A STUDY ON THE DEVELOPMENTAL BIOLOGY OF CALLOSOBRUCHUS MACULATUS (FABRICIUS) IN DIFFERENT PULSES

B. Malaiakozhundan and S. Thiravia Raj

Department of Zoology,
Alagappa Govt. Arts College, Karaikudi-630 003, India

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ABSTRACT

The development of Callosobruchus maculatus on five different varieties of pulses were studied. The cowpea variety CoCp-7 recorded significantly highest number of eggs oviposited and percentage adult emergence, the shortest developmental period, highest susceptibility indices and the highest weight loss. Dobie’s susceptibility index showed that the cowpea variety CoCp-7 and Co-6 were found to be highly susceptible to C. maculatus, whereas greengram varieties Km-2 and VBN2 were found to be moderately resistant to C. maculatus. The blackgram varieties VBN3 and VBN4 were resistant and regarded as non-suitable hosts for the development of C. maculatus.

Key words: Biological parameters, Longevity, Susceptibility, Pulses, C. maculatus.

INTRODUCTION

Pulses (grain legumes) are the second most important group of crops worldwide. Globally, 840 million people are undernourished mainly on account of inadequate intake of proteins, vitamins and minerals in their diets. Pulses are excellent sources of proteins (20-40%), carbohydrates (50-60%) and are fairly good sources of thiamin, niacin, calcium and iron. One of the major constraints in production of pulses are the insect pests which inflict severe losses both in the field and storage. In India, over 200 species of insects have been recorded infesting various pulses (CABI, 2007). Among these, pulse beetle, C. maculatus is a major pest that causes serious damage and is cosmopolitan.

Studies on biology and demography are important in developing population models, sampling and trapping methods, in understanding intra and inter-specific relationships, and in developing and applying new control methods (Papadopoulos et al., 2002). The purpose of the study was to analyse the development of the bruchid beetle, C. maculatus on different pulse varieties.

MATERIALS AND METHODS

A stock culture of the bruchid beetle, C. maculatus was maintained for five generations on greengram and cowpea seeds at normal room temperature in the laboratory before start of experiment. The rearing procedures of insects were similar to that of Giga and Smith (1983). Six different varieties of pulses greengram (Km2 and VBN2), blackgram (VBN3 and VBN4) and cowpea (CoCp-7 and Co-6) were obtained from the National Pulses Research Centre, Vamban, Pudukkottai district for experimental purposes. These seeds were sterilized at 60ºC for 5 hours to kill any hidden infestation and conditioned at a temperature of 30±1ºC and relative humidity of 60±5% for 24 hours.

The experiment were performed in plastic containers (10 x 12mm) using 50 gram of conditioned seeds of each accession under five replicated trials. Virgin pair of newly emerged adults (0-24 hrs old) were introduced in each plastic container and kept for 7 days. The lid of plastic container was removed and covered with a muslin cloth to supply air. The experiments were conducted under the controlled conditions of temperature of 30±1ºC and 60±5% RH. After 7 days, the number of eggs laid on the seeds of each accession were counted. If oviposition had not occurred, the pair was replaced by another virgin pair and the procedure was repeated. The eggs were observed daily to determine the exact date of hatching. All replicates were left until the emergence of first progeny. Fecundity was determined by counting the number of eggs in each replication at the interval of...
24 hours till the death of female. The developmental period of *C. maculatus* was determined by counting the days between the oviposition by the released adults and the first adult emergence in each treatment. Adult emergence were recorded by counting the number of adults emerged from eggs on each pulses. The per cent damage and per cent weight loss were determined by releasing two pairs of freshly emerged adults in 50 gram sample of each of the above six pulses. Each treatment was replicated five times. The material was kept undisturbed for a period of one-month storage at the controlled laboratory conditions of 35º C and 60 ± 5% RH.

The susceptibility index of different pulses was calculated using the formula by Dobie (1974).

\[
\text{DSI} = \frac{\text{Loge } Y}{t} \times 100
\]

where; 
- \( Y \) = total number of adult bruchid emerged.
- \( t \) = median development period (estimated as the time from the middle of oviposition to the emergence of 50% of F1 generation).

Dobie susceptibility index | Resistance class
---|---
1-5 | Resistant
6-10 | Intermediate/moderate resistant
11-15 | Susceptible
16-21 | Highly susceptible.

**RESULTS AND DISCUSSION**

The results of the present study revealed the obvious effects of pulse varieties on fecundity and development of *C. maculatus* (Table 1). Studies by researchers demonstrated that the growth and development of *C. maculatus* affected by the nutritional value of the seeds (Credland, 1987; Van Hius and deRooy, 1998), temperature and humidity (Chandrakantha and Mathavans, 1986; Guntrip et al., 1997), host size (El-Halfawy et al., 1972; Sandhus et al., 1987), mother’s age (Van Hius and deRooy, 1998; Wasserman and Asami, 1985), body weight (Sibly et al., 1991), population density (Mansour et al., 1975), competition (Meyer et al., 1986) and strain of *C. maculatus* (Dick and Creadland, 1984). In the present study, the significant variations in fecundity of *C. maculatus* among pulses showed that

<table>
<thead>
<tr>
<th>Biological Parameters</th>
<th>Km-2 (Greengram)</th>
<th>VBN2 (Greengram)</th>
<th>VBN3 (Blackgram)</th>
<th>VBN4 (Blackgram)</th>
<th>CoCp-7 (Cowpea)</th>
<th>Co-6 (Cowpea)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oviposition period</td>
<td>7.34±0.23</td>
<td>7.46±0.16</td>
<td>5.82±0.15</td>
<td>6.12±0.33</td>
<td>4.75±0.40</td>
<td>5.02±0.20</td>
</tr>
<tr>
<td>Post-oviposition period</td>
<td>0.90±0.10</td>
<td>0.96±0.35</td>
<td>2.23±0.50</td>
<td>3.10±0.08</td>
<td>1.71±0.29</td>
<td>1.98±0.31</td>
</tr>
<tr>
<td>Adult longevity</td>
<td>7.76±0.23</td>
<td>8.4±0.13</td>
<td>6.52±0.60</td>
<td>7.1±0.05</td>
<td>5.27±0.22</td>
<td>5.62±0.24</td>
</tr>
<tr>
<td>Mean eggs per female</td>
<td>67.6±6.02*</td>
<td>77.0±4.35*</td>
<td>66.6±5.13*</td>
<td>76.0±4.00*</td>
<td>91.3±4.72*</td>
<td>88.0±3.60*</td>
</tr>
<tr>
<td>Mean Adults emerged</td>
<td>66.3±1.13*</td>
<td>75.6±3.78*</td>
<td>52.3±2.51*</td>
<td>61.0±1.73*</td>
<td>90.6±4.16*</td>
<td>81.0±2.30*</td>
</tr>
<tr>
<td>Mean development days of Adult</td>
<td>28.0</td>
<td>27.0</td>
<td>33.0</td>
<td>35.0</td>
<td>26.0</td>
<td>26.0</td>
</tr>
<tr>
<td>% of adult emergence</td>
<td>98.07±0.20</td>
<td>98.18±0.68</td>
<td>78.52±2.01</td>
<td>80.26±1.06</td>
<td>99.2±0.10</td>
<td>92.04±0.12</td>
</tr>
</tbody>
</table>

Values represent mean ± SE of 5 replicates.

*Data statistically significant at P≤0.05 using Student's t-test.
different varieties have not the same nutritional composition for the development of *C. maculatus*. The mean total fecundity observed in this study ranged from 66.6±5.13 to 91.3±4.72 eggs per female on VBN3 (blackgram) and CoCp-7 (cowpea) respectively (Table 1 & Fig. 1). These results were in agreement with the previous studies by Cope and Fox (2003).

The oviposition period of *C. maculatus* in this study was shortest on CoCp-7 (4.75±0.40 days) and longest on VBN2 (7.46±0.16 days), this period lasted 7.34±0.23 days on Km-2, 6.12±0.33 days on VBN4, 5.82±0.15 days on VBN3 and 5.02±0.20 days on C0-6 (Table 1). These results were supported by the findings of El-Halfawy et al. (1972). The different varieties of pulses significantly affected the adult longevity of *C. maculatus* (Fig. 3). Fox (1993) and Gokhale and Srivastava (1975) showed that mated females have higher longevity compared to unmated females. The adult longevity of *C. maculatus* (Table 1) in this study was longest on VBN2 (8.40±0.13 days).

In this study, legume seeds which had the highest mean egg count and high percentage of adult emergence (Fig. 2) correspondingly had the shortest development period (Swella and Mushobozy, 2009). Yadav and Pant (1974) reported that *C. chinensis* breed successfully on many legume seeds except blackgram. This supports our finding in the present study (Fig. 4) on blackgram which has a longer development period of 35.0 days (VBN4) and 33.0 days (VBN3). The cowpea varieties (CoCp-7 and Co-6) suffered the highest weight loss of 65.2% and 61.6% respectively compared to other pulse varieties (Fig. 5). The results are in accordance with the studies of Abdullahi and Muhammad (2004). The susceptibility indices revealed that blackgram varieties (VBN3 and VBN4) were resistant and could be regarded as non-suitable hosts for *C. maculatus*. The greengram varieties (Km-2 and VBN2) were least susceptible/moderately resistant to *C. maculatus*. The cowpea variety CoCp-7 and Co-6 were susceptible to *C. maculatus* and regarded as
most suitable host for the development of *C. maculatus* among the pulses investigated (Fig. 6). The same has been reported by Swella and Mushobozy (2009).

**CONCLUSION**

The study obviously concluded that cowpea seeds were preferred much by *C. maculatus* than other pulses. The biological parameters of *C. maculatus* showed that blackgram seeds were not the suitable host for *C. maculatus*. Further investigation should be carried out to biochemically analyse the non-preference of blackgram seeds by *C. maculatus* for its development.

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**REFERENCES**


