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Prevalence of haemoprotozoan diseases in cattle and buffaloes in Eastern Uttar Pradesh (2020-2025)

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Abstract
Haemoprotozoan diseases such as babesiosis, theileriosis, and anaplasmosis continue to pose significant health challenges to livestock in tropical countries like India. These vector-borne infections are caused by intra-erythrocytic protozoan parasites transmitted primarily through ticks, with significant implications on animal health and economic productivity. The current study investigates the prevalence of these infections among cattle and buffaloes in Eastern Uttar Pradesh, a region characterized by humid subtropical climatic conditions conducive to vector proliferation. Over six years (2020-2025), 969 blood samples were examined using Giemsa-stained peripheral blood smear microscopy. The overall prevalence of *Babesia spp.*, *Theileria spp.*, and *Anaplasma spp.* were found to be 10.73%, 10.01%, and 10.52% respectively. A distinct seasonal trend was observed, with a higher number of infections occurring during the monsoon and post-monsoon seasons. The study provides crucial epidemiological insights necessary for designing strategic control measures and improving the management of haemoprotozoan infections in bovines.

Keywords: Haemoprotozoan, babesiosis, theileriosis, anaplasmosis, cattle, buffalo, prevalence, Eastern Uttar Pradesh, vector-borne, tick-borne disease, epidemiology

1. Introduction
Livestock forms a vital component of the agricultural economy in India, especially in rural regions where cattle and buffaloes are essential for milk, meat, manure, and draft power. However, infectious diseases remain a major constraint to optimal productivity. Among these, haemoprotozoan infections, particularly babesiosis (*Babesia bigemina*, *Babesia bovis*), theileriosis (*Theileria annulata*), and anaplasmosis (*Anaplasma marginale*), are of significant concern (Sivakumar *et al*., 2012; Aktas *et al*., 2015) [13, 1].
These infections are primarily transmitted by ixodid ticks, including *Rhipicephalus (Boophilus) microplus* and *Hyalomma anatolicum*, whose population dynamics are influenced by climatic conditions such as temperature, humidity, and rainfall (Ghosh *et al*., 2007) [4]. Eastern Uttar Pradesh (E-UP), with its dense bovine population, abundant vector presence, and warm-humid climate, is particularly susceptible to these diseases (Kumar *et al*., 2018) [7].
Despite the endemic nature of these infections, systematic longitudinal studies on their prevalence and seasonal trends in E-UP are scarce. Hence, this study was designed to bridge this gap and generate comprehensive data for better regional disease control planning.

2. Materials and Methods
2.1 Study Area
The study was conducted in Eastern Uttar Pradesh, encompassing districts such as Gorakhpur, Deoria, Azamgarh, Ballia, Mau, and adjoining regions. The region has a typical humid subtropical climate with hot summers, monsoon rains, and cool winters, favoring tick development and survival.

2.2 Sample Collection
From January 2020 to April 2025, a total of 969 blood samples were collected from cattle and buffaloes. Samples were collected from both clinically symptomatic and asymptomatic animals through jugular venipuncture into EDTA-coated vials from Veterinary Clinical Complex, Kumarganj, Ayodhya.

2.3 Diagnostic Procedure
Thin blood smears were prepared, air-dried, and fixed with methanol. The smears were stained with Giemsa stain and examined under oil immersion (1000×) to detect *Babesia spp.*, *Theileria spp.*, and *Anaplasma spp.*, based on morphological criteria (Soulsby, 1982; Radostits *et al*., 2007) [14, 10].

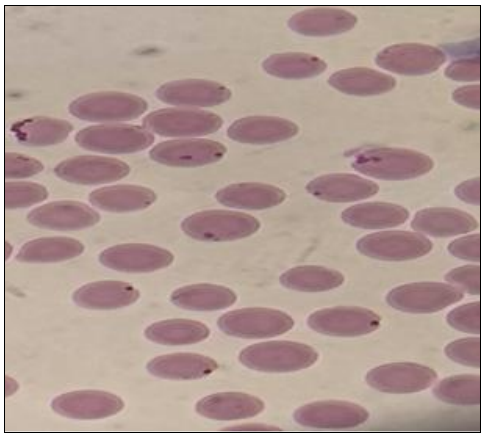

Fig 1: Presence of Anaplasma species in erythrocyte

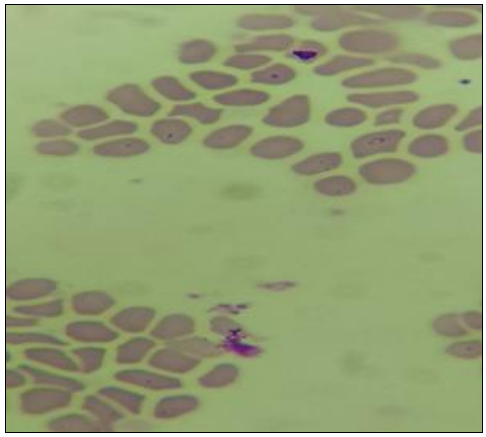

Fig 2: Presence of Theleria piroplasm in erythrocyte

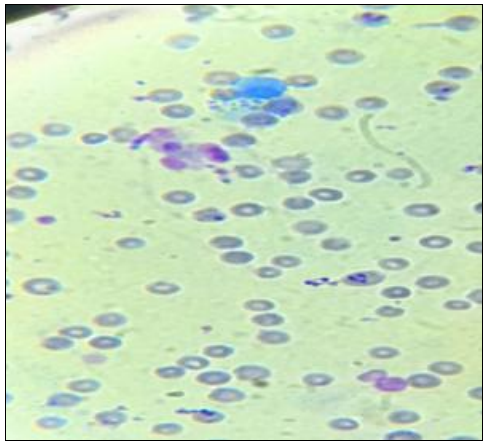

Fig 3: Presence of Babesia piroplasm in erythrocyte

2.4 Data Categorization
Samples were grouped by three seasonal quarters:
- Jan-Apr (winter-early summer)
- May-Aug (monsoon)
- Sep-Dec (post-monsoon-winter)

Table 1: Data were recorded yearly and analyzed for prevalence patterns.

Month		2020	2021	2022	2023	2024	2025
Jan - April	Total sample	36	20	27	67	92	89
	Positive	9	4	6	13	13	16
	Babesia	5	1	1	6	6	4
	Theleria	2	1	0	4	3	6
	Anaplasma	2	2	5	3	4	6
May-Aug	Total sample	32	23	31	81	113	86
	Positive	7	5	9	16	17	12
	Babesia	1	3	4	7	7	7
	Theleria	1	2	2	5	7	0
	Anaplasma	5	0	3	3	3	5
Sep-Dec	Total sample	41	30	21	76	104	
	Positive	9	8	9	11	21	
	Babesia	3	3	3	2	9	
	Theleria	4	2	4	7	7	
	Anaplasma	2	3	2	2	5	
Total sample		109	73	79	224	309	175
	Babesia	9	7	8	15	22	11
	Theleria	7	5	6	16	19	6
	Anaplasma	9	5	10	8	12	11

3. Results

Table 2: Year-Wise and Pathogen-Wise Prevalence

Year	Total Samples	Babesia (%)	Theileria (%)	Anaplasma (%)
2020	109	9 (8.26%)	7 (6.42%)	9 (8.26%)
2021	73	7 (9.59%)	5 (6.85%)	5 (6.85%)
2022	79	8 (10.12%)	6 (7.59%)	10 (12.65%)
2023	224	15 (6.70%)	16 (7.14%)	8 (3.57%)
2024	309	22 (7.12%)	19 (6.14%)	12 (3.88%)
2025	175	11 (6.29%)	6 (3.43%)	11 (6.29%)
Total	969	72 (7.43%)	59 (6.09%)	55 (5.67%)

The highest positivity for *Babesia* was noted in 2024, while *Theileria* peaked in 2023. *Anaplasma* prevalence remained stable with slight increases in 2022 and 2025.

3.1 Seasonal Trends
Monsoon (May-August) and post-monsoon (September-December) showed a higher burden of infections, particularly in 2023 and 2024. This trend correlates with the lifecycle of *Rhipicephalus* and *Hyalomma* ticks, which peak in warm, humid environments (Kumar *et al*., 2020) [8].

4. Discussion
The current study confirms that haemoprotozoan diseases are endemic in E-UP, with a fluctuating yet persistent presence. The overall positivity rate aligns with earlier studies conducted in adjacent regions (Jaiswal *et al*., 2017; Singh *et al*., 2021) [5, 12].

4.1 Babesiosis
The prevalence of *Babesia* ranged from 6.29% to 10.12%, comparable to national estimates of 7-12% (Bansal *et al*., 2015; Kolte *et al*., 2021) [2, 6]. The pathogen is responsible for acute intravascular hemolysis, and subclinical infections may

persist in carrier animals, contributing to its transmission.

4.2 Theileriosis
Theileriosis was consistently observed, with a peak in monsoon months, supporting the role of *Hyalomma* ticks (Ghosh *et al*., 2007) [4]. Reports by Sharma *et al*. (2019) [11] and Nandi *et al*. (2020) [9] have noted similar seasonal patterns.

4.3 Anaplasmosis
Though generally considered less pathogenic than babesiosis or theileriosis, anaplasmosis had notable prevalence, particularly in 2022 and 2025. The mechanical transmission through biting flies, along with persistent carriers, may explain this trend (de la Fuente *et al*., 2005) [3].

5. Conclusion
This six-year surveillance confirms that haemoprotozoan diseases continue to pose a significant threat to bovine health in Eastern Uttar Pradesh. There is a marked seasonal influence, with monsoon and post-monsoon months showing higher prevalence. These results underscore the need for:

- Regular tick surveillance and control programs
- Strategic prophylaxis during peak vector seasons
- Awareness and training among farmers on early diagnosis

Future studies should include molecular diagnostics (PCR, ELISA) for better pathogen differentiation and detection of carrier states.

6. Conflict of Interest
Not available.

7. Financial Support
Not available.

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