

Biology of aphid, *Aphis gossypii* Glover in cumin

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Abstract

The experiment on biology of aphid, *Aphis gossypii* infesting cumin crop was conducted under ambient conditions in the Entomology Laboratory, Agricultural Research Station, Mandor, Jodhpur. The study was conducted on potted plants of cumin variety GC-4. The aphid, *A. gossypii* nymphs were moulted four times before attaining the adult stage. The mean body length, width, antennal length and cornicle length of first, second, third and fourth instar nymphs were 0.50 ± 0.04 , 0.28 ± 0.03 , 0.28 ± 0.02 and 0.036 ± 0.01 mm; 0.90 ± 0.04 , 0.38 ± 0.04 , 0.40 ± 0.03 and 0.065 ± 0.01 mm; 1.11 ± 0.05 , 0.49 ± 0.04 , 0.54 ± 0.03 and 0.095 ± 0.01 mm and 1.31 ± 0.06 , 0.65 ± 0.05 , 0.64 ± 0.04 and 0.175 ± 0.01 mm, respectively. The mean body length, width, antennal length and cornicle length of adult aphid were 1.68 ± 0.06 , 0.71 ± 1.53 , 0.88 ± 0.02 and 0.266 ± 0.01 mm, respectively. The mean duration of first, second, third and fourth instar nymphs were 1.30 ± 0.42 , 2.05 ± 0.62 , 2.40 ± 0.52 and 1.45 ± 0.45 days, respectively. The total nymphal duration was 7.75 ± 1.61 days. The mean longevity of adult aphid was 9.65 ± 1.75 days with an entire life span of 17.75 ± 2.91 days. The pre-reproductive, reproductive and post-reproductive periods were 1.35 ± 0.56 , 7.20 ± 1.47 and 1.75 ± 0.71 days, respectively. The fecundity of the adult female was 24.45 ± 6.21 nymphs per female and the intrinsic rate of single female was an average of 4.80 ± 2.01 nymphs/day.

Keywords: *Cuminum cyminum*, GC 4, *Aphis gossypii*, biology, morphometric observations

Cumin (*Cuminum cyminum* L.) is an important seed spice crop that belongs to family Apiaceae, which is commonly known as "Jeera or Zeera". Cumin is the most popular aromatic and herbaceous plant having medicinal, pharmaceutical and nutraceutical properties (Allaq *et al.*, 2020). India is the largest producer and consumer of cumin in the world, it occupies an area of 12.76 lakh hectares with annual

production of 9.12 lakh tonnes with average productivity of 715 kg/ha (Anonymous, 2020). Rajasthan and Gujarat are the major cumin growing states and both the states together account for more than 95 per cent of the total cumin production in the country. In Rajasthan, cumin is cultivated in an area of 7.79 lakh hectares with an annual production of 4.28 lakh tonnes and the average productivity of 549

kg/ha (Anonymous, 2020). Cumin is very sensitive to various abiotic and biotic factors viz., insect pests, diseases, and the weather conditions, which affect the development of crop. The crop is infested by many insect pests viz., aphids, *Aphis gossypii* Glover and *Myzus persicae* Sulzer; thrips, *Thrips tabaci* Lindeman, *Scirtothrips dorsalis* Hood and *Frankliniella schultzei* Trybom; leafminer, *Empoasca* sp., seed bug, *Nysius* spp.; and whitefly, *Bemisia tabaci* Gennadius. The insects like red cotton bug, *Dysdercus koenigii* Fab., sting bug, *Nezara viridula* L., termite, *Odontotermes obesus* Rambur, seed borer, *Hellula undalis* Fabricius, grasshopper, *Acrida* sp. and tobacco caterpillar, *Spodoptera litura* Fab were reported as minor and occasional pests, respectively of cumin crop. Among the insect pests, aphid is the major insect pest of cumin in Rajasthan (Meena *et al.*, 2018; Yadav *et al.*, 2018). Both nymphs and adults of aphid cause damage to the crop by sucking the cell sap from leaves, tender stems, inflorescences, and developing grains and also by secreting honey dew. Due to their rapid multiplication within a few days, the aphids cover the entire surface of the apical shoots and feeding by large population can cause the leaves to turn yellow, curling and subsequent drying of leaves takes place resulting in poor and shriveled seed formation. In unprotected crop, loss due to aphid infestation could be more than 50 per cent of total yield (Lal *et al.*, 2014). The knowledge about the biology of the pest is necessary for planning a suitable management

schedule for the pest. The present work was planned to study the of biology of predominant species of aphid, *A. gossypii* infesting cumin, under laboratory conditions, to develop timely, economical and environmentally safe pest management approaches.

The experiment on biology of aphid, *A. gossypii* was conducted in the Entomology Laboratory, Agricultural Research Station, Mandor, Jodhpur. It was carried out under ambient conditions of temperature and relative humidity on potted plants of cumin variety GC-4. Initial culture of aphid was collected from the cumin plants grown at Research Farm, Agricultural Research Station, Mandor, Jodhpur, thereafter, to maintain a pure culture, the aphids were maintained on cumin plants grown in pots of size 6 inches (Fig. 1). To study the different aspects of its biology, the aphids was collected from the pure culture maintained in potted plants and reared individually in potted plants grown in jars of size 250 ml (Fig. 2). The observations on different parameters viz., duration of different nymphal instars, total nymphal period, adult longevity, pre-reproductive period, reproductive period, post-reproductive period, fecundity, intrinsic rate and total life span were recorded. Morphometric observations viz., body length and width, antennal length and cornical length of different instars and adult were also recorded with the help of stereo-zoom binocular microscope (Model: ASZM-1) using the Axio-vision 2.8 software.



Fig. 1. Maintenance of aphid, *A. gossypii* pure culture on potted cumin plants



Fig. 2. Rearing techniques of aphid, *A. gossypii* on potted cumin plants

The first nymphal instar was delicate, transparent, oval in shape, dorsally convex, greenish-brown in color with three pairs of legs. The antennae were five segmented, which was fairly long, setaceous but shorter than the body length. The compound eyes were small, just behind the base of antennae and blackish. The thoracic legs were well developed and uniformly covered with thin hairs. A pair of small blackish coloured cornicles was visible laterally near the tip of the abdomen (Fig.3). The duration of first

nymphal instar was 1 to 2 days (Table 1). The second nymphal instar was oval and greenish-brown to dark green in colour. Compound eyes were similar to the first instar both in colour and shape (Fig.3). The cornicles were quite distinct and cylindrical. The duration of second nymphal instar was 1 to 3 days (Table 1). The colour of third nymphal instar was more or less similar to that of the second instar nymph, but differed in its comparative size (Fig.3). The compound eyes were round, little larger than the second instar and brownish. The duration of third nymphal instar was 2 to 3 days. Fourth nymphal instar was dark green to blackish in colour and somewhat elongated in shape. The nymph was very active and moved rapidly when disturbed. The compound eyes were larger and reddish black. The cornicles were distinctly visible to the naked eyes (Fig.3). The duration of fourth nymphal instar was 1 to 2 days and total nymphal period varied from 5 to 10 days (Table 1). Same number of nymphal instars of aphid, *Aphis gossypii* were noticed by Patil & Patel (2013); Ranila *et al.* (2013); Vadher & Acharya (2022) on isabgol, coriander and cumin crop, respectively. Ghetiya (1992) reported that the total nymphal duration of aphid, *A. gossypii* was 6.58 ± 1.08 days on coriander crop. The present findings are in support of Vadher & Acharya (2022) who found that the average period of first, second, third and fourth nymphal instars were in the range of 1.44 ± 0.50 , 2.20 ± 0.65 , 2.50 ± 0.51 and 1.50 ± 0.51 days, respectively. Similarly, the size and shape of different instars of aphid, *A. gossypii* are found in support of the results of Ranila *et al.* (2013); Vadher & Acharya (2022).

Table 1. Biological parameters of nymphal instars and adult, *Aphis gossypii* in cumin

Stage	Biological parameter	Range	*Mean \pm S.D.
Nymph	First instar (Days)	1-2	1.30 \pm 0.42
	Second instar (Days)	1-3	2.05 \pm 0.62
	Third instar (Days)	2-3	2.40 \pm 0.52
	Fourth instar (Days)	1-2	1.45 \pm 0.45
	Total nymphal period (Days)	5-10	7.75 \pm 1.61
	Pre-reproductive period (Days)	1-2	1.35 \pm 0.56
	Reproductive period (Days)	5-10	7.20 \pm 1.47
Adult	Post-reproductive period (Days)	1-3	1.75 \pm 0.71
	Adult longevity (Days)	7-12	9.65 \pm 1.75
	Fecundity (Number of nymphs/female)	12-32	24.45 \pm 6.21
	Intrinsic rate (Number of nymphs/ female/day)	1-8	4.80 \pm 2.01
	Total life span (Days)	12-22	17.75 \pm 2.91

*Mean of 20 observations

**Fig. 3.** Larval stages and adult of *Aphis gossypii*

Adult was dark green to blackish in colour with a somewhat pear-shaped elongated pyriform body (Fig.3). The antennae of adult composed of six segments and were shorter than body length. Body length of adult varied from 1.6 to 1.8 mm and the body width varied from 0.65 to 0.78 mm. The antennal length varied from 0.86 to 0.92 mm while the cornicle length varied from 0.26 to 0.27 mm (Table 2). Similarly, Patil & Patel (2013) reported that the average body length and width of adult aphid *A. gossypii* were

1.68 \pm 0.02 and 0.89 \pm 0.01 mm, respectively in isabgol crop. The present findings are more or less similar to earlier workers (Ranila *et al.*, 2013; Vadher & Acharya, 2022) who reported body length and width of adult aphid, *A. gossypii* were 1.10 \pm 0.09 and 0.60 \pm 0.02 and 1.38 \pm 0.05 and 0.69 \pm 0.03 mm when it was reared on coriander and cumin crop, respectively. Similarly, Ranila *et al.* (2013) and Vadher & Acharya (2022) reported that antennal and cornicle length adult aphid, *A. gossypii* were 1.12

± 0.03 and 0.27 ± 0.01 and 0.68 ± 0.05 and 0.18 ± 0.03 mm, respectively. Adult aphid lived up to 7 to 12 days. The entire life span varied from 12 to 22 days. Lamy (2016) reported that the average longevity of *Aphis gossypii* in four cultivars of *Cucurbita pepo* (Lebanese, Arab marrow, Alma and Caserta) were 20.30 ± 0.73 , 19.57 ± 0.71 , 19.86 ± 0.23 and 17.70 ± 0.41 days, respectively. Similarly, Vadher & Acharya (2022) also reported that the average longevity of an adult aphid, *A. gossypii* was 10.09 ± 1.30 days and total life span of 17.72 ± 1.45 days in cumin. Pre-reproductive, reproductive and post-reproductive periods varied from 1 to 2, 5 to 10

and 1 to 3 days, respectively. Young ones produced by a single female per day ranged from 1 to 8 nymphs. Number of young ones produced by a single female throughout its entire reproductive period varied from 12 to 32 nymphs (Table 2). Saha et al. (2016) reported that the average reproductive period of cotton aphid, *Aphis gossypii* was 5.4 to 7.8 days on cotton plants and 8.6 to 11.2 days on egg plants. Vadher & Acharya (2022) found that the average pre-reproductive, reproductive and post-reproductive periods of *A. gossypii* were 1.31 ± 0.47 , 7.04 ± 1.13 and 1.72 ± 0.70 days, respectively in cumin.

Table 2. Morphometrical data of nymphal instars and adult of aphid, *Aphis gossypii* in cumin

Stage	Body length (mm)		Body width (mm)		Antennal length (mm)		Cornicle length (mm)	
	Range	*Mean \pm S.D.	Range	*Mean \pm S.D.	Range	*Mean \pm S.D.	Range	*Mean \pm S.D.
First instar	0.43-0.60	0.50 ± 0.04	0.22-0.32	0.28 ± 0.03	0.24-0.31	0.28 ± 0.02	0.03-0.04	0.036 ± 0.01
Second instar	0.80-0.99	0.90 ± 0.04	0.31-0.44	0.38 ± 0.04	0.38-0.47	0.40 ± 0.03	0.06-0.07	0.065 ± 0.01
Third instar	1.00-1.20	1.11 ± 0.05	0.42-0.55	0.49 ± 0.04	0.50-0.57	0.54 ± 0.03	0.09-0.10	0.095 ± 0.01
Fourth instar	1.20-1.40	1.31 ± 0.06	0.56-0.71	0.65 ± 0.05	0.60-0.69	0.64 ± 0.04	0.17-0.18	0.175 ± 0.01
Adult	1.60-1.80	1.68 ± 0.06	0.65-0.78	0.71 ± 1.53	0.86-0.92	0.88 ± 0.02	0.26-0.27	0.266 ± 0.01

*Mean of 20 observations

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