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Impact of wax moth infestation (*Galleria mellonella*) on honey bee hive

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Abstract
Honey bees, scientifically known as *Apis* spp., greatly contribute to ecosystems globally. They are vital for pollination and enhance crop yields worldwide. Economically, honey bees are also significant, as they produce wax and honey, which has numerous medicinal benefits. Honey is rich in antioxidants and exhibits antimicrobial and wound-healing properties. However, recent years have seen a decline in bee populations, raising concerns about ecosystem imbalance. Several factors contribute to this decline, including climate change, pesticides, and infestations by pests like the wax moth. The larval stage of the wax moth causes significant destruction to the hive. This study examines the impact of wax moth infestations on bee hives, which result in severe structural and functional damage. In the present study it was found that with increasing percentage of infestation as the months progressed, the production of honey kept decreasing whereas the mortality rate of honey bee kept on increasing.

Keywords: *Apis mellifera*, *Galleria mellonella*, pests, honey

Introduction

Honeybees (*Apis mellifera* L.) are the most significant agricultural pollinators globally. However recent Climatic conditions significantly influence bee colony health, as the brood chamber inside the hive must be maintained at controlled temperature range of 33 to 35 °C to maintain proper brood development (Eouzan *et al*., 2019) [4]. Moreover, the spraying of pesticide for preventing insect attacks reduces the immunity of the honey bees and makes them more vulnerable to disease and parasite. Wax moth, *Galleria mellonella* is a moth species, belonging to family pyralidae of order Lepidoptera, regularly used in scientific research (Wojda *et al*., 2020) [17]. These moths have fascinating characteristics and causes destruction to honey bees and hive, both eggs and larvae cause damage to the weakened bee colony and ruin stored honey bee combs and transmit different bee viruses such as the deformed wing virus (DWV) and black queen cell virus (BQCV) (Kwadha *et al*. 2017) [10], whereas they are no risk to healthy colonies as the bee workers continues eliminate them and keep population check (Cameron, and Jamie, 2018) [2]. These moths are found everywhere were bee keeping is practiced (Williams, 1990) [15]. *Galleria mellonella* pest of all four honey bee species *viz*., *Apis mellifera*, A. cerana, A. dorsata and A. florea (Hood, 2011) [6] Vijaykumar *et al*. 2019 reported that *Galleria mellonella* adult attacks the hive of weaker bee colony at night and are considered responsible for 60-70% of economic loss in beekeeping in India. The life cycle of *Galleria mellonella* go through four life stages *Viz*., egg, larva, pupa and adult (Komala and Seram, 2020) [9]. They go through first stage by laying the eggs in the cracks and crevices of the hive (Vijaykumar *et al*. 2019). As soon as the eggs hatch the larva start to feed on the wax combs (Britannica, and Editors of Encyclopaedia, 2017) [3] they also feed on pollen, and bee castings (Hosamani *et al*. 2017; Kwadha *et al*. 2017) [7, 10]. They mainly feed on the midrib of the comb and prepare galleries lined with silken threads. The bees get knotted in those silk and starves to death, leading to a condition called galleriasis (Kwadha *et al*. 2017; Gulati and Kaushik, 2004) [4, 10]. As the cells are fed by the larvae, it affects honey bee by emergence of deformed adults or dead adults entangled in silk. The continued infestation of the hive may lead to absconding, colony loss and lower bee swarms, if proper steps are not adopted to control it (Kwadha *et al*. 2017; Gulati and Kaushik, 2004; Williams, 1997) [5, 10, 16]. Latita and Kumar (2022) observed that larval infestation has high peak in September, concerning A. mellifera. Investigating A. dorsata, Raghunandan and Basavarajappa (2014) [12] showed the highest infestation in semi arid region in summer (30.8%) and in rainy season (23.4%) Comparatively lowest rates were observed in the malnad region during summer (11%) and winter (6.6%), reduced infestations were observed across all seasons in arid regions, higher prevalence during warmer months and reduced occurrences in colder seasons. Additionally, Lalita and Kumar (2022) [11] noted the highest number of larvae per comb, noting ten combs per hive, followed by 9, 8, and 7 combs in descending order. The moth population typically reaches its peak during warmer months and diminishes as temperatures decrease. Jia *et al*. (2020) [8] observed the seasonal dynamics of G. mellonella and heightest population density during spring and summer, correlating with optimal temperatures and environmental conditions favourable for their growth and reproduction.

The study carried out by Lalita *et al*., (2022) [11] reveals that highest count of G. mellonella moths in July month and lowest count in month of March in the Apis melifera hives. They demonstrate a consistent pattern of population increase from April to July and a decline toward March. Similarly, Bhatnagar *et al*. (2020) [1] observed minimal or no infestation of G. mellonella on Apis melifera in February and March, with the first noticeable increase in April and a subsequent rise in population until July. The adult G. mellonella population within the A. mellifera hive peaked from May to November, with August identified as the period of maximum abundance (Sohail *et al*., 2017) [13].

Material and Methods

The present study was carried in Chhatrapati Sambhajinagar (Aurangabad), Maharashtra. The study was carried out to study the impact of the greater wax moth (Galleria Melonella) on honey bee hive. Langstroth hive frame was used in the study. The study was carried out between May 2025 to August 2025.

Total population of honey bees in a frame was calculated by measuring the weight of empty frame and then measuring the weight of frame with honey bee colonies, accordingly the difference in weight was considered as weight of total honey bee population. This difference in weight was divided by the weight of a single honey bee to calculate the total honey bee population.

To calculate the number of deaths of honey bees, the dead honey bee number outside the frame was counted every day, and total deaths for a month was estimated.

The mortality rate of honey bees per thousand population in a month was calculated as -Number of deaths in a month*1000/Total population of honey bees.

The percentage of infestation by moth was calculated by counting the number of cells infested. Percentage of infestation=number of cells infested*100/ Total number of cells in a frame.

The production of honey was calculated as the weight of honey extracted in a month from a frame.

Fig 1: Infested wax moth in bee hive

Fig 2: Healthy bee hive

Results

Percentage of infestation

The percentage of cells infested by the moth increased in the rainy season as the months progressed

Table 1: Percentage of Infestation wax moth in bee hive

Month	No. of cells infected	percentage of infestation
May 2025	00	0%
June 2025	458	19%
July 2025	675	28%
August 2025	892	37%
Total number of cells=2412		

Production of honey

The production of honey kept decreasing with increasing percentage of infestation as the months progressed.

Table 2: Production of honey as compared to percentage of infestation

Month	Production of honey	percentage of infestation
May 2025	2.5Kg	0%
June 2025	1.3Kg	19%
July 2025	0.8Kg	28%
August 2025	0.3 Kg	37%

Mortality rate of honey bee

Mortality rate of honey bee kept increasing with increasing percentage of infestation.

Table 3: Mortality rate in different months

Month	Total population of honey bees in a frame	No of honey bee death in a month	Mortality Rate (per thousand population) in a month
May 2025	3328	45	13.52
June 2025	3280	690	210.4
July 2025	2590	1080	417
August 2025	1510	1470	973.5

Table 4: Mortality rate compared with percentage of infestation

Month	Mortality Rate (per thousand population) in a month	percentage of infestation
May 2025	13.52	0%
June 2025	210.4	19%
July 2025	417	28%
August 2025	973.5	37%

Comparison of all parameters

In our study it was found that with increasing percentage of infestation as the months progressed, the production of honey kept decreasing whereas the mortality rate of honey bee kept on increasing.

Table 5: Table comparing all parameters

Month	Percentage of infestation	Production Of honey (per month per frame)	Mortality rate of honey bee (per thousand population) in a month
May 2025	0%	2.5Kg	13.52
June 2025	19%	1.3Kg	210.4
July 2025	28%	0.8Kg	417
August 2025	37%	0.3 Kg	973.5

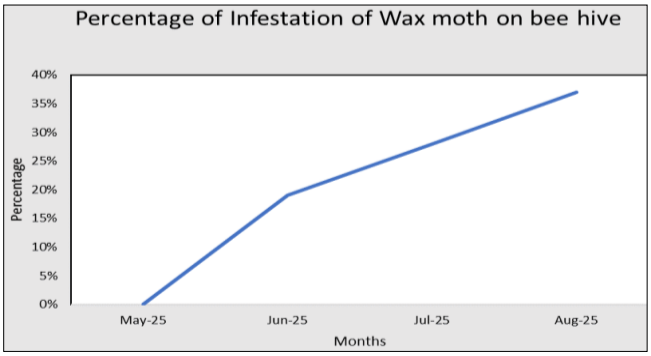

Fig 3: Percentage of Infestation of Wax moth on bee hive

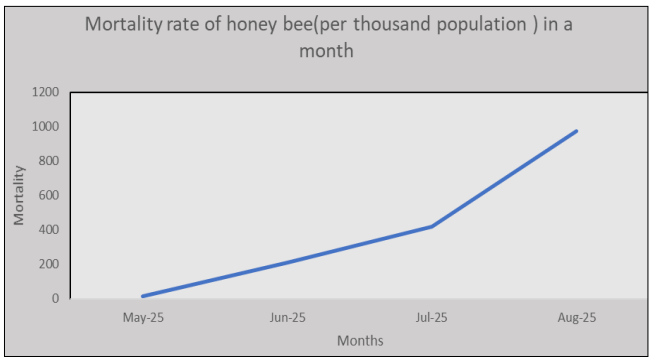

Fig 4: Mortality rate of honey bee (per thousand population) in a month

Discussion

The present study deal with infestation of wax moth on bee hive, it shows that in the month of August it was high as compared with May month in the weaker bee hive of A. mellifera. Latita and Kumar (2022) observed that larval infestation has high peak in September, concerning A. mellifera. Investigating A. dorsata, Raghunandan and Basavarajappa (2014) [12] showed the highest infestation in semi arid region in summer (30.8%) and in rainy season (23.4%) Comparatively lowest rates were observed in the malnad region during summer (11%) and winter (6.6%), reduced infestations were observed across all seasons in arid regions, higher prevalence during warmer months and reduced occurrences in colder seasons. A 2025 study in Nigeria examined co-infestation with small hive beetles (*Aethina tumida*): among 45 managed colonies, 68.4% of weak hives showed dual infestation, with worker/drone bee weights significantly lower (F=3.736, p=0.005 for workers; F=9.385, p=0.001 for drones) than in uninfested hives. Absconded colonies exhibited severe comb damage, underscoring synergistic effects: beetles weaken defenses, enabling wax moth larval dominance. This interaction heightens collapse risk in tropics, where both pests thrive year-round.

In our study it was found that with increasing percentage of infestation as the months progressed, the production of honey kept decreasing whereas the mortality rate of honey bee kept on increasing.

Conclusion

Wax moth infestation in honey bee colonies shows devious pest dynamics, flourishing on host vulnerable to impose dropping damage. Intervention of pest like Wax moth disturb the bee colonies by weaken in nutrition, increase in mortality rate. As climate changes it amplifies risks of infestation, infestation of the pest can be over come by the method of Integrated Pest Management, frameworks blending cultural, biological, minimal use of chemical tools and shifting the hive in poper place, all this will safeguard apiculture's sustainability. In our study it was found that with increasing percentage of infestation as the months progressed, the production of honey kept decreasing whereas the mortality rate of honey bee kept on increasing, thereby impacting bee hives and becoming a significant threat to bee keeping.

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