

BIONOMICS OF APHID, *LIPAPHIS ERYSIMI* (KALTENBACH) ON CAULIFLOWER

N. M. PATEL*, P. H. GODHANI AND V. R. GOHEL

All India Coordinated Research Project on Biological Control Research Laboratory,
Anand Agricultural University, Anand, Gujarat - 388 110, INDIA
e-mail: nehampatel25@gmail.com

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*Corresponding
author

ABSTRACT

Investigations on "Bionomics" of aphid, *Lipaphis erysimi* (Kaltenbach) on cauliflower was carried out at the All India Coordinated Research Project on Biological Control Research Laboratory, Anand Agricultural University, Anand during 2014-15. The nymph passed through four distinct instars before attaining the adult stage. The instars were determined from the exuviae casted off at each moult. The length of first, second, third and fourth instar nymph was: 0.76 ± 0.03 , 0.87 ± 0.01 , 1.41 ± 0.21 and 1.59 ± 0.05 mm, whereas it was 0.37 ± 0.03 , 0.44 ± 0.01 , 0.77 ± 0.09 and 0.85 ± 0.05 mm incase of breadth, respectively. The total nymphal period was 4 to 8 days with an average of 6.03 ± 0.89 days. The length and breadth of female adult was 1.86 ± 0.18 and 1.15 ± 0.02 mm, respectively. The longevity of female adult was ranged from 6 to 11 days with an average of 8.63 ± 1.17 days and the total life cycle 12 to 17 days with an average of 15.29 ± 1.73 days. The average pre-oviposition, oviposition and post-oviposition periods were 1.46 ± 0.51 , 6.23 ± 0.97 and 0.89 ± 0.72 days, respectively. The average number of nymphs produced by a female was 26.86 ± 5.89 nymphs during its life cycle.

INTRODUCTION

Cauliflower is one of the oldest cultivated vegetable. India is the second largest producer of cauliflower in the world, next to China. More than 24 insect pests attack on cauliflower. The important pests of cauliflower are diamondback moth (DBM), *Plutella xylostella* Linnaeus; webworm *Hellua undalis*, Fabricius, cabbage butterflies, *Pieris brassicae* Linnaeus, aphid, *Lipaphis erysimi* Kaltenbach; and flea beetles *Chaetocnema basalis* Bally (Chaudhary *et al.*, 2001; Srinivaran and Murthi, 1991). Among them, aphid, *L. erysimi* (Kalt.) is the most destructive and predominant pest. The infestation of the aphid *L. erysimi* caused extensive damage up to 54.2% to cauliflower crop (Srivastava and Gularia, 2003; Muthukumar and Sharma, 2009). The basic information on life history is necessary before deciding the strategy for management of any insect pest. Available information exposed that on bionomics of aphid, *L. erysimi* is scanty, under middle Gujarat conditions so far. This paper discusses bionomics, of aphid, *L. erysimi* under laboratory condition.

MATERIALS AND METHODS

The study on bionomics of aphid, *L. erysimi* on cauliflower was carried out at the All India Coordinated Research Project on Biological control Research Laboratory, Anand Agricultural University, Anand during Rabi season of year 2014-15. For mass rearing of aphid, younger (5-6 leaves or 6-7 weeks old) cauliflower plants were transplanted individually into pots which were filled one week earlier with mixture of soil and rotten manure in the ratio of 1:1. Sufficient moisture was provided to cauliflower plants. The cauliflower aphids,

L. erysimi collected from infested leaves were used for further study. In order to rear the aphids, equal numbers of viviparous females were transferred individually to potted plants with help of fine moist camel hair brush. All plants were covered with fine net in order to prevent the attack on aphids by parasites and predators and kept under net house condition.

For studies on different stages of aphid, the newly hatched nymphs were carefully placed on leaves with help of fine moist camel hair brush. Cauliflower leaves were place in glass petri-dish having 10 cm diameter and 2 cm height. The nymphs when settled on leaves were observed daily till adult stage for various aspects of bionomics. Fresh leaves were provided as food material and replaced as and when required to avoid physical injury to aphid. Different life stages of *L. erysimi* were examined using Olympus SZX 10 binocular microscope and critically observed for their colour and shape, whereas length and breadth of body as well as various appendages were measured by the help of software "Magnus-Pro", developed by M/S Olympus India Pvt. Ltd., New Delhi. The changes of instar were recorded based on the presence of exuviae casted by the nymphs. Growth of nymphs, moulting and passing into next instar and the number of nymphs laid per female were also observed at an interval of 12 hrs. From these observations, duration of instar, total nymphal period, pre-reproductive, reproductive and post-reproductive period, longevity, fecundity as well as total life cycle were recorded.

RESULTS AND DISCUSSION

Nymphal instars

The nymph passed through four distinct instars before

attaining the adult stage. The instars were determined from the exuviae casted off at each moult. The present findings is in accordance with the report of the Vekaria and Patel (1999), Sangekar (2012) and Ranila *et al.* (2015).

First instar

Freshly borne first instar nymph was elongated, wingless, delicate, transparent and pale yellowish or light greenish in colour. Compound eyes were small, placed just behind the base of the antennae and were reddish black. Later, the body shape became oval and colour changed from light green to green. The body length of first instar nymph varied from 0.72 to 0.79 mm with an average of 0.76 ± 0.03 mm and breadth was 0.34 to 0.41 mm with an average of 0.37 ± 0.03 mm (Table 1). The antenna was setaceous type with five segments. The length of antennae varied from 0.44 to 0.55 mm with an average of 0.48 ± 0.05 mm. Three pairs of thoracic legs were well developed and colourless. The length of fore, middle and hind leg varied from 0.39 to 0.47, 0.38 to 0.54 and 0.52 to 0.65 mm with an average of 0.42 ± 0.02 , 0.44 ± 0.06 and 0.57 ± 0.05 mm, respectively. A pair of small cornicles was visible laterally near the tip of abdomen, which varied from 0.08 to 0.10 mm with an average of 0.08 ± 0.01 mm in length. Due to small size of cauda, it was not clearly visible. Vekaria and Patel (1999) and Sangekar (2012) also found more or less similar results on first instar nymph.

Second instar

Freshly moulted second instar nymph differed from first instar in its comparative size and appearance. Nymph was little dark green in colour at lateral sides of abdomen and slightly bulged. Compound eyes were similar to first instar both in colour and shape. Second instar was very active and avoids light. The body length of second instar nymph varied from 0.85 to 0.89 mm with an average of 0.87 ± 0.01 mm and breadth was 0.43 to 0.46 mm with an average of 0.44 ± 0.01 mm (Table 1). Five segmented antenna varied from 0.56 to 0.67 mm with an average of 0.62 ± 0.05 mm in length. The length of fore, middle and hind legs varied from 0.45 to 0.56, 0.55 to 0.66 and 0.65 to 0.74 mm with an average of 0.51 ± 0.05 and 0.61 ± 0.05 and 0.72 ± 0.04 mm, respectively. The cornicles were quite distinct and cylindrical in shape and varied from

0.07 to 0.09 mm with an average of 0.08 ± 0.01 mm in length. Vekaria and Patel (1999) and Sangekar (2012) also found more or less similar observations on second instar.

Third instar

Freshly moulted third instar nymph was dark yellowish to green in colour. The compound eyes were round, little bigger than second instar and blackish in colour. The morphometric study of third nymphal instar indicated that each nymph varied from 1.25 to 1.65 mm with an average of 1.41 ± 0.21 mm in length and 0.77 to 0.87 mm with an average of 0.77 ± 0.09 mm in breadth (Table 1). The antenna was six segmented and varied from 0.80 to 0.95 mm with an average of 0.87 ± 0.07 mm in length. The length of fore, middle and hind legs varied from 0.61 to 0.85, 0.72 to 0.94 and 0.82 to 1.14 mm with an average of 0.73 ± 0.09 , 0.80 ± 0.10 and 1.01 ± 0.13 mm, respectively. The length of cornicles varied from 0.13 to 0.16 mm with an average of 0.15 ± 0.01 mm. Vekaria and Patel (1999) and Sangekar (2012) also found more or less similar findings on third instar.

Fourth instar

Freshly moulted fourth instar nymph was dark green in colour and elongated in shape. The compound eyes were still enlarged and were dark black in colour. The nymph was very active and looked like adult except that it did not acquire deep green colour and fully developed wings. The body length of fourth instar nymph varied from 1.51 to 1.64 mm with an average of 1.59 ± 0.05 mm and breadth was 0.76 to 0.88 mm with an average of 0.85 ± 0.05 mm (Table 1). It possessed six segmented antenna which varied from 0.99 to 1.18 mm with an average of 1.10 ± 0.08 mm in length. The length of fore, middle and hind legs varied from 0.67 to 0.81, 0.86 to 1.06 and 1.05 to 1.44 mm with an average of 0.75 ± 0.05 , 1.00 ± 0.08 and 1.30 ± 0.15 mm, respectively. The cornicles were clearly visible with naked eyes and varied from 0.16 to 0.19 mm with an average of 0.17 ± 0.01 mm. Vekaria and Patel (1999) and Sangekar (2012) also found more or less similar observations on fourth instar.

The apterate adult

The apterate adults were dark deep olive green in colour with

Table 1: Measurement of different stages of aphid, *L. erysimi*

Developmental Stages	Length (mm)			Breadth (mm)			Cornicle (mm)			Cauda (mm)		
	Min.	Max.	Mean \pm S.D.	Min.	Max.	Mean \pm S.D.	Min.	Max.	Mean \pm S.D.	Min.	Max.	Mean \pm S.D.
I instar	0.72	0.79	0.76 ± 0.03	0.34	0.41	0.37 ± 0.03	0.08	0.10	0.08 ± 0.01	-	-	-
II instar	0.85	0.89	0.87 ± 0.01	0.43	0.46	0.44 ± 0.01	0.07	0.09	0.08 ± 0.01	-	-	-
III instar	1.25	1.65	1.41 ± 0.21	0.77	0.87	0.77 ± 0.09	0.13	0.16	0.15 ± 0.01	-	-	-
IV instar	1.51	1.64	1.59 ± 0.05	0.76	0.88	0.85 ± 0.05	0.16	0.19	0.17 ± 0.01	-	-	-
Apterate adult	1.72	2.15	1.86 ± 0.18	1.12	1.18	1.15 ± 0.02	0.15	0.24	0.21 ± 0.04	0.12	0.20	0.15 ± 0.03
Alate adult	1.71	2.02	1.76 ± 0.06	1.02	1.09	1.05 ± 0.02	0.41	0.57	0.48 ± 0.05	0.09	0.13	0.11 ± 0.01

Developmental Stages	Antenna (mm)			Fore leg (mm)			Middle leg (mm)			Hind leg (mm)		
	Min.	Max.	Mean \pm S.D.	Min.	Max.	Mean \pm S.D.	Min.	Max.	Mean \pm S.D.	Min.	Max.	Mean \pm S.D.
I instar	0.44	0.55	0.48 ± 0.05	0.39	0.47	0.42 ± 0.02	0.38	0.54	0.44 ± 0.06	0.52	0.65	0.57 ± 0.05
II instar	0.56	0.67	0.62 ± 0.05	0.45	0.56	0.51 ± 0.05	0.55	0.66	0.61 ± 0.05	0.65	0.74	0.72 ± 0.04
III instar	0.80	0.95	0.87 ± 0.07	0.61	0.85	0.73 ± 0.09	0.72	0.94	0.80 ± 0.10	0.82	1.14	1.01 ± 0.13
IV instar	0.99	1.18	1.10 ± 0.08	0.67	0.81	0.75 ± 0.05	0.86	1.06	1.00 ± 0.08	1.05	1.44	1.30 ± 0.15
Apterate adult	1.34	1.46	1.41 ± 0.04	0.85	1.19	0.98 ± 0.14	0.94	1.64	1.24 ± 0.28	1.36	2.13	1.74 ± 0.30
Alate adult	0.82	1.02	0.92 ± 0.08	1.33	1.54	1.46 ± 0.06	1.38	1.59	1.50 ± 0.07	1.92	2.04	1.97 ± 0.04

Note: mm = millimeter; S. D. = Standard Deviation; Min. = Minimum; Max. = Maximum

Table 2: Duration of different stage(s) of aphid, *L. erysimi* on cauliflower

Stages	Duration {Day(s)}		
	Min.	Max.	Mean \pm S. D.
Nymph			
I instar	1	2	1.80 \pm 0.41
II instar	1	2	1.17 \pm 0.38
III instar	1	2	1.54 \pm 0.51
IV instar	1	2	1.51 \pm 0.51
Total nymphal period	4	8	6.03 \pm 0.89
Adult			
Pre-reproduction period	1	2	1.46 \pm 0.51
Reproduction	5	8	6.23 \pm 0.97
Post-reproduction period	0	2	0.89 \pm 0.72
Adult longevity	6	11	8.63 \pm 1.17
Total life span	12	17	15.29 \pm 1.13

Table 3: Fecundity of aphid, *L. erysimi* on cauliflower no. of nymphs/female

Min	Max	Mean \pm SD
16	35	26.86 \pm 5.89

Note: S. D. = Standard deviation; Min. = Minimum; Max. = Maximum

spindle shaped to elongated pyriform body. The compound eyes were dark black in colour and were bulged. The body length varied from 1.72 to 2.15 mm with an average of 1.86 ± 0.18 mm and the body breadth which varied from 1.12 to 1.18 mm with an average of 1.15 ± 0.02 mm. (Table 1). The antenna composed of six segments and which varied from 1.34 to 1.46 mm with an average of 1.41 ± 0.04 mm. Legs were rather stout, long and covered with small hairs. Third pair of leg was longer than first and second ones. The length of fore, middle and hind legs varied from 0.85 to 1.19, 0.94 to 1.64 and 1.36 to 2.13 mm with an average of 0.98 ± 0.14 , 1.24 ± 0.28 and 1.74 ± 0.30 mm, respectively. Abdomen was dark to black colour, shining appearance and bulged. The cornicles, a prominent morphological feature of adult aphid was in pair of long tubes and greenish in colour. The length of cornicles varied from 0.15 to 0.24 mm with an average of 0.21 ± 0.04 mm. Cauda was prominently visible in adult, varied from 0.12 to 0.20 mm with an average of 0.15 ± 0.03 mm in length. Blackman and Eastop (1984), Vekaria and Patel (1999) and Sangekar (2012) also found more or less similar observations on apterous adult.

Alate adult

Alate adult was similar to the apterous adult except in the presence of wings. Both fore and hind wings were transparent and oblong in shape but forewing was greater in length and width as compared to hind wing. Alate adult was comparatively smaller in size than that of apterous adult and measured 1.71 to 2.02 mm in length with an average of 1.76 ± 0.06 mm and 1.02 to 1.09 mm in breadth with an average of 1.05 ± 0.02 mm (Table 1). The six segmented antenna varied from 0.82 to 1.02 mm in length with an average of 0.92 ± 0.08 mm. The length of fore, middle and hind legs varied from 1.33 to 1.54, 1.38 to 1.59 and 1.92 to 2.04 mm with an average of 1.46 ± 0.06 , 1.50 ± 0.07 and 1.97 ± 0.04 mm, respectively. The length of cornicles and cauda varied from 0.41 to 0.57 mm

and 0.09 to 0.13 mm with an average of 0.48 ± 0.05 and 0.11 ± 0.01 mm, respectively. Blackman and Eastop (1984), Vekaria and Patel (1999) and Sangekar (2012) also found more or less similar observations on alate adult.

Duration of various stages of aphid, *L. erysimi*

The durations of all nymphal instars (Table 2) varied from 1 to 2 with an average of 1.80 ± 0.41 , 1.17 ± 0.38 , 1.54 ± 0.51 and 1.51 ± 0.51 days, respectively. The total nymphal period of aphid, *L. erysimi* varied from 4 to 8 days with an average of 6.03 ± 0.89 days. The duration of different nymphal instars were comparable with similar observations reported by Vekaria and Patel (1999).

Pre-reproduction, reproduction and post-reproduction period

The pre-reproduction, reproduction and post-reproduction period was ranged from 1 to 2, 5 to 8 and 0 to 2 days with an average of 1.46 ± 0.51 , 6.23 ± 0.97 and 0.89 ± 0.72 days, (Table 2) respectively. Vekaria and Patel (1999) also found more or less similar results on pre-reproduction, reproduction and post-reproduction period.

Adult longevity

The longevity of adult was ranged from 6 to 11 days with an average of 8.63 ± 1.17 days (Table 2). Vekaria and Patel (1999) also found similar observations on apterous adult.

Total life cycle

The total life cycle of adult was ranged from 12 to 17 days with an average of 15.29 ± 1.13 days (Table 2). Vekaria and Patel (1999) reported 14 to 16 and 13 to 16 days with an average of 15.16 ± 0.75 and 14.69 ± 1.04 days in the first and second set of insect observation, respectively.

Fecundity

Each female produced 16 to 35 nymphs with an average of 26.86 ± 5.89 nymphs (Table 3). Rout and Senapati (1968) and Vekaria and Patel (1999) also found similar results on reproductive capacity of aphid, *L. erysimi*. Whereas, Ranila *et al.* (2015) found more or less similar observation on the fecundity of aphid, *Aphis gossypii* on coriander 30.76 ± 7.61 .

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