



Seasonal occurrence of greater wax moth, *Galleria mellonella*, in *Apis mellifera* L. colonies

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Abstract

In the current study, a seasonal occurrence of Greater wax moth *Galleria mellonella* was found in *Apis mellifera* colonies from May 2022- May 2025. The data showed that there was the occurrence was maximum in September and then in the subsequent months the population of wax moth increased rapidly till late July to September and minimum in November, December, and January. The observations may be affected by changes in the climatic conditions of the study location.

Keywords: Greater wax moth, *Galleria mellonella*, *Apis mellifera*, Infestation

Introduction

Greater (*Lepidoptera: Pyralidae, Galleria mellonella*) and Lesser (*Lepidoptera: Pyralidae, Achroia grisella*) Wax moths are common pests of honeybee hives and hive products by Paddock, 1918^[15]; Williams, 1997^[23]; Watkins, 2005^[22]; Gillard, 2009^[9]; Ellis and Hayes, 2009^[7]; Ellis *et al.*, 2013^[8]; Kwadha *et al.*, 2017^[12] in tropical and subtropical climates around the world.

More precisely, wax moths are *Lepidopteran* insects that have the ability to feed on and destroy beeswax combs, which bees utilize to store pollen, honey, and eggs for future generations observed by Dessalegn, 2001. Stored combs are suitable breeding grounds for wax moths. Adult wax moths are nocturnal insects that spend the day escaping in dark regions before emerging at night suggested by Gillard, 2009^[9]. They flourish in places that are warm, dark, and poorly ventilated, and that honey bees are unable to effectively defend by Paddock, 1918^[15]; Williams, 1997^[23]; Ellis *et al.*, 2013^[8]. Arbogast *et al.*, 1980^[1]; Chase, 1921^[3]; Eischen and Dietz, 1987^[6]; Smith, 1965^[17]; Warren and Huddleston, 1962^[21] observed the female wax moth entered the hive and laid eggs in the darker, neglected combs. The eggs hatch after three days. Thus, the emerging larvae are becoming major wax comb pests, particularly in stressed colonies, and they can also seriously harm beekeeping equipment that is stored suggested by Dessalegn, 2001; Chase, 1921^[3]; Eischen and Dietz, 1987^[6]; Smith, 1965^[17].

In India, wax moth is the most severe pest of honeybee hives; it is the primary cause of bee migration and colony destruction; and the infestation of wax moth began in June and grew steadily until reaching a peak in September, after which it decreased to a minimum in November observed by Kumari and Jha 2013^[11]. Furthermore, they discovered that the level of damage was minimal between June and August. September saw the highest percentage of colonies (54.8%) with moderate damage. Compared to other months, October had a larger number of colonies with substantial damage (45.4%) and complete damage (15%). Omkar (2017)^[14] suggests that beekeepers need to have a sufficient storage place for hive components that are prone to pest attacks, as well as safeguard colonies from diseases and pests.

However, given the economic importance of the pest in India's beekeeping business and the need of developing strategies to reduce the impact of wax moth, it is evident

that exploring for alternatives is an extremely vital task. As a result, the current study sought to investigate the seasonal occurrence of *G. mellonella* under a variety of environmental conditions, which could be extremely beneficial to beekeepers in preventing wax moth infestation in honeybee colonies.

Materials and Method

Wax moth-prone areas and willing beekeeper farmers with wax moth-infested colonies were purposefully chosen based on stakeholder feedback, personal observations, and survey results. Colonies that are infestation-free were moved to new, hygienic hives. To reduce the impact of human error in this experiment, efforts were made to make the strength and other aspects of the honeybee colonies.

The present investigation entitled was carried out in Lucknow. Lucknow is located at 26.50°N and 80.50°E in central zone of Uttar Pradesh. The mean annual rainfall is roughly 726mm, most of which occurs during the months of July and August. Dust storms are common in the summer, while hailstorms occur between February and April.

For observing seasonal occurrence of Greater wax moth, 10 colonies with 8 bee frames were observed. The colony with the same queen age was chosen. Every hive observed in the experiment were equal in strength. During time of a dearth periods, colonies were strengthened by supplemental feeding with a sugar solution 2:1 (sugar: water) administered every seven days. The main actions carried out during the experimentation were collecting data, understanding possible prevailing conditions, and on every three days, a standard follow-up is conducted to assess the colonies overall performance.

Statistical Analysis

The findings were analyzed using analysis of Two-way ANOVA with ten colonies and the crucial difference at the 5% level of significance was used to determine if the differences were significant or not.

Results

The honey bee colonies were examined for wax moth larvae, cocoons/pupae, adults, and silken galleries on the brood and honeycomb. It was shown that wax moths are more inclined to attack weaker colonies. Wax moths have

four developmental stages: eggs, larvae, pupae, and adults. Table 1 shows the seasonal occurrence of wax moth population, which varies every month. The outbreak of infestation was maximum in September, followed by a rapid increase in the population of wax moths from late July to September, with the lowest numbers occurring in November, December, and January. The study may be affected by changes in the climatic conditions of the study location.

The observation table revealed that the wax moth population fluctuated every month of the year in 8-frame bee strength. The population of wax moths increased rapidly throughout the monsoon months, peaking in September, and then declining until March both years. In year 2022-23, average population of wax moths was found maximum in July followed by August, October, September, June, May,

March, April, February, January, November, December. In year 2023-24, average population of wax moths was found maximum in September followed by July, October, August, June, May, April, March, November, February, January and December. In year 2024-25, average population of wax moths was found maximum in February followed by March, September, August, July, January, June, May, October, December minimum in November. As we performed two-way ANOVA found a significant difference at $P \leq .05$ were highlighted. Wax moth populations showed a significant monthly variation during year 2022-25 with effect of mean of developmental stages (larval, pupal, adult) on wax moth population counts ($F(2,27) = 3.36, P = .049$). The analysis revealed significant variations in column-related variance ($F(2,27) = 5.35, P = .011$) and an interaction effect between stage and month ($F(4,27) = 2.88, P = .041$).

Table 1: Average Population of *Galleria mellonella* in *A. mellifera* colonies during the year 2022-23

Month	Average Population of Larva	Average Population of Pupa	Average Population of Adult	Average Population of Wax Moth
May	4.8	2.6	2	3.13
June	6.4	2.8	0.8	3.33
July	7.2	4	1.2	4.06
August	7.2	5	1.4	4.13
September	6.2	2.6	1.2	3.33
October	6.2	3.6	1.6	3.8
November	1.4	0.6	0.4	0.8
December	0.2	0.2	0.8	0.4
January	3.2	0.4	0.4	1.3
February	4.4	1.8	0.4	2.2
March	5.6	2.2	0.8	2.87
April	4.6	2	1.2	2.6
S. e	0.64	0.42	0.15	0.36
Mean	4.26	2.07	0.87	2.66

Table 2: Average Population of *Galleria mellonella* in *A. mellifera* colonies during the year 2023-24

Month	Average Population of larva	Average Population of Pupa	Average Population of Adult	Average Population of Wax Moth
May	6.2	4.2	0.6	3.67
June	6.4	3.8	1.2	3.8
July	6.2	4.2	2.8	4.47
August	6	3.6	2	3.87
September	7.4	5	1.4	4.6
October	7.2	3.6	1.2	4
November	4.4	2	1	2.47
December	3.6	1.4	1.4	1.47
January	3.4	1.2	0.8	1.8
February	3.6	1.2	1	1.93
March	3.8	2.4	1.4	2.53
April	6.2	2.4	1.2	3.27
S. e	5.37	2.92	1.33	0.31
Mean	0.43	0.38	0.17	3.16

Table 3: Average Population of *Galleria mellonella* in *A. mellifera* colonies during the year 2024-25

Month	Average Population of Larva	Average Population of Pupa	Average Population of Adult	Average Population of Wax Moth
May	5.8	2.8	1.2	3.27
June	6.2	4.2	0.6	3.67
July	7.2	5	1.6	4.6
August	8.6	4.2	2	4.93
September	8.2	4.8	4.2	5.73
October	3.2	4	1.6	2.93
November	1.8	1.2	0.2	1.07
December	3.4	1.4	1	1.93
January	7.4	4.4	1.8	4.53
February	9.2	6	3	6.07
March	9.4	6.2	2.4	6
April	7.8	5.6	1.8	5.07
S. e	0.80	0.49	0.37	0.46
Mean	5.55	3.45	1.55	4.15



Fig 1: Wax moth stages and webs

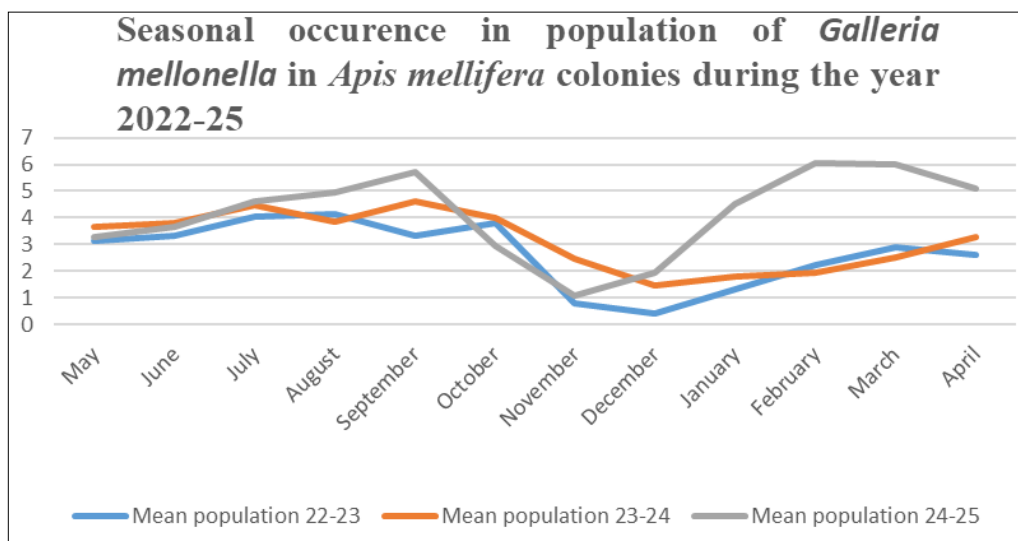


Fig 2: Seasonal occurrence in population of wax moth

Discussion

The seasonal incidence of wax moth occurrence is maximum from July to September, followed by May, June, October, and April, and minimum in November, December, and January. The findings are consistent with a prior study by Brar *et al.*, 1985, which found that wax moth populations vary depending on climate conditions. We noticed that the larval stage of the wax moth was the most serious threat to the colonies, damaging the combs by feeding on honey, pollen, and bee eggs, forming silken tubes and tunnels, and covering the combs with web and black feces.

These findings align with Earp 1925^[5]. According to Grout 1946^[10] and Warren and Huddleston 1962^[21], weaker

colonies experienced year-round infestations of larger wax moth. Kumari and Jha, 2013^[11], Swamy *et al.*, 2005^[19] and Varshneya *et al.*, 2008^[20] observed pest infestation in the hive and raised comb storage, finding the highest infection in September and the lowest in June. This could be related to the high temperature and humidity in the surroundings. Full-coverage frames with bees had the lowest infestation rate. It might be due to the self-defense behavior of worker bees.

Previous research had revealed that the incidence of moth larvae were equivalent to those of previous studies conducted in India, indicating that a heightened infestation occurred during June and July. Raghunandan and

Basavarajappa, 2014 ^[16] noted that, while wax moth infection is prevalent, the level of infestation is determined by the strength of the colony and the prevailing ecological conditions Sohali *et al.* 2017 ^[18]. It was found that average population of wax moth abundance was maximum in between May and November. The infestation initially started out in the month of April and expanded in May and June. Reported by Lalita *et al.*, 2018 ^[13], Shivani Bhatnagar *et al.*, 2020 ^[2].

Conclusion

Wax moth infestations in honey combs pose significant challenges for beekeepers globally and within the studied region. The larval stage of the moth is responsible for the destruction of the comb and its contents. To prevent infestations, it is crucial to maintain strong and healthy colonies. No proper methods are available to quantify moth numbers and losses. Management actions should be implemented according to seasonal incidence to save hives and bee colonies. Environmentally friendly treatments and correct seasonal management measures can help protect honey bee colonies.

References

1. Arbogast RT, Lecato GL, Van Byrd R. External morphology of some eggs of stored-product moths (*Lepidoptera Pyralidae, Gelechiidae, Tineidae*). *Int J Insect Morphol Embryol*,1980;9(3):165-77. Ben HB. Bee disease diagnosis. Zaragoza: International Centre for Advanced Mediterranean Agronomic Studies, 1999,147-65.
2. Bhatnagar S, Suman RK, Sharma N, Sankhla M. Infestation of greater wax moth *Galleria mellonella* in *Apis mellifera* colonies in Jodhpur (Rajasthan). *J Entomol Zool Stud*,2020;8(5):1194-7.
3. Chase RW. The length of the life of the larva of the wax moth, *Galleria mellonella* L., in its different stadia. *Trans Wis Acad Sci Arts Lett*,1921;20:263-7.
4. Desalegne B. Origin and characterization of honeybee (*A. mellifera*) pollen source around Utrecht University, The Netherlands [MSc thesis]. Utrecht University, Faculty of Biology, Department of behavioural social insect unit, 2001.
5. Earp EA. The Wax-moth and its Control, 1925.
6. Eischen FA, Dietz A. Growth and survival of *Galleria mellonella* (*Lepidoptera: Pyralidae*) larvae fed diets containing honey bee-collected plant resins. *Ann Entomol Soc Am*,1987;80:74-7.
7. Ellis AM, Hayes GW. Assessing the efficacy of a product containing *Bacillus thuringiensis* applied to honey bee (*Hymenoptera: Apidae*) foundation as a control for *Galleria mellonella* (*Lepidoptera: Pyralidae*). *J Entomol Sci*,2009;44(2):158-63.
8. Ellis JD, Graham JR, Mortensen A. Standard methods for wax moth research. *J Apic Res*,2013;52(1). DOI, 10.3896/IBRA.1.52.1.10
9. Gillard G. My Friend, the Wax Moth. *Am Bee J*,2009;149(6):559-62.
10. Grout RA. The hive and honeybee. Hamilton, Illinois, U.S.A.: Dadant and Cons, 1946.
11. Kumari S, Jha MM. Efficacy of non-chemical method in management of wax moth infestation of *Apis mellifera*. *Bull Pure Appl Sci Zool*,2013;32(1):37-44.
12. Kwadha CA, Ong'amo GO, Ndegwa PN, Raina SK, Fombong AT. The biology and control of the greater wax moth, *Galleria mellonella*. *Insects*,2017;8(2):61.
13. Lalita YK, Yadav S. Seasonal incidence of Greater wax moth, *Galleria mellonella* Linnaeus in *Apis mellifera* colonies in ecological condition of Hisar. *J Entomol Zool Stud*,2018;6:790-5.
14. Omkar. Industrial Entomology. *Int J Zool Stud*,2017;28:978-81. DOI:10.1007/978-981-10-3304-910-3303-2.
15. Paddock FB. The beemoth or waxworm. Texas Agricultural Experiment Station: USA, 1918. 44.
16. Raghunandan KS, Basavarajappa S. Incidence of *Galleria mellonella* infestation on Apisdorsata colonies at different regions of South-Western Karnataka. *Zoology*, 2014, 3(2).
17. Smith TL. External morphology of the larva, pupa and adult of the wax moth *Galleria mellonella* L. *J Kans Entomol Soc*,1965;38:287-310.
18. Sohali M, Aqueel MA, Ellis JD, Afzal M, Raza AM. Seasonal abundance of greater wax moths (*Galleria mellonella* L.) in hives of Western honey bees (*Apis mellifera* L.) correlates with minimum and maximum ambient temperature. *J Apic Res*,2017;56(4):281-5.
19. Swamy BC, Rajagopal D, Kencharaddi RN. Seasonal incidence of greater wax moth, *Galleria mellonella* in Indian Honeybee colonies. *Ind Bee J*,2005;67:3-4.
20. Varshneya I, Pandey AK, Mall P, Rathore RRS. Seasonal incidence of wax moth (*Galleria mellonella* L.) in European honey bee (*Apis mellifera* Linn.) Colony. *J Entomol Res*,2008;32(1):1-6.
21. Warren L, Huddleston P. Life history of the greater wax moth, *Galleria mellonella* L., in Arkansas. *J Kans Entomol Soc*,1962;35:212-6.
22. Watkins M. Control of wax moths: Chemical, physical, and biological methods. *Am Bee J*, 2005, 144.
23. Williams JL. *Insects: Lepidoptera (moths)*. In: Morse R, Flottum K, editors. Honey bee pests, predators, and diseases. Ohio, USA: The AI Root Company, 1997, 121-41.