Major Pest and Disease of Honey Bees and Their Management

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INTRODUCTION

Honey bees are indispensable pollinators crucial for global agriculture and ecosystem stability. However, honey bee colonies are vulnerable to various pests and diseases that threaten their health and vitality. An overview of major honey bee pests and diseases, including wax moths, hive beetles, *Varroa destructor* mites, *Nosema spp*. microsporidia, the bacterial pathogen *Paenibacillus larvae*, causing American foulbrood and some mites. Effective management strategies for these threats are essential for sustaining honey bee populations and the services they provide. The wax moths are attached to unhygienic hives, following suitable handling practices. Varroa destructor, a parasitic mite, infests honey bee colonies, feeding on their bodily fluids and transmitting devastating viruses. Integrated pest management (IPM) approaches, combining chemical treatments with cultural practices such as drone brood removal and the use of resistant bee stocks, are crucial for mitigating Varroa infestations. Nosema spp., microscopic gut-dwelling parasites, can compromise honey bee health and reduce colony productivity. Management involves good apiary hygiene, proper nutrition, and the use of biopesticides to control Nosema infections. American foulbrood, caused by the bacterium *Paenibacillus larvae*, poses a serious threat to honey bee brood. Management strategies include strict hygiene practices, antibiotic treatments, and, in severe cases, the destruction of infected colonies to prevent the disease's spread. Implementing these management strategies requires a holistic and sustainable approach, combining cultural, biological, and chemical methods. Ongoing research, education, and collaboration between beekeepers, scientists, and policymakers are crucial for developing effective and environmentally responsible solutions to safeguard honey bee health and ensure the continued success of pollination services worldwide.

Keywords: Honey bees, wax moths, American foulbrood, mite, Mosema and management

1. Introduction

Honey bees play a crucial role in the pollination of flowering plants, contributing significantly to global agricultural productivity and biodiversity. However, honey bee colonies worldwide

face numerous challenges, with pest infestations and diseases being among the most significant threats. The health of honey bee colonies is vital not only for honey production but also for sustaining the delicate balance of ecosystems (Kishan *et al*., 2017). Pests and diseases affecting honey bees can have devastating effects on colony strength, honey production, and, ultimately, the overall well-being of these essential pollinators. Effective management strategies are essential to mitigate the impact of these threats and ensure the survival of honey bee colonies. The major pests and diseases of honey bees are Wax moths, hive beetles, American foulbrood, Thai sacbrood, European foulbrood, *Acarapis woodi*, *Varroa jacobsoni,* etc.

This overview will explore some of the major pests and diseases that afflict honey bee colonies, exploring their characteristics, causes, and potential consequences. Furthermore, we will explore various management approaches, ranging from cultural and biological methods to chemical interventions, highlighting the importance of a holistic and sustainable approach to beekeeping practices.

2. Insect pests of honey bees

a. Wax Moth

Wax moths are a major pest problem to beekeeping in Asia as well as in India. Wax moth occurs because of the poor management practices by beekeepers. *Galleria mellonella* (greater wax moth) and *Achroia grisella* (lesser wax moth) are the major damaging wax moth species. *Vitula* spp. (dried fruit moth), *Plodia interpunctella*, *Ephestia kuehniella* and *E. cautella* are the other moths associated with colonies of honeybees (*Apis cerana*, *A. mellifera*, *A. dorsata* and *A. florea*) (Kishan *et al*., 2017).

b. Greater Wax Moth (*Galleria mellonella*)

In India, it is the major pest of *A. cerana* causing the colonies to abscond. It causes considerable damage if the beekeeper does not follow the proper storage of empty combs, rendered wax, comb foundation sheets, and bee-collected pollen. The larval stage is the damage-causing stage, and the larva is about 3–30 mm long, lives in silken tunnels, and feeds on pollen, nectar, and newly emerged honeybees. The larval period is between 22 and 60 days. In India, they are active from March to October, but from June to October which is considered a dearth period in India, their activity is high (Kishan *et al*., 2017).

c. Lesser Wax Moth (*Achroia grisella*)

As the name suggests, it is smaller than the greater wax moth, but it is widely distributed and is also seen in higher altitudes. The length of the larvae is about 15–20 mm and the larva feeds on the same food as the greater wax moth do. Their highest activity will be from June to October in India and complete three to four generations during that period.

Maintaining hygienic beekeeping practices is the best way to prevent or control honeybee colonies from wax moth attacks. By keeping the infested combs in hot water (60 °C) for 4–5 h, the larvae can be killed. Fumigation of the affected wax combs with paradichlorobenzene (PDB) will be effective. The use of biocontrol agents like *Bacillus thuringiensis*, *Galleria nuclear polyhedrosis virus* (GNPV), oviposition attractants and genetic manipulation are some of the measures for keeping the wax moth population in check. *Apanteles galleriae* is a larval parasite of

wax moth. Major work was carried out on Bt formulations. Initial larval stages of Galleria were more susceptible to Bt treatment than the later stages.

d. Hive Beetle (*Aethina tumida*)

This is a small black beetle that is present in and around the bee colonies; it will eat and destroy the cells constructed by the bees and also feed on pollen, eggs, and small honey bee grubs. When the population of these beetles is high, they will cause considerable damage.

For management, fume boards can be placed over the beehive, and the hive may be kept on a concrete floor as the beetle is a soil pupation.

e. *Vespa sp.*

Large social wasps *Vespa sp.* prey honey bees with ease. *V. orientalis*, *V. magnifica* and *V. cincta* are some of the species that devour honey bees and weaken the colonies. The bees kill wasps through shimmering behaviour forming balls around wasps. The intruders are killed either by being stung or due to high temperature at the centre of the ball (43–46 °C) and suffocation.

Destruction of wasp nest and, use of protective screens and bait lures have been suggested for managing wasps.

3. Diseases of honey bees

I. Bacterial Diseases

American foulbrood (AFB) disease caused by *Paenibacillus larvae* and European foulbrood (EFB) caused by *Melissococcus pluton* is the dangerous bacterial disease infecting honeybee colonies (Oldroyd and Wongsiri, 2006).

a. American Foulbrood Disease

AFB is the one of most widely spread bacterial diseases. AFB-infected larvae normally die after their cell is sealed. The caps of these dead brood cells are usually darker than the caps of healthy cells. The entire population of the hive gets infected.

To manage this disease, sterilization of equipment can be done using formalin at 6 ml per liter, and Terramycin at 250–400 mg in 5 l of sugar syrup can be fed to the diseased colony twice at weekly intervals for effective control (Mishra, 1995).

b. European Foulbrood Disease

European foulbrood is less harmful compared with American foulbrood, and it infects the midgut of infected bee larvae (Suwannapong *et al*., 2011). In India, it was first observed in Maharashtra in 1971 by Diwan and his co-workers on *A. cerana indica*. The honeybee colonies that are attacked by the Varroa are highly susceptible to EFB disease as this bacterial disease is a stress-related disorder. Young larvae of 4–5 days old are highly susceptible to EFB, and the colour of the larvae also changes from shiny white to yellow or brown in colour.

For control of the EFB disease, Terramycin and formalin can be used as mentioned in AFB control. Other mechanical methods namely shook swarm (where the adult bees are shaken into new hives discarding the infected brood combs) can be adopted to avoid the use of antibiotics.

II. Viral Diseases

a. Thai sacbrood virus

Honeybees in India are affected by *Apis iridescent virus*, the Thai sacbrood virus (TSBV), and the Kashmir bee virus. Among them, TSBV was an introduced virus. This virus caused a disastrous outbreak and devastated more than 90 % of *A. cerana* colonies in India. Both the larval and pupal stages are susceptible to this disease, but the adult is an immune stage. Because of viral attack, the brood will die in the prepupal unsealed stage, dead larvae

can be seen with the tip of the head capsule turned upwards, dead prepupae turn into saclike structures and the colour of the affected larvae also changes from white to yellow or grey (Devanesan and Jacob, 2001).

The disease can be avoided to a certain extent by avoiding, replacing, or mixing bee colonies and hive types of equipment from TSBV-affected apiaries. Recently RT-PCR-based method of diagnosis of TSBV has been developed (Aruna *et al*., 2016).

4. **Mite Enemies of Honeybee**

Mites are an important adversary of honey bees in India; they spread from one place to another as the beekeeper moves the colonies to a floral-rich source and also because of migratory beekeeping (Boecking *et al*., 2000).

a. *Acarapis woodi*

Acarapis woodi was first reported in India from *A. cerana* colonies. This mite was first named *Tarsonemus woodi*, but later it was renamed *Acarapis*, Acar from Acarus (mite), and Apis from bee (Suwannapong *et al*., 2011). This mite attacks the tracheal system of the honeybee; it attacks all three castes of honeybee. The typical symptom is "K"-winged condition, where the bees cannot fly and the wings are disjoined in condition. It is mite also feeds on haemolymph and the life span of the honeybee is reduced.

To manage this mite by using formic acid, menthol, or thymol can be applied; fumigation using Folbex strips can be done (Suwannapong *et al*., 2011).

b. *Varroa jacobsoni*

It is a native pest to *A. cerana* in India, but after the introduction of *A. mellifera* to India, it started affecting the Italian bee colonies also (Mishra, 1995). Mite is reddish brown in color and female mite is about 1.1 mm in length and 21.6 mm. It can pierce and tear open the host's integument and feed on the haemolymph of the honeybee (Suwannapong *et al*., 2011). The symptom is called as varroasis and the larval stage of the honeybee is the most susceptible stage.

For control, sugar powder can be dusted over the honeybees and in the frames; as the bees tend to groom, and by the process, the Varroa mite can be dislodged. Other than sugar dust, sulphur, and Acorus calamus (sweet flag) powder can also be dusted. Presently some commercial products are available such as Coumaphos®, Bayer Bee Strips®, or CheckMite® (Suwannapong *et al*., 2011) which are hardly practised in India.

c. *Tropilaelaps clareae*

This mite species attacks all five species of honeybee but is primarily found on *A. dorsata* and *A. mellifera*. The mite attacks the pupae and prepupae stages of bees. Mature female mites attach to and suck the haemolymph from the larvae and adults. Infected honey bees have poor wings; irregular brood pattern is a typical symptom of this mite (Suwannapong *et al*., 2011).

For management, Sulphur dusting is an effective method. The use of organic products like formic acid, oxalic acid, and other essential oils at the right time can be effective for all mite species. *T. create* is difficult to control compared to other mite species, as this mite is readily available with *A. dorsata* colonies, but professional beekeepers remove the brood frames from their hives so that the female mite will starve to death as this mite can live only 7 days without food (Suwannapong *et al*., 2012).

Conclusion

The management of pests and diseases affecting honey bees is a critical aspect of modern beekeeping practices. The vitality of honey bee colonies not only influences honey production but also plays a crucial role in maintaining the ecological balance through pollination. The challenges posed by pests and diseases are multifaceted, requiring a comprehensive and integrated approach to ensure the health and resilience of honey bee populations. Efforts to manage honey bee pests and diseases should encompass a combination of preventive measures, early detection, and targeted interventions. Beekeepers must adopt cultural practices that promote colony health, such as providing nutritionally balanced diets, maintaining clean hive conditions, and ensuring proper hive ventilation. Additionally, the integration of biological controls, such as the use of beneficial organisms that prey on or compete with pests, can contribute to sustainable and environmentally friendly management strategies.

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