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ORIGINAL RESEARCH ARTICLE

A comparative study of biology and morphometrics of two different species of *Earias* on okra crop

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Abstract

Okra shoot and fruit borers, *Earias insulana* and *Earias vittella* are the major pests of economically important crops like okra and cotton. It is important to understand pest biology and ecology before initiating control measures, however little is known about their comparative biology on okra. Therefore, we studied biometrics of *E. insulana* and *E. vittella* in laboratory conditions on okra fruits and recorded the duration of different life stages along with their morphological parameters, to differentiate both the species. Oviposition was comparable in both species, however, incubation period and oviposition period was shorter in *E. vittella.* Although incubation, oviposition, post-oviposition period were at par in both the species, but there was a significant difference in larval and pupa periods. Total life cycle being comparable in both species, the larval period was significantly longer in case of *E. insulana* (13.8 days), while its pupal period (8.5 days) was significantly shorter in comparision to *E. vittella* (9.9 days). Sex ratio in *E. insulana* and *E. vittella* was recorded as 1:0.72 and 1: 0.61 (male: female) respectively. Both species were slightly different in terms of their morphological parameters. This study provides basic knowledge about the biology of these pests that may be helpful while formulating IPM strategies against them in okra as well as cotton.

Keywords Biometrics · Control · Okra · Oviposition · Sex ratio

Introduction

Spiny bollworm, *E. insulana* (Boisduval) and spotted bollworm, *E. vittella* (Fabricius) (Lepidoptera: Noctuidae) are two important lepidopteran pests, substantially dispersed in India, Pakistan, North Africa and other nations. The host range includes a number of crops, particularly from Malvaceae such as okra (Aziz et al. 2011) and cotton (Nada et al. 2010; Kumar et al. 2014). In cotton, larvae of *Earias* spp. attack soft and growing tissues especially the terminal bud and cause "top boring" and afterwards, they attack flower buds and bolls, which ultimately shed (Atwal and Dhaliwal 2005), while in okra, these insects cause direct damage to tender shoots and fruits, ultimately leading to smaller and deformed pods of infested plant (Rahman et al. 2013). Fruit and shoot borers attack okra at all the life stages and cause considerable damage to the crop in terms of quality as well as of quantity (Aziz et al. 2011; Kumar et al. 2014). In cotton, *Earias* spp. cause shedding of buds (12.5 to 16.6%), flowers (0.9 to 2.5%) and bolls (7.9 to 9.5%) and ultimately leading to 3.8 to 12.6% fruit damage (Leghari and Kalro 2002). Due to infestation of *Earias* spp., 21.00% to 91.58% fruit damage had been noticed in different varieties of okra as well (Shah et al. 2001; Pareek and Bhargava 2003; Kanwar and Ameta 2007; Sandeep et al. 2015; Jalgaonkar et al. 2018). As far as the nature of damage is concerned, they have a remarkable propensity to bore into the terminal part of the shoots. Further, *Earias* spp. also bore buds, flowers and fruits with their emergence. Ultimately, the buds and flowers drop down, while the fruits become stunted in growth and deformed in shape (Atwal and Dhaliwal 2005). They damage the crop throughout vegetative and the reproductive stages, thus causing ample decline in yield (Kataria and Singh 2021).

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With reference to insects, morphometrics is the measurement and analysis of form including general measurement and analysis viz., size, ratios and shape; determining number of instars; genetics, environment and phenotypic variation; and morphometric characters in insect systematic (Daly 1985). Additionally, the name "biometrics," which is intended for life measurements, is made out of the Greek terms "bio" (life) and "metric" (to measure) (Gupta 2020). A thorough understanding of the biology of the pest is must for efficient management of insects. As the dimensions and shapes of an insect's exoskeleton also mirror its mode of life clearly, so the morphometric techniques are spectacular scientific approaches when used for the purpose of detailed biological knowledge, in order to develop a finer grasping of the way insects grow and develop, which significantly contributes for their management. Although many studies are available on biometrics of *E. insulana* and *E. vittella* all over the world, but the broad work on their comparison is lacking. Hence, the present study focuses on the comparative study of biology and morphometric of *E. insulana* and *E. vittella* on okra.

Material and methods

Raising okra crop

Okra variety "Varsha Uphar" was sown in plots size of 3 m × 5 m (15m^2) with a row to row and plant to plant spacing of 60 cm × 30 cm, during *kharif* season, 2019–2020 at experimental area, Department of Entomology, Chaudhary Charan Singh Haryana Agricultural University, Hisar, India. No chemical treatment was done on these plots, in order to utilize the fruits from these plots for insect rearing. The same fields were used to collect insects which were then taken to laboratory for rearing.

Culture maintenance

We reared *E. insulana* and *E. vittella* under environmentally controlled conditions (27 ± 1 °C temperature and 70 ± 5% relative humidity) in the insect rearing laboratory of Department of Entomology, CCS HAU, Hisar (29°10'N, 75°46'E, 215.2 m AMSL). We checked the temperature and relative humidity at regular intervals throughout the experiment to ensure it falls within the desirable limits. Many researchers have followed different methods for rearing various insects. During this experiment, insects were reared by following the methods described by Dhillon and Sharma (2004), Gaddanakeri (2019).

To start the culture, we collected larvae of *E. insulana* and *E. vittella* in separate vials directly from unsprayed fields of okra. The insects were identified by using available keys and other already published relevant sources (Sri et al. 2009, 2010; Mazed et al. 2016; Muddasar and Venkateshalu 2018), and also matching the insects with specimens present in the insect museum at Department of Entomology, CCS Haryana Agricultural University, Hisar (India). Soon after, we separated the larvae of both species in the laboratory and reared them separately in the glass jars (20.0 cm height and 15.0 cm diameter) provided with fresh okra fruits, picked from the field. The glass jars were secured with muslin cloth with the help of rubber band. Okra fruits in the rearing jars were replaced with fresh fruits at alternate days along with removing the leftover fruits and insect excreta. Pupae were collected at regular intervals and placed in another glass jars in complete darkness to allow adult emergence. We filled the glass jars with moist sand and covered with filter papers to maintain the moisture. First, 5%, 10%, and 20% concentrations of honey solution were tested on adult moths to see what they preferred to eat. Comparatively, the food offered as a 5% honey solution had a higher feeding and survival rate of moths. Hence, 10 pairs of freshly emerged adults of *E. insulana* and *E. vittella* were released in separate glass jars, having a piece of cotton dipped in 5% honey solution. Honey solution acts as a source of nutrition, food for the moths and also keeps them hydrated. The moths were allowed to be paired (female and male). Fresh fruits of okra were kept in jars as the substrate for egg laying. The adults were observed regularly to record oviposition and incubation period. We allowed two generations of both species to complete before recording observations, to allow them to acclimatize to the laboratory conditions. By taking 10 mated females into consideration, oviposition period and egg laying was observed on daily basis. Eggs were observed with the help of hand-held magnifier and identified by using microscope. Most of the eggs were found on muslin cloth covered over the glass jar. Freshly laid eggs were transferred into petri dishes with moist filter paper to prevent desiccation. The eggs laid by gravid females were used for further investigations on biology and morphometric parameters.

Observations of different growth stages

Eggs

To record the fecundity, ten pairs of moths were released into different jars having fresh okra fruits providing a surface for egg laying. Prior to egg laying, the adult females were provided with cotton swab dipped in 5% honey. By taking 10 mated females into consideration, oviposition period was observed. Egg laying by these mated females was observed on daily basis. The period between starting of egg laying to stopping of egg laying was recorded as oviposition period (in days), while period between stopping of egg laying and death of female was considered as post-oviposition period

(in days). The small pieces of fruits and the muslin cloth (covered over the container) were examined with stage and ocular micrometer to locate the oviposition sites, to see the structure and color of eggs, and to estimate the number of eggs laid. From these sites eggs were collected for the observations and kept in separate petri-dishes. The numbers of eggs hatched were recorded daily till no more eggs hatched. Thus, the mean number of eggs hatching daily and time period of egg laying was recorded to estimate the incubation period. Further, hatching percentage was worked out with the help of data on number of eggs hatched and total number of eggs laid.

Larva

Soon after hatching, first instar larvae were collected by using camel hair brush and reared on the soft and fresh pieces of okra fruit, which were washed thoroughly with running tap water and then treated with 0.02% formaldehyde solution and air-dried before feeding to the larvae. This treatment helps to avoid any kind of microbial infection to the fruit surface. Food was replaced on alternate days until they were passed through all the instars and reached pupation. The larvae were carefully removed from the okra fruits and the excreta were cleaned regularly by using a brush. The duration starting from hatching of larva from the egg to its transformation into pupa, was considered as larval period. All the above observations (including number of larval instars, period of each larval instar and total larval period) were recorded from ten replicates.

Pupa

Once the full-fed larva suspended feeding and became inactive or sluggish just before molting, they were transferred into another container having few cm thick layer of sand below the moistened filter paper. Thus, pre- pupal period was calculated by taking the time period between inactivation of full fed larva to its ecdysis into pupal stage. After the formation of pupae, they were collected on daily basis from the fruit surface, lower surface of filter paper and also by sieving the sand. The cocoons were then kept in a glass jar until adult emergence. The glass jars were covered by muslin cloth tied with the help of a rubber band. Thus, pupal period was calculated by noting the time duration from pupa formation to adult emergence. Pupae were subjected to the morphometric parameters.

Adult

Adult longevity was recorded by calculating the time period from the emergence of adults from the pupae till their death. Ten pairs of adult moths (Male and Female) were released into the glass jar. Cotton soaked with 5% honey solution was provided in that jar. Periodical observations were recorded each day, to calculate the average period of survival of adult moths. The total life period was considered right from the date of egg laying to death of adult. The sex ratio was worked out based on adult emergence. The ratio between total number of female and male adults of *E. insulana* emerged out from the same lot of pupae constitutes sex ratio. The adults emerged from pupae were examined critically. Pupae of *E. insulana* were collected from the laboratory raised culture and noticed for adult emergence. The differentiation of sexes of adult moths was made on the basis of their size (male smaller than female) and also the presence or absence of thick hairs at the end of anal part (female having V shape at the end of the anal part, while male has thick hairs at anal end) (Figs. 1 and 2).

Data analysis

All the statistical analyses were performed using R 4.0.4 software (R Core Team 2022). We compared the biometrics of *E. insulana* and *E. vittella* using analysis of variance (ANOVA). In our model, the explanatory variables/ factors were the two insect species and their different biological parameters within different life stages.

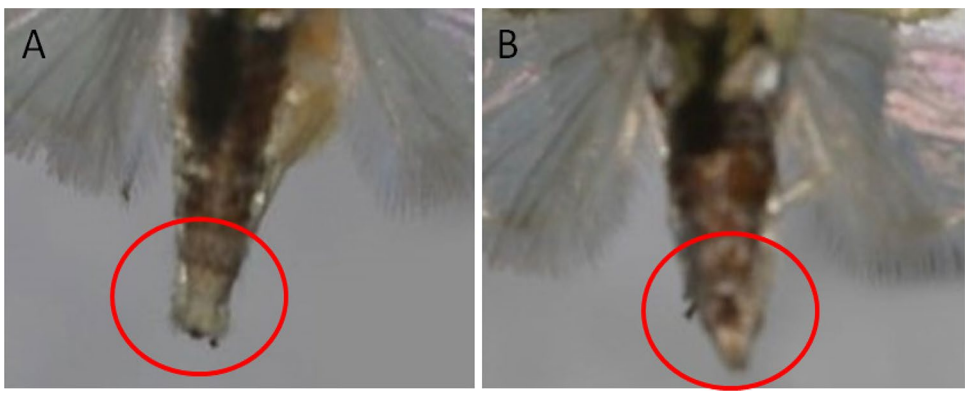

Fig. 1 Sex differentiation of adults of *E. insulana*; **A** Male having thick hairs at anal end; **B** female having V shape at the end of the anal part

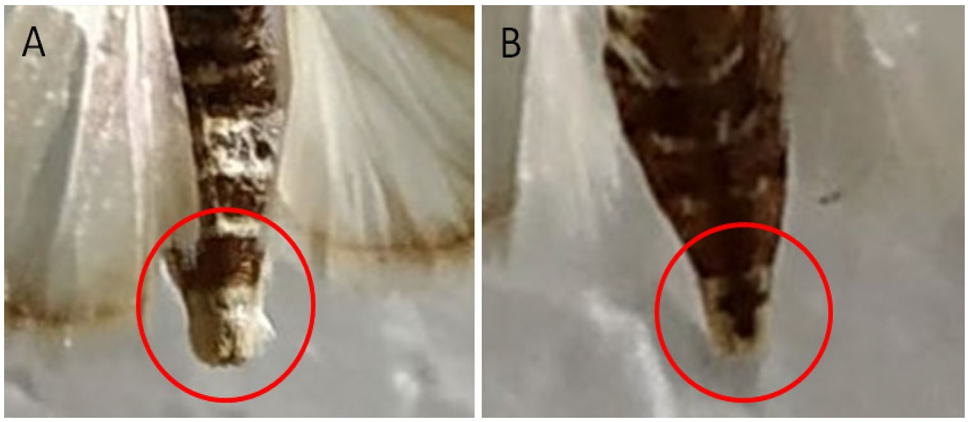

Fig. 2 Sex differentiation of adults of *E. vittella*; **A** Male having thick hairs at anal end; **B** female having V shape at the end of the anal part

Pairwise comparisons of biology (incubation period of egg, duration of different larval instars, pupal period, adult period, total life period,) and morphometric (egg diameter, length and width of larval instars, cocoon, pupa, adult) of both these species of insect were conducted. When required, data transformation (Box-Cox transformation) was done to meet the criterion for normality.

Results and discussion

Life cycle

Like other members of the order Lepidoptera, *E. insulana* and *E. vittella* pass through four growth stages (egg, larva, pupa and adult) during their life cycle. Detailed observations of duration of different stages and morphometrics of both these species are presented in Suppl. Tables 1 and 2 respectively.

Egg stage

This study done on biology of both species showed that eggs laid by females of *E. insulana* and *E. vittella* were morphologically similar in appearance (small, bluish green, globular shaped with parallel longitudinal ridges projecting upwards). They became brownish at the top, after emergence of larvae (Fig. 3). This observation is consistent with the findings of Shah et al. (2012), Sagar and Nebapure (2018), who found blue colored globular eggs with upward projecting longitudinal ridges. Eggs were very difficult to see with naked eye, so they were seen using hand magnifying glass and microscope. The mean diameter of eggs of *E. insulana* and *E. vittella* was recorded 0.5 ± 0.02 mm and 0.48 ± 0.02 mm respectively, comparable with the findings of Patel et al. (2010). Nevertheless, previous findings showed that eggs were less than 0.5 mm diameter in size when the same insects reared on cotton (Vennila et al. 2007; Shah et al. 2012). This difference in size of eggs might be justified by the fact that we used okra in our study, and hence the nutrients provided to larvae in this study were different from those of studies conducted on cotton. Incubation period of eggs in case of both these species were also significantly comparable (4.1 ± 0.99 days and 3.7 ± 0.82 days for *E. insulana* and *E. vittella*, respectively), which is in line with the findings of Dhillon and Sharma (2004), Hassan and El-Khidir (2005), Kandil Mervat (2013), Shah et al. (2014), Moustafa et al. (2015).

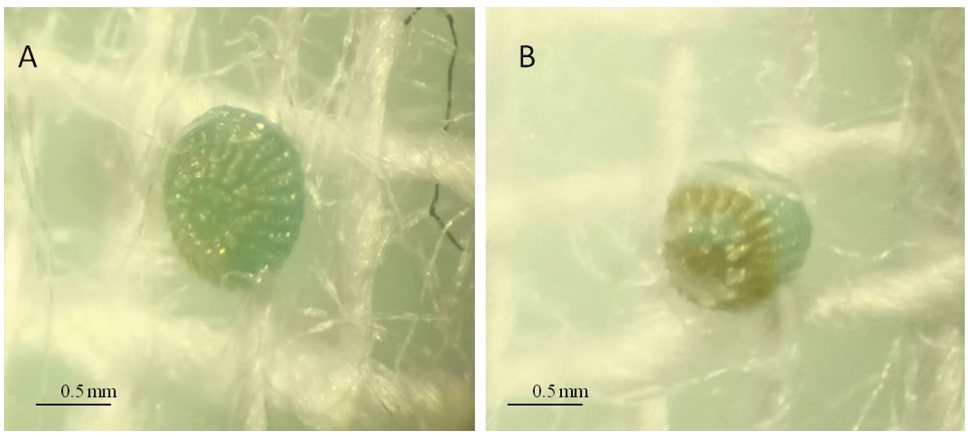

Fig. 3 Eggs laid by *E. insulana* and *E. vittella* on muslin cloth in laboratory conditions; **A** egg before hatching; **B** egg after hatching

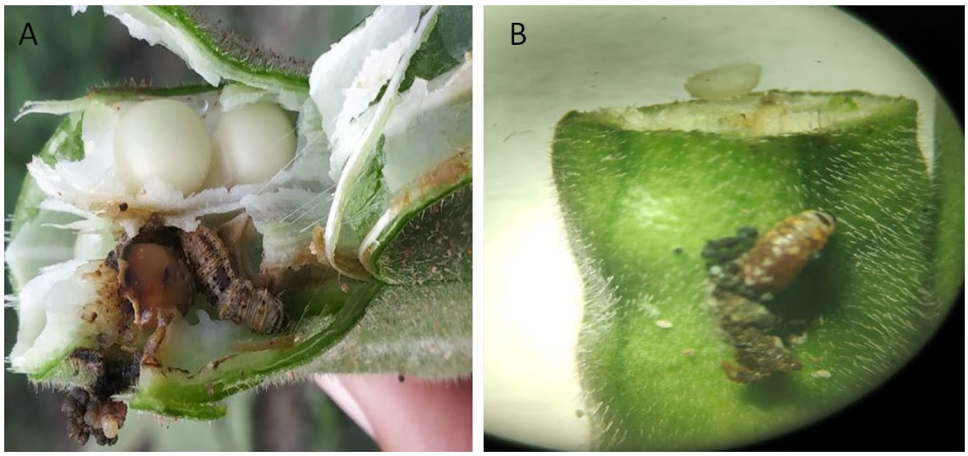

Fig. 4 **A** Larva of *Earias insulana* feeding inside okra fruits; **B** larva of *Earias vittella* feeding inside okra fruits

Larval stage

Larva is the only damaging stage of *Earias* sp. This is mainly because they directly feed on the target crop (Shah et al. 2012) (Fig. 4). Therefore, understanding their growth and development during this stage is important for managing these pests. In our study, both *E. insulana* and *E. vittella* had four larval instars. This observation is consistent with the previous findings (Kathiriya et al. 2007; Patel et al. 2010; Shah et al. 2012). However, conversely, Naresh et al. (2004) reported five larval instars of *E. vittella* while reared under laboratory conditions in the months of June-July, in West Bengal, India. This is likely to be associated with difference in the variety of okra and hence the nutrition provided to the larvae. Another possible reason may be difference in larval density, and their feeding rates. Previous studies have also found that feeding rate of larvae cause impacts on the life history of larvae (Jannat and Roitberg 2013).

First instar larva

After emergence from egg, first larval instars immediately started feeding on small, delicate and fresh fruits of okra. They were very small sized, hence not clearly visible with naked eyes. When observed under microscope, they looked as brownish white larvae with reddish tinge and prominent dark head (Fig. 5). First instar larvae of both, *E. insulana* and *E. vittella* were morphologically similar in appearance, with non-significant difference in their dimensions (Suppl. Table 3). The measurements of larvae at this stage are similar to the findings of Shah et al. (2012), who also

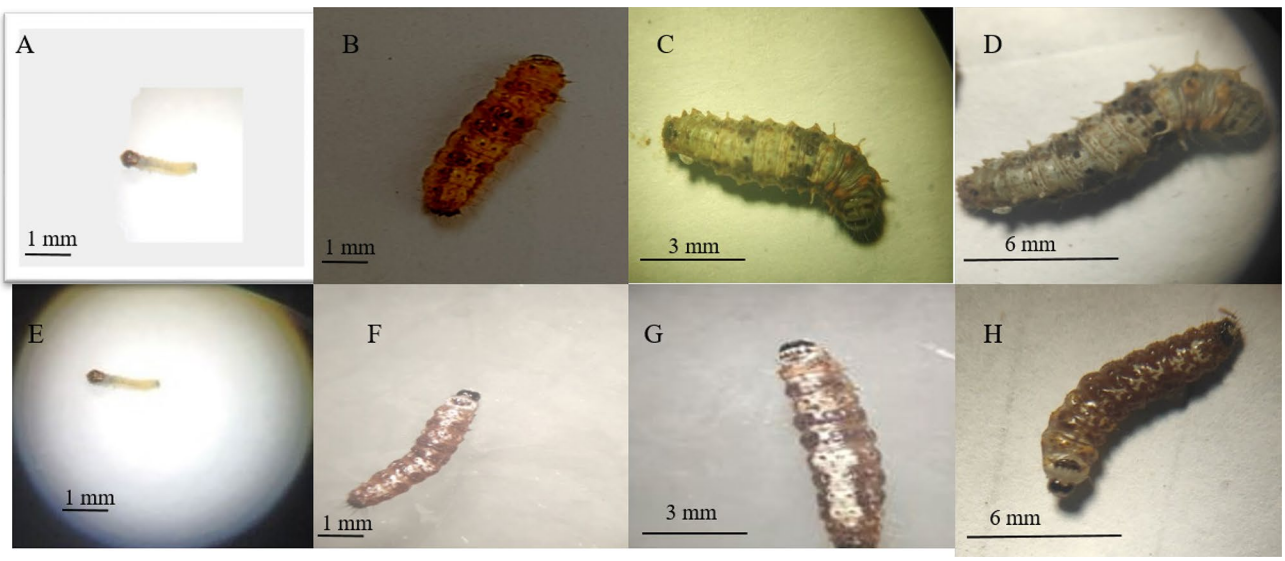

Fig. 5 First, second, third and fourth instar larva of *E. insulana* (**A**–**D** respectively); First, second, third and fourth instar larva of *E. vittella* (**E**–**H** respectively)

recorded the length of first instars larvae of *E. vittella* to be 1.3–2.0 mm. The duration of first instar larvae recorded in present study is consistent with the findings of Naresh et al. (2004), Kathiriya et al. (2007) and Patel et al. (2010), who also found that they lasted for a period of 3 to 6 days. While, Shitole and Patel (2010), Sahito et al. (2019) found a comparatively shorter duration (less than 3 days at room temperature) of first instar larva of *Earias vittella*, when reared on okra and cotton respectively. When compared to other life stages, the first instars of larvae of both the species took longer time to molt into second instars, which make them more vulnerable to insecticides applications (Ahmad et al. 2017). Previous study on another lepidopteran insect (*Spodoptera exigua*) also recorded higher susceptibility of initial larval instars as compared to grown up larvae *(*Wang et al. 2014).

Second instar larva

Second instars were closely related to their previous stage in appearance, confirmed with the findings of Shah et al. (2012), who also observed the similar morphological appearance of initial larval instars. At this stage, larvae of *E. insulana* (length = 3.65 ± 0.29, width = 1.78 ± 0.18) were significantly larger than *E. vittella* (length = 3.33 ± 0.33, width = 1.43 ± 0.30) (F1,18 = 5.06 and 10.12; p = 0.04 and 0.005 for length and width respectively) (Suppl. Table 3). So, significantly larger larvae of *E. insulana* probably points to the fact that their larvae consume more food as compared to *E. vittella*, which means that the larvae of *E. insulana* could cause more damage to fruits than later one. Duration of second instars in both species differed non- significantly. Second instar larvae of *E. insulana* lasted for an average of 3.2 days, while those of *E. vittella* lasted for 2.8 days. Previously, for same stage of these pests under similar conditions, Sagar and Nebapure (2018) recorded a period of 2 days for *E. insulana*. While for *E. vittella*, Naresh et al. (2004), Shitole and Patel (2010), Pardeshi et al. (2011) noticed that 2.15, 1.48 and 2.30 days needed for developing from second instar to third instar larvae.

Third instar larva

Once the larvae enter into their third instars, both the species were easily identified based on their characteristic appearance (Fig. 5). Third instar larvae of *E. insulana* were dark brown in color and had more thick body compared to first and second instar larvae. In addition, spines became clear and visible on the body. While, third instar larvae of *E. vittella* were brown in color, with orange tinge and no spines on their body, unlike those of *E. insulana* (Fig. 5). Naresh et al. (2004), Sagar and Nebapure (2018) specified the same morphological features of *E. insulana and E. Vittella* respectively. Further, the time taken for the transformation of third to fourth instars (Suppl. Table 1) and the body measurements (Suppl. Table 2) were statistically similar in both the species under observations.

Fourth instar larva

The larvae entered into their last instars (fourth instars) after 14.9 days and 13.8 days of oviposition by *E. insulana* and *E. vittella* respectively. Fully developed larvae of *E. insulana* were light grey to grey, with spiny terminal tubercles covering whole body surface, while that of *E. vittella* were soft and glossy, spindle shaped, without spines over their body surface. In our study, the average length of last instar larvae in both the species was 11.21 mm (*E. insulana*) and 10.49 mm (*E. vittella*). These observations and measurements were similar to the previous findings of Pardeshi et al. (2011), Shah et al. (2012), Sagar and Nebapure (2018). At this stage, the difference between dimensions of larvae of both species was non-significant, indicating the fast growing nature of *E. vittella* larvae from their second instars to fourth instars.

Total larval duration

The total larval duration of *E. insulana* (13.8 ± 0.79 days) was significantly longer than that of *E. vittella* (12.9 ± 0.88 days) ($F_{1,18} = 5.83$, p = 0.02). This can probably be a possible explanation of comparatively more damaging nature of former species, because these pests can only damage the plants in larval stage and hence longer larval duration allows more time for them to be active on the plants. Additionally, this comparatively longer duration of *E. insulana* might correlate the synchronization of their life cycle with phenology of host plants. Their longer larval stage means that there will be overlapping of destructive stage of larvae with the susceptible stage of plants, thus causing higher damage to plants. On the other hand, the other species (*E. vittella*) could enter pre-pupal or pupal stage until that time, which would not allow them to cause any kind of damage to fruiting bodies of plants. Previously, total larval period of *E. vittella* recorded by Shitole and Patel (2010), Syed et al. (2011), Sahito et al. (2019) was 9.74 days, 9.2 to 15.9 days and 13.00 days respectively. The larval parameters of *E. insulana* were quite similar to that of study done by Sagar and Nebapure (2018), who recorded a total larval duration to be 11 to 14 days.

Pupal stage

Pupal stage is the resting stage in which development of moth takes place. Before the larvae were converting to pupae, the full-grown larvae started becoming sluggish,

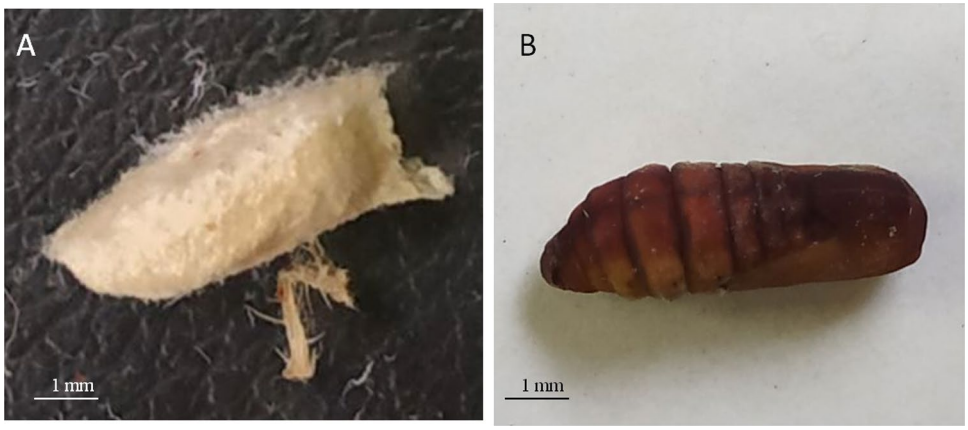

Fig. 6 **A** Cocoon; **B** Pupa (after removing outer covering of cocoon)

slowed down their activities and stopped feeding slowly. This we call as the pre-pupal stage, where they prepare themselves to enter in pupal stage. Therefore, the larvae of both the species started shrinking in size, which is probably to facilitate their pupation stage. Decrease in size of larvae before converting to pupae has previously been reported in *Papilio polytes* (Atluri et al. 2002), *Euthalia aconthea* (Tara and Gupta 2016), *Papilio polytes* (Islam et al. 2017) and *Maruca vitrata* (Mahankuda and Tiwari 2020). They remained in this condition of pre-pupal stage for about a day, without showing any significant difference. After that, they entered to pupal stage to undergo the changes needed for transforming them into adults.

Pupae of both the species were pale to dark brown colored, stout, formed inside cocoons (Fig. 6). Although the length of pupae in case of both the species were almost similar, pupae of *E. vittella* (2.86 ± 0.24 mm) were significantly broader ($F_{1,18} = 7.13$, $p = 0.01$) as compared to *E. insulana* (2.64 ± 0.11 mm). The fully weaved white cocoon was inverted boat shaped with an average length and width 11.07 ± 0.59 mm and 3.42 ± 0.25 mm. Most of the previous findings were done separately on species level, but we compared both the species here. *E. insulana* pupae developed significantly ($F_{1,18} = 4.57$, $p = 0.04$) faster than *E. vittella*, with pupal period of 8.5 ± 0.85 and 9.9 ± 1.20 respectively. More damaging nature of *E. insulana* further reflected in the shorter resting/ pupal stage of this species as compared to *E. vittella* (with longer pupal period). However, our results also suggest that faster development of *E. insulana* pupae may emerge as a compensation for larval growth, where the duration of *E. insulana* larvae was significantly longer than *E. vittella.* The current observations of pupal parameters are consistent with the findings of Kathiriya et al. (2007), Patel et al. (2010), Sagar and Nebapure (2018).

Adult stage

The adults of *E. insulana* were small sized moths with parrot green forewings and dorsal thorax, whereas hind wings were silvery white with brownish outer margin and have filiform antennae (Fig. 7), well supported by the previous study done by Sagar and Nebapure (2018). On the other hand, adults of *E. vittella* were pale white in colour with green longitudinal wedge-shaped band in the middle of the forewings (Fig. 8), supported by Pardeshi et al. (2011), Shah et al. (2012). All the observations related to adults of both the species were statistically similar, depicting that adults of both the species performed in a similar pattern

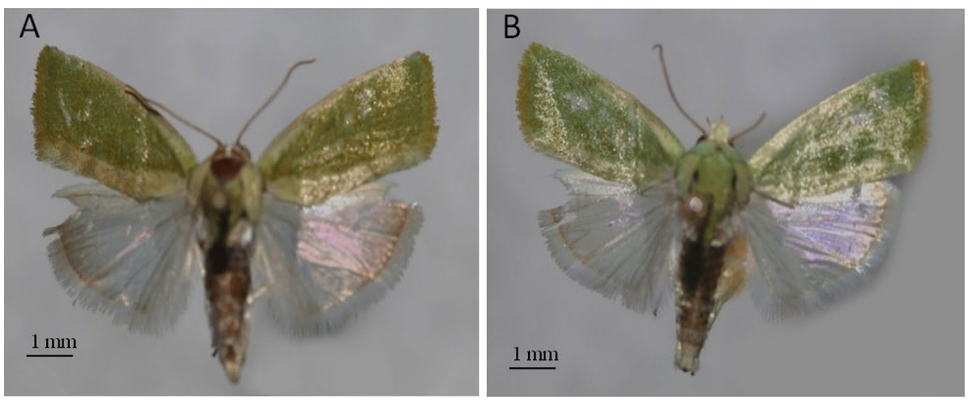

Fig. 7 Adults of *E. insulana*: **A** female; **B** male

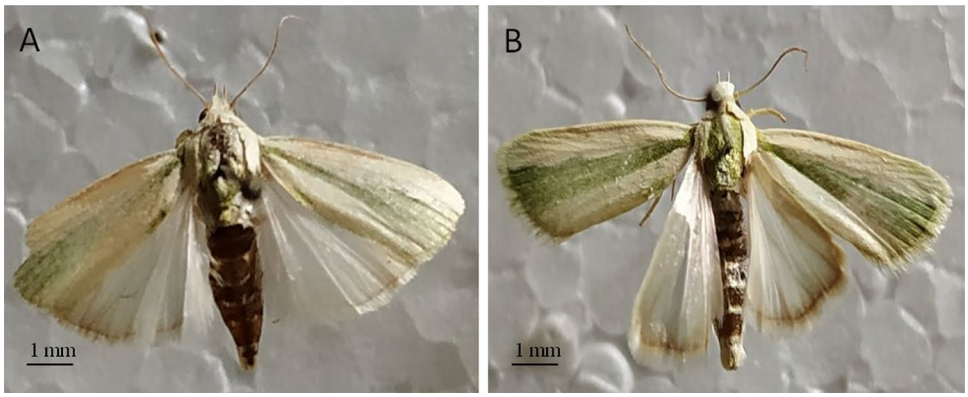

Fig. 8 Adults of *E. vittella*: **A** female; **B** male

of growth and development. Adult females of *E. insulana* (10.33 ± 0.58 days) and *E. vittella* (10.50 ± 1.29 days) survived for longer period as compared to adult male. There are multiple studies (Naresh et al. 2004; Shah et al. 2012, 2014), confirming the longer survivability of females. Total life cycle of females was also longer in case of both, *E. insulana* (37.50 ± 2.29 days) *and E. vittella* (38.31 ± 2.19 days), with a sex ratio (male: female) 1: 0.72 and 1:0.61 respectively. While looking at other studies, we found that Hassan and El-Khidir (2005), Shah et al. (2014) and Sagar and Nebapure (2018) recorded total life cycle of *E. insulana* 46.63 days, 51–53 days and 37 to 43 days, respectively. For *E.* vittella, Patel et al. (2010) observed total life cycle of female and male 34.18 and 29.90 days, respectively.

Other morphological parameters of adults, including total length of head, thorax, abdomen, forewing, hindwing, antennal length, wing span and body weight, were also measured (Suppl. Table 2) and noticed that females were leading to male in all these measurements of both species. The morphological parameters of this study are similar to the studies done by Kathiriya et al. (2007), Shah et al. (2012), Sagar and Nebapure (2018). Larger size of female adults might be because of the reason that abdomen of females has to carry eggs, so larger body and abdomen of females makes this biological process more convenient. Previously, some biologists have also mentioned that larger size of females produce more offsprings (Stillwell and Davidowitz 2010). It might also be possible that females maintain a comparatively longer larval phase, so having more time to eat as caterpillars, thus grow larger than males, who metamorphosize quickly (Esperk and Tammaru 2006). Some other researchers (Telang et al. 2001) mentioned that females of *Heliothis virescens* accumulate their nutrient reserves during caterpillar stage and hence are heavier than males.

After 2–3 days of emergence, adult moths started mating, which generally happened at night, hence eggs were also laid preferably during night (10:00 pm to 4:00 am), which clearly indicates their nocturnal behavior (active at night/dark). Additionally, the eggs were laid on the muslin cloth, covered on the top. In many previous studies researchers used muslin cloth as a substrate for egg laying by other lepidopteran insects, including *Helicoverpa armigera* (Kathuria and Kaushik 2004) and *Plutella xylostella* (Kahuthia-Gathu et al. 2008). The fecundity of *E. insulana* was 68.20 ± 8.68 eggs / female, and that of *E. vittella* was 70.6 ± 9.89 eggs / female, with a hatching percentage of 72.63 ± 7.99% and 75.33 ± 6.46% respectively. Sagar and Nebapure (2018) recorded fecundity of *E. insulana as*171 ± 20.6 eggs/female, while Shah et al. (2014) recorded fecundity of same species as 75–150 eggs/ female. Egg lying or oviposition continued for an average of 5.7 ± 0.95 days in *E. insulana*, while 5.1 ± 1.10 days in case of *E. vittella*. Syed et al. (2011), Rehman and Ali (1981) recorded oviposition period of 3-11 days and 5.83 days respectively.

Conclusion

Development of effective strategies for controlling pest populations requires a detailed knowledge of life stages of target pest species. This study enhances our understanding of biology and morphometric variability associated with two different species of *Earias*. Overall, both these pests cause huge loss to okra crop, but which among those has more damaging nature; and how their biology or morphomoterics differ; has not been recorded in detail. According to the previous findings, the rate of population growth of species depends on fecundity, survival rate and sex ratio. However, in this study both the species were found to be similar to each other in terms of their eggs, fecundity, hatching %, oviposition period, post-oviposition period, incubation period, adult period and total life cycle, they differed in few of their characters (more specifically the larval and pupal period), which can be actually associated with duration of feeding on target plants and hence damaging the plants. In the present study, average fecundity of both the pests (*E. insulana* and *E. vittella*) is high, along with their proportionate number of males and females per generation, leading to their fast replication or multiplication.

In addition, comparatively shorter life- span of both the species cause faster population growth. From the current study, we may further conclude that some of the parameters (significantly longer larval duration, smaller pupal period, and more number of females per unit of male) reflect more damaging nature of *E. insulana* compared to *E. vittella.* However, our study was confined to controlled laboratory conditions; it should be expanded further in the field environment to test the applicability of these findings in the natural conditions.

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Data availability Data supporting the findings is available upon request from the corresponding author.

Declarations

Conflict of interest The authors declare that they have no conflict of interest.

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