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**V Karuppaiah**ICAR-Directorate of Onion and  
Garlic Research, Pune,  
Maharashtra, India**Soumia PS**ICAR-Directorate of Onion and  
Garlic Research, Pune,  
Maharashtra, India**Priyanka D Wagh**ICAR-Directorate of Onion and  
Garlic Research, Pune,  
Maharashtra, India**Major Singh**ICAR-Directorate of Onion and  
Garlic Research, Pune,  
Maharashtra, India**Correspondence****V Karuppaiah**ICAR-Directorate of Onion and  
Garlic Research, Pune,  
Maharashtra, India

## *Ephestia cautella* (Lepidoptera: Pyralidae): An emerging pest on Garlic in storage

V Karuppaiah, Soumia PS, Priyanka D Wagh and Major Singh

### Abstract

A study was conducted to investigate the occurrence and biology of *Ephestia cautella* (Walker) on garlic in storage during 2015 at Directorate of Onion and Garlic Research, Pune. At first, pest infestation was noticed during August month in 30 days old harvested seed bulbs stored for the next season. Pest activity observed throughout August-November months. The sampling for infestation at fortnight interval revealed that, maximum infestation up to 14 larvae in a sample was recorded at 45 days after storage (DAS). Presence of adult activity, webbed galleries and fecal matter in the stored bulbs were the mark of infestation. All the stages of the life cycle of the insects were observed on garlic. Egg-incubation, larva, pupa and adult survival duration was  $4.4 \pm 0.24$  days,  $9.87 \pm 0.12$ ,  $7.12 \pm 0.37$  and  $11.50 \pm 1.50$  days, respectively. The total life cycle of moth last about 32.99 days while reared on garlic. The total numbers of eggs laid per female was  $146.6 \pm 10.76$  and adult to egg laying duration was  $4.65 \pm 0.29$  days. The information on pest description, damage symptom and biology documented with this study would be helpful in early detection and monitoring of this pest on garlic at storage and future research to managing this emerging pest. This is a new record from Maharashtra.

**Keywords:** *Ephestia cautella*, tropical warehouse moth, biology, garlic pest, storage, emerging pest

### Introduction

Garlic is one of important bulb vegetable crop of India. The cloves are most often used for seasoning and as condiment <sup>[1]</sup>. Habitually, garlic is used number of forms of cooking for its flavor. It is good source of minerals and vitamins <sup>[2]</sup>. The cloves containing properties are known for its medicinal value for various human health hazards like indigestion, anti-cancer, reducing blood pressure, heart diseases and atherosclerosis <sup>[3-7]</sup>. Besides, garlic extracts are widely used as chemical protectant for various agricultural pests <sup>[8]</sup>. The states including Madhya Pradesh, Gujarat, Rajasthan, Uttar Pradesh and Maharashtra are the major garlic growing states. Globally, India rank second position next to China in terms of cultivation area and production <sup>[9]</sup>. However, the productivity is much lower than world average and is in static. The major constraints in garlic cultivation is lack of improved variety, quality seed bulbs particularly virus-free seed material, incidence of diseases and pests and deficient post-harvest handling methods and storage conditions <sup>[10, 11]</sup>.

Garlic is mainly grown as a *rabi* vegetable and it is planted during moth of October-November and harvested in March-April <sup>[12]</sup>. To make available of produce round the year, for better market price, generally the harvested bulbs are stored up to six month for domestic consumption as well as for seed purpose <sup>[13]</sup>. Certainly, that results in significant weight loss of produce and is often experienced while at storage. The post-harvest loss incurred at storage is either due to physiological weight loss or occurrence of diseases and pests infestation. These factors are considered as major bottleneck while going for long term storage of garlic <sup>[12, 13]</sup>.

In India, fungal disease like black mold by *Aspergillus niger* and *A. fumigatus* and bulb mite, *Rhizoglyphus robini* Claparede are common issues in garlic under storage <sup>[11]</sup>. Besides, four decades before the occurrence of lepidopteran almond moth, *E. cautella* (Walker) on storage garlic was reported at Himachal Pradesh of India <sup>[14]</sup>. However, no more reported information available elsewhere in India. Looking into the nature of damage and severity, the pest is seemed to be one of the emerging challenges in garlic storage. The female moths lay eggs on the bulbs, newly hatched larvae mine in the outer layer of bulbs and enter into cloves. The later larval instar starts feeding on bulbs by makes galleries; pupates within the bulb. Adults emerged out from the bulb by making hole <sup>[14]</sup>.

*E. cautella* is a cosmopolitan pest of storage commodities in warmer climate and commonly known as tropical ware-house moth, almond moth, fig moth and flour moth [15]. It is a Lepidopteran pest belonging to Pyralidae family. The moth attacks number of stored products including rice, wheat, maize, beans, cotton seeds, flours, brans, dried fruits such as figs, almond, dates, pears, groundnut, walnuts, cocoa and tobacco [16-18]. Although, there is lot of work has been done on this pest in other commodities, in garlic no much work is available. As it is new issue in garlic storage, to generate basic information for devising viable management strategies, a study on biology and damage has been conducted. The outcome of this study would be useful in future line of research to effective management in stored garlic.

## 2. Materials and Methods

### 2.1. Study period and location

The present study was conducted at ICAR-Directorate of Onion and Garlic Research Rajgurunagar, Pune, Maharashtra, India during July to December, 2015. The study site is situated in the western Maharashtra (18°32'N latitude, 73°51'E longitude and altitude of 553.8m above mean sea level), India. The annual prevailing temperature at this station is range of 5.5 °C - 42.0 °C having annual mean rainfall of 669 mm.

### 2.2. Assessment of *E. cautella* infestation and damage

The pest infestation and nature of damage of *E. cautella* was studied with freshly harvested garlic variety Bhima Omkar. The bulbs were kept in plastic crates of 5 kg capacity with bottom and side ventilation. Each set considered as a replication. Five such replications were maintained. Fortnightly, from each replication five garlic bulbs were selected randomly and cloves were separated and examined for pest infestation. The nature and symptom of damage was recorded. The number of larvae in each bulb was counted and recorded. The initial sampling for infestation was done while set the experiment with fresh garlic bulbs. Further sampling and observation was taken at 15 days intervals for three months of storage to observe the pest infestation trend.

### 2.3. Study of biology of *E. cautella*

To study the biology, the larvae and pupa were collected from harvested bulbs which were stored for next season seed purpose in the storage unit (bottom ventilated) of ICAR-Directorate of Onion and Garlic Research, Pune, Maharashtra, India.. The infested garlic bulbs were identified collected on the basis of webbing and bore holes. The collected bulbs were cloves separated and examined for larvae and pupa and collected. They were kept in a plastic container containing 3 kg of garlic bulbs under ambient temperature. The bulbs were monitored regularly, and fungal infested bulbs were removed systematically and insect culture was established. This culture was treated as nucleus/stock culture for the further studies on biology. Twenty pupae were collected from stock culture and placed in a plastic container of 7.1 × 5.6 cm, for adult emergence. Adult sex pairs were made and kept for mating for 24 hrs. The mated females were transferred to rearing plastic container of 30 × 20 cm for egg laying and top of the container was covered with black muslin cloth for egg laying. The complete set up was kept under ambient conditions. The egg laid was collected and used for further life cycle studies. A set of twenty five (25) eggs and larvae were considered as a replication and five replications were maintained. Observations on life cycle parameters including egg-

incubation, larval, pupal, adult longevity, number of egg laid and adult to eggs laying duration in days were recorded at 24 hr interval. The mean data for each biology parameter and pest population infestation were computed and descriptive statistics were worked out.

### 2.4. Data analysis

The mean number of larva in each sample was polled for each observation date. The number of larvae in a sample was calculated at fortnight interval. The mean growth parameters recorded while biology study was subjected to descriptive analysis using SPSS statistical software.

## 3. Results and discussion

The regular sampling for pest incidence on garlic bulbs kept under storage revealed the occurrence of tropical warehouse moth, *E. cautella* damage during storage. At first the infestation was noticed during the month of August continued till November, 2015. The observation of nature of damage revealed that, upon hatching the larvae feed on bulb/clove and making galleries and leaving the feces with in the bulbs. Infested sample have shown the typical infestation mark of webbed galleries, adult activity, contaminated bulb with fecal matter and dry rotted bulbs with secondary black mold infections (Fig 1). The result of infestation affects the quality and weight of bulb. The morphology of adult moth was greyish-brown in colour. Larva was greyish-white with sparse setae on the body and dark brown head. Pupa was pale brown in colour (Fig. 2). The fort-night observation on pest infestation revealed that, infestation or first appearance of pest starts after 30 days of storage (4 larvae in a sample) and maximum population of 14 larvae in a sample noticed at 45 days after storage (Fig.3). Till 75 days after storage, constant infestation was noticed and at 90 and 105 sampling there was no pest was recorded. However, infestation was noticed up to 135 days after storage. The trend of pest infestation revealed that possibility of two generation cycle in a season at storage and particularly in monsoon months.

Almond moth *E. cautella* is a serious pest of various storage food commodities in world-wide [16]. In Taiwan Yao *et al.* [17] reported 11 insect species on stored garlic and in which almond moth was one of the major pests. However, occurrence *E. cautella* in garlic was not reported elsewhere in India except Himachal Pradesh [14]. We report second time in India and first in Maharashtra. Bhardwaj and Thakur (1974) described that larvae of *E. cautella* starts boring the garlic bulbs from the base, continued feeding inside the bulblets. Presence of yellowish brown excreta and emergence hole in the bulbs were the marks of infestation. The nature of damage and mark of infestation observed in the present study showed conformity with the earlier report [14].

The data on life cycle of *E. cautella* reared on garlic cloves shows that egg-incubation period of was  $4.4 \pm 0.24$  days. The mean larval, pupal and adult survival duration were  $9.87 \pm 0.12$ ,  $7.12 \pm 0.37$  and  $11.50 \pm 1.50$  days, respectively. The average life cycle period of moth reared on garlic was 32.99 days. The total numbers of eggs laid per female was  $146.6 \pm 10.76$  and adult to egg laying duration was  $4.65 \pm 0.29$  days (Table 1). Likewise, Bhardwaj and Thakur reported that under controlled condition ( $27 \pm 1^\circ \text{C}$ ) the moth completes its life cycle in a month and at room temperature it undergo hibernation during the month of October and facilitate adult emergence in the next April from the hibernating pupa. This indicates that the pest could able to sustain up to next season crop and capable of attack on freshly harvested produce.

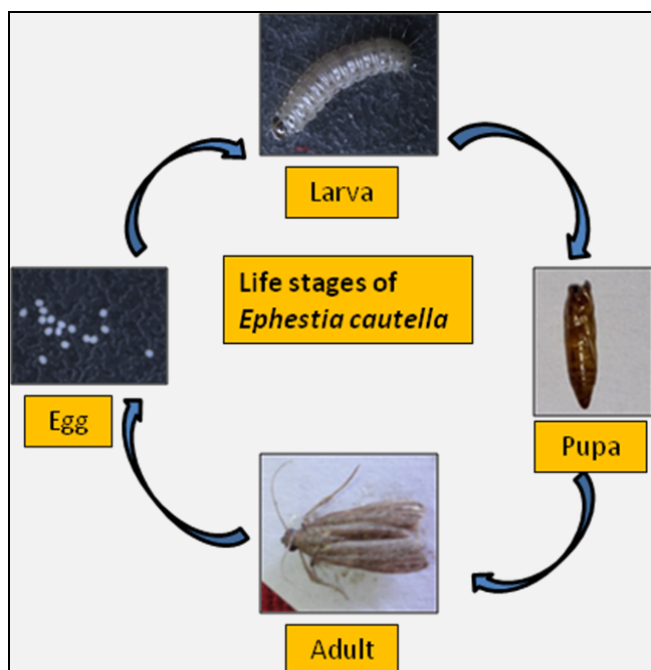
Understanding pest biology is critical to identify suitable pest life stage for control application and devise viable management strategies. The growth indices of a pest may vary with the type of diet utilized and was reported in number of polyphagous pests. Studies were also reported that, biology of *E. cautella* varied according to type of food used for rearing. A study by Allotey and Goswami [18] revealed that, total life cycle duration of *E. cautella* was 26.95 days while reared in broken sorghum. However, it was 40.14 days when reared on ground maize. The variation in the nutrient composition of the diet and preference could be the reason for the differential development [16]. It may also be the case in our present study conducted with garlic.

**Table 1:** Biology of *Ephestia cautella* on garlic

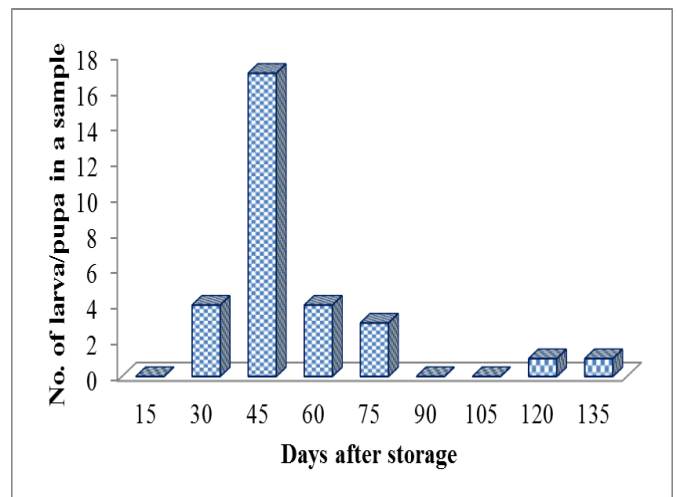
Stage	Duration in days (Mean $\pm$ SE) (Mean of five replications, each replication consist of 25 egg/ larvae)
Egg incubation	4.4 $\pm$ 0.24
Larval	9.87 $\pm$ 0.12
Pupal	7.12 $\pm$ 0.37
Adult	11.50 $\pm$ 1.50
Adult to egg laying	4.65 $\pm$ 0.29
Total egg laid	146.6 $\pm$ 10.76



**Fig 1:** *Ephestia* infested Garlic bulbs with webbings



**Fig 2:** Life stages of almond moth



**Fig 3:** *Ephestia cautella* infestation at different intervals of storage

#### 4. Conclusion

In conclusion, present study revealed that garlic is a new host for tropical warehouse moth, *E. cautella*. This is the first report from Maharashtra, India. The occurrence of this moth was prevalence throughout the period (August-November) of storage and maximum population at 45 days after storage. Infestation was noticed until 135 days after storage. The moths complete a single life cycle on garlic in 32.99 days. Looking into the nature of damage the pest is seems to be emerging issue in garlic. Keeping the view of this pest dynamics, damaging capability and biology systemic monitoring is required to diagnose this pest at the early stage of infestation. The outcome and information generated on pest description, nature and damage symptom, and infestation trend and pest biology from this study would be much useful for monitoring of *E. cautella* infestation in garlic as well as in developing control strategies and future line of research.

#### 5. Acknowledgment

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