



Incidences of *Heterocrasa expansalis* (*Insecta: Lepidoptera: Pyralidae*) Attack on *Quercus floribunda* in Western Himalaya

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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

Quercus floribunda (Green Oak) which is locally known as Moru Oak, is one of the important species of oaks widely distributed in the north western Himalayan ecosystems in the altitudinal range of 2000 to 2800m above msl. The Moru Oak is very vulnerable to insect pests attack and sometimes these attacks transformed into the outbreak of pests. During the study extensive surveys were carried out in the selected sites i.e. Chamba, Kullu and Shimla to assess the insect pest infestation during different seasons i.e. pre-monsoon, monsoon, post-monsoon using an appropriate design. During this study different insect pests attacking different parts (Leaves, stem, acorns etc.) of Moru Oak were observed along with the extent and frequency of insect attack.

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Insects were collected in the field and geo-information of the study sites was also recorded. The study on life history of a major defoliator *Heterocrasa expansalis* was undertaken in the laboratory. Assessment of the damage by different insect pests on Oak species was monitored and data on infestation status was recorded. Management of defoliators using IPM methods was also discussed.

Keywords: Infestation; Moru Oak; Lepidoptera; Pyralidae; insect pests.

1. INTRODUCTION

Oaks assume considerable conservation significance as they are providers of numerous ecosystem services (conservation of soil, water, native flora and fauna) and serve as lifeline for the local communities [1]. The most valued of all oaks is *Quercus floribunda*, which is lopped for fodder, construction and agricultural tools. It has been used for axe handles, sledge runners, carrying poles, and walking sticks. It is appropriate for tool handles [2]. The stem bark is used to clean foul sores. The seeds are used to treat gastrointestinal hypertrophy, menorrhagia, and diarrhoea. The Moru Oak is mostly used for charcoal and fuel. Its distribution has been relatively remote and constrained due to its high sensitivity to grazing, browsing, lopping, and fires. Young regeneration must be enclosed by game-proof fencing, including seedlings and coppice [2].

Many insects find ideal places to live and/or feed in oak trees. Some of these species are regarded as pests on their own, but others are only a danger to trees when working simultaneously with other pathogenic agents or concurrently with certain stress conditions. Numerous studies have shown that insects, in especially defoliators, can play a significant role in the process' development and in the outbreaks of decline [3].

Oak decline is widespread in all its distribution range and seems to be triggered mainly by both mismanagement and unfavourable climatic factors. As a result, Oak forests become susceptible to pest attack, which accelerates the onset of decline [4]. A number of insect have been reported to attack the foliage, branches and wood of Moru Oak. A large number of insect pests infest the wood of felled trees. Mathur and Singh [5] listed 33 species of the order Coleoptera, 6 species of Lepidoptera and 2 species of Hemiptera infesting Moru Oak.

Insect defoliators damage the foliage of the affected trees to varying degrees. These insects' mechanical damage will have significant physiological repercussions. Less leaf area

results in a slower rate of photosynthetic activity. As a result, the amount of carbohydrates that are stored decreases, which causes the growth of new buds that might replace the lost foliage. Lepidopterans from the family Tortricidae are mostly responsible for these damages to buds and foliage [6].

The present study is proposed in the context of the current precarious pest situation on Moru Oak prevailing in hills of Himachal Pradesh. The study led to the collection and identification of the defoliator belonging to the order Lepidoptera. The insect specimens were identified from Entomological Museum, FRI, Dehradun and consulting the related literature. It was observed that a Lepidopteron leaf defoliator, *Heterocrasa expansalis* (Lepidoptera: Pyralidae) was heavily defoliating the Moru (Green) oak and has been reported as a new record on Moru Oak. Previously, the same defoliator was recorded in *Quercus oblongata* [7]. Insect specimens were arranged and preserved for permanent storage. Different management strategies were discussed to control this insect pest.

1.1 Systematic Accounts

Superfamily: *Pyraloidea*
Family: *Pyralidae*, Latreille, 1809
Genus: *Heterocrasa*, Warren, 1896

2. MATERIALS AND METHODS

2.1 Field Survey

Moru Oak inhabited sites were extensively surveyed across Himachal Pradesh to assess the infestation in *Quercus floribunda* (Moru oak). During the surveys three sites Bhrundhar (32°12'26.10" N, 77°12'04.45" E; 1897m above msl), Bairagarh (32°54'25.18" N, 76°09'02.19" E; 1709m above msl) and Larot (31°13'54.92" N, 77°58'20.32" E; 3047m above msl) were found affected by larvae of *Heterocrasa expansalis* (Fig. 1). Sampling surveys were carried out during pre-monsoon, monsoon and post-monsoon from April, 2021 to October, 2021 using

an appropriate design. Most of the insect pests are frequently found on the leaves of Moru Oak trees, thus foliage exploration is the most widespread collecting method. In this study, sweeping, handpicking and direct observation on the trees were performed as most productive techniques for the collection of insect pests. Site details were recorded and insects were collected to study the life history of pests in the laboratory and field. Study on effect of pest incidences was carried out by assessing and monitoring the different affected plant parts. Life cycle and complete biology of the *Heterocrasa expansalis* was also studied.

2.2 Identification

In order to fully understand the biology of the insect pest and identify it, twigs from the plants were cut off and collected along with *H. expansalis* larvae. For better interpretation, some of the larvae were raised on fresh *Q. floribunda* leaves in plastic flasks, covered with muslin cloth and kept there until adult emergence. To determine the species, the morphology, wing maculation and external genitalia were investigated. For the identification and characterization of the species, the methodologies adopted by Kumar [8], Kumar and Thakur [9], Kumar et al. [10], Kumar & Sharma [11], Kumar et al. [9] and Thakur et al. [12] were also consulted.

3. RESULTS AND DISCUSSION

The present study found that the Lepidopteron leaf defoliator, *Heterocrasa expansalis* (Lepidoptera: Pyralidae), is heavily defoliating the Moru oak, which is a new record for this species. Defoliation was observed at three locations: Bairagarh (Fig. 2), Bhrunderhar (Fig. 3) and Larot (Fig. 4), with defoliation rates of 37.5%, 56.25% and 35%, respectively. A total of 88 larvae were collected from Bhrunderhar, 65 from Bairagarh, and 15 from Larot (Fig. 5). While some plants naturally experience defoliation, such as deciduous trees losing their leaves in the fall, defoliation at the wrong time or under unusual circumstances can cause stress or even death in trees. This is because leaf loss can reduce a plant's ability to photosynthesize and nourish itself, leading to stunted growth, twig and branch dieback, mortality in small feeder roots, or even tree death [13]. It is worth noting that the same defoliator, *Heterocrasa expansalis*, was previously recorded in *Quercus oblongata* in Bhimtal, Uttarakhand [7]. These findings suggest

that the *Heterocrasa expansalis* species is expanding its range and may be causing damage to other tree species beyond *Quercus oblongata*.

3.1 Biology of *Heterocrasa expansalis* (Warren, 1896)

During the monsoon season, when insect activity is at its peak [14], larvae were collected from the Moru oak forest. The majority of the larvae were in the second and third instar stages and were found in webs. After collection, they were reared in an insect growth chamber with a temperature of 28°C and humidity of 72%. Over the course of 12 weeks, the larvae transformed into black-coloured pupae and then, within 10-15 days, into adult moths (Fig. 6).

The damage caused by these caterpillars is significant, as they primarily feed on oak tree leaves. Fourth and fifth instar larvae are particularly destructive, consuming foliage at a rapid rate and sometimes causing 100% defoliation in oak trees before entering pupation. It is important to study the life cycle and behaviour of these insects to better understand their impact on the environment and develop effective control methods to mitigate their damage.

3.2 Description of Adult moth

H. expansalis has striking and distinct physical characteristics (Fig. 7). Its forewings are an ochreous color, adorned with a pink suffusion that is most prominent at the base, along the costa, and the inner margin. The two lines on the wings are slightly darker, with the first curving at one-fourth and the second nearly parallel to the hind margin. A discernible, slightly darker discal spot can be observed, with the fringe concolorous. The hindwings, on the other hand, are ochreous and hardly tinged with pink but dusted with pale fuscous. A faint submarginal darker line is visible as well. The moth's head, face, thorax, and abdomen share a similar ochreous color, with varying degrees of pink suffusion. The patagia, or the wing covers, are distinctly pink. The underside of the moth resembles the upper side, with the forewings appearing darker as they are dusted with fuscous. This moth has a wingspan, measuring between 40-48 mm [15]. A thorough and detailed description of this moth's physical characteristics is essential for identification purposes, aiding in further study.

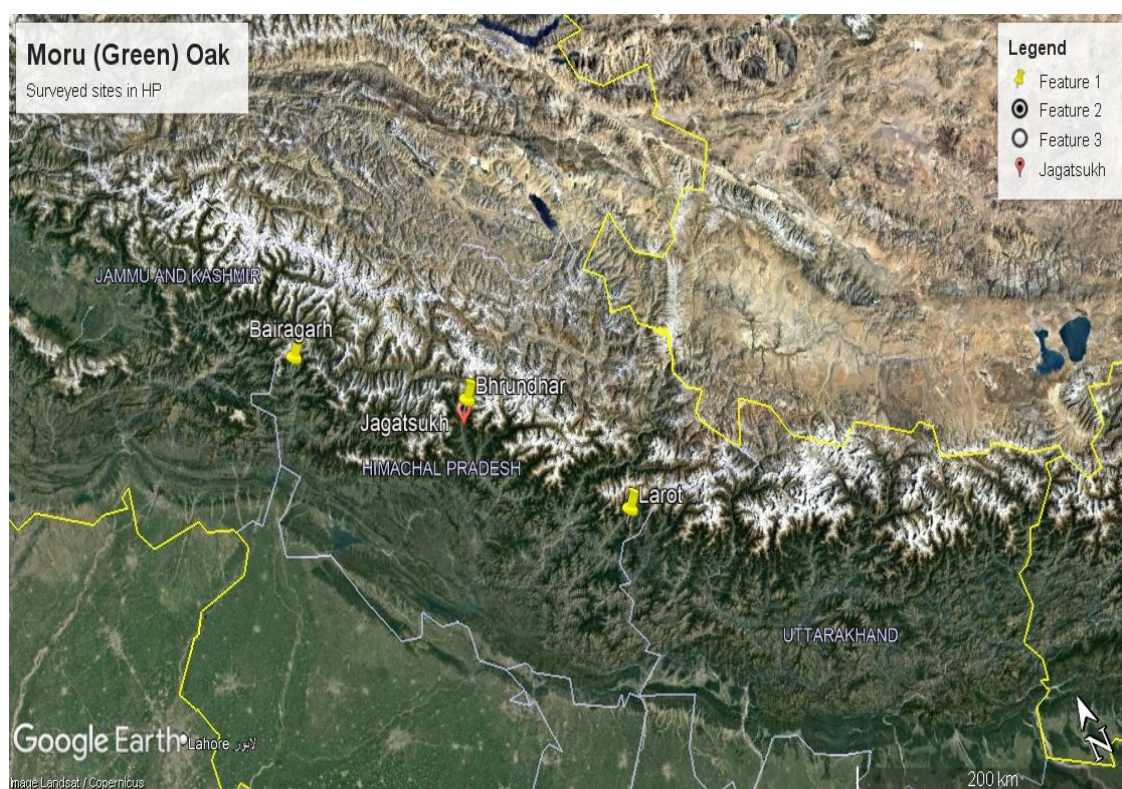


Fig. 1. Locations of surveyed sites in google map



Fig. 2. *Heterocrasa expansalis* webbing on Moru Oak at Bairagarh (Chamba)

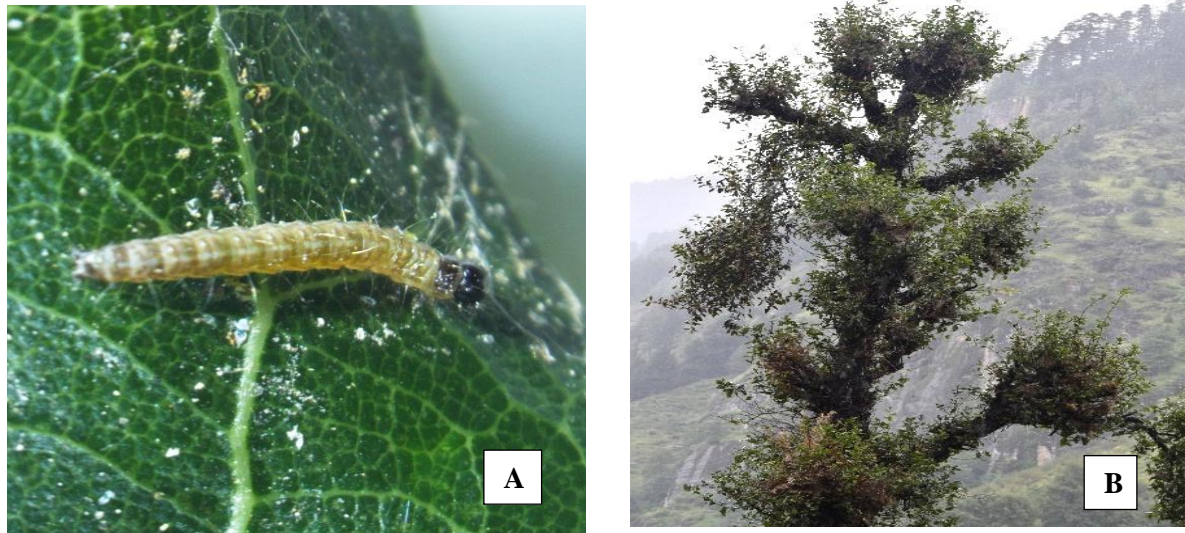


Fig. 3A. 1st instar larva of *Heterocrasa expansalis*; B. Defoliation at Bhrunderhar (Kullu)



Fig. 4. Web of *Heterocrasa expansalis* larvae at Larot (Shimla)

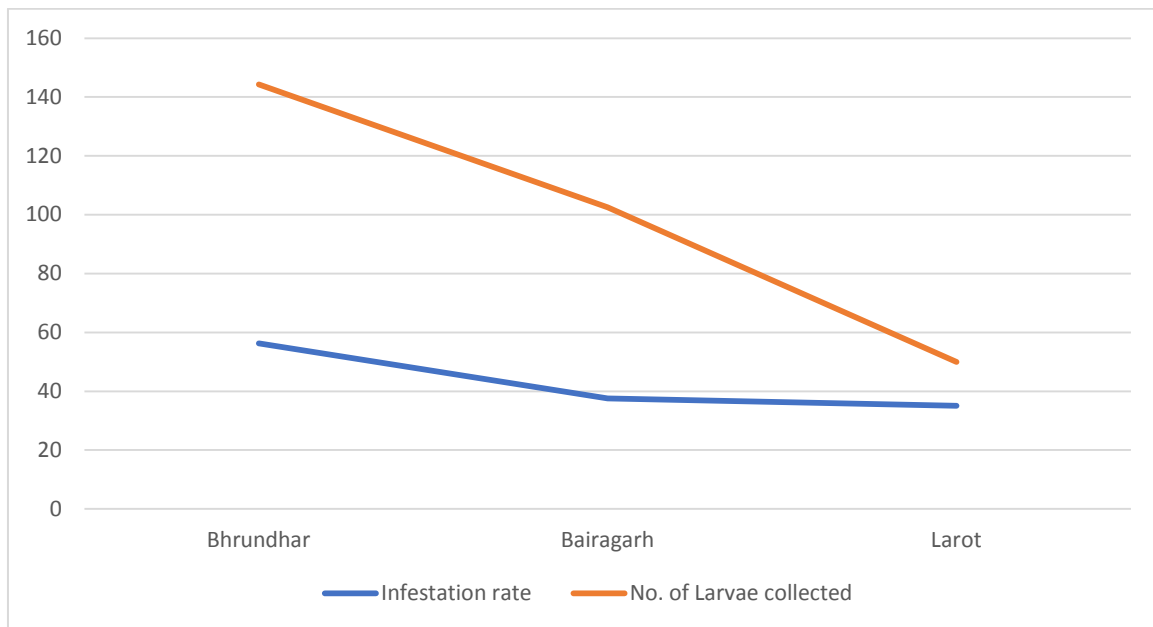


Fig. 5. Rate of infestation by larvae in surveyed sites

3.3 Management of *Heterocrasa expansalis*

To control infestations of *H. expansalis* Warren, 1896, a range of effective measures have been identified. Chemical sprays of synthetic pyrethroids, such as Chloropyriphos (0.1%) and extract of *Boenninghausenia albiflora* (2%), have proven efficient in suppressing moth larvae [16-18]. Additionally, these defoliators are naturally controlled by a variety of predators and

parasites. Birds, grasshoppers, ladybird beetles, and *Chrysoperla carnea* prey on the moth at various stages, from egg to pupa. *Trichogramma chilonis*, mites, and parasitic wasps of the family Ichneumonidae and Braconidae also parasitize and prey on these pests. Trapping male moths with sex pheromones is another effective control measure. This helps to prevent attacks by disrupting the mating cycle of the moth population.





Fig. 6 Life stages of *Heterocrasa expansalis* (Warren, 1896) in Moru Oak (B to D)
A. Defoliated Moru Oak; B. Third instar Larvae; C. Pupal Stage; D. Adult Moth

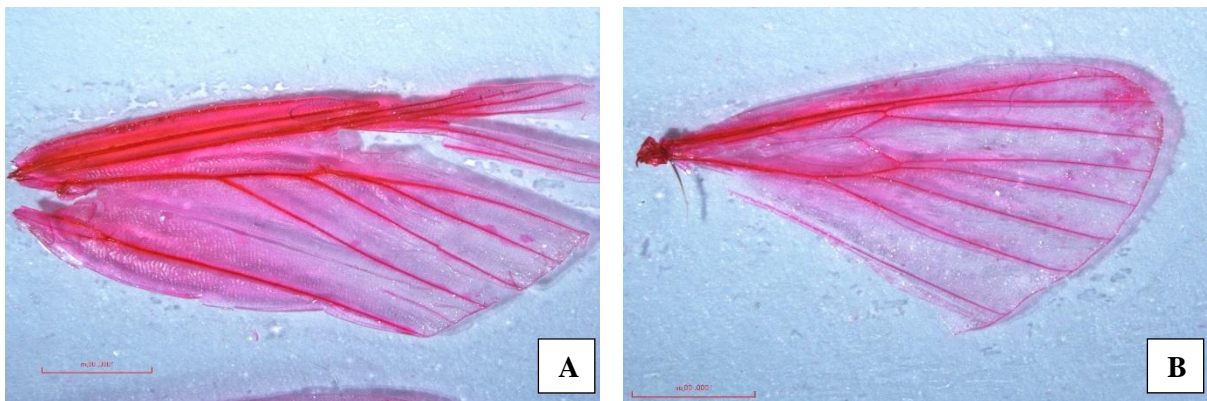


Fig. 7. Wing maculation of *H. expansalis* A. Forewing; B. Hindwing

To control the population of caterpillars that descend to the tree trunks for the winter and then climb back up to continue feeding, mechanical measures can be employed. Applying adhesive bands (15 cm plastic bands coated with a sticky glue surface) around the entire circumference of the tree trunk at breast height can effectively trap and control these pests. By implementing these control measures, it is possible to mitigate the damage caused by *H. expansalis* Warren, 1896, and promote the healthy growth of trees and surrounding ecosystems [16].

4. CONCLUSION

Most of the moth infestation was recorded in monsoon and post-monsoon season. Some of the Moru Oak trees were defoliated completely. Infestation rate was maximum at Bhrundhar site as the number of larvae collected from this site was maximum and minimum at Larot. It was

observed that *Heterocrasa expansalis* attacks more on lopped and felled trees. Insect attacks are responsible for damaging the living trees, thereby causing large scale mortality due to repeated infestation. The entire western Himalaya is witnessing an 'Oak Decline' throughout its distributional range and the insect pest attacks are aggravating the problem thus, present study was an effort to conserve this valuable species.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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