BIOLOGY AND BIOLOGICAL PARAMETERS OF MALLADA BONINENSIS (OKAMATO) (NEUROPTERA: CHRYSOPIDAE) ON DIFFERENT HOSTS

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ABSTRACT
Laboratory experiments were conducted during 2013-14 to know the biology of Mallada boninensis on Aphis craccivora, Aphis gossypii, Aleurodicus dispersus and Corcyra cephalonica. Total developmental period was 23.04 days and female longevity and male longevity with 52.48, 28.04 days respectively. Fecundity per female was with 317.2 eggs per female. All the parameters were more on C. cephalonica compared to all the other hosts tested. Larval survival, pupation and adult emergence percentages were 92.8, 85.3 and 85.3 which were more on C. cephalonica compared to the other hosts. Eggs of C. cephalonica was found to be superior for all the parameters tested followed by spiralling whitefly- Aleurodicus dispersus (nymphs/adults), cotton aphid- Aphis gossypii (nymphs/adults) and cowpea aphid - Aphis craccivora Koch (nymphs/adults). The present study revealed that other hosts can be used as substitute for rearing of M. boninensis in the laboratory.

INTRODUCTION
Due to the ill effects of pesticides the concept of pest management changed from chemical control to the Integrated Pest Management (IPM). These include the use of natural enemies as one of the important components for pest management because they are ecologically safer, ecologically viable, self-perpetuating and long term effective against crop pest. Now a days, Integrated Pest Management (IPM) is well known to all of us where all the suitable pest control techniques are being used to find ecologically sound and environmentally safe ways of pest control (Abhishek shukla and Darshana S. Jadhav 2014). During the last two decades or so, the role of chrysopids as a predator of pest of different crops has been appreciated all over the world in IPM programme. They are encountered in most of the agricultural and horticultural ecosystems including plantation crops and mulberry (Narendra Kumar et al, 2001, 2010). Their ability to adapt to a wide range of ecological factors (Ulhaq et al, 2006) and tolerance to insecticides (Bigler, 1984; Vogt et al, 2001) has made them important candidates in the biological control programs. Conservation of predators particularly green lacewings being potential predators is very necessary (Nikitha S. Awasthi et al, 2013). Amongst the Mallada spp., M. boninensis, M. basalis, M. aster and M. desjardinsi are important as these are found to be potential predators of aphids, leaf miners, psylla, blackfly and whitefly. They can be successfully reared on eggs of C. cephalonica Stainton in the laboratory (Krishnamoorthy and Mani, 1982; Bakhavatsalam et al., 1994; Jalali et al, 2003; Elsiddig et al., 2006; Syed et al., 2008; Riddick, 2009). As the natural population is inadequate, biological control would be best achieved by mass rearing and seasonal colonization of the aphid lion, M. boninensis. These predators can be reared in large numbers and can be released with less cost. Keeping the scenario in view an attempt has been made to know the biology and biological parameters of M. boninensis on A. craccivora, A. gossypii, A. dispersus and C. cephalonica for mass production purpose.

MATERIALS AND METHODS
Biology of M. boninensis on three natural hosts along with laboratory host was studied. The natural insect hosts were: cotton aphid (nymphs/adults), cowpea aphid (nymphs/adults) and spiralling whitefly (nymphs/adults) and laboratory host was C. cephalonica. The nymphs/adults of natural hosts were collected from fields, while eggs of C. cephalonica was collected from the Biological control laboratory in the Department of Entomology, TNAU, Coimbatore. The experiments were conducted in a completely randomized design (CRD) with five replications to analyse the biology and biological parameters of different hosts on M. boninensis.

Mass culturing of Corcyra cephalonica
C. cephalonica commonly called as rice meal moth or rice moth is a pest of stored foods, viz., cereals, cereal products,
oilseeds, pulses, dried fruits, nuts and spices. The basins (37.5 cm dia and 11 cm ht.) used for Corcyra multiplication are thoroughly cleaned with 0.5% detergent wash and rinsed in tap water followed by wiping with dry, clean used towel and shade drying. Sterilized baja, groundnut, yeast and wettable sulphur (2.5kg: 100g: 5g: 5g) were placed in plastic basins. Nucleus eggs of C. cephalonica were sprinkled in plastic basins @ 0.5 cc per 2.5 kg of grains fortified with 5 g of yeast 5 g of wettable sulphur and 100g of groundnut kernel powder and the basins were covered with gada cloth. Care was taken to maintain the culture free from storage mite and diseases by mixing 5g of wettable sulphur (80%) and spraying streptomycin sulphate 0.05 per cent respectively. Emerged moths were collected from 40th day onwards and continued

Emerged larvae were collected and rearing was continued for getting a steady supply of grubs for different experiments. Two to three days old grubs were used for various experiments.

**Collection of natural hosts**

The natural hosts used in the present experiment were: cotton aphid- A. gossypii (nymphs/adults), cowpea aphid- A. craccivora Koch (nymphs/adults) and spiralling whitefly- A. dispersus (nymphs/adults). Cotton aphids were collected from cotton plants, cowpea aphids were collected from cowpea plants and spiralling whiteflies were collected from tapioca plants reared in insectary, Department of Entomology, TNAU, Coimbatore as per the methodology suggested by (Hassan et al., 1985).

**RESULTS**

Egg period varied from 3 days on A. dispersus to 3.1 days on A. craccivora. Duration of first instar was maximum on A. gossypii with 3.54 days and minimum on C. cephalonica with 2.48 days. Duration of second and third instars was maximum on A. dispersus and minimum on C. cephalonica with 3.46 and 3.58 days respectively. Total grub period was maximum on A. dispersus with 11.7 days followed by A. craccivora with 11.6 days, A. gossypii with 11.1 days and C. cephalonica with 9.52 days respectively. Lowest prepupal period was recorded on C. cephalonica with 1.26 days and maximum was recorded on A. dispersus with 1.5 days. Pupal period was more on A. craccivora with 10.12 days and lowest on A. dispersus with 8.82 days. Total developmental period was more on A. craccivora with 26.14 days and lowest was recorded on C. cephalonica with 23.04 days. Both female and male longevity was more on C. cephalonica with 52.4, 28.04 days and lowest on A. craccivora and A. gossypii with 45.9, 19.3 days and 45.8, 19.9 days respectively. Fecundity per female was more on C. cephalonica with 317 eggs and least on A. craccivora with 134 eggs (Table 1).

Larvae survived comparatively more on grubs fed with C. cephalonica with 92.8 per cent followed by A. gossypii with 83 per cent, A. dispersus with 79.3 per cent and A. craccivora with 76 per cent survivals respectively. Pupation per cent was more on C. cephalonica with 85 per cent followed by A. dispersus with 78 per cent, A. gossypii with 76 per cent and A. craccivora with 73 per cent. Adult emergence also followed the same pattern as pupation with 85, 74.3, 74.2 and 70 per

### Table 1: Biology of *Mallada boninensis* (days) on different hosts

<table>
<thead>
<tr>
<th>Hosts</th>
<th>Developmental period</th>
<th>Mean (days)</th>
<th>Pre-pupal</th>
<th>Pupal</th>
<th>Total developmental period</th>
<th>Female longevity</th>
<th>Male longevity</th>
<th>Fecundity per female</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Egg period</td>
<td>1instar</td>
<td>II instar</td>
<td>III instar</td>
<td>Total grub period</td>
<td>Pupal period</td>
<td>Total developmental period</td>
<td></td>
</tr>
<tr>
<td>A. dispersus</td>
<td>3c</td>
<td>2.68c</td>
<td>4.28a</td>
<td>4.74a</td>
<td>11.7a</td>
<td>1.5b</td>
<td>8.82d</td>
<td>25.02b</td>
</tr>
<tr>
<td>A. gossypii</td>
<td>3.02ab</td>
<td>3.54a</td>
<td>3.82b</td>
<td>3.74c</td>
<td>11.1b</td>
<td>1.42a</td>
<td>9.82b</td>
<td>23.36b</td>
</tr>
<tr>
<td>A. craccivora</td>
<td>3.12a</td>
<td>3.22b</td>
<td>3.82b</td>
<td>4.56b</td>
<td>11.6a</td>
<td>1.5c</td>
<td>10.12a</td>
<td>26.14a</td>
</tr>
<tr>
<td>C. cephalonica</td>
<td>3.04a</td>
<td>2.48d</td>
<td>3.46c</td>
<td>3.58d</td>
<td>9.52c</td>
<td>1.26d</td>
<td>9.22c</td>
<td>23.04c</td>
</tr>
<tr>
<td>Sd</td>
<td>0.05</td>
<td>0.03</td>
<td>0.04</td>
<td>0.05</td>
<td>0.07</td>
<td>0.04</td>
<td>0.09</td>
<td>0.16</td>
</tr>
<tr>
<td>CD(0.05)</td>
<td>0.11</td>
<td>0.07</td>
<td>0.09</td>
<td>0.10</td>
<td>0.15</td>
<td>0.09</td>
<td>0.20</td>
<td>0.34</td>
</tr>
</tbody>
</table>
cent on C. cephalonica, A. dispersus, A. gossypii and A. craccivora respectively. Sex ratio of 1:4:1 was noticed, when grubs were fed with C. cephalonica, 1:3:0:9 when fed with A. gossypii, 1:2:0:9 when fed with A. dispersus and 1:1:0:8 when fed with A. craccivora. Maximum fecundity per female with 325 eggs was recorded on C. cephalonica followed by A. dispersus with 213 eggs, A. gossypii with 140 eggs and A. craccivora with 134 eggs (Table 2).

**DISCUSSION**

Egg incubation period, the developmental period of first, second and third instar grubs, pre-pupal period, pupal period, female longevity, male longevity and total developmental period of M. boninensis on different hosts vary from one prey to the other prey. Chen and Liu (2001) studied effects of A. gossypii and Myzus persicae on C. rufilabris: survival (100,100 %). Legaspi et al. (1996) reported that C. rufilabris larvae feeding on B. tabaci reared on poinsettia and lima bean lived only to the third instar and died before reaching the pupal stage; however, larvae provided whitely from cucumbers and cantaloupes reached the adult stage. They speculated that B. tabaci reared on poinsettia or lima bean were nutritionally inadequate for the lacewing, or the whitely reared on these plant hosts may have an accumulative toxic effect on C. rufilabris (Legaspi et al., 1994). The difference in this even could be due to superabundant honeydew that was ejected by whitely colony as food assistance role in development of predator, and prey species, environmental conditions, or geographical population of C. carnea. Maximum fecundity per female with 325 eggs was recorded on C. cephalonica followed by A. dispersus with 213 eggs, A. gossypii with 140 eggs and A. craccivora with 134 eggs. Zhang et al., (2004) recorded female fecundity of C. pallens as 326 eggs when fed on A. craccivora whereas El-Serafi (2000) reported female fecundity of C. carnea on A. gossypii, S. avenae, R. maidia and A. nerii as 480.2±14.2, 320.26±10.9, 336.44±12.5, and 215.7±9.6 eggs respectively on different hosts. Larvae survived comparatively more on grubs fed with C. cephalonica followed by A. gossypii, A. dispersus and A. craccivora. Pupation and adult emergence per cent was more on C. cephalonica followed by A. dispersus, A. gossypii and A. craccivora. Maximum fecundity per female with 325 eggs was recorded on C. cephalonica followed by A. dispersus with 213 eggs, A. gossypii with 140 eggs and A. craccivora with 134 eggs. It is widely reported that unsuitable food can extend the pre-imajinal development of chrysopids and decrease the survival, fecundity and longevity of the adults (Principi and Canard, 1984; Obrycki et al., 1989; Zheng et al., 1993). Narendra Kumar et al. (2011) reported that on the B. mori larvae (1st instar), the total larval duration of M. desjardinsi (Okamoto) lasted for 14.6 ± 0.13 days, whereas on that of S. cynthia ricini, it was 14.75 ± 0.19 days at a constant temperature of 25 ± 2°C and 65 ± 5% R.H. A single M. desjardinsi larva on an average consumed 103.35 ± 2.31 and 100.40 ± 2.05 chawki larvae (1st instar) of B. mori and S. c. ricini, respectively. The sex ratio of male: female was 1:1.4 and 1:1.2 with 78.9 and 69.3 per cent adult emergence, respectively on B. mori and S. c. ricini. The results were on par with the results of Nagamallikadevi et al. (2013). They observed that eggs of C. cephalonica were superior over all treatments followed by sucking pests for all biological parameters. The total larval (16.95, 15.60, 16.39), pupal (12.32, 13.57, 14.91), pre oviposition (16.33, 14.85, 15.60) and incubation period (5.90, 5.20, 5.97) days, when larvae reared on neonates of H. armigera, S. litura and E. vitella, respectively. Male and female longevity of predator was found superior for neonates of S. litura (21.16, 35.58) followed by H. armigera (18.11, 34.41) and E. vitella (19.61, 33.35) days. Reproductive potential was recorded as 84.66, 94.50, 91.16 eggs/female of M. boninensis when its larvae fed with neonates of H. armigera, S. litura and E. vitella, respectively. The study revealed that other sucking pests can be used as substitute for rearing of M. boninensis in the laboratory for experimental purposes.

**ACKNOWLEDGEMENT**

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**REFERENCES**


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**Table 2: Effect of different hosts on biological parameters of Mallada boninensis under laboratory conditions**

<table>
<thead>
<tr>
<th>Hosts</th>
<th>Larval survival (%)</th>
<th>Pupation (%)</th>
<th>Adult emergence (%)</th>
<th>Sex ratio (Female:Male)</th>
<th>Fecundity/female</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. gossypii(Nymphs/Adults)</td>
<td>83.6 ± 0.28b</td>
<td>76.82 ± 0.38c</td>
<td>74.3 ± 0.20c</td>
<td>1.3:0.9</td>
<td>140.24 ± 0.19c</td>
</tr>
<tr>
<td>A. craccivora(Nymphs/Adults)</td>
<td>76.64 ± 0.35d</td>
<td>73.20 ± 0.26d</td>
<td>70.98 ± 0.24d</td>
<td>1.1:0.8</td>
<td>134.9 ± 0.24d</td>
</tr>
<tr>
<td>A. dispersus(Nymphs)</td>
<td>79.34 ± 0.13c</td>
<td>78.04 ± 0.17b</td>
<td>74.20 ± 0.21b</td>
<td>1.2:0.9</td>
<td>213.08 ± 0.22b</td>
</tr>
<tr>
<td>C. cephalonica(eggs)</td>
<td>91.80 ± 0.19a</td>
<td>85.34 ± 0.26a</td>
<td>85.52 ± 0.17a</td>
<td>1.4:1</td>
<td>323.5 ± 0.33a</td>
</tr>
<tr>
<td>Sd</td>
<td>0.36</td>
<td>0.39</td>
<td>0.29</td>
<td>-</td>
<td>0.36</td>
</tr>
<tr>
<td>CD(0.05)</td>
<td>0.77</td>
<td>0.85</td>
<td>0.63</td>
<td>-</td>
<td>0.77</td>
</tr>
</tbody>
</table>

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