



## Biology of cabbage aphid under laboratory condition in Nagaland

Jesonkere Sutnga<sup>1</sup> • Hijam Shila Devi<sup>1\*</sup> • Waluniba<sup>1</sup> • Susanta Banik<sup>2</sup> • J. Akato Chishi<sup>1</sup>

<sup>1</sup>Department of Entomology, <sup>2</sup>Department of Plant Pathology, School of Agricultural Sciences, Nagaland University, Medziphema campus, Nagaland – 797106

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### ABSTRACT

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A field experiment was carried out in the laboratory of Department of Entomology, School of Agricultural Sciences (SAS), Nagaland University, Medziphema campus during November, 2021 to March, 2022 to study biology of *Brevicoryne brassicae* on cabbage in laboratory condition. The duration of total nymphal period, pre-reproductive period, reproductive period, post-reproductive period, adult longevity and total life span was 10.00±0.28, 2.00±0.34, 17.70±3.34, 2.70±1.40, 27±3.91 and 35.5±5.38 days, respectively. Number of nymphs produced per female was 69.65±1.18 and reproductive rate was 3.00±0.98 nymphs per female per day. Mean duration of first, second, third and fourth instar of nymph were 2.00±0.37, 3.00±0.29, 3.00±0.43 and 3.00±0.12 days, respectively. The morphometry studies of *B. brassicae* revealed that there was a progressive increase in size of the body. The 1<sup>st</sup>, 2<sup>nd</sup>, 3<sup>rd</sup> and 4<sup>th</sup> instar of nymphal were measured from 0.658, 1.095, 1.537 and 1.985 mm, respectively. The total length of the antennae of 1<sup>st</sup>, 2<sup>nd</sup>, 3<sup>rd</sup>, and 4<sup>th</sup> nymphal instar were 0.401, 0.687, 0.989 and 1.293 mm, respectively. The apterous adult are dark-greyish green in colour with a body length of 2.31 mm and a width of 1.56 mm. The length of antennal segment III, VI and total antennae were 0.431 mm, 0.565 mm, and 1.75 mm, respectively. Length of Ultimate Rostral Segment (URS) in adult stage is 0.129 mm and hind tarsal segment 2 is found to be 0.126 mm.

### 1. Introduction

One of the first known cultivated crops, cabbage (*Brassica oleraceae* var. *capitata* Linn.) has been grown for more than 4,000 years. It is among India's most preferred vegetables for temperate climates. In India, cabbage ranks fourth among vegetables and is grown as an annual vegetable crop for its thick leaf heads. It is a biennial plant with green or purple leaves that is native to Europe (Sharma *et al.* 2022). Although it originated in Europe, the cabbage aphid, *B. brassicae* is now widespread across the temperate and warm temperate zones of the world (Blackman and Eastop, 2000). This aphid is a severe pest of cabbage and a specialist of plants in the Brassicaceae family (Gabrys *et al.*, 1997). *B. brassicae* establishes colonies on the stems, petioles, and leaves of its hosts, where it causes direct damage from the absorption of host sap as well as indirect damage from the transmission of phytopathogenic viruses and the ejection of honeydew that impairs the photosynthetic activity of cabbage

1991). They caused mature plants to wilt, yellow, and stunt. The infected plants grow slowly, losing 9–77% of their seed production and 11% of their seed oil content (Kelm and Gadomski, 1995).

Many researchers have investigated the biology of cabbage aphids in various regions of the world because understanding of fecundity, survivorship, development, and lifespan is crucial for aphid management. However, information on the biology of *B. brassicae* is lacking in North East India. Therefore, keeping in view the importance of cabbage aphid, an attempt to study on cabbage aphid under laboratory condition was undertaken.

### 2. Materials and Methods

The biology of cabbage aphid, *B. brassicae* was studied in the laboratory of Department of Entomology at room temperature using a widely mounted 3.5 cm transparent plastic vials of 50 ml capacity. Twenty newly moulted

\*Corresponding author: [hsdevi@nagalanduniversity.ac.in](mailto:hsdevi@nagalanduniversity.ac.in)

apterous aphid females were collected and placed on cut pieces of cabbage leaves using a triple zero brush and put them in the vial separately. The leaf was removed from plant and cut into pieces of about 2.5cm square and one piece will be placed in each vial. The leaf was washed with tap water and air dried before feeding to the females. Leaves were replaced daily and vial was cleaned daily. Observations were recorded after every 24 hours for pre-reproduction, reproduction, post-reproduction period, mortality and fecundity.

Twenty number of nymphs borne on the same day and reproducing on cut leaves in laboratory in plastic vial were chosen for studies on development of nymphs. Individual were checked daily for ecdysis and survivorship. The exuviae were used to determine moulting. Data were recorded for determining number of instars, duration between the moults, mortality rate and development time. Three replication was done for the study of the biology of cabbage aphid. Nymphs of different stages were collected and mount it on a slide through a various process of preparation of permanent slides. Body length (BL), body width (BW), Antenal segment 3 (ANT III), Antenal segment 6 (ANT VI), Length of Antenna (ANT), Length of Untimate Rostral Segment (URS), Hind Tarsal Segment 2 (HT II) were observed and measured under stereomicroscope.

### 3. Results and Discussion

The pre-reproductive, reproductive and post reproductive period lasted for  $2\pm 0.34$ ,  $17.7\pm 3.34$  and  $2.7\pm 1.40$  days as shown in Table 1. The duration of the pre-reproductive is supported by Aslam *et. al.* (2011) who reported that *B. brassicae* had a pre-reproductive period of 2.34 days. Meenakshi *et. al.* (2014) reported that the average pre-natal period was  $3.2\pm 0.63$  days which was contrary with the present findings. However, they recorded that the reproductive period was ( $16.1\pm 4.09$  days) which corroborates the present findings. In contrast, Gupta and Neranjan (2013) observed the average reproductive period of *B. brassicae* was 21.26 days on cabbage. This may be attributed to the difference in climatic conditions of two different locations.

**Table 1.** Biological parameters of cabbage aphid, *B. brassicae* on cabbage under laboratory condition

| Reproduction in females  | Days/nymphs |
|--------------------------|-------------|
| Pre-reproductive period  | 2.00±0.34   |
| Reproductive period      | 17.70±3.34  |
| Post reproductive period | 2.70±1.40   |
| No. of nymphs/female     | 69.65±1.18  |
| Nymphs/day               | 3.00±0.98   |
| Adult longevity          | 27±3.91     |
| Total life span          | 35.5±5.38   |

The average number of nymph laid by the female was found to be  $69.65\pm 1.18$  nymphs with a mean number of  $3\pm 0.98$  nymphs/female/day (Table 1), which are more or less contradictory with the finding of Gupta and Neranjan (2013) who recorded 72.08 nymphs/female on cauliflower but different to that reported by Debaraj *et. al.* (1995) who observed 28.6 nymphs/female in cabbage. Ulusoy and Bayhan (2006) also observed the net reproductive rate of *B. brassicae* on cauliflower with 35.98 nymphs/female. It could be due to different host plants and environmental conditions. The adult longevity and the total life span of cabbage aphid, *B. brassicae* was found to be  $27\pm 3.91$  and  $35.5\pm 5.38$  respectively.

**Table 2.** Duration of different developmental stages of cabbage aphid, *B. brassicae* on cabbage

| Stages of nymphs     | Duration in days |
|----------------------|------------------|
| 1st Instars          | 2.00±0.37        |
| 2nd Instars          | 3.00±0.29        |
| 3rd Instars          | 3.00±0.43        |
| 4th Instars          | 3.00±0.12        |
| Total nymphal period | 10.00±0.28       |

The present observation revealed that the aphid had four nymphal instars. The mean duration of the first, second, third and fourth nymphal instar was  $2\pm 0.37$ ,  $3\pm 0.29$ ,  $3\pm 0.43$  and  $3\pm 0.12$  days (Table 2), respectively. The total nymphal period was found to be  $10\pm 0.28$  days. The mean duration of first, second and third nymphal instar was found to be similar to that reported by Aslam *et. al.* (2011) who observed the mean duration of first, second, and third instar was 2.09, 3.50 and 3.5 days, respectively. Mortality of nymphs during development was nil in the present study which is different to that reported by Ulusoy and Bayhan (2006). The total nymphal period in the present study is supported by Rossa *et. al.* (2005) who informed that *B. brassicae* took 11-12 days to reach its adult stage on cabbage. Ulusoy and Bayhan (2006) observed that the total development time of *B. brassicae* on cabbage was 10.4 days which coincide with the present findings. However, Debaraj *et. al.* (1995) found that the total nymphal period on cabbage was 13.23 days and Gupta and Neranjan (2013) reported that the total developmental period of four nymphal instars on cabbage was 21.26 days which is contradictory with the present findings. Reproduction rate was low but increased suddenly reaching its maximum on the third day of reproduction period and thereafter stated to decrease to the lowest on twenty one day of the reproduction period (Table 3) which was closely related to the findings of Aslam *et. al.*

(2011) who observed the increased of reproduction rate to third day and thereafter decreased to a minimum on eighth day.

**Table 3.** Reproduction and female mortality of cabbage aphid, *B. brassicae* on cabbage under laboratory conditions

| Day    | Reproduction rate (Nymphs/female/day) | Female Mortality % |
|--------|---------------------------------------|--------------------|
| Day 1  | 4.00                                  | 0.00               |
| Day 2  | 4.45                                  | 0.00               |
| Day 3  | 5.60                                  | 0.00               |
| Day 4  | 4.55                                  | 0.00               |
| Day 5  | 5.15                                  | 0.00               |
| Day 6  | 3.35                                  | 0.00               |
| Day 7  | 3.80                                  | 0.00               |
| Day 8  | 3.42                                  | 5.55               |
| Day 9  | 3.68                                  | 5.88               |
| Day 10 | 2.85                                  | 0.00               |
| Day 11 | 3.85                                  | 0.00               |
| Day 12 | 2.85                                  | 0.00               |
| Day 13 | 3.20                                  | 0.00               |
| Day 14 | 3.10                                  | 0.00               |
| Day 15 | 3.40                                  | 0.00               |
| Day 16 | 2.94                                  | 6.25               |
| Day 17 | 3.00                                  | 0.00               |
| Day 18 | 2.50                                  | 0.00               |
| Day 19 | 2.05                                  | 0.00               |
| Day 20 | 1.95                                  | 0.00               |
| Day 21 | 0.33                                  | 14.28              |

n= 20 females, calculation based on 20 females

Maximum reproduction (5.6 nymphs/female/day) was noted on third day and minimum (0.33 nymphs/female/day) on twenty one day of reproduction period. No female mortality was noted in first seven days of reproductive period. Maximum mortality (14.28%) was recorded on twenty one day and minimum mortality (5.55%) on eight day of the reproductive period which was different from Aslam *et. al.* (2011) who reported maximum mortality (35.09%) on eighth day. The different in result could be due to different experimental conditions and different crops.

The morphometry studies of cabbage aphid, *B. brassicae* revealed that there was a progressive increase in size from the first instar to the adult stage (Table 4). The first nymphal instar were greyish green in colour and measured from 0.658±0.052 mm long with a width of 0.377±0.034 mm.

The second instar had a body length of 1.095±0.21 mm and width of 0.708±0.16 mm. The length of antennal segment 3 (ANT III) for the first and second nymphal instar was found to be 0.104±0.029 mm 0.181±0.13 mm respectively. The total length of antennae (ANT) was 0.401±0.14 mm in the first instar and 0.687±0.33 mm in the second instar. The morphological characters showed considerable increase in size as shown in Table-4.5. The average size of third instar nymph was found to be 1.537 mm× 1.021 mm. There were five antennal segments in the first and second instar but six antennal segment was observed from the third nymphal instar onwards. The length of the antennal segment 6 (ANT VI) was 0.289±0.42 mm and total length of the antennae was found to be 0.989±0.42 mm. Similar findings were reported by Devi and Singh (2007) who observed that there were five antennal segments in the first and second nymphal instar and six in the third, fourth and adult in *Myzus persicae*. However, Asante and Cairns (1995) found that there were five antennal segments in the first instars and six in the second, third and fourth nymphal instars of apterous virginoparae. The variation could be due to different in species, rearing conditions and climatic conditions. The fourth nymphal instar are dark-greyish green in colour. The average size of fourth instar nymph was 1.985 mm × 1.371 mm. The average length of antennal segment III, VI and total length of antennae of the fourth instar were 0.349 mm, 0.397 mm and 1.293 mm, respectively.

The apterous adult are dark-greyish green in colour with a body length of 2.31±0.46 mm with a width of 1.56±0.37 mm. The length of antennal segment III, VI and total antennae were 0.431 mm, 0.565 mm, and 1.75 mm, respectively. Length of Untimate Rostral Segment (URS) in adult stage is 0.129±0.06 mm and hind tarsal segment 2 is found to be 0.126±0.08 mm. The initial stages of *B. brassicae* were observed to be more or less identical in appearance. There was significant increase in size from the first instar to the adult stage. Devi and Singh (2007) reported that the body length and body width of *M. persicae* showed 2.61-2.97 and 2.49-2.97 times increase in size from the first instar to the adult stage which corroborate the present findings.

#### 4. Conclusion

The metric analysis showed gradual developmental changes from the first instar nymph to the adult stages in size, shape and number of characters. Reproduction period and number of nymph produced per female were also counted for further understanding about the population dynamics of *B. brassicae*. The information on the biology will be useful in conducting future research on this pest for identification in its different stages and for the management of the pest.

**Table 4.** Morphometric data (mean  $\pm$  SE) of different stages of *B. brassicae*

| Body parts                                  | Body size (mm)         |                        |                        |                        |                  |
|---|------------------------|------------------------|------------------------|------------------------|------------------|
|   | 1 <sup>st</sup> Instar | 2 <sup>nd</sup> Instar | 3 <sup>rd</sup> Instar | 4 <sup>th</sup> Instar | Apterous adult   |
| 1. Body Length (BL)                         | 0.658 $\pm$ 0.052      | 1.095 $\pm$ 0.21       | 1.537 $\pm$ 0.31       | 1.985 $\pm$ 0.4        | 2.31 $\pm$ 0.46  |
| 2. Body width (BW)                          | 0.377 $\pm$ 0.034      | 0.708 $\pm$ 0.16       | 1.021 $\pm$ 0.23       | 1.371 $\pm$ 0.3        | 1.56 $\pm$ 0.37  |
| 3. Antenal segment 3 (ANT III)              | 0.104 $\pm$ 0.029      | 0.181 $\pm$ 0.13       | 0.231 $\pm$ 0.2        | 0.349 $\pm$ 0.24       | 0.431 $\pm$ 0.34 |
| 4. Antenal segment 6 (ANT VI)               | 0                      | 0                      | 0.289 $\pm$ 0.42       | 0.397 $\pm$ 0.3        | 0.565 $\pm$ 0.37 |
| 5. Length of Antenna (ANT)                  | 0.401 $\pm$ 0.14       | 0.687 $\pm$ 0.33       | 0.989 $\pm$ 0.42       | 1.293 $\pm$ 0.31       | 1.75 $\pm$ 0.44  |
| 6. Length of Ultimate Rostral Segment (URS) | 0.083 $\pm$ 0.15       | 0.098 $\pm$ 0.35       | 0.098 $\pm$ 0.44       | 0.115 $\pm$ 0.05       | 0.129 $\pm$ 0.06 |
| 7. Hind Tarsal Segment 2 (HT II)            | 0.09 $\pm$ 0.14        | 0.09 $\pm$ 0.32        | 0.111 $\pm$ 0.41       | 0.119 $\pm$ 0.0008     | 0.126 $\pm$ 0.08 |

#### 4. References

- Asante, S.K. and Cairns, S.C. (1995) Age-Grading Nymphal Instars of Apterous Virginoparae of *Eriosoma lanigerum* (Hausmann) (Hemiptera: Aphididae). *Journal of Australian Entomology Society*. 34: 111-115.
- Aslam, M., Razaq, M., Hussain, S. and Khan, P.K. (2011) Biology of cabbage aphid under laboratory Conditions. *Pakistan Journal of Zoology*. 43 (5): 1009-1012.
- Blackman, R.L. and Eastop, V.F. (2000) Aphids on the world crops. An Identification and Information Guide. 2<sup>nd</sup> edition (Revised), Chichesler, U.K: John Wiley and sons Limited. 39 pp.
- Chan, C.K., Forbes, A.R. and Raworth, D.A. (1991) Aphid-transmitted virus and their vectors of the world. *Agriculture Canada Research Branch technical Bulletin*. 216: 184-186.
- Debaraj, Y., Singh, S.L., Shantibala, K. and Singh, T.K. (1995) Comparative biology of the cabbage aphid, *Brevicoryne brassicae* (L.) on six cruciferous hosts. *Journal of Aphidology*. 9: 30-35.
- Devi, P.B. and Singh, T.K. (2007) Studies on the morphometry of the green peach aphid, *Myzus persicae* (Sulzer) (Homoptera: Aphididae). *Entomological Research*. 37: 81-85.
- Gabrys, B.J., Gadomski, H.J., Klukowski, Z., Pickett, J.A., Sobota, G.T., Wadhams, L.J. and Woodcock, C.M. (1997) Sex pheromone on cabbage aphid, *Brevicoryne brassicae*: Identification and Field Trapping of male aphids and parasitoids. *Journal of Chemical Ecology*. 23: 1881-1890.
- Gupta, M.K. and Niranjana, C. (2013) Influence of some cruciferous plants on biological parameters of cabbage aphid *Brevicoryne brassicae* (L.) (Homoptera: Aphididae). *Indian Journal of Entomology*. 75 (4): 290-294.
- Kelm, M. and Gadomski, H. (1995) Occurrence and harmfulness of the cabbage aphid (*Brevicoryne brassicae* L.) on winter rape. *Materialy Sesji Instytutu Ochrony Roslin*. 35: 101-103.
- Meenakshi, A., Masarrat, H. and Uzma, M. (2014) Biology and seasonal incidence of aphid, *Brevicoryne brassicae* on cabbage. *Annals of Plant Protection Sciences*. 22 (2): 275-277.
- Rossa, F.I., Vasicek, A., López, M., Mendy, M. and Paglioni, A. (2005) Biology and demography of *Brevicoryne brassicae* (L.) (Homoptera: Aphididae) on four cultivars of *Brassica oleracea* L. under laboratory conditions (II). *Revista de Investigaciones Agropecuarias*. 34 (3): 105-114.
- Sharma, B., Chaudhary, A.K., Gangwar, B. and Sharma, N.R. (2022) Seasonal incidence of cabbage insect pest. *The Pharma Innovation Journal*. 11(8): 116-119.
- Ulusoy, M.R. and Bayhan, S.O. (2006) Effect of certain Brassica plants on biology of the cabbage aphid *Brevicoryne brassicae* under laboratory conditions. *Phytoparasitica*. 34: 133-138.