Biology and control of rice moth, *Corcyra cephalonica* (Lepidoptera: Pyralidae) by using botanical

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Abstract

*Coryxra cephalonica* is a secondary pest of stored grains like wheat, maize, and rice. The biological studies revealed that the life cycle of rice moth passed through four different stages i.e. egg, larva, pupa and adult. The egg duration ranged from 3-5 days. The larva passed through six instars and the average duration (days) of each instar was found to be 4.88±0.7, 4.48±0.7, 3.96±0.7, 3.70±0.6, 3.76±0.8 and 10.04±0.7 days respectively. The longevity of females was higher at 4.24±0.9 days than the males 3.52±1.0 days. The average pupal period was 11.34 days. Powdered leaves of *Ocimum tenuiflorum* (Lamiaceae) were tested for their efficacy against the stored grain insect pest *C. cephalonica*. At the higher measurements of 2.5 and 3.5 g of *Ocimum tenuiflorum* it shows 100% mortality of second instar larvae of rice moth.

Keywords: Biology and control, *Corcyra cephalonica*, botanical

Introduction

The rice moth, *Corcyra cephalonica* (Stainton) (Lepidoptera: Pyralidae) is one of the destructive insect pests found in stored grains, mainly cereals, including rice, and jowar. It is widely distributed in India and many other parts of the world (Osman, 1984). Since the pest predominantly attacks rice grains, it is commonly known as the rice moth. The pest in India is known to cause 5-10% of loss in stored grains (Champ & Dyte, 1977, Tooba et al., 2005). The annual loss of food grains in Indian godowns due to insect infestation had been recorded about five million tons of grains (Neelakanthan, 1972). The larvae damage stored grains by feeding under silken webs (Alam, 1972). At the point when infestations are high, the whole load of grains might be changed over into a webbed mass, building up a trademark awful stench and delivering the grains are unsuitable for human consumption (Alam, 1965). The rice moth is known for attacking rice, wheat, corn, sorghum, groundnut, cotton seeds, coffee, spices, cocoa beans, maize, and millets. In tropical, Asia, Africa, North America and Europe (Allotey & Kumar, 1985).

Like many other lepidopterous insects, the rice moth also passes through four different stages (egg, larva, pupa, and adult) in its life cycle. The larval stage of *C. cephalonica* causes serious damage to grains by feeding, leaving dense and tough silk threads in grains (Ayyar, 1934; Prevett, 1964). The damage is mainly caused by the larvae which feed on grains under silken webs and convert them to mere frass making them unfit for human consumption (Frenemore & Prakash, 1992). The use of insecticides against storage pests has not been proved effective as the chemicals are unsafe to humans and are known to cause various types of environmental and health hazards (Tillman & Mulrooney, 2000). In recent years, the use of synthetic pesticides for pest management has become highly controversial. These insecticides are known to cause environmental hazards, the pesticides are well known for accumulating at different levels of the ecosystem, and causing pesticide resistance in insects. The insects exposed to insecticides, for long-duration not only develop resistance against the specific insecticides but also generate cross-resistance against a group of insecticides. To beat these problems, attempts were made to find alternate methods of insect pest control like cultural method, biological control, use of antifeedant and plant extracts, etc (Rathore, 1978; Kalyanasundaram and Das, 1985; Sahayaraj and Paulraj, 2001). Many plants possess chemical substances with remarkable biological activities that provide protection and resistance against pests and herbivores (Dwivedi and Garg, 2003). So, the present investigation was conducted to study the Biology and control of the rice moth, *Corcyra*.
Materials and methods

Mass-rearing of rice moth Corcyra cephalonica

The stock culture, of rice moth was maintained on broken maize and yeast at 30 °C and 60% R. H during the period of studies in the Entomology laboratory Lovely Professional University. From the stock culture, male and female moths of Corcyra cephalonica were differentiated and kept in separate containers for further studies.

Adult longevity, Incubation period and fecundity

The total fecundity of female moths was recorded during the oviposition period. The duration of adult life was recorded from the day of the emergence of adults till death. Five percent of the honey solution was provided to adults as food. Ten moths of each gender were observed for recording their longevity and the average longevity of each gender was calculated.

The Incubation period was counted as the number of days between the laying of egg till their hatching. For finding out the incubation period Ten Petri-dishes, each containing 50 eggs of rice moth were observed and the average incubation period was calculated.

Duration of larval instars and pupal period

The newly emerged larvae were transferred into jars for studying the larval instars and their duration. The larval duration was recorded in days from the hatching of eggs till the formation of pupae. To find out the duration of different larval instars, observations were made on the casting of exuviae daily and thus, the duration of different larval instars and total larval periods were recorded.

The time duration between pupae formation and the emergence of moths was considered as the pupal period. For observing the pupal period, the last instar larvae were removed and placed in twenty-five containers having ten pupae in each and average pupal periods were also calculated.

Efficacy of the botanical leaf powder on Corcyra Cephalonia

Preparation of leaf powder Fresh leaves of Ocimum tenuiflorum was collected from the university garden and nearby locality. They were washed with distilled water, shade-dried and ground to a fine powder using a mixer. These mixers are kept in airtight containers. Different concentrations ranging from 0.5 g to 3.5g (0.5, 1.5, 2.5 and 3.5 g) per 30 g maize grains (broken) were selected for assessing the insecticidal effects of one botanical against rice moth (Harinder et al., 2019)[8].

Experimental design for Mortality Percentage (Insecticidal property) Five sets were set up simultaneously with four concentrations of each plant leaf powder (0.5, 1.5, 2.5 and 3.5 g) and control in small 250 ml plastic vials. Each vial was also containing 30 g of fresh broken rice with a few yeast granules. All six stages of 10 larvae were separated from stock cultures and transferred to pre-treated vials. Control cultures without any leaf powder treatment were also maintained along with the same experimental conditions. These vials were checked at regular intervals of 24 hours to see the toxic effect of these plant powders. The number of dead larvae was removed after noting. This was continued till all the 10 larvae were dead in each experimental set. The mortality percentage was calculated using the below formula.

\[ \text{Mortality (\%)} = \frac{\text{Number of larvae of dead}}{\text{Total no. of larvae}} \times 10 \]

Results and discussion

Biology of Corcyra cephalonica

Adult Longevity, Incubation period and fecundity

The female lived slightly longer than males (Table 1). The results revealed that the longevity of males ranged from 1 to 5 days and on average of it survived for 3.52 days. The female longevity ranged from 3 to 6 days with an average of 4.24 days. The adult moths were comparatively small, uniformly dark grey in colour with a few dark lines of hairs. The females were larger than the male. The incubation period of eggs ranged from 3 to 5 days with an average of 4.12 days under laboratory conditions (Table 1). A single female of C. cephalonica laid eggs ranging from 64 to 182 eggs with an average of 122.08 eggs per female during her lifetime. The freshly laid eggs were elliptical in shape and white in colour. Just before hatching colour of the eggs changed to black.

Table 1: Adult longevity, Egg duration and fecundity per female of C. cephalonica

<table>
<thead>
<tr>
<th>Duration</th>
<th>Range (days)</th>
<th>Mean ±SD (days)</th>
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<tbody>
<tr>
<td>Incubation period</td>
<td>3-5</td>
<td>4.12±0.66</td>
</tr>
<tr>
<td>Fecundity (No. of eggs)</td>
<td>64-182</td>
<td>122.08±37.2</td>
</tr>
<tr>
<td>Adult longevity(days)</td>
<td>Male</td>
<td>1-5</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>3-6</td>
</tr>
</tbody>
</table>

Duration of larval instars, total pupal period

It was revealed that larval stages of C. cephalonica passed through six instars, before transforming into the pupal stage. Newly hatched larvae were light creamish white in colour. The first larval instar took 4 to 6 days to become the second instar on Maize. The second instar larva was dirty white in colour and having deep yellowish-brown coloured the head capsule. The second instar larvae moulted to third instar in 4 to 6 days with an average of 4.48 days. Similarly, the duration of third instar larvae range from 3 to 5 days with an average of 3.96 days. The third instar was having a head capsule which dark brown in colour. The fourth instar larva was dirty white having a dark borderline. The Mandibles were darker and the eyes conspicuously dark. In this stage, larva was less active and seeks hiding places more eagerly when exposed to light. The fifth instar larva, the setae were brownish in colour, mandibles and head capsules were darker in colour than the previous stage. The sixth instar larva was dirty white in colour, cylindrical in shape, slightly tapered towards ends and reddish-brown head capsule with dark distinct mandibles. Fourth, fifth and sixth instar larvae took 3 to 5 days, 3 to 6 days and 9-11 days with an average of 3.76 and 10.04 days, respectively. The total larval period ranged from 27-35 days with an average of 31.04 days. The pupal period of C. cephalonica ranged between 9 to 14 days with an overall average of 11. 12 days. The results revealed that the rice moth completed its life cycle in 48.6 days. Similarly, Teotia & Singh, (1975) [19] reported 44.97 days on maize at 26.5°C and 73 percent humidity. Ray, (1994) [16] also worked on rice moth biology using maize. The result revealed that 50.03 days were required by rice moth to complete its life cycle on maize.
Effect of Ocimum tenuiflorum leaf powder on different larval stages of C. cephalonica

The impact Ocimum tenuiflorum leaf powder was concentrated on C. cephalonica larval mortality. In the first instar of rice moth, 68 and 82% mortality was recorded at 0.5 and 1.5 g, while 100% mortality was recorded at 1.5 and 2.5 g separately. In the second instar, mortality was 67 and 73% at 0.5 and 1.5 g, though 100% mortality was recorded at 2.0 g. In the third instar, mortality was 44 and 56% at 0.5 and 1.5 g, though 87 and 90% mortality was recorded at 1.5 and 2.5 g respectively. In fourth instar, mortality was 35 and 49% at 1.5 and 2.5 g respectively. In fifth and sixth instar no mortality was recorded at 0.5 and 1.5 g. But at 2.5 g leaf powder mortality was recorded as 25 and 20% respectively. While at 3.5 g leaf powder mortality was recorded as 22 and 18 % respectively (Table 3).

Table 3: Toxic effect of Ocimum tenuiflorum leaf powder against larvae of Corcyra cephalonica

<table>
<thead>
<tr>
<th>Instar</th>
<th>Percentage of larvae mortality in different doses</th>
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<tr>
<td></td>
<td>0.5 g</td>
</tr>
<tr>
<td>1&lt;sup&gt;st&lt;/sup&gt;</td>
<td>68</td>
</tr>
<tr>
<td>2&lt;sup&gt;nd&lt;/sup&gt;</td>
<td>67</td>
</tr>
<tr>
<td>3&lt;sup&gt;rd&lt;/sup&gt;</td>
<td>44</td>
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<td>4&lt;sup&gt;th&lt;/sup&gt;</td>
<td>35</td>
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<td>5&lt;sup&gt;th&lt;/sup&gt;</td>
<td>0</td>
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<td>6&lt;sup&gt;th&lt;/sup&gt;</td>
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Khani <i>et al.</i> (2012) reported that <i>Piper nigrum</i> and <i>Jatropha curcas</i> extracts decreased a population of rice moth. Khan and Qamar (2015) detailed that <i>Argemone mexicana</i>, and <i>Parthenium hysterophorus</i> decreased feeding or act as an antifeedant. Hence to control this store grain pests substitute technique, for example, utilization of botanicals as antifeedants and larvicidal. The persistent utilization of chemical insecticides for control of stored grain insects has come about difficult problems such as dangers to the environment including non-target organisms and human wellbeing (Sighamony <i>et al.</i>, 1986).

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References
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