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Overwintering of the stinging nettle caterpillar *Parasa lepida* (Cramer) in Northern India: A case study

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Abstract
The stinging nettle caterpillar, *Parasa lepida* (Cramer), is a polyphagous pest of several commercial crops/trees widely distributed across Asia and known for inflicting painful stings through urticating hairs. Although its biology has been extensively studied in tropical and sub-tropical regions, little is known about its overwintering behavior in colder northern climates. This case study documents the overwintering of a *P. lepida* larva on a white fig (*Ficus virens*) tree in Gurugram, Haryana. Observations spanned from larval movement in mid-December 2022 to adult emergence in late May 2023, revealing a prolonged larval diapause of 136 days. Diapause initiation appeared to coincide with declining temperatures and photoperiod, while termination aligned with the onset of warmer temperatures and increasing day length. This is the first documented account of overwintering and survival of *P. lepida* under subtropical northern Indian conditions.

Keywords: Carryover, *Parasa lepida*, overwintering, diapause, nettle caterpillar

Introduction

The stinging nettle caterpillar, *Parasa lepida* (Cramer) (Lepidoptera: Limacodidae), is a widely distributed species occurring across several Asian countries, including India, China, Bangladesh, Pakistan, Sri Lanka, and others (Kapoor, K., *et al*., 1985; Arumugam, *et al*., 2019) [6, 3]. Traditionally considered a high-altitude pest (Viqar, S.N., *et al*., 2008) [12]. it is known for its highly polyphagous feeding behavior, infesting a broad range of economically important crops and trees such as castor, mango, coconut, citrus, banana, tea, and coffee (Ananthanarayaian, K.P, *et al*., 1955; Kapoor, K., *et al*., 1985) [1, 6].

The larvae of *P. lepida* are easily identified by the urticating hairs along their dorsal surface, which cause intense pain, burning sensations, and dermatitis due to a lectin with bacterial agglutination properties (Mitpuangchon, N., *et al*., 2021) [7]. Early instars feed on the lower epidermis of leaves, while later instars consume entire leaf blades, often leaving only the midribs and veins. Severe infestations can lead to significant defoliation, especially in host trees like mango (Kapoor, K., *et al.*, 1985) [6], tea (Kapoor, K., *et al.*, 1985) [6], coconut (Pillai, K.S., *et al.*, 1968) [8], and *Populus deltoides* (Shamila, K., *et al.*, 2014) [10].

Larval pupation typically occurs in the soil, where urticating hairs are shed, posing occupational hazards for workers in tea plantations (Viqar, S.N., *et al*., 2008) [12]. However, on coconut, pupation is commonly observed on the ventral side of leaflets (Pillai, K.S., *et al.*, 1968) [8]. The insect's biology has been well documented across various regions of India—Kerala on coconut (Pillai, K.S., *et al.*, 1968) [8], Gujarat on mango (*Chaudhary, N.J., et al., 2016*) [5], Uttarakhand on *P. deltoides* (*Shamila, K., et al.*, 2014) [10], and Maharashtra on *Terminalia bellirica* (Bhoye, *S.B., et al., 2024*) [4]. Despite these studies, the overwintering strategy or cold-season survival mechanisms of *P. lepida* remain undocumented, particularly in northern Indian states like Haryana, Punjab, and Jammu and Kashmir, where the pest's preferred host trees are widespread but winters are relatively severe.

This case study emerged from a routine insect survey conducted in the Westerlies township of Sector 108, Gurugram. On 16 December 2022, a mature larva of *P. lepida* was observed climbing the trunk of a roadside white fig (*Ficus virens*) tree, planted among firebush (*Hamelia*) shrubs. The township, home to over 200 *F. virens* trees, provides critical microhabitats for various insect species, including defoliators like *Trilocha varians* (Shalini, S., *et al*., 2023) [9]. This observation led to an extended monitoring of the larva until its adult emergence, yielding valuable insights into the overwintering behavior of *P. lepida* in a subtropical northern setting.

Materials and methods

Study location

The study was conducted in the townships of Experion developers in Sector 108, Gurugram, Haryana (28.4972° N, 76.9867° E).

Weather of the experimental area

Weather parameters (2011 to 2021) of Gurugram were sourced through meteorological observatory at Palam Airport (Fig. 1). However, weather parameters of specific location Sector 108, Dharampur 122017, Gurugram were recorded through Apple weather (Smart Apple I phone 12 Pro) from Mid December 2022 to last week of May 2023, covering the entire life cycle (Fig. 2).

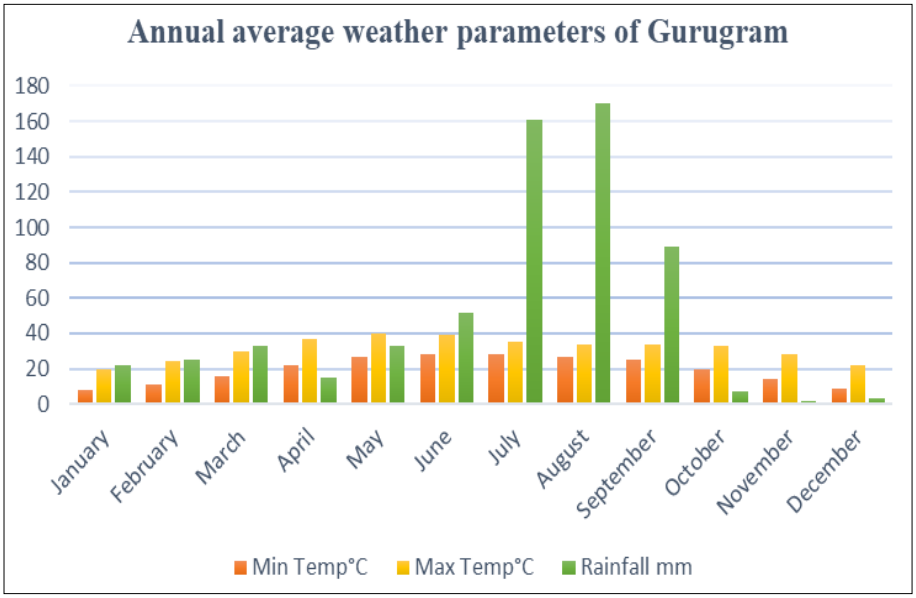

Fig 1: Annual average weather parameters of Gurugram from 2011 to 2021 (Source- Observatory Palam Airport-14 km from study area)

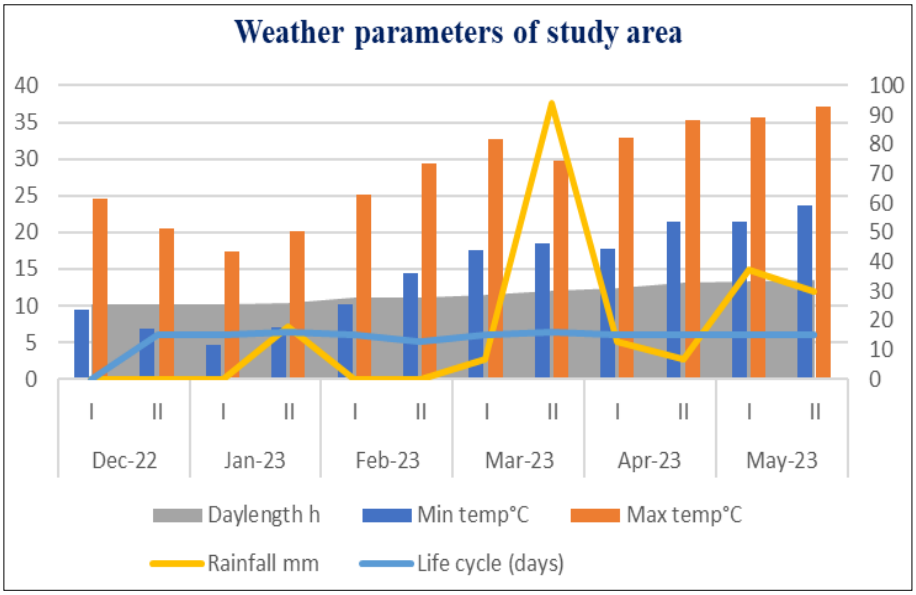

Fig 2: Weather parameters of Sector 108, Gurugram, Haryana between third week of December 2022 to last week of May, 2023

Observations of various insect stages

On 16 December 2022, a fully mature larva (Fig. 3-pic 1) of *Parasa lepida* was observed crawling on the trunk of a white fig (*Ficus virens*) tree (photo) in the Westerlies township, Sector 108, Gurugram the tree was planted alongside a *Hamelia* (firebush) shrub hedge in the colony's green belt. After about 5 h, larva covered about 125 cm along the trunk to find a suitable site (Fig. 3-pic 2) indicated with red arrow for constructing a protective case for safe shelter in winter season or till emergence as adult. The activity of larva recorded daily for 167 days till adult emergence in the field and controlled room (maintaining maximum temperature up to 32°C). Notably, the larva entered a state of diapause inside this capsule and remained inactive for a prolonged period. On 2 February 2023—47 days after capsule formation—the structure was carefully opened (Fig.3-pic 7&8) to assess the condition of the larva. The capsule was detached cautiously to avoid any damage to hibernating larva and placed in an open Petri plate containing moist filter papers and cotton swab (Fig.3-pic9). Petri plate was kept in glass jar covered with muslin cloth. The jar was kept in a control room for rest of the period exposed to natural variations in temperature and photoperiod except maximum temperature kept below 32°C with air conditioning. Daily observations were recorded till adult emergence.

			
1	2	3	4
			
5	6	7	8
			
9	10	11	12
			
13	14	15	16

17	18	19	20

1.Diapausing larva; 2. Host tree *Ficus virens*; 3. Diapausing site; 4. Webbing over larva; 5. Concealment in capsule; 6. Broadview of diapause site; 7. Encircling and ejection of capsule; 8. Detached capsule from substrate; 9. Ventral view of capsule; 10. Diapausing larva; 11. Prepupal stage; 12. Prepupa and capsule; 13. Fresh pupa; 14, 15 &16. Colour changes in pupa; 17 & 18. Capsule with operculum and cocoon; 19 & 20. Dorsal and lateral view of moth

Fig 3: Pics 1 to 20 depict different sequences of life stages of *Parasa lepida* in chronological order till moth emergence

Results and Discussion

Overwintering diapausing larva: Previous studies have reported the final instar of *Parasa lepida* to be the seventh, as documented on hosts such as *Terminalia bellirica* (*Bhoye, S.B., et al., 2024*) [4], mango (Chaudhary, N.J., *et al., 2016*) [5], and coconut (Pillai, K.S., *et al.,* 1968) [8]. The mature larva exhibits an apple-green coloration with three distinct green longitudinal bands. A deep blue mid-dorsal line and lateral stripes are visible, along with subdorsal and sublateral spinous tubercles bearing red-tipped spines. The lateral scoli are pale green, while dorsal scoli are dark green. The setae are stiff, sharply pointed, and well-developed (Fig. 3- pic 1). Dorsally, the larva appears pale or yellowish green. In the present study, a diapausing larva was observed selecting a pupation site on the trunk of a *Ficus virens* tree. On 16 December 2022, the larva was seen climbing about 125 cm vertically indicated with red arrow (Fig. 3- pic 2 & 3) using abdominal sucker-like appendages and secreting semi-fluid silk that aided in adhesion—behavior consistent with *Bhoye, S.B., et al., (2024*). Within 24 hours, it constructed a robust, hemispherical, chocolate-brown capsule measuring approximately 12–13 mm in length, 10 mm in width, and 9 mm in depth (Photo). Outwardly, the capsule was camouflaged against the tree bark (Fig. 3-pic 4 &5) and firmly attached to the substrate using a viscous reddish-brown fluid secreted by the larva, which later hardened to form a base layer, as earlier reported by Pillai, K.S., *et al.,* (1968) [8].

Since it was uncertain about the future of larva inside shielded capsule, it was planned to remove the capsule carefully after 47 days of formation (Fig.3-pic 6&7) on 2nd February 2023. This capsule containing larva opened like a window door sideways (Fig. 3-pic 8), removed and kept in Petri plate containing moist cotton swab and filter papers (Fig.3-pic 9), carried to control room in a glass jar covered with muslin cloth for the remaining period. On 9th February after one week in control room, ventral/inner wall of the capsule was broken open carefully with forceps without causing any injury to diapausing larva (Fig.3 -pic 10)) for visual examination. Inactive larva was taken out of capsule first time, measured and replaced back in the capsule for subsequent observations. On 19th February 2023, larva became yellowish in colour, more active, 9-10 mm long, 7-8 mm wide and 7 mm depth seems to be shrinking and beautifully accommodated inside the smooth inner surface of brown chocolate capsule. The larva was kept under daily watch for any transformations/ activities. The caterpillar remained in flattened oblong shape till first May 2023 (Fig. 3-pic 10). The flattened, yellowish larva was gently removed, measured (approx. 9–10 mm in length and 7–8 mm in width), and then replaced inside the capsule. By early May, the larva underwent noticeable morphological changes. On 2 May 2023, it became more cylindrical—indicative of the onset of the prepupal stage (Fig. 3-pic 11&12). Remarkably, diapause lasted for 136 days, a significant deviation from the usual 5–8-day seven instar larval duration reported under non-diapausing conditions (Pillai, K.S., *et al*., 1968 [8]; Chaudhary, N.J., *et al*., 2016 [5]; Bhoye, S.B., *et al*., 2024 [4]).

The onset of larval diapause corresponded with a substantial drop in environmental temperatures during the second half of December (6.8–24.5°C), reaching a minimum range of 4.7–20.1°C in January. Concurrently, photoperiods shortened to 10.2–10.4 hours (Fig. 2). These environmental cues—especially temperature and day length—appear to be critical triggers for initiating diapause, consistent with the findings of Shudeer, *et al*., (2024) [11]. Although host plants such as castor, mango, citrus, rose, fig, and banana were abundantly available, the larva still entered diapause, underscoring the dominance of abiotic factors in its overwintering strategy. By late April, with rising temperatures (21.5–35.3°C) and extended day length (13.8 hours), the larva resumed development and exited diapause.

Pre-pupal stage: By 2 May 2023, the larva transitioned into the prepupal stage. It became noticeably narrower, cylindrical, and more rigid (Fig. 3-pic 12), measuring 10 mm in length and 6 mm in width. The prepupal period lasted four days. Earlier reports indicated shorter durations: 2 days on coconut (Pillai, K.S., *et al*., 1968) [8], 1.43 days on mango (Chaudhary, N.J., *et al*., 2016) [5], and 5–6 days on Terminalia (Bhoye, S.B., *et al*., 2024) [4].

Pupal stage: On 6 May 2023, the larva pupated inside the same capsule, transforming into an obtect pupa (Fig. 3-pic 13). It turned out to be male pupa based on morphology described earlier (Avasthy, P.N., *et al.,* 1964) [2]. The pupa was initially light brown, becoming darker over time (Fig.

3-pic 14). On 16 May, it was carefully removed and measured: 11 mm long and 6 mm wide. The pupa was actively responsive to light stimuli and was subsequently returned to its capsule (Fig. 3-pic 15). By 23 May, it had darkened further (Fig. 3-pic 16), and that evening, the adult emerged through a circular operculum (5 mm in diameter) at the anterior end of the capsule (Fig. 3-pic 17 & 18)). The total pupal duration was 12 days—significantly shorter than durations recorded on *Terminalia* (30–32 days), mango (29.2 days), and coconut (27–37 days).

Adult stage: The emerged adult (Fig. 3-pic 19 dorsal & 20 lateral view) was a male moth, as identified by pupal morphology and confirmed post-emergence. The moth displayed greenish head and thorax, with reddish-brown markings on the sides and vertex. The forewings were pea green with a broad oblique medial green band and reddish-brown costa—matching descriptions given by Viqar, S.N., *et al*., (2008) [12]and Pillai, K.S., *et al*., (1968) [8]. The adult measured 16–17 mm in body length with a wingspan of 34–35 mm. The male moth survived for five days under controlled conditions, consistent with previous reports indicating a lifespan of 3–6 days for males (Pillai, K.S., *et al*., 1968[8]; Bhoye, S.B., *et al*., 2024) [4].

Earlier literature suggests that non-diapausing generations of Parasa lepida complete their life cycle in 42–60 days on tea (Viqar, S.N., *et al*., 2008) [12] 78.4 days on coconut (Pillai, K.S., *et al*., 1968) [8], 84 days on Terminalia (Bhoye, S.B., *et al*., 2024) [4], and 71.34 days on mango (Chaudhary, N.J., *et al*., 2016) [5]. In contrast, the current study reports a markedly extended larval life cycle due to overwintering diapause lasting over 136 days, emphasizing the species' adaptive strategy in subtropical northern Indian climates.

Conclusion

The present study documents, for the first time, the overwintering behavior of the stinging nettle caterpillar *Parasa lepida* in the subtropical region of northern India. A single late-instar larva was observed entering a prolonged state of diapause during winter, encapsulated within a robust, camouflaged hemispherical cocoon. Despite the continued availability of host plants, diapause was induced by low temperatures and reduced photoperiods—highlighting the critical role of abiotic environmental cues in the seasonal development of this pest species. The larva remained in diapause for 136 days, significantly extending the insect's developmental timeline when compared to earlier studies conducted under non-diapause conditions in tropical regions. As temperatures increased and daylight lengthened in spring, the larva resumed development, progressing through prepupal and pupal stages before emerging as a healthy adult male moth. This successful overwintering strategy reflects the species' adaptability and potential to persist in varied climatic zones. Understanding the diapause behavior and seasonal biology of *P. lepida* is essential for predicting its population dynamics and implementing timely pest management strategies, particularly as climate variability influences the distribution and phenology of lepidopteran pests. The findings serve as a baseline for further ecological studies and may inform integrated pest management (IPM) approaches in regions susceptible to *P. lepida* outbreaks.

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