
- Pasture larval counts of different Trichostrongylid nematodes

RESULTS

Six species of Trichostrongylid nematodes, viz., *H. contortus* (Rudolphi, 1803), *T. axei* (Cabbold, 1879), *T. colubriformis* (Giles, 1892), *O. trifurcata* (Stiles, 1892), *O. circumcincta* (Stafrlmann, 1894) and *C. curticei* (Raillet, 1893) representing four genera were recovered from 65% (624/960) gastrointestinal tracts. *H. contortus* was the highest (61.5%) in prevalence followed by *T. axei* (32.7%), *T. colubriformis* (13.4%) *O. circumcincta* (26.0%), *O. trifurcata* (7.0%) and *C. curticei* (18.5%). A majority (94.6%) of the infected sheep harbored more than one species of nematode parasites. The maximum (46.8%) occurring combination was of *H. contortus, Trichostrongylus* species and *Ostertagia* species followed by *H. contortus* and *C. curticei* (23.6%); *H. contortus* and *Trichostrongylus* species (19.2%), and *H. contortus, Ostertagia* species and *Cooperia* species (5%). The prevalence had a decreasing trend with an increase in age of sheep being 69.2, 60.7 and 46.6% for *H. contortus*; 50.8, 46.3 and 35.4% for *Trichostrongylus* species; 37.3, 36 and 21.1% for *Ostertagia* species; and 18.4, 19.1 and 17.4% for *C. curticei* in < 1, 1–2 and > 2 years old animals, respectively. The prevalence was higher in females compared with that in males for all the nematodes recorded.

The cumulative prevalence, pasture larval counts, worm burden and number of arrested larvae have been presented in Fig. 2. The prevalence of the recorded nematodes ranged between 24.1 to 65.7%, lowest being in January and peak in August. The pasture larval counts were lowest (*n*=603) in December and a peak (*n*=1748) in August. The worm burden in sheep was minimum (*n*=207) in January and maximum (*n*=378) in October. The number of arrested larvae ranged from 116 to 228, lowest being in May and peak in November.

The prevalence of *H. contortus* ranged between 26.3 to 92.5%, lowest being in January and peak in July (Fig. 3). The pasture larval counts of *H. contortus* were lowest (*n*=225) in December and a peak (*n*=688) in September. The worm burden ranged from 72 to 136, being minimum in January and maximum in October. The number of arrested larvae ranged from 28 to 88, lowest being in May and peak in November.

The prevalence of *Trichostrongylus* species ranged between 25 to 80%, lowest being in December and peak in August (Fig. 4). The pasture larval counts of *Trichostrongylus* species were lowest (*n*=226) in December and a peak (*n*=730) in March. The worm burden ranged from 58 to 149, being minimum in January and maximum in March. The number of arrested larvae ranged from 24 to 49, lowest being in March/July and peak in November.

The prevalence of *Ostertagia* species ranged between 20 to 53.8%, lowest being in January/April and peak in November (Fig. 5). The pasture larval counts of *Ostertagia* species were lowest (*n*=78) in December and a peak (*n*=178) in August. The worm burden ranged from 38 to 66, being minimum in March and maximum in September. The number of arrested larvae ranged from 28 to 52, lowest being in April and peak in December.

The prevalence of *C. curticei* ranged between 22.5 to 51.3%, lowest being in January and peak in September (Fig. 6). The pasture larval counts of *C. curticei* were lowest (*n*=74) in December and a peak (*n*=244) in August. The worm burden ranged from 29 to 62, being minimum in June and maximum in August. The number of arrested larvae ranged from 22 to 45, lowest being in May/June and peak in November.

Fig. 1. Monthly mean ambient temperature (ºC), humidity (%) and total rainfall (mm) for the year 2000-2001 in the study area

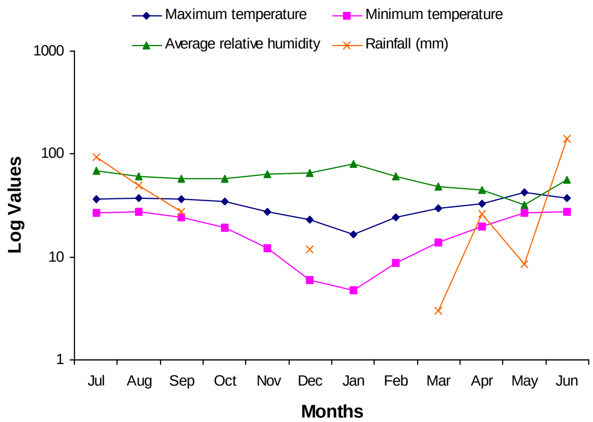


Fig. 2. Month-wise cumulative prevalence, worm burden, arrested larvae and pasture larval counts of different species of nematodes of sheep

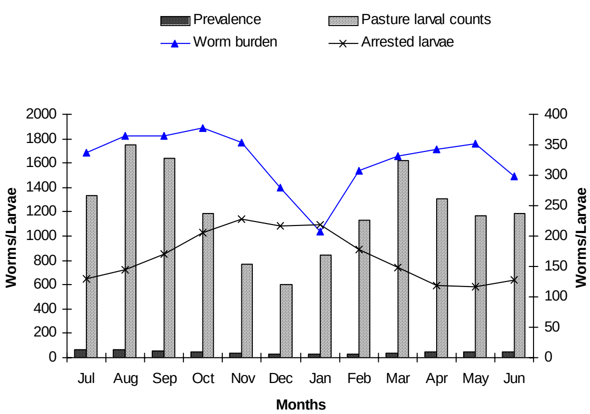


Fig. 3. Month-wise prevalence, worm burden, arrested larvae and pasture larval counts of *Haemonchus contortus* of sheep

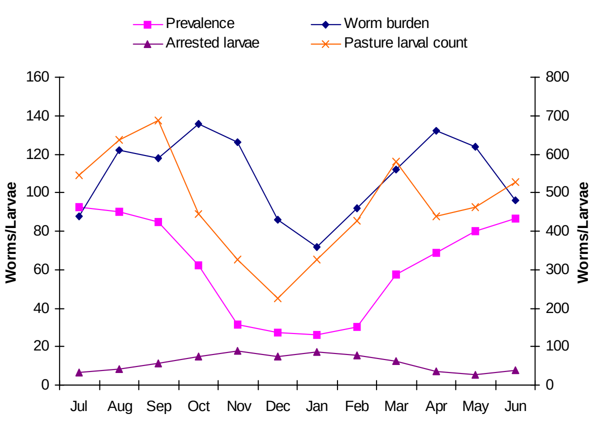


Fig. 4. Month-wise prevalence, worm burden, arrested larvae and pasture larval counts of *Trichostrongylus spp.* of sheep

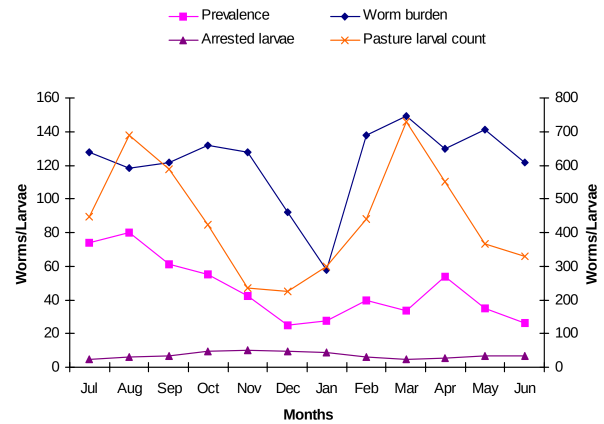


Fig. 5. Month-wise prevalence, worm burden, arrested larvae and pasture larval counts of *Ostertagia spp.* of sheep

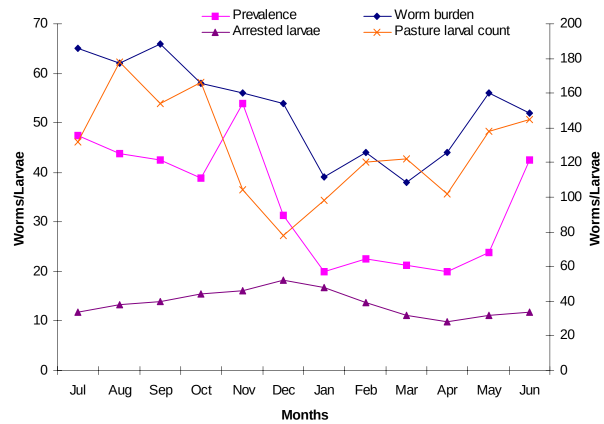
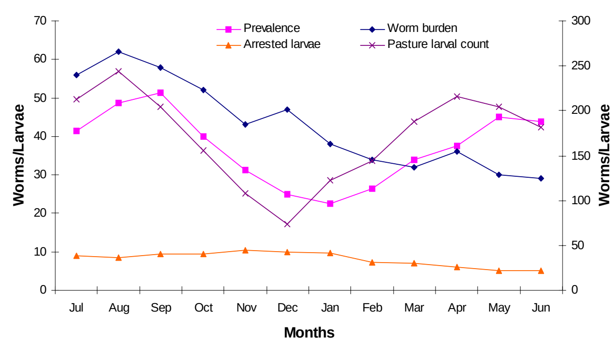


Fig. 6. Month-wise prevalence, worm burden, arrested larvae and pasture larval counts of *Cooperia curticei* of sheep



DISCUSSION

Haemonchus contortus was the major contributor to the prevalent nematodes of sheep followed by

Trichostrongylus species, *Ostertagia* species and *C. curticei*. The epidemiological findings of *H. contortus* were typical of this nematode reported elsewhere (Bali & Singh, 1977; Ahmed & Ansari, 1987; Gupta *et al*., 1987). The higher prevalence of *H. contortus* could be due to the fact that this nematode has a relatively short generation interval and ability to take the advantage of favorable environmental conditions (Grant, 1981). The mean monthly maximum temperature of 18°C or above and total monthly rainfall of 50 mm are conducive for translation and transmission of *H. contortus* (Gordon, 1953). The prepatent period for *H. contortus* in sheep is on an average of 15 days (Soulsby, 1982). Therefore, the contamination of pasture by ewes produces a peak in larval availability from mid summer and when ingested by lambs results in heavy infection capable of producing disease in late July, August and September (Armour, 1980). The larval development of *H. contortus* occurs optimally at relatively high temperatures, high humidity, microclimate of faeces and herbage, and high rainfall (Urquhart *et al*., 1987). The low rate of Haemonchosis during winter months (November to February) may be attributed to unfavorable climatic conditions like low temperature that retards the development of free–living stages and even at 9°C no development takes place (Soulsby, 1982).

The prevalence of *Trichostrongylus* species was higher in summer as that of *H. contortus*. These findings, however, are in contrast to those of Southcott *et al*. (1976) and Gordon (1953), who have considered *Trichostrongylus* species as cool–season parasites which thrive best at mean monthly temperatures ranging from 2.8°C to 18.3°C and disappear when temperature exceeds 20°C. These findings, however, are consistent with those of Gupta *et al*. (1987), who have reported no conducive effects of cool season on the *Trichostrongylus* species.

The prevalence of *Ostertagia* species was also higher in summer like that of *H. contortus* and *Trichostrongylus* species. The present findings, therefore, do not support the conclusions that the free–living stages of *Ostertagia* species thrive better in cool moist conditions (Kates, 1950; Gordon, 1953). The current findings of *C. curticei* infection are typical of those reported in other subtropical areas of the world (Stear *et al*., 1998).

The factors that may influence the prevalence of gastrointestinal nematodes include their age, sex and breed (Jorgensen *et al*., 1998), stress conditions like extreme weather (Suarz & Busetti, 1995), periparturient period (Agyei *et al*., 1991), lactation (Connan, 1976) and poor nutrition (Etter *et al*., 1999). As found in the present study, young animals have often been reported to have higher rates of worm infection and burden (Maqsood *et al*., 1996). This may be due to better immune status and establishment of immunocompetence of the host because of repeated exposure to worm infection in older age (Silverman & Patterson, 1960). Similar to the findings of current study, most of the researchers have observed higher rates of nematode infection/worm burden in female hosts compared with the males (Iqbal *et al*., 1993; Maqsood *et al*., 1996). In contrast to the current results, Gulland and Fox (1992) reported that prevalence and intensity of infection (faecal egg counts) were higher in males than females, except during the lambing periods, and decreased with age in both sexes.

The trend of prevalence of different nematodes synchronized with the periods of increased availability of nematode larvae on pastures. A warm and moist summer, as in the study area, is well suited to the development and survival of the free–living stages of nematodes (Grant, 1981). The reduction of pasture larval counts during winter is attributed to low resistance of the free–living stages of nematodes to quick varying weather conditions (Kates, 1950). The higher number of pasture larval count during summer is due to their rapid development in these months as also reported by Boag and Thomas (1971). A fall in the larval counts from November to January is considered due to high mortality of free–living stages as a result of the depletion of energy reserves associated with low temperature and inadequate rain in winter season. The current findings of pasture larval counts are supported by the climatic data, which indicates better rainfall or the post rainfall effect during February to October compared with that during November to January. Similar observations on the availability and abundance of nematode larvae during rainy season have been made previously (Dorny *et al*., 1995; Amarante & Barbosa, 1998). The pasture contamination, therefore, have direct influence on the population dynamics of nematodes like that of *T. colubriformis* (Almeria & Uriarte, 1999).

The phenomenon of hypobiosis was observed in all the nematodes recorded in the present study. The higher trend in the number of arrested larvae during winter, however, indicated its association with the adverse climatic conditions. Arrested larval development (El–Azazy, 1995) of nematodes is an important factor having high epidemiological significance. In addition to the above factors, the development of nematode eggs to infective larvae and the survival of these larvae on pasture are influenced by temperature, rainfall and other environmental conditions (Banks *et al.*, 1990; Besier & Dunsmore, 1993). Altaif and Issa (1983) and El–Azazy (1995) have demonstrated summer inhibition (hypobiosis) of *Ostertagia* species, *Trichostrongylus* species and *H. contortus* due to high temperature and desiccation.

The effect of periparturient stress on the prevalence of nematodes was observed for all the nematodes except *Ostertagia* species. Lyons *et al*. (1992) and reported a progressive increase in the egg per gram and number of helminths in ewes during and after the parturition period. This phenomenon has been attributed to a variety of reasons like seasonal changes, host factors, activation of hypobiotic larvae, parturition stress, poor nutritional status, peri–parturient relaxation in immunity (PPRI), hormonal changes around parturition, breed differences etc. etc. Pandey *et al*. (1990) reported that faecal egg counts of ewes showed two peaks: the first in March due to the acquisition of larvae during the rainy season and peri–parturient rise, the second in October probably due to maturation of inhibited larvae.

It may be concluded that nematode burdens remained at levels at which production is severely impaired throughout the year. Therefore, strategic treatments of sheep flocks leading to sustained benefits are recommended. Four treatments, i.e. February, May, August, October, each 12 weeks apart is recommended for the study area. Apart from this, lambing and lactating ewes may particularly be targeted for tactical treatments keeping in view their clinical situation. These strategic treatments will cover the peri–parturient periods, time of movement to the pastures, weaning periods and summer rainfall times (best time for egg hatching) leading to lesser pasture contamination with nematode eggs/larvae. The timing of these treatments, however, may be modified to coincide better with husbandry procedures determined by actual lambing time. Grazing management, although is of value but nearly impossible to be carried out in the study area due to communal grazing practices on the canal banks, roadsides, etc.

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