

**Studies on the parasitic mite affecting
honey bee (*Apis mellifera* L.)**

SUMMARY OF THE THESIS

SUBMITTED TO
BABASAHEB BHIMRAO AMBEDKAR UNIVERSITY
(A CENTRAL UNIVERSITY)
LUCKNOW

FOR THE AWARD OF THE DEGREE OF

**Doctor of Philosophy
In
Zoology**

BABASAHEB
BHIMRAO
AMBEDKAR
UNIVERSITY



• LUCKNOW •

प्रज्ञा शील करुणा
ESTABLISHED 1996

Submitted By

Anurag Kumar Sonker

Enrollment No. 203/18

Under the Supervision of

Prof. Suman Mishra

DEPARTMENT OF ZOOLOGY
SCHOOL OF LIFE SCIENCES
BABASAHEB BHIMRAO AMBEDKAR UNIVERSITY
(A CENTRAL UNIVERSITY)
VIDYA VIHAR, RAEBARELI ROAD, LUCKNOW,
UTTAR PRADESH, INDIA-226025

2023

SUMMARY

Parasitology deals with the scientific study of parasites, which are organisms that live in or on another organism known as the host and that feed on the host body for their nourishment. Pollinators are a key line of protection against micronutrient shortages in developing countries because they pollinate fruits, vegetables, and nuts that contain vitamins, minerals, lipids, and other essential nutrients. *Apis mellifera* is considered one of the most important honey bee species of the genus *Apis* which is essential for both pollination and honey production.

The honey bee, *Apis mellifera* is most widely used for beekeeping and is not only a widespread cultural practice but it is also a significant global business. The production of honey, beeswax, and other bee-related goods provides income for beekeepers.

Honeybees, *Apis mellifera* are susceptible to parasites and pathogens, including viruses, bacteria, protozoa, and parasitic mites. Among them, infection by the parasitic mites is one of the major problems faced by beekeepers of the honey bee, *Apis mellifera* which is also one the major causes of colony losses in most honey bee apiaries. The majority of researchers believe that the most detrimental enemy of the honey bee, *Apis mellifera* is the parasitic mite (Anderson and Morgan, 2007; Dietemann *et al.*, 2013) have been responsible for destruction of the thousands of bee hives around the globe.

Parasitic mites are small insects that belong to the class Arachnida including spiders, ticks, and scorpions. The mites feed on the haemolymph of bees and while consuming the haemolymph, the parasitic mites transmit viruses that lead to

morphological distortion (Small body size, shortened abdomens, and deformed wings) and affect the flight duration and potential foraging habits. The majority of workers have reported that *Varroa and Tropiolaelaps* are the two genera of ectoparasites commonly known as parasitic mites, causing the most harm to the honey bees and their colonies' survival. They have recently been shown to be one of the key factors contributing to colony losses around the globe.

Mite infestations are managed and controlled in a variety of ways by beekeepers. Chemical treatments (such as acaricides), cultural practices such as drone brood removal and integrated pest management strategies are widely used to control the mite infestation. However, mites may become resistant to chemical treatments, making it impossible to control the mite population.

The study of parasitic mites in honey bee colonies is crucial for understanding and reducing the effects of these parasites on honey bee health and pollination. A large number of studies have been carried out in several countries on parasitic mites of honey bee, *Apis mellifera*, but it is largely unexplored in India. In India, a majority of studies have been carried out on several honey bee diseases caused due to *Nosema* spp., and bacterial and fungal diseases; but studies on parasitic mites are still a neglected area of research

Keeping and its detrimental impact of honey bees in view, this study has been carried out to gather more information about these mites in apiaries located in Lucknow and nearby districts in Uttar Pradesh. This study was designed out to investigate the prevalence, and seasonal dynamics of parasitic mites in honey bee apiaries in order to help to understand the morphology, ultrastructure and further molecular characterization of these mites was done to identify the species. This study may also be may provide additional insights into the taxonomy of the parasite and also may

contribute information regarding the relationship of mites with their host and for further management of these parasites.

The first chapter of the thesis provides a useful introduction to the research topic emphasizing the aims and objectives of the study.

The second chapter contains a review of the literature from previous research work done by the workers dealing the various aspects of their objectives of this present study.

The third chapter of the thesis provides a detailed account of the prevalence of parasitic mites and seasonal dynamics of mite infection of honey bee (*Apis mellifera* L.) from the apiaries situated in Lucknow and nearby districts of Uttar Pradesh.

The prevalence of parasitic mites was calculated as a percentage or a rate of the total number of infected pupae/bees divided by the total number of pupae/bees examined. The highest prevalence from March 2019 to February 2020 was observed during summer 17.48% (272/1556) followed by winter 10.80% (115/1065) and the least in Monsoon 8.59% (66/768). Similarly, in March 2021 to February 2022 the overall prevalence was observed during summer 15.09% (245/1623) followed by winter 11.50% (144/1252) and the least in Monsoon 11.05% (98/848) and total prevalence (%) was 13.08%.

Maximum prevalence (%) was observed during summer, while the least prevalence (%) was observed during the monsoon season. The prevalence was moderate during the winter season. Therefore the overall prevalence of mites infestation in the several honey bee colonies of the study area was in the order summer > winter > Monsoon.

The fourth chapter describes the ultra-structure of parasitic mites of honey bees (*Apis mellifera* L.) as observed by Light and Scanning Electron Microscopy. The mites isolated from the honey bee, *Apis mellifera* colonies and based on the information revealed by Light and SEM showed that two types of ectoparasites viz. *Varroa* and *Tropilaelaps* mites mostly affected the honey bee colonies and were commonly found in most of the apiaries surveyed in Lucknow and other nearby districts of Uttar Pradesh. The mites were easily observed in the hives of the honey bee as they are visible to the naked eye. The present study also revealed the details of *Varroa* and *Tropilaelaps* mites. It was concluded that observed mites belongs to Phylum Arthropoda, Class Arachnida, Subclass Acari, Order Parasitiformes, Suborder Mesostigmata, and Family Varroidae and Genus *Varroa*. The taxonomic details of *Tropilaelaps* mite revealed by the observations by Light and Scanning electron microscopy showed revealed that it belongs to the Phylum Arthropoda, Class Arachnida, Subclass Acari, Order Parasitiformes, Suborder Mesostigmata, and Family Laelapidae. These mites adversely affected the honey bees, *Apis mellifera* colonies and were mainly responsible for colony loss in most surveyed apiaries as well as verbally informed by the honey bee, *Apis mellifera* rearers.

The fifth chapter describes the molecular characterization of parasitic mites of honey bees (*Apis mellifera* L.) using the Polymerase Chain Reaction (PCR) method. Molecular techniques are an important tool used for genomic study of biological samples. The present work describes the molecular characterization of *Varroa* mites for species identification and the results will help to provide additional insights into the taxonomy as well as establish a better understanding helps in understanding the role of modern molecular tools in species identification.

The result of present study revealed that BLAST analysis of the ITS region of *Varroa destructor* showed higher similarity with *Varroa destructor* 28S ribosomal RNA gene (FJ911801.1) with 96.82 % similarity and 96.48% with *Varroa destructor* DNA (LC604777.1). Based on the data obtained from BLAST analysis it was revealed that the parasitic mite found from the apiaries located in and around different regions of Lucknow and nearby districts of Uttar Pradesh, India is identified as *Varroa destructor*. It was found to be the most abundant in mite species in the Honey bee, *Apis mellifera* colonies and mainly responsible for the destruction of honey bee colonies surveyed in this study as informed by the rearers of *Apis mellifera* of the different apiaries.

The present study underlines a detailed study on the prevalence, seasonal dynamics, morphology, ultrastructure and molecular characterization of the parasitic mite in different apiaries located in Lucknow and nearby districts of Uttar Pradesh. It can be concluded that the parasitic mite associated with the honey bee *Apis mellifera* in the survey honey bee colonies of *Apis mellifera* and belongs to *Varroa destructor* and was mainly responsible for the destruction of bee colonies. The other mite of genus *Tropilaelaps* was also identified from the different surveyed apiaries and responsible of destruction of honey bee colonies.