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Impact of Ant Infestation on Muga Silkworms: Insights from Farmer Observations

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

The present study investigates the incidence and infestation of ants, a ubiquitous predator in muga silkworm (*Antheraea assamensis* Helfer) rearing. A survey was conducted during August 2021 to July 22 across Jorhat and Lakhimpur districts of Assam, involving 120 respondents from 8 villages. The findings revealed 100% of ant infestation during muga silkworm rearing, by *Oecophylla smaragdina* (Fabricus) emerging as the most frequently observed and predacious species, particularly targeting the early larval instars. The respondents reported peak ant predation during the *Aherua* (June-July) crop cycle, with an estimated 1-25% crop loss. This study highlights the need for developing effective management strategies to mitigate the impact of ant predation on muga silk production.

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Keywords: Assam; ant infestation; Muga silkworm; Oecophylla smaragdina.

1. INTRODUCTION

Sericulture is an agro-based cottage industry that is well-suited to small and marginal farmers, which requires little financial input and is also carried out by women and family members [1]. India is one of the most important silk-producing countries ranking second, next to China, in the world for silk production [2]. The four commercially raised species of silkworms in India are the mulberry silkworm (*Bombyx mori* L.), tasar silkworm (*Antheraea mylitta* D.), muga silkworm (*Antheraea assamensis* Helfer), and eri silkworm (*Samia ricini* Donovan). Muga silkworm, *A assamensis* (Lepidoptera: Saturniidae), which produces golden silk, is endemic to north-east India [3]. Muga silkworm is reared on two primary host plants, *Som*, *Persea bombycina* (King ex Hook f.) Kost and *Sualo*, *Litsea monopetala* (Roxb.) under outdoor conditions [4]. Assam has a total area of 12661.64 hectares of muga food plants under both government and private farms [5].

Muga silk is of significant economic importance in northeast India due to its exceptional quality and traditional cultivation methods. The production of Muga silk, known for its golden yellow hue, takes place primarily in Assam where favorable climate and soil conditions promote its growth [6]. The silk industry plays a crucial role in the economic development of rural areas and provides sustainable income opportunities to local communities through sericulture [7]. The Lakhimpur district of Assam is known for its biodiversity, including the significant rearing of Muga silkworms, which play a crucial role in the local economy and culture [8]. Furthermore, the Assam region in which both districts are located is rich in natural resources and is home to diverse flora and fauna, influenced by factors such as temperature and rainfall. This unique geographical location of the north-eastern region of India, which includes Lakhimpur and Jorhat, enables the successful rearing of muga silkworms, thereby contributing significantly to the rural development and economy of the region.

The success of all types of commercial silkworm culture is largely dependent on the quality of the leaves, ideal environmental conditions for raising silkworms, maintenance of hygienic conditions during rearing and protections against diseases and pests both in silkworm and host plants. As the leaf protein gets transformed into silk protein, leaves provided as food are the only source of nutrition for the silkworms. These perennial trees are attacked by several insect pests and diseases, thereby affecting the quality and reduction in the leaf yield which indirectly influences the production of muga silk. There are about 23 species of pests of muga host plants, belonging to the order Lepidoptera, Coleoptera Thysanoptera, Hymenoptera, Homoptera, Diptera, and Isoptera causing considerable loss to the tune of 11 to 95% of the total leaf biomass [9]. Among these pests, ants (Hymenoptera: Formicidae) infests both host plants and silkworm. They are easy to identify, and collect because of stationary nesting habits. Generally, the relationship of ants and plants is mutualistic but in the case of muga ecosystem the scenario is different because reduces the food of muga silkworm and at the same time they are the predators of muga silkworm. Considering the importance of muga culture in the region, the study was carried out to know the predation of muga silkworm by ants from muga farmers.

2. MATERIALS AND METHODS

The investigation was carried out in the Lakhimpur and Jorhat district of Assam during August 2021 to July 22. These districts were purposively selected to collect information on ant infestation during Muga rearing as the two districts lie in two different geographical areas of the state. Lakhimpur and Jorhat districts lie in the North Bank Plain zone and the upper Brahmaputra Valley, respectively. Both districts are known for significant rearing of Muga silkworms. A purposive and random sampling design was followed for selection of respondents. Two developmental blocks from each district *viz., Kaliapani* block, and *Titabar* block of Jorhat district and *Telahi* block, and *Dhakuakhana* Block from Lakhimpur district were selected. Two (2) villages from each block of the selected districts *ie.,* eight districts *in toto* were selected randomly for the collection of data. Fifteen respondents from each selected village were selected randomly. Thus, the total number of respondents for the present study was obtained to be 120. An interview schedule was created in order to collect data. The data were collected personally by the researcher through the scheduled interview. All

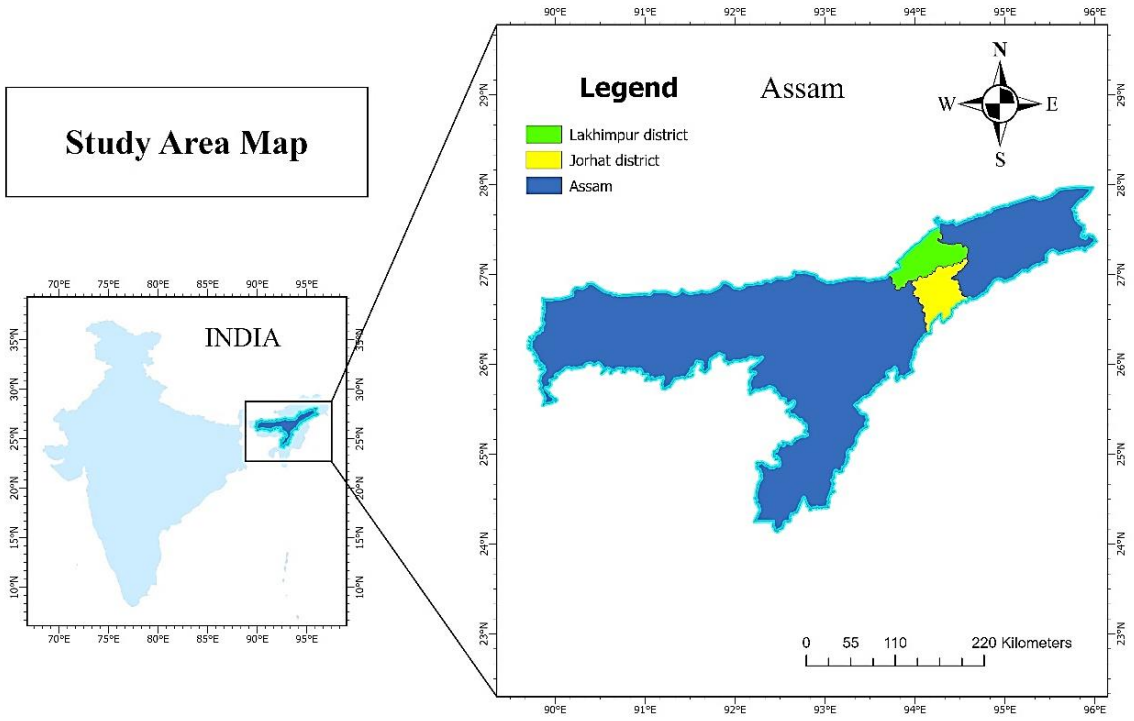

Fig. 1. Location map of study area

the respondents were interviewed by the investigator himself in the residence as well as in the muga farms. It was ensured that the questions were answered, accurately. During the interview, a cordial atmosphere was maintained to make sure that respondents felt comfortable.

2.1 Target Group

Active muga farmers were considered as target group in both the traditional districts.

3. RESULTS AND DISCUSSION

The study was carried out based on the preliminary investigation of Rajkhowa (2022) in which 8 species of ants belonging to 8 genera and 4 subfamilies i.e., *O. smaragdina, Paratrachina longicornis* (Latreille)*, Cataulacus taprobanae* Smith, *Crematogaster anthracina* Smith*, Pheidole* sp.*, Diacamma* sp.*, Odontoponera denticulate* (Smith) and *Tetraponera rufonigra* (Jerdon) were identified in the aforementioned location of muga eco-system.

The study revealed that 100% of the respondents responded that ants infest muga silkworms during rearing (Table 1). 70% of the respondents responded that ants are active during the afternoon period of the day (Fig. 2). The respondents opined that ant were predacious to 1st instar (20.3%) and 2nd instar (20.3%) muga silkworm larvae followed by 3rd instar (5.9%), 4th instar (2.2%) and least predacious to 5th instar (1.2%) muga larva (Fig. 3). The majority of the respondent i.e., 12.8 % had the opinion that ants were most predacious during *Aherua* (June-July) muga crop cycle, followed by *Bhodia* (August-September) (10.9%) muga crop cycle, *Jethua* (May-June) (10.2%) muga crop cycle, *Chotua* (March- April) (8.6%) muga crop cycle, *Kotia* (October-November) (6.8%) muga crop cycle and least predacious during *Jarua* (December-February) (0.8%) muga crop cycle (Fig. 4).

Table 1. Distribution of the respondents regarding ant infestation during muga silkworm rearing

Sl. no.	Category	Frequency	Percentage (%)
1.	Yes	120	100.00
2.	No	0	0

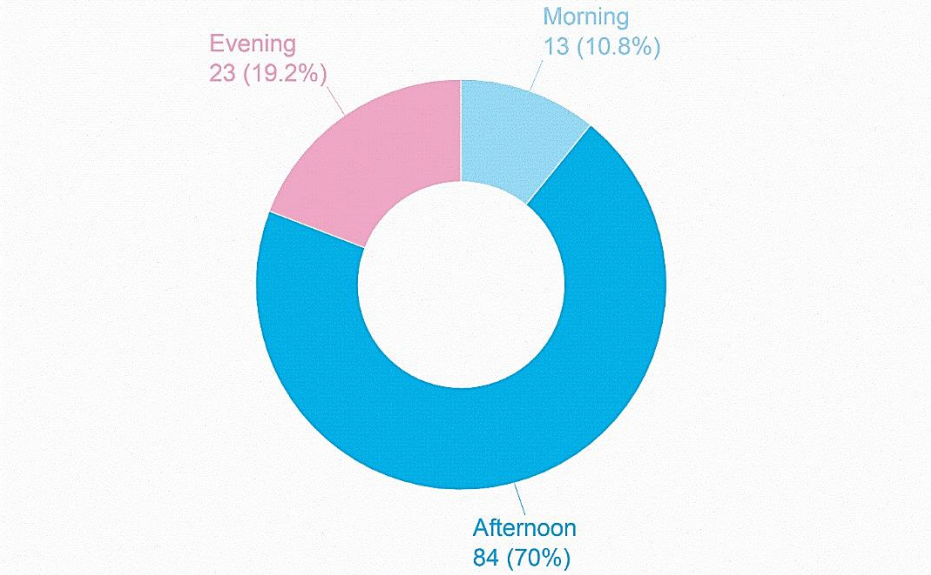

Fig. 2. Distribution of the respondents regarding the activeness of ants during muga silkworm rearing

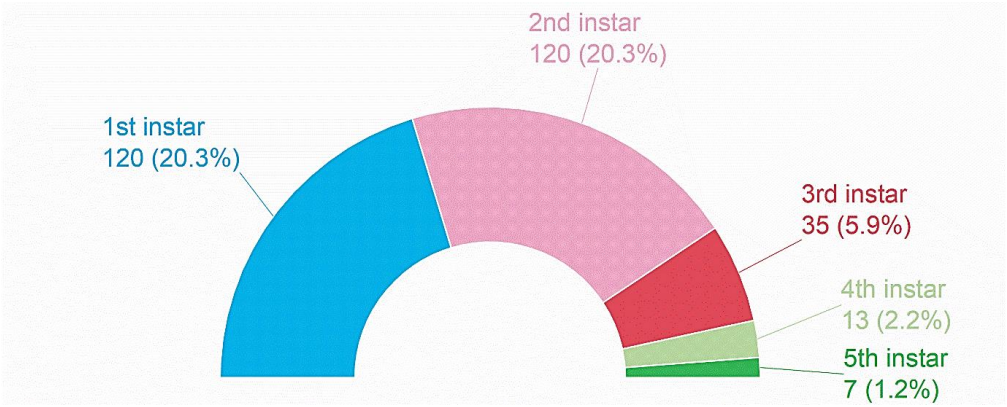

Fig. 3. Distribution of respondents regarding predaciousness of ants to larval instar of muga silkworm

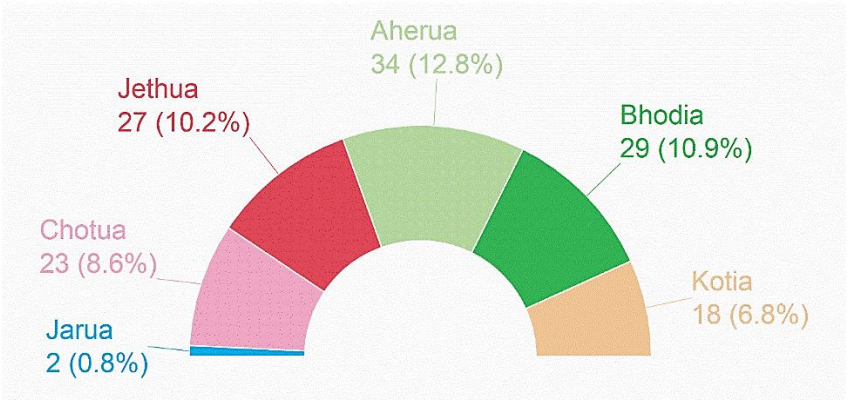

Fig. 4. Distribution of the respondents regarding the predaciousness of ants to muga crop cycle

Muga farmers were asked only about the infestation of ant species recorded during the study period. The data depicted in the Fig. 5., shows that majority of the respondent i.e., 40% responded that *O, smaragdina* was observed most frequently in muga ecosystem, followed by *T. rufonigra* (15%), *C. antracina* (12.50%), *P. longicornis* (10.83%), *O. denticulate* (7.50%), *Pheidole* sp. (6.67%), *Diacamma* sp. (4.17%) and *C. taprobanae* (3.33%) was observed least frequently in muga ecosystem.

The study on the respondents' response revealed that ants create infestation during muga silkworm rearing. *Oecophylla smaragdina* was the most predacious ant species and mainly infested 1st and 2nd instar muga silkworm larvae. According to the farmers, the infestation of ants was highest in the *Aherua season* of rearing.

The study on the response of the respondents revealed that ants create infestation during muga silkworm rearing. *Oecophylla smaragdina* (33.9%) was the most predacious ant species followed by *P. longicornis* (6.7%) both in early instar muga silkworm rearing (Fig. 6). Similarly, it was also observed that *O. smaragdina* (40%) was the most predacious ant species followed by *P. longicornis* (7.5%) both in early instar and late instar muga silkworm rearing (Fig. 7).

The majority of the respondents i.e., 97.50% revealed that 1-25% of crop loss was done by ants and only 2.50% of the respondent responded that 26-50% of crop loss was done by ants (Table 2).

The survey conducted across Jorhat and Lakhimpur districts reveals the infestation of ant during muga silkworm rearing, as reported by 100% of the respondents. The findings underscore the predominance of *O. smaragdina* as the most frequently observed and predacious ant species, particularly targeting the early larval instars of the muga silkworm. Subharani and Jayprakash (2015) also reported that *O. smaragdina*, *Solenopsis* sp., *Camponotus* sp. attacked larvae of muga silkworm [10].

The present study supports the findings of Chowdhury (1981) and Singh et al. (2013), who reported that *O. smaragdina* attacks first to third instar larvae and is mainly active in spring and summer, resulting in a significant reduction in the effective rearing rate [11,12].

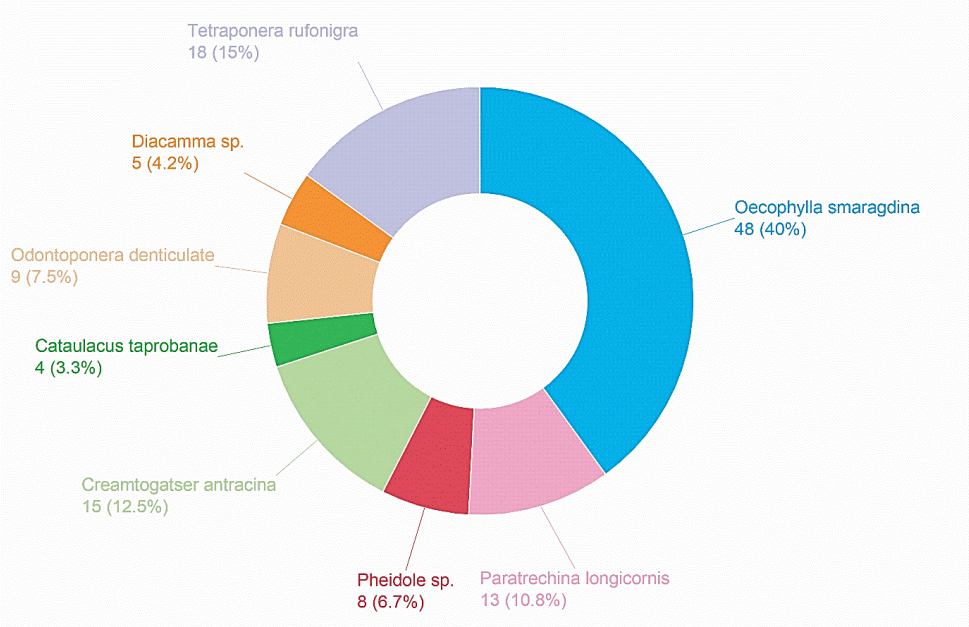

Fig. 5. Distribution of the respondents regarding frequently observed ant species in muga ecosystem

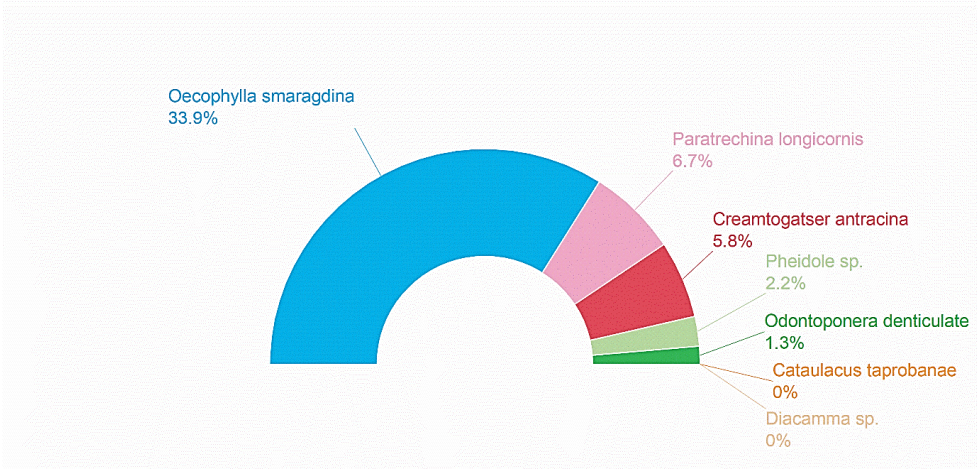

Fig. 6. Distribution of respondents regarding most predacious ant species to early instar muga silkworm

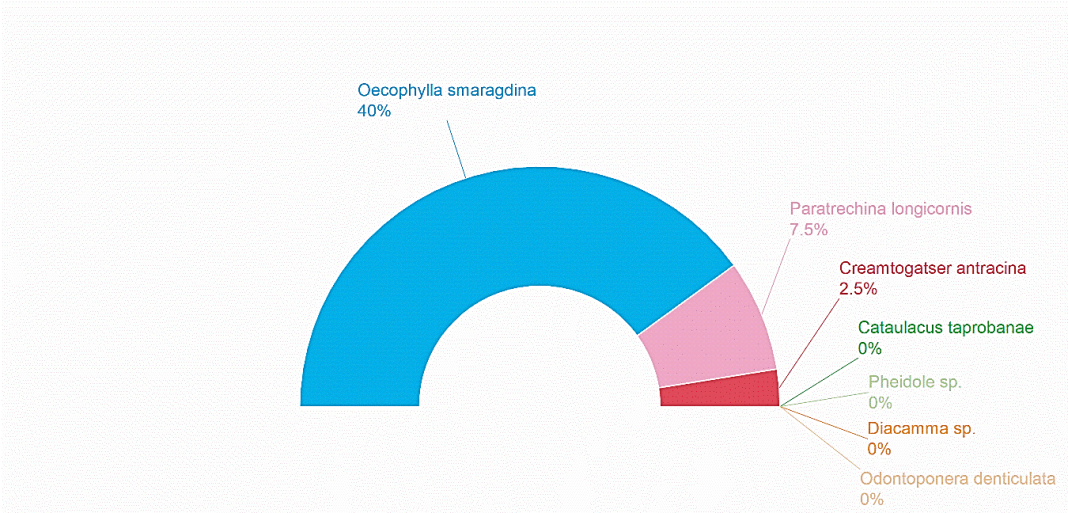

Fig. 7. Distribution of respondents regarding most predacious ant species to late age muga silkworm

Table 2. Distribution of the respondents regarding muga crop loss done by ants

Sl no.	Category	Frequency	Percentage (%)
1.	1-25%	117	97.50
2.	26-50%	3	2.50
3.	51-75%	0	0
4.	76-100%	0	0

Notably, the respondents identified the *Aherua* (June-July) crop cycle as the period of peak ant predation, highlighting the need for focused management strategies during this rearing season. Furthermore, the estimated crop loss of 1-25% attributed to ant infestation, as reported by the majority of respondents, which reveals the economic implications of this predatory threat on muga silk production.

4. CONCLUSION

The study's findings contribute to a comprehensive understanding of the ant-muga silkworm interaction dynamics, emphasizing the urgency for developing effective and sustainable management approaches. Potential strategies may include integrated pest management techniques, biological control methods, or the

exploration of environmentally benign ant repellents or deterrents. Future research endeavors should focus on elucidating the ecological factors influencing ant predation, as well as investigating the potential impact of climate change on these interactions.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of manuscripts.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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