IJCRT.ORG ISSN : 2320-2882
INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)
An International Open Access, Peer-reviewed, Refereed Journal

A Study on biology of cattle tick , *Rhipicephalus microplus* (Order :Arachnida)

Vipul Pandey

P.G. Department of Zoology, B.S.N.V.P.G. College (University of Lucknow), Lucknow , UP, India.

ABSTRACT

The review paper delves into the biology of *Rhipicephalus microplus* which is a significant cattle tick species. As a pervasive ectoparasite, *R. microplus* poses a substantial threat to livestock, causing economic losses and compromising animal welfare. By comprehensively examining its life cycle, morphology, and pathogenicity, this review aims to shed light on the tick's impact on cattle health and productivity. Additionally, the paper explores preventive measures and discusses the potential consequences of tick-borne diseases, emphasizing the urgent need for effective control strategies. Studying *R. microplus* is crucial for safeguarding cattle farming and ensuring sustainable livestock management in the face of these challenges.

Keywords : ***Rhipicephalus microplus* , Ectoparasite, Pathogenicity , Livestock.**

INTRODUCTION

Rhipicephalus (*Boophilus*) microplus (formerly *Boophilus microplus*) is an important livestock tick in tropical and subtropical regions. Although cattle and other bovids are its primary hosts, it can be found on other domestic animals and wildlife, and goats might be a maintenance host in some locations. Heavy tick burdens can cause anemia, decrease livestock productivity and damage hides. The significance of cattle ticks lies in their potential to severely impact cattle health, growth, and productivity. The resulting economic losses, ranging from reduced meat and milk production to treatment expenses and losses from tick-borne diseases, emphasize the need for effective tick management strategies. Understanding the biology and behavior of cattle ticks, such as *Rhipicephalus microplus*, is crucial for devising strategies to mitigate their negative effects and ensuring the sustainability of cattle farming operations. Vector-borne pathogens cause diseases with a great impact on public and veterinary health and have accounted for 22% of emerging infections between 1940 and 2004 (Jones et al., 2008). As obligate hematophagous arthropod pests of vertebrates, ticks pose serious threats to beef and dairy cattle producers. It has been estimated that 80% of the world's cattle population is at risk from tick and tick-borne diseases (TBDs) causing estimated annual losses of US$ 22–30 billion (Lew-Tabor and Rodriguez Valle, 2016).

Since the establishment of extensive vector control programs, a steady decline in vector-borne diseases was observed last century, however recently the emergence and re-emergence of vector-borne diseases has been observed. This re-emergence may be linked to new global trends associated with changes in animal husbandry, urbanization, animal transboundary transportation, and globalization (Ogden and Lindsay, 2016). In this scenario, various approaches for tick control are in practice around the world in accordance with local legislation, environmental conditions, price based selection, and geography. Acaricide (synthetic pesticides) application is the most common component of tick control strategies, however the use of acaricides impose numerous limitations including the selective pressure for the development of more resistant ticks, environmental contamination, drug residues in food products, the expense of developing new acaricides, and the difficulty of producing tick-resistant cattle while maintaining desirable production characteristics (Willadsen, 2004; Abbas et al., 2014). Anti-tick vaccines are a very promising alternative to acaricide usage, however are still insufficient to confer protection against multiple tick species in various geographical regions (de la Fuente and Contreras, 2015; de la Fuente et al., 2016; Schetters et al., 2016).

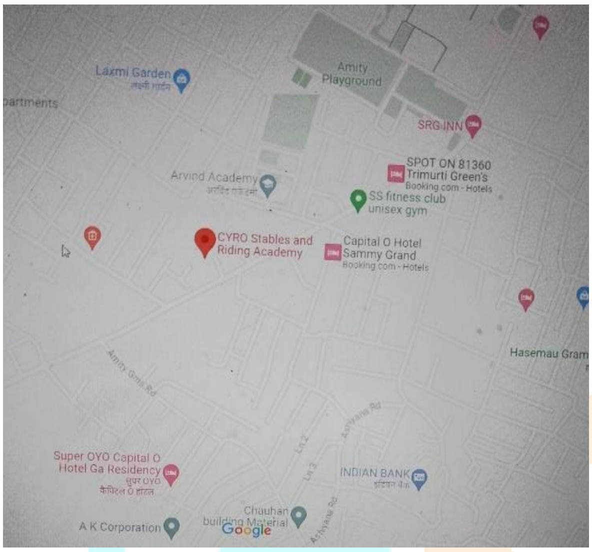
Anti-tick immunity has been described in guinea pigs, cattle and rabbits, and refers to the capacity of previously exposed hosts to interfere with tick feeding and reproductive fecundity (Nuttall, 1911; Trager, 1939; Hewetson, 1972). A reduction in tick weight, duration of attachment, number of ticks feeding, egg mass, and molting success are some of the parameters measured to determine host anti-tick immunity (Trager, 1939). For the first time, Nuttall (1911) demonstrated host immunity to ticks as a phenomenon of natural immunity in humans. Experimentally, acquired resistance to tick infestation was observed by Trager (1939), who noticed that after repeated infestation of Dermacentor variabilis on guinea pigs, the host developed resistance to subsequent tick infestation, shown by the decreasing number of successfully feeding larvae. Furthermore, it was found that as compared with larvae infesting a host with no previous exposure to ticks, larvae infesting resistant hosts weighed less. Several researchers continued to observe host resistance to tick feeding affecting each tick life stage (Gregson, 1941; Feldman-Muhsam, 1964; Wikel, 1996). In this review paper the methodology of tick collection, the taxonomy of R. microplus, its habit and habitat, morphology , life cycle , pathogenicity and preventive measures have been discussed.

STUDY SITE :

Majority of the ticks were collected directly from Mishra Gaushala and Rescue Unit behind Amity University, STP road , Gomti nagar extension, Lucknow (26.8522° N, 81.0501° E) and some were obtained from a cowshed near Lucknow University . It is a private sector oriented unit where help is aided to the animals who end up becoming the victims of accidents and also includes cattles for the supply of dairy products.

MATERIAL AND METHOD :

Several techniques have been used by many workers for the collection of ticks , but in this investigation hand picking and picking with forceps has been used. These parasites were preserved in 70% alcohol with some drops of glycerine and were brought to the laboratory. Before the mounting, ticks are treated with dil. KOH and dehydrated in ascending series of alcohol. After proper dehydration the ticks were processed for morphological preparations. Prepared slides were examined under light microscope for all changes in morphological organizations (Kumar and Singh , 2005).



A **B**

Fig A : Google map showing the location of the site.
Fig B : Study Site.

CLASSIFICATION

Kingdom: Animalia

Phylum: Arthropoda

Subphylum: Chelicerata

Class: Arachnida

Subclass: Acari

Order: Ixodida

Family: Ixodidae

Genus: *Rhipicephalus*

Species*: microplus*

This classification places *Rhipicephalus microplus* within the Ixodida order, Ixodidae family, and Rhipicephalus genus.

HABIT AND HABITAT

Rhipicephalus microplus, commonly known as the southern cattle tick or tropical cattle tick, exhibits a widespread geographical distribution, primarily in tropical and subtropical regions. Its adaptability to warm and humid environments has contributed to its prevalence in various parts of the world**.** This tick is endemic in Mexico, parts of Asia, Africa and South and Central America, and various islands (e.g., Madagascar, Comoro Islands, Mascarene Islands, French Polynesia, Guam, Solomon Islands, the Caribbean).
Rhipicephalus microplus, the southern cattle tick or tropical cattle tick, has a range of preferred hosts, mainly livestock species. Its feeding habits and attachment to various hosts can have significant impacts on different animals. Cattle are the primary hosts for *R. microplus*. The impact of tick infestations on cattle includes blood loss over time. This can lead to anemia, weakness, reduced weight gain, and decreased milk production.Tick bites cause skin irritation, leading to constant itching and restlessness among cattle. While not as common as on cattle, *R. microplus* can infest horses. The impact on horses includes skin irritation, itching, and potential transmission of tick-borne diseases.These livestock species can also be hosts for R. microplus. Infestations can lead to skin irritation, blood loss, anemia, and reduced productivity, affecting meat and wool production. In some cases, *R. microplus* can also infest wildlife species, including deer and other mammals. These infestations can impact wildlife health and contribute to the spread of ticks to domestic animals. Though less common, *R. microplus* can infest dogs and cats. While the impact is generally lower than on livestock, tick infestations can still cause skin irritation, itching, and the transmission of tick-borne diseases.
The impact of *R. microplus* infestations varies depending on factors such as the animal's species, age, health status, and the severity of infestations. For livestock, the economic consequences can be substantial, affecting meat and milk production, causing treatment expenses and leading to reduced animal well being.

MORPHOLOGY

The size of *R. microplus* ticks can vary based on their developmental stage. On average, adult females measure about 3-4 mm in length, while adult males are slightly smaller, ranging from 2.5-3 mm. Nymphs and larvae are even smaller, with nymphs measuring around 0.5 mm and larvae around 0.3 mm. The color of *R. microplus* ticks can vary depending on their life stage and whether they have recently fed. Generally, unfed ticks appear light gray or brownish in color. After feeding on blood, their bodies become engorged and their color darkens to a reddish-brown hue. One of the most distinguishing features of *R. microplus* ticks is the scutum, a hard shield-like structure on the dorsal side of the tick's body. In females, the scutum covers a smaller portion of the body compared to males.The scutum is ornamented with patterns that can help differentiate *R. microplus* from other tick species. These patterns often include intricate markings and shapes that vary based on the tick's developmental stage.The hypostome is a specialized structure on the tick's mouthparts used for attaching to hosts during feeding. *R. microplus* ticks have a prominent and serrated hypostome that facilitates their attachment to the host's skin. The ticks have eight legs and a capitulum (mouthparts) that extend from the front of their body. The capitulum contains the hypostome and structures used for feeding. The palpi are paired structures located near the front of the tick's body. They are used for sensing the host and locating suitable feeding sites.There is sexual dimorphism in *R. microplus*, with adult females generally larger and having a broader body compared to males. Additionally, the scutum covers a larger area in males. (Plate 1, Figure 1).

LIFE CYCLE

R. microplus is a one-host tick: once the larva hatches and finds a host, all of its life stages are usually spent on that animal.Female *R. microplus* typically deposit their eggs in crevices or debris, or under stones.Once the larvae hatch, they crawl up grass or other plants to find a host. They may also be blown by the wind. The larvae can survive for as long as 3 to 4 months without feeding in summer and upto 6 months in cooler temperatures.Newly attached larvae (also called ‘seed ticks’) are usually found on the softer skin inside the thigh, flanks, and forelegs.They may also occur on the abdomen and brisket. Each developmental stage (larva, nymph and adult) feeds only once, over a period of several days. Larvae and nymphs molt to the next stage after feeding, while remaining on the same animal. Adult male ticks become sexually mature after feeding and mate with feeding females.An adult female tick that has fed and mated detaches from the host and deposits a single batch of many eggs in the environment, then dies after ovipositing. (Plate 2 , Figure 1).

PATHOGENICITY

Rhipicephalus microplus, the southern cattle tick or tropical cattle tick, is a vector for several diseases that can affect both cattle and other potential hosts. These tick-borne diseases can have significant impacts on the health, productivity, and economic viability of livestock and other animals.

Bovine Babesiosis (Texas Cattle Fever) is caused by protozoan parasites of the genus *Babesia*, such as *Babesia bovis* and *Babesia bigemina*. Bovine babesiosis leads to symptoms such as fever, anemia, jaundice (yellowing of the skin and mucous membranes), and hemoglobinuria (presence of blood in urine). Severe cases can result in death, especially in young cattle.The tick transmits Babesia parasites to cattle during feeding. The parasites infect red blood cells, leading to the disease.

Anaplasmosis is caused by the bacteria of the genus *Anaplasma*, specifically *Anaplasma marginale*. Anaplasmosis causes anemia, fever, jaundice, and reduced weight gain in cattle. Severe infections can lead to death. *R. microplus* transmits *Anaplasma marginale* while feeding. The bacteria infect red blood cells, causing destruction and anemia.

The tick is associated with the transmission of equine piroplasmosis, caused by parasites *Babesia caballi* and *Theileria* . Infected horses can experience fever, anemia, and other health issues. *R. microplus* can infest various wildlife species, transmitting tick-borne diseases to these animals and serving as a reservoir for infection.The tick-borne diseases not only affect animal health but also have economic implications for livestock industries. The loss of productivity, treatment costs, and potential deaths caused by these diseases can impact farmers' livelihoods and agricultural economies.

PREVENTION AND CONTROL

Various methods of tick control are employed to manage infestations and mitigate their impact on livestock and agriculture. These methods include chemical interventions, biological control, and integrated pest management (IPM) strategies.

Chemical Interventions include the use of Acaricides which are the chemicals designed to kill or repel ticks are commonly used. Acaricides are available in various formulations, including sprays, dips, pour-ons, and collars. They target ticks at different stages of their life cycle, from larvae to adults. Systemic Treatments are medications or feed additives administered to livestock. When ticks feed on treated animals, they ingest chemicals that disrupt their life cycle. One example is the use of ivermectin.

Biological Control includes introduction of natural predators or parasitoids that feed on ticks can help control tick populations. Birds, poultry, and certain insects (e.g., predatory mites) are examples of organisms that can be utilized for biological control.Certain species of beneficial nematodes can infect and kill ticks. These microscopic organisms target tick larvae and nymphs in the soil.

Integrated Pest Management (IPM) Strategies combine multiple methods to effectively manage tick populations while minimizing negative environmental and health impacts. It involves a holistic approach that considers ecological, biological, and chemical factors. Some key components of IPM for tick control include regularly assessing tick populations and identifying infestation patterns, implementing practices that reduce tick-friendly habitats, such as keeping pastures well-maintained and avoiding overgrazing. Rotating pastures, using resistant cattle breeds, and maintaining host animals' health to reduce tick vulnerability.Using acaricides strategically and judiciously to avoid resistance and minimize environmental impact.Introducing natural predators or competitors to maintain tick populations at manageable levels and altering the environment to discourage tick breeding and survival.

Research is ongoing to develop vaccines that target tick-borne diseases. Vaccinating cattle against pathogens transmitted by ticks can reduce the impact of tick-borne diseases and improve overall cattle health. Vaccination holds significant potential as a preventive measure against Rhipicephalus microplus infestations and the tick-borne diseases it transmits. While the development and deployment of tick vaccines present certain challenges, they offer a promising avenue for managing tick populations and reducing the impact of tick-related diseases on livestock and agriculture.Breeding cattle for tick resistance or tolerance can reduce the susceptibility of animals to tick infestations and associated diseases. Maintaining clean and well-kept pastures, rotating grazing areas, and reducing brush and vegetation can create less favorable environments for tick reproduction and attachment.Educating farmers, veterinarians, and the public about effective tick control practices, disease risks, and the importance of regular monitoring can contribute to better tick management.An integrated approach that combines these methods based on local conditions, tick species, and disease prevalence is often the most effective way to control tick populations while minimizing negative impacts on the environment and animal health.

DISCUSSION AND CONCLUSIONS :

An introductory book to the field of Acarology is recommended. Family Ixodidae is the largest tick family (Kumar and Singh, 2005). The Rhipicephalus species is abundant and widely distributed all over the world. Its host range is within the animals of domestic reach. The occurrence of ticks and tick-borne diseases follows a trend of the country’s affinity for specific domestic species and outbreak incidence. Those with higher buffalo population, such as Thailand and Cambodia , would have an increased report of Rhipicephalus. In some countries , there are absolutely no reports. Babesiosis , Anaplasmosis and theileriosis are the most reported tick-borne diseases of animals.Diagnosis is based on the signs and symptoms of jaundice, fever , anemia etc., while treatments range from antibiotics to antiprotozoals.

PLATE -1

A

B

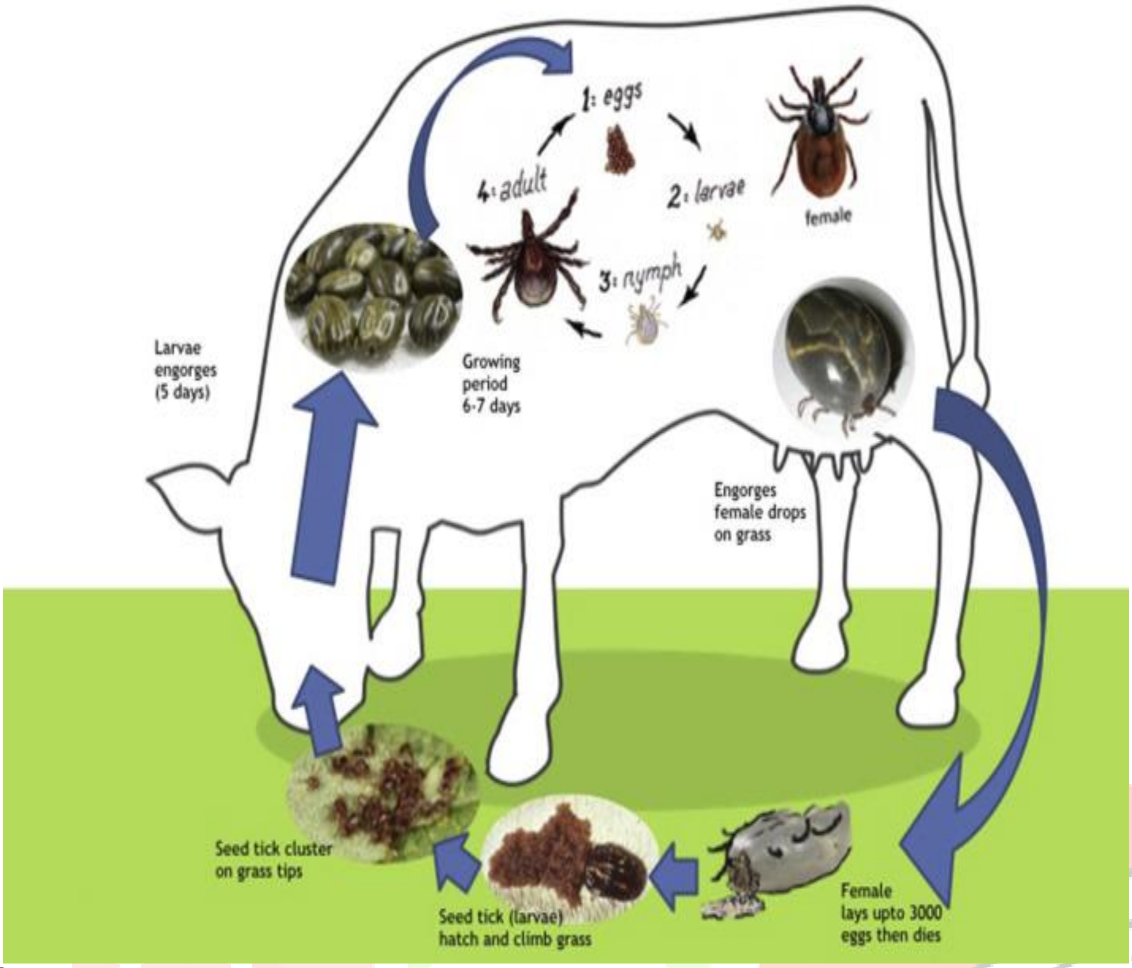
C

Fig. 1 *Rhipicephalus microplus*(Cattle tick)

Host animals : Cows and Buffaloes

A , Dorsal view ; B, Ventral view ; C, Sucking and Piercing type of mouth parts.

PLATE – 2



Source : ScienceDirect.com

Figure 1 : Life cycle of *Rhipicephalus microplus*

REFERENCES -

1. Abbas, R. Z., Zaman, M. A., Colwell, D. D., Gilleard, J., and Iqbal, Z. (2014). Acaricide resistance in cattle ticks and approaches to its management: the state of play. Vet. Parasitol. 203, 6–20. doi: 10.1016/j.vetpar.2014.03.006 PubMed Abstract | CrossRef Full Text | Google Scholar
2. de la Fuente, J., and Contreras, M. (2015). Tick vaccines: current status and future directions. Expert Rev. Vaccines 14, 1367–1376. doi: 10.1586/14760584.2015.1076339 PubMed Abstract | CrossRef Full Text | Google Scholar
3. Feldman-Muhsam, B. (1964). Laboratory colonies of Rhipicephalus. Bull. World Health Organ. 31, 587–589. PubMed Abstract | Google Scholar
4. Gregson, J. D. (1941). Host immunity to ticks (Acarina). J. Entomol. Soc. 38, 12–13. Google Scholar
5. Hewetson, R. W. (1972). “The inheritance of resistance by cattle to cattle tick,” in Australian Veterinary Association Conference Paper (Brisbane, QLD). Google Scholar
6. Jones, K. E., Patel, N. G., Levy, M. A., Storeygard, A., Balk, D., Gittleman, J. L., et al. (2008). Global trends in emerging infectious diseases. Nature 451, 990–993. doi: 10.1038/nature06536 PubMed Abstract | CrossRef Full Text | Google Scholar
7. Kumar and Singh (2005). Morphological study of some ectoparasites of domestic animals. Flora and Fauna Vol. 11 No. 2 PP 119-122
8. Lew-Tabor, A. E., and Rodriguez Valle, M. (2016). A review of reverse vaccinology approaches for the development of vaccines against ticks and tick borne diseases. Ticks Tick Borne Dis. 7, 573–585. doi: 10.1016/j.ttbdis.2015.12.012 CrossRef Full Text | Google Scholar
9. Nuttall, G. H. F. (1911). On the adaptation of ticks to the habits of their hosts. Parasitology 4, 46–67. doi: 10.1017/S0031182000002456 CrossRef Full Text | Google Scholar
10. Ogden, N. H., and Lindsay, L. R. (2016). Effects of climate and climate change on vectors and vector-borne diseases: ticks are different. Trends Parasitol. 32, 646–656. doi: 10.1016/j.pt.2016.04.015 PubMed Abstract | CrossRef Full Text | Google Scholar
11. Schetters, T., Bishop, R., Crampton, M., Kopacek, P., Lew-Tabor, A., Maritz-Olivier, C., et al. (2016). Cattle tick vaccine researchers join forces in CATVAC. Parasit. Vectors 9:105. doi: 10.1186/s13071-016-1386-8 PubMed Abstract | CrossRef Full Text | Google Scholar
12. Trager, W. (1939). Acquired immunity to ticks. J. Parasitol. 25, 57–81. doi: 10.2307/3272160 CrossRef Full Text | Google Scholar
13. Wikel, S. K. (1996). Host immunity to ticks. Ann. Rev. Entomol. 41, 1–22. doi: 10.1146/annurev.en.41.010196.000245 PubMed Abstract | CrossRef Full Text | Google Scholar
14. Willadsen, P. (2004). Anti-tick vaccines. Parasitology 129, S367–387. doi: 10.1017/S0031182003004657 PubMed Abstract | CrossRef Full Text | Google Scholar