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Short communication

# Epidemiology and seasonal dynamics of adult *Haemonchus contortus* in goats of Aligarh, Uttar Pradesh, India.

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ABSTRACT

A survey was carried out to determine the prevalence and seasonal abundance of *Haemonchus contortus* in the semi arid zone of Uttar Pradesh, India between January 2010 to December 2013. Entire gastrointestinal tract from slaughtered goats were brought to the laboratory. Parasites were collected from the abomasum, counted and recorded on monthly basis. The collected data were analyzed on the basis of temperature, rainfall and humidity of the months/seasons. Out of total 635 goats, 383 (60%) were found to be infected with *H. contortus*. The mean intensity and abundance was found as 354 and 263 respectively. Marked variations in the prevalence, mean intensity and abundance were noticed during different month/season of the year. Highest values of these infection indices were found in the rainy season and lowest in summer. Although prevalence, intensity and abundance were positively correlated with temperature, rainfall and humidity but only the effect of rainfall was found to be statistically significant. The present study provides a consolidated account on the seasonal dynamics of *H. contortus*, which can be used for integrated control measures of this blood sucking parasite under local environment conditions.

## 1. Introduction

India is basically an agricultural country where almost 70% of the population depends on agriculture for livelihood (Delphine and Thatheyus, 2003). Rearing of livestock is an integral part of agriculture where over 15–20% families are landless and about 80% of the land holders belong to the category of small and marginal farmers (Anon, 2010). The rural livestock population is still reared on grazing based system and breeding is mostly done through the natural method although artificial insemination is now practiced by the government institutes to improve the productivity (Anon, 2017). Parasitic infections are highly prevalent in India due to its hot and humid climate, which favours the development and survival of parasites. Among the diseases that constrain the survival and productivity of sheep and goats, gastrointestinal nematode infection ranks highest on a global index on the basis of their impact on poor with *Haemonchus contortus* being of overwhelming importance (Perry et al., 2002).

*H.contortus* is a haematophagous parasite of small ruminants and a significant cause of morbidities and mortalities worldwide especially in warm and moist climate. The importance of this worm is due to combination of high fecundity and a short developmental period that provides an enviable developmental plasticity for adaptation/resistance to control measures (Besier et al., 2016; Emery et al., 2016; Rashid and Irshadullah, 2014). The usual mode of control of haemonchosis is based on the repeated use of anthelmintics. However, indiscriminate uses of anthelmintics in organized and private farms cause multiple drug resistant among parasites, which is currently a major issue in the production of small ruminants in different parts of India. Because of development of drug resistance among gastrointestinal nematodes alternative control strategies like rotational grazing, selective breeding, nutritional supplementation, selective treatment and use of plants, containing natural anthelminthics are being used to cope with increasing anthelmintics resistance (Sahoo and Khan, 2016). Efficient and effective parasite control is only possible if sufficient information is available on prevailing epidemiological factors which determine the frequency and transmission of diseases (Barger 1999). Many studies around the world have confirmed that the development and survival of *H. contortus* depends upon various climatic factors (Fernández et al., 1994; Miro et al., 1991; Connor et al., 2007, 2006;). This situation warns the need of comprehensive epidemiological knowledge in order to devise an appropriate and cost effective strategy to control this parasite.

Literature survey reveals that *H. contortus* is one of the most dominating parasites of sheep and goats and is quite prevalent throughout the world (Akkari et al., 2013; Asif et al., 2008; Burke et al., 2016; Gebresilassie and Tadele, 2015; Holm et al., 2014; Miller et al., 1998;

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Nahar et al., 2015; Rajapakseet al., 2008; Tan et al., 2014; Uriarte et al., 2003; Vlassoff et al., 2001) as well as in many parts of India (Bandyopadhyay et al., 2010; Bukhari and Sanyal, 2011; Mir et al., 2013; Palanivel et al., 2012; Pathak and Pal, 2008; Shirale and Made, 2007; Singh et al., 2015,1997; Sood, 1983; Sutar et al., 2010; Tariq et al., 2010) but no comprehensive studies have been done so far in Aligarh district of Uttar Pradesh. Therefore in the present study the seasonal dynamics and the effect of various environmental factors on the prevalence of *H. contortus* in goats was studied in Aligarh district, a semi-arid region of north India.

## 2. Materials and methods

### 2.1. Study area

The present study was carried out from January 2010 to December 2013 in Aligarh district, located in the western part of Uttar Pradesh approximately 140 km south-east of the capital city, New Delhi. It lies between 27°53′N, 78°05′E and 27°88′N, 78°08′E coordinates, covering a total area of 3747 square km and having a population of about 3.7 million. It has an elevation of approximately 178 m. The city is in the middle portion of the doab, the land between the Ganga and the Yamuna rivers (Anon, 2011a,b). The total livestock population in Aligarh district is about 1.05 million, among which there are 153,453 cattle, 841,392 buffaloes, 11,841 sheeps, 172,196 goats and 25,711 pigs (Anon, 2013).

### 2.2. Climate

Aligarh has a monsoon-influenced climate typically that of subtropical humid type with three types of seasons, summer (March to June), rainy/monsoon (July to September) and winter (October to February) (O'Hare, 1997). Mean temperature, relative humidity and rainfall during different months/season is presented in Table 1, which is based on the data collected from the Meteorological Centre, Department of Physics, Aligarh Muslim University, Aligarh. Summer is very hot in Aligarh, with maximum temperature (46 °C) recorded in May. The average temperature range in summer is about 25–35 °C. The rainy season starts from late June and continues till September. Annual rainfall in Aligarh district was recorded as 899 mm out of which about 80% was received during the monsoon period. Winters are usually very cold in December and January where temperature drops to $^{<}2$ °C. The relative humidity was comparatively low during summer and high during rainy and winter seasons.

**Table 1**
Mean temperature, relative humidity and rainfall during different months of the year in Aligarh city (2010–2013).
Source: Metrological Center, Department of Physics, A.M.U., Aligarh.

| Month | Temperature (°C) | Rainfall (mm) | Relative humidity (%) |
|---|---|---|---|
| January | 12.8 (1.4–26.5) | 10 (0.1–16.2) | 71 (49–98) |
| February | 17.7 (7.4–31.5) | 30 (1.6–27) | 74 (36–98) |
| March | 24.5 (10–38.5) | 1 (0.4–1.8) | 57 (27–90) |
| April | 29.8 (18.2–43.8) | 11 (0.1–12.6) | 39 (15–78) |
| May | 33.7 (21–46.4) | 20 (0.1–26.2) | 39 (17–66) |
| June | 34.7 (27–44.6) | 73 (0.4–94.6) | 54 (22–98) |
| July | 30.1 (25–38.6) | 285 (1–103.6) | 79 (46–98) |
| August | 29.3 (25–35) | 249 (0.2–69.2) | 85 (63–100) |
| September | 28.7 (23.4–36) | 198 (0.1–122.6) | 75 (61–98) |
| October | 26.4 (16–35) | 11 (1.6–7.4) | 65 (38–98) |
| November | 21.1 (10–32) | 5 (0.2–11) | 69 (42–94) |
| December | 15.6 (4–24) | 6 (0.6–12.8) | 76 (48–97) |

Values are the mean of 4 years data (2010–2013). Values in parenthesis represent the minimum and maximum range.

### 2.3. Sample collection and examination

The entire gastrointestinal tracts were collected twice a week from goats of approximately an year old, slaughtered at the Aligarh abattoir and brought to the laboratory in separate plastic bags. Abomasum was separated from GI tract, opened longitudinally and the content was collected in a large beaker. The mucosae were washed with Hanks balanced salt solution (HBSS) and washing was drained in the same beaker and then carefully scraped to remove any adhering worms. If the worms were embedded in the mucosa they were removed with the help of forceps. The entire washings from the abomasum were diluted with HBSS and examined for worms. *H. contortus* worms were separated, counted and recorded on monthly basis. The obtained data on *H. contortus* were used to calculate the prevalence, mean intensity and abundance (infection indices) according to the following formulae as given by Margolis et al. (1982).

$$\text{Prevalence}(\%) : \frac{\text{Total number of individuals infected with particular parasite species}}{\text{Total number of host examined}} \times 100$$

$$\text{Mean intensity}: \frac{\text{Total number of individuals of a particular parasite species}}{\text{Total number of infected individuals of the species}}$$

$$\text{Abundance} : \frac{\text{Total number of individuals of a particular parasite species}}{\text{Total number of the host species examined (infected+uninfected)}}$$

Furthermore, the data were analyzed on the basis of temperature, rainfall and relative humidity of different months of the year, to assess the influences of meteorological factors.

### 2.4. Statistical analysis

Pearson's correlation coefficient was calculated by using SPSS 16 (SPSS Inc., USA) to assess the association between meteorological factors and infection indices throughout the year. Chi Square analysis was used to find out the significant differences between prevalence values of different months of the year whereas Kruskal–Wallis test (nonparametric ANOVA) was performed to determine the significant differences between the values of mean intensity and abundance during different months. $p$ value $\leq 0.05$ was considered as significant. The software used was Graph Pad Instat version 3.06, (Graph Pad Software, U.S.A).

## 3. Result

A total of 635 abomasa were examined among which 383 (60%) were found to be infected with *H. contortus*. The mean intensity and abundance was found as 354 and 263 respectively. Although, goats were found to be infected with *H. contortus* throughout the year but considerable variations were noticed in the worm burden during different months. The prevalence was highest in the month of August (96.66%) followed by September (90.38%) while the lowest infection was recorded in January (24.48%) and February (31.81%) (Table 2). Statistical analysis by Chi square test revealed significant difference between the prevalence rate of all months ($\chi = 79.85$, $p < 0.001$). It was observed that prevalence rate declines with the decrease of temperature from 29 °C (August) to 10 °C (January) and then slowly increases with the rise of temperature. Low prevalence was found in those months in which either temperature is very high (June, 34 °C) or very low (January, 12.8 °C). Prevalence of *H. contortus* was found higher during monsoon season (July–September) and then decreases with the decline of rainfall. Relative humidity was found to be partially related with the prevalence. It was noticed that when the relative humidity was below 40% (April and May) the prevalence rate was low, whereas in August when the humidity was very high (85%) the prevalence rate was