Biology of (Corcyra cephalonica, Stainton) on different host

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Abstract
The present investigation entitled “biology of rice moth on different host” was carried out under laboratory condition. Department of Entomology, Rajasthan College of Agriculture, MPUAT, Udaipur during August, 2017. The experiment was conducted to assess the effect of five host viz., maize, rice, pearl millet, wheat and sorghum on the biology of C. cephalonica. The result revealed that the minimum larval period (32.40 days) was recorded on sorghum and maximum was on wheat (43.15 days). The maximum larval weight was recorded on sorghum (52.55 mg) and minimum on wheat (42.00 mg). The minimum pupal period was recorded on sorghum (9.45 days) and maximum on wheat (10.20 days); while maximum pupal weight was recorded on sorghum (38.50 mg) and minimum on wheat and maize (33.95 mg). The minimum hatching period (4.00 days) was observed on sorghum and maximum on wheat (5.50 days). The maximum adult emergence was recorded on sorghum (80.00%) and minimum on wheat (68.75%). The Growth Rate Index was maximum on sorghum (1.73) and minimum on wheat (1.18). The highest mean fecundity of female (301.75 eggs/female) was recorded on sorghum and minimum was on wheat (230.75 eggs/female). The maximum adult longevity period (10.50 days) was recorded on sorghum and minimum on wheat (8.25 days). The minimum developmental period was recorded on sorghum (46.20 days) and maximum was on wheat (57.80 days).

Keywords: Biology, rice moth, C. cephalonica, host

1. Introduction
The rice moth, Corcyra cephalonica Stainton (Family: Pyralidae, Order: Lepidoptera) is one of the most destructive pests of stored cereals in Asia, Africa, North America and Europe causing severe economic losses (Atwal and Dhaliwal, 2008) [1]. It attacks rice, wheat, corn, sorghum, groundnut, cotton seeds, coffee, spices and cocoa beans under storage conditions. The adults are nocturnal and each female lays about 90-300 eggs with an incubation period of 5 days, 23-25 days of larval period, 10 days of pupal period and adult life span of 1 week (Fenemone and Prakash, 2009) [2]. The larvae cause damage to broken grains by forming silken webs and feeding inside them. Hence the present investigations entitled “Biology of rice moth (C. cephalonica, Stainton) on different host.

2. Materials and Method
2.1 Experimental details
The present experiment was conducted on the biology of rice moth on different host was conducted in the Department of Entomology, Rajasthan College of Agriculture, Udaipur during 2017, under laboratory conditions with 31.3 °C temperature and 72-74% humidity. The detailed methodology used for the investigation is described as under:

2.2 Maintenance of nucleus culture
The nucleus culture of the rice moth was maintained by collecting adult moths from the infested sorghum seeds at Biocontrol laboratory, Department of Entomology, RCA Udaipur. For carrying out the experiment, adults of rice moth were reared in laboratory in glass jars of 5 kg capacity, containing both broken as well as unbroken rice grains. The filled in jars were covered with muslin cloth and introduced into oven for sterilization at 100 °C for about 1 hour, in order to kill eggs and other hibernating macro as well as some microorganisms. The oven exposed broken rice was then introduced @ 3 kg in each of the glass jars. A cotton plug soaked in 5 per cent sucrose solution was provided in the jars for feeding the adults moths to increase the fecundity of moth (Pareek and Kushwaha 1971) [3]. Each jar was then scattered with 5 gram yeast extract and 0.5 gm streptomycin sulphate. Most of the eggs were laid between the double layer of muslin cloth from where these were collected daily with the help...
of a soft brush and kept in separate petri dishes. The egg laying chambers were kept in an incubator at 28±2 °C and 75±5 percent relative humidity. The culture so maintained was used for various investigations undertaken. The newly hatched larvae when required, were taken from dated culture for further experimentation.

2.3 Effect of different hosts on the biology of C. cephalonica

In order to study the biology of C. cephalonica on different hosts, 250g grains of each host were taken in separate containers, one fourth part of grains were ground and disinfested by placing the grains in oven at 60°C for 2 hrs. The grains were treated with 0.1% formaldehyde @ 2.5ml per 250g grains and air dried. The varieties of each host used for the experiment included: wheat (Raj-4079), rice (P-1509), sorghum (PJ-1430), maize (pratap makka), bajra (RHB-67). About 1000 (0-6 hr old) eggs were kept in petri dish covered with blotting paper for hatching. From these, twenty neonate larvae of C. cephalonica were released by wet brush into each container containing different hosts as food material. The mouth of each container was covered with muslin cloth and tightened with rubber band. The containers were regularly observed and following observations were recorded.

1. Larval period (days): To assess the larval period of C. cephalonica, the time period starting from the introduction of newly hatched larvae to the formation of silken web in each container was carefully observed and recorded.

2. Larval weight (mg): Weight of full grown larvae (20 in number) were taken with the help of electronic balance from each replication.

3. Pupal period (days): To assess the pupal period, the time period starting from formation of pupa or silken webs in grains to adult emergence in each container was recorded.

4. Pupal weight (mg): Weight of fully developed pupa was taken with the help of electronic balance from each replication.

5. Adult emergence: Adult emergence was calculated by counting the number of adults emerged in each replication and the per cent adult emergence was calculated using the following equation:

   \[ \text{Adult emergence} = \left( \frac{\text{Number of adults emerged}}{\text{Total number of pupae}} \right) \times 100 \]

6. Growth index: was calculated by using the following equation (Singh and pant, 1995)

   \[ \text{Growth index} = \frac{\text{Percent adult emergence}}{\text{Average developmental period (days)}} \]

7. Fecundity: Fecundity of adults was measured by collecting female from each host and placing them in separate jars for egg laying. Females were identified by observing the following characteristics viz., long, pointed labial palpi and comparatively larger body size. The total number of eggs laid by female was counted daily till their death.

8. Adult longevity (days): Adult longevity was recorded from the date of emergence of adult to date of death of adult in each replication of host.

9. Hatching period (days): Eggs laid by female moths were used for recording the hatching period and were placed in the petri-dishes and allowed to hatch. For this 50 eggs of C. cephalonica reared on each replicated treatment were collected. The time period between eggs laying to hatching was recorded for each replication.

10. Developmental period (days): The time period from hatching of the eggs to the emergence of adults in each replication of each host was recorded to estimate the developmental period of the insect.

2.4 Statistical Analysis

Statistical analysis was performed using MS-excel. Data was submitted to analysis of variance (ANOVA). Percentage data was turn into angular transformed value by using angular transformation.

3. Results and Discussion

3.1 Effect of hosts on the biology C. cephalonica

The comparative study of five different hosts viz., maize, sorghum, rice, wheat and pearl millet was studied on biological parameters of C. cephalonica. The ultimate purpose of this study was to find out the most preferred host by C. cephalonica. The preference of the host was assessed on the basis of their effects on the hatching period, larval period and weight, pupal period and weight, adult emergence, Growth Rate Index, fecundity, adult longevity of adult and developmental period.

3.1.1 Hatching period (days)

During the study of hatching period we found that the minimum hatching was observed on sorghum (4.00 days) and in rice (4.25 days), pearl millet (4.50 days), which was at par with wheat (5.25 days) and maize (5.50 days). The maximum hatching period recorded in maize. Similarly, Patel and Mehta (2011) [6] recorded minimum hatching period on sorghum (3.43 days). While Prakash and Senthilkumar (2005) [5] reported that the shortest incubation period of 4.21 days was recorded on pearl millet. The slightly different results may be due to uncontrolled rearing environment.

3.1.2 Larval period (days)

In case of larval period, minimum larval period was observed on sorghum (32.40 days) whereas, it was maximum on wheat (43.15 days) and on remaining hosts viz., maize, rice, pearl millet are 42.45, 40.73, 41.46 days, respectively. Similarly, Patel and Mehta (2011) [6] recorded minimum larval period on sorghum (37.34 days). Whereas Deulkar et al. (2012) [2] reported that the least larval development period of (30.86 days) was observed on Bajra based diet.

3.1.3 Larval weight (mg)

The mean larval weight ranged from 42.00 to 52.55 mg on different hosts. So the larval weight of sorghum, rice, pearl millet, wheat, maize are 52.55, 46.88, 46.31, 42.00, 43.25 respectively. The maximum larval weight was recorded on sorghum 52.55 mg, while minimum on wheat 42.00mg. Results were also found to be in accordance with the previous studies of Patel and Patel (2007) [6] who reported that the sorghum proved to be best host for the growth of the larvae.
3.1.4 Pupal period (days)
The pupal period varied from 9 to 11 days and the minimum mean pupal period (9.45 days) was recorded on sorghum whereas, it was maximum on wheat (10.20 days) and on remaining hosts viz., maize, rice, pearl millet are 9.75, 9.50, 9.70 days, respectively. The results were found to be in line with the work of Patel and Mehta (2011) [8] who reported that the minimum pupal period of (8.14 days) was observed on sorghum. Similarly Patel and Patel (2007) [6] reported the minimum pupal period was observed in sorghum.

3.1.5 Pupal weight (mg)
The mean pupal weight ranged from 33.95 to 38.50 mg days on different hosts. The maximum pupal weight was recorded on sorghum (38.50 mg), while it was minimum on wheat and maize (33.95 mg).

3.1.6 Adult emergence
The adult emergence on different host grains ranged from 68.00 to 80.00 per cent. The maximum adult emergence was recorded on sorghum (80.00%), followed by rice (78.75%). However minimum adult emergence was recorded on wheat (68.75%) and on remaining host viz., maize, pearl millet adult emergence were recorded are 70.00%, 75.00% respectively. Similarly Pathak et al. (2010) [7] reported the maximum adult emergence was observed in sorghum.

3.1.7 Growth rate index
The growth rate index ranged from 1.18 to 1.73 in different host being minimum in wheat (1.18) followed by maize (1.21) and in pearlmillet (1.35). The maximum growth rate index was recorded in sorghum (1.73) followed by rice (1.42). This finding was also supported by Patel and Patel (2007) [6] reported that the higher growth index (1.62). Similarly Patel and Mehta (2011) [8] reported the higher growth index (1.60) in sorghum.

3.1.8 Fecundity
The average number of eggs from single female on different host was ranged from 230.75-301.75 in number. The maximum mean fecundity recorded per female was observed as 301.75 in sorghum host whereas minimum mean fecundity recorded per female was 230.75 in wheat host and on remaining host viz., maize, pearl millet, rice were 268.25, 291.25, 292.50. This finding was also supported by Patel and Patel (2007) [6] reported that the higher growth index (1.62). Similarly Patel and Mehta (2011) [8] reported the higher growth index (1.60) in sorghum.

3.1.9 Adult longevity
The mean value of adult longevity recorded on five host; sorghum, rice, pearl millet, wheat, maize are 10.50, 10.00, 9.50, 8.25, 8.75 days respectively. The maximum adult longevity recorded in sorghum while minimum in wheat.

3.1.10 Developmental Period
The average developmental period of C. cephalonica varied significantly on different hosts grains. The minimum developmental period was recorded on sorghum (46.20 days) followed by rice (55.20 days). The maximum developmental period was recorded on wheat (57.80 days) followed by maize (57.55 days) and in pearl millet (55.20 days). Similarly Patel and Mehta (2011) [8] reported minimum developmental period in sorghum (50.59 days).

Table 1: Influence of different host on larval period and larval weight of C. cephalonica

<table>
<thead>
<tr>
<th>Hosts</th>
<th>Larval period (days)</th>
<th>Larval weight (mg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rice</td>
<td>40.73</td>
<td>46.88</td>
</tr>
<tr>
<td>Pearl millet</td>
<td>41.46</td>
<td>46.31</td>
</tr>
<tr>
<td>Sorghum</td>
<td>32.40</td>
<td>52.55</td>
</tr>
<tr>
<td>Wheat</td>
<td>43.15</td>
<td>42.00</td>
</tr>
<tr>
<td>Maize</td>
<td>42.45</td>
<td>43.25</td>
</tr>
<tr>
<td>SEm±</td>
<td>0.204</td>
<td>0.789</td>
</tr>
<tr>
<td>CD 5%</td>
<td>0.615</td>
<td>2.379</td>
</tr>
</tbody>
</table>

Table 2: Influence of different host on pupal period and pupal weight of C. cephalonica

<table>
<thead>
<tr>
<th>Hosts</th>
<th>Pupal period (days)</th>
<th>Pupal weight (mg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rice</td>
<td>9.50</td>
<td>37.50</td>
</tr>
<tr>
<td>Pearl millet</td>
<td>9.70</td>
<td>37.00</td>
</tr>
<tr>
<td>Sorghum</td>
<td>9.45</td>
<td>38.50</td>
</tr>
<tr>
<td>Wheat</td>
<td>10.20</td>
<td>33.95</td>
</tr>
<tr>
<td>Maize</td>
<td>9.75</td>
<td>33.95</td>
</tr>
<tr>
<td>SEm±</td>
<td>0.068</td>
<td>0.199</td>
</tr>
<tr>
<td>CD 5%</td>
<td>0.204</td>
<td>0.601</td>
</tr>
</tbody>
</table>

Table 3: Influence of different host on different parameters of biology of C. cephalonica

<table>
<thead>
<tr>
<th>Hosts</th>
<th>Fecundity (No. of eggs/female)</th>
<th>Hatching Period (days)</th>
<th>Adult longevity (days)</th>
<th>Adult Emergence (%)</th>
<th>Developmental Period (days)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rice</td>
<td>292.50 (17.12)</td>
<td>4.25</td>
<td>10.00</td>
<td>78.75 (62.58)</td>
<td>55.20</td>
</tr>
<tr>
<td>Pearl millet</td>
<td>291.25 (17.08)</td>
<td>4.50</td>
<td>9.50</td>
<td>75.00 (60.06)</td>
<td>55.40</td>
</tr>
<tr>
<td>Sorghum</td>
<td>301.75 (17.39)</td>
<td>4.00</td>
<td>10.50</td>
<td>80.63 (53.52)</td>
<td>46.20</td>
</tr>
<tr>
<td>Wheat</td>
<td>230.75 (15.21)</td>
<td>5.50</td>
<td>8.25</td>
<td>68.75 (56.06)</td>
<td>57.80</td>
</tr>
<tr>
<td>Maize</td>
<td>268.25 (16.39)</td>
<td>5.25</td>
<td>8.75</td>
<td>70.56 (57.90)</td>
<td>57.55</td>
</tr>
<tr>
<td>SEm±</td>
<td>0.024</td>
<td>0.242</td>
<td>0.438</td>
<td>1.183</td>
<td>0.497</td>
</tr>
<tr>
<td>CD 5%</td>
<td>0.074</td>
<td>0.728</td>
<td>1.320</td>
<td>3.565</td>
<td>1.499</td>
</tr>
</tbody>
</table>

Data in parentheses are angular retransformed values of adult emergence
Data in parentheses are square root transformed values of fecundity

4. Conclusion
From the present study it can be concluded that biology of rice moth on different Corcyra cephalonica (Stainton) (Pyraliidae: Lepidoptera) is a pest of wide range of commodity like stored cereals, pulses, dried fruits, grocery products etc. It particularly prefers broken grains and flour. Caterpillars cause the damage by webbing together grains and forming lump and feed its contents from inside. Larvae before pupation wander about and leave a lot of webbing in the grains, causing excessive lumping, which reduces marketing quality of the grains.

During the study of biology of C. cephalonica, it was found that sorghum is preferred by the rice moth. In general, hatching period of rice moth ranged from 4.25 to 5.50 days; while it was maximum in wheat and minimum in sorghum. Similarly larval period varied from 32.40 to 43.15 days to
complete the 6 instars of larval period. The maximum larval weight was recorded on sorghum while minimum on wheat, larval weight ranged from 42 to 52.55 mg. The pupal period varied from 9.45 to 10.20 days, maximum in wheat and minimum in sorghum whereas, pupal weight maximum in sorghum and minimum in wheat with mean pupal weight ranged from 33.95 to 38.50 mg. The maximum adult longevity recorded in sorghum while minimum in wheat with adult emergence on different host ranged from 68.00 to 80.00 per cent. The maximum mean fecundity and growth rate index was recorded on sorghum; whereas, development period was minimum in sorghum. Among all five host sorghum found best host for biology of rice moth.

5. Acknowledgement
The authors gratefully acknowledge Dr. Anil Vyas, Asst professor, Rajasthan College of Agriculture, MPUAT, Udaipur, for providing laboratory and culture of C. cephalonica.

6. References