Journal of Entomology and Zoology Studies

Available online at www.entomoljournal.com

E-ISSN: 2320-7078
P-ISSN: 2349-6800
www.entomoljournal.com
JEZS 2017; 5(5): 2032-2035

Received: 15-07-2017
Accepted: 12-08-2017

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Biology of aphid, *Myzus persicae* (Sulzer) [Homoptera: Aphididae] on cumin (*Cuminum cyminum* L.) under net-house condition

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DOI: https://doi.org/10.22271/j.ento.2017.v5.i5z.9438

Abstract
An experiment was conducted under net house condition to study the biology of aphid, *Myzus persicae* (Sulzer) [Homoptera: Aphididae] on cumin (*Cuminum cyminum* L.) during January, 2016 to February, 2016. It was indicative from the studies on biology of *M. persicae* on cumin that the average first, second, third and fourth instar nymphal period were 1.68 ± 0.58, 1.84 ± 0.62, 1.56 ± 0.8 and 1.48 ± 0.51 days, respectively. The total nymphal period was varied from 4 to 13 days with an average of 6.56 ± 1.29 days. The pre-reproduction, reproductive and post reproductive periods of M. *persicae* on cumin were 1.48 ± 0.51, 5.16 ± 1.46 and 1.72 ± 0.61 days, respectively. The female aphid throughout its entire reproductive period produced 18.52 ± 4.27 nymphs at the rate of 4.00 ± 2.23 nymphs/day. The longevity of adult and entire life period was 8.36 ± 1.82 and 14.92 ± 2.00 days, respectively on cumin. During the study period, the average minimum temperature, maximum temperature and relative humidity were recorded as 14.2 ˚C and 26.95 ˚C and 59.77 per cent, respectively. The aphid passed two stages *i.e.*, nymph and adult during entire life cycle.

Keywords: Aphid, *Myzus persicae*, Cumin, *Cuminum cyminum*, biology, nymph

Introduction
Cumin (*Cuminum cyminum* Linnaeus) belongs to family *Umbelliferae*. The cumin is also known as *Jiru* or *Jeeru* in Gujarati; *Safaid jira* or *Zeera* in Bengali; *Jira, Jeera, Zira* or *Safaid jeera* or *Zeera* in Hindi; in Kanada; *Zyur* in Kashmiri; *Jeerakam* in Malayalam; *Jeregire* in Marathi; *Jira* or *Jeera* in Oriya; *Zero* in Sindhi; *Jiraka*, *Jira* in Sanskrit; *Ziragum* or *Jeeragam* in Tamil and *Jidakara*, *Jikaka* in Telugu (Das, 2014) [3]. Cumin is said to be the native of Egypt and its cultivation has now spread over many tropical and sub-tropical regions of the world. The chief countries growing this crop are India, China, Morocco, Sicily, Persia, Arabia, Egypt and Jawa. In India, cumin is cultivated from very ancient times. It is grown in almost all the states except, West Bengal and Assam. Its extensive cultivation is confined to states of Rajasthan and Gujarat. In Gujarat, Ahmedabad (17,370 ha and 8,109 MT production), Banaskantha (32,000 ha and 28,800MT production), Mehsana (18,000 ha and 12,600 MT production), Sabarkantha (5950 ha and 2380 MT production) and Surendranagar (58,900 ha and 44,175 MT production) are the principle cumin growing districts (Anonymous, 2015) [2].
The insects are one of the limiting factors for higher production of good quality seeds. Aphid, thrips, cutworm, tobacco caterpillar and root-knot nematode are attacking the cumin crop in field, while cigarette beetle & drugstore beetle are attacking in storage under Indian condition. Among the pest infesting the cumin crop, aphid**,** *Myzus persicae* (Sulzer) is reported as a serious pest of cumin (Agrawal *et al.*, 2001) [1]. *M. persicae* belongs to order Homoptera and family Aphididae of class Insecta, which reproduces parthenogenetically and gives the birth to young ones. Aphid passes through two stages *i.e.*, nymph and adult during entire life cycle. Owning to high rate of reproduction of this pest and continuous desapping of the flower, the grain formation is very much reduced. In case of severely infested umbels, the seeds are not set at all or poorly developed which fail to add flavor in vegetable preparation and other consumable products. Secondly, they excrete honeydew like substance. The excessive excretions of honeydew by the aphids lead to growth of black sooty mould on the leaves which

inhibit the photosynthetic activity of the plants. Thus, it is posing a threat to cumin cultivation under Gujarat conditions. To frame out management strategy for any pest one should have information about biology and number of generations in a season. Keeping in view these facts, the present study was carried out at the laboratory of Department of Entomology, B. A. College of Agriculture, Anand Agricultural University Anand, Anand – 388 110 (Gujarat).

Materials and Methods

The biology of *M. persicae* was carried out on Gujarat cumin - 4 variety of cumin in the net house condition from January, 2016 to February, 2016. During the study periods, the minimum and maximum temperature and average relative humidity was recorded as 6.5 ˚C and 31.5 ˚C and 64.79 per cent, respectively. The changes of instar were recorded based on the presence of exuviae casted by the nymph. Observations were also recorded on morphological characters, number of nymphs laid daily by individual aphid and date of death. Number of nymphal instars, duration of each nymphal instar, total nymphal period and pre-reproductive, reproductive and post-reproductive period, total life period, longevity and fecundity of adult were worked out from above observations.

Biology of aphid, *M. persicae* on cumin

The cumin plants were individually covered with a glass chimney (16 x 7 cm). The top end of the chimney was covered with black muslin cloth. Newly produced nymphs were transferred separately on each potted plant. Such 25 sets were arranged for the study and it was observed daily with the help of magnifying lens and binocular microscope.

Nymph

Nymphs were observed under magnifying lens for moulting on plant and binocular microscope for colour and morphological characters till they reach adult stage. Total nymphal period was calculated on the basis of birth of first instar to the end of fourth instar. The moulting was confirmed by the presence of exuviae on the plant or on the posterior end of the nymphs. The numbers of nymphs laid per female were also observed.

Adult

After fourth moulting, the nymph attained to adult stage. In order to study the adult longevity on cumin, the newly developed adults were reared individually in potted plant. Thus, longevity of adult, entire life span, pre-reproductive, reproductive and post-reproductive period and fecundity were worked out. A period between date of attaining the adult stage and date of laying young ones for the first time was considered as pre- reproduction period. The period during which adult laid young ones was considered as reproduction period. The reproduction rate (Number of nymphs/day/female) was also worked out. The adult period in which it stops reproduction to its death was considered as post reproduction period. The longevity period of adult was calculated from the date of attaining the adult stage to the death of adult. The reproductive potential of female adult aphid was recorded by counting the number of individuals produced by each adult aphid during its reproduction period. It is the entire life period starting from birth of young ones to death of adult.

Results and Discussion

Investigation on the biology of aphid, *M. persicae* was carried out in the net house of Department of Agricultural Entomology, B. A. College of Agriculture, Anand Agricultural University, Anand during the January to February 2016. The results are given hereunder different subheads.

Nymph

Different stages of nymph were studied with the help of binocular microscope for their external features. Twenty-five nymphs were observed to work out duration of different instars, total nymphal period and adult period.

First instar

The nymph of first instar was wingless, delicate, transparent, oval in shape and greenish yellow in colour. A pair of cornicles was visible laterally near the tip of abdomen. The antennae were five segmented, fairly long, setaceous and conspicuous. These were longer than the body width and shorter than the body length. The compound eyes were small, just behind the base of antennae and blackish in colour. The legs were well developed and found uniformly covered with thin hairs. The results revealed that the first instar nymphal period was varied from 1 to 3 days with an average of 1.68 ± 0.58 days (Table 1). Jid (2011) [4] reported the first instar nymphal period of *M. persicae* was varied from 1 to 2 days with an average of 1.64 ± 0.52 days on cumin at Sardarkrushinagar (Gujarat). Kathrotia (1995) [5] reported the first instar nymphal period of *A. gossypii* as 1.67 ± 0.47 days on cumin at Junagadh (Gujarat).

Second instar

The second instar nymph was bigger than the first instar and also different in appearance. It was greenish yellow in colour with cornicles visible easily. The data indicated that the second instar nymphal period varied from 1 to 3 days with an average of 1.84 ± 0.62 days (Table 1). Jid (2011) [4] reported the second instar nymphal period of *M. persicae* varied from 1 to 3 days with an average of 1.81 ± 0.58 days on cumin at Sardarkrushinagar (Gujarat). Kathrotia (1995) [5] reported the second instar nymphal period of *A. gossypii* as 1.83 ± 0.64 days on cumin at Junagadh (Gujarat).

Table 1: Duration of different nymphal instars of aphid, *M. persicae* under net house condition

Particulars	Duration in day(s)		
	Minimum	Maximum	Mean ± S.D.
Nymph			
I Instar	1	3	1.68 ± 0.58
II Instar	1	3	1.84 ± 0.62
III Instar	1	4	1.56 ± 0.8
IV Instar	1	3	1.48 ± 0.51
Total nymphal period	4	13	6.56 ± 1.29
Adult			
Pre – reproductive period	1.00	2.00	1.48 ± 0.51
Reproductive period	3.00	7.00	5.16 ± 1.46
Post – reproductive period	1.00	3.00	1.72 ± 0.61
Total adult period	5.00	12.00	8.36 ± 1.82
Birth rate (nymphs/day)	1	8	4.00 ± 2.23
Total nymphs laid/female	10	28	18.52 ± 4.27
Total Longevity			
Nymph	4.00	13.00	6.56 ± 1.29
Adult	5.00	12.00	8.36 ± 1.82
Total duration	9.00	25.00	14.92 ± 2.00

Third instar

The colour remained more or less similar to that of second instar nymph but it was comparatively bigger in size than second instar nymph. The compound eyes were round, little bigger than the second instar and brownish in colour. The results indicated that the third instar nymphal period was from 1 to 4 days with an average of 1.56 ± 0.8 days (Table1). The third instar nymphal period of *M. persicae* was varied from 1 to 2 days with an average of 1.74 ± 0.66 days on cumin at Sardarkrushinagar, Gujarat as reported by Jid (2011) [4]. Kathrotia (1995) [5] stated that the third instar nymphal period of *A. gossypii* was 1.774 ± 0.717 days on cumin at Junagadh (Gujarat).

Fourth instar

Fourth instars nymph was dark yellow in colour and elongated in shape. The nymph was very active and moved rapidly, when disturbed. The compound eyes were enlarged and reddish black in colour. The cornicles were clearly visible with naked eyes. The result presented in Table 1 revealed that the fourth instar nymphal period was varied from 1 to 3 days with an average of 1.48 ± 0.51 days. Jid (2011) [4] reported the fourth instar nymphal period of *M. persicae* varied from 1 to 2 days with an average 1.55 ± 0.52 days on cumin at Sardarkrushinagar (Gujarat) which is in accordance with the present observation. Kathrotia (1995) [5] reported the fourth instar nymphal period of *A. gossypii* as 1.56 ± 0.51 days on cumin at Junagadh (Gujarat).

Total nymphal period

The nymphal period was considered from birth of the nymph to the end of the fourth instar. The results showed that the total nymphal period was varied from 4 to 13 days with an average of 6.56 ± 1.29 days (Table 1). The average nymphal periods of *M. persicae* were 11.57 ± 0.12, 11.90 ± 0.30 and 12.52 ± 0.39 days on brinjal, potato and tomato, respectively at Meerut, Uttar Pradesh (Khajuria *et al.*, 2008) [6] it was ranged from 4 to 9 days with an average of 6.53 ± 1.02 days on cumin at Sardarkrushinagar, Gujarat (Jid, 2011) [4] and 4 to 5 days on *Beta vulgaris* var. *cicla* (L) at Mayabeque, Cuba (Leticia *et al*,. 2011) [7].

Adult

It was observed that adult was yellowish green to yellow in colour and polymorphic in nature with somewhat pear shaped elongated pyriform body. The apterate (wingless) and alate (winged) forms of adult were observed. The alate form of adult was similar to apterate adult except the presence of wings. Wings were transparent with black veins. Alate adult was comparatively smaller in size than that of apterate adult. The antennae were six segmented and shorter than the body length. The compound eyes were bulging and reddish in colour; legs were rather stout, long and covered with hairs. The third pair of legs was longer than the first and second one. The abdomen was yellowish and bulged. The cornicles were prominent long tubes and dark brown to black in colour. The cauda was paler than the siphunculi and usually with six or more than six hairs.

Pre-reproduction, reproduction and post-reproduction period

The results revealed that the pre-reproduction period was varied from 1.00 to 2.00 days with an average of 1.48 ± 0.51 days. The aphid was observed to reproduce for a period of 3 to 7 days with an average of 5.16 ± 1.46 days under net house condition. The post-reproduction period was ranged between 1 to 3 days with an average of 1.72 ± 0.61 days. The total adult period was 5 to 12 days with an average of 8.36 ± 1.82 days (Table 1). According to Meena (1993) [8], the average duration of pre-reproductive period, reproductive period and post reproductive period of *M. persicae* on cumin was 2.72, 14.10 and 5.45 days, respectively at Bikaner (Rajasthan), while it was 1.71 ± 0.70, 5.13 ± 1.83 and 1.84 ± 0.67 days, respectively on cumin at Sardarkrushinagar, Gujarat (Jid, 2011) [4].

Rate of reproduction and reproduction capacity

The mother aphid was found to withhold the newly born nymph in protruded gonopore until the legs of new nymph are spread out and capable of movements. The reproductive capacity of each female was determined by recording number of nymphs laid per day and during its entire life span. The data indicated that the rate of reproduction and reproductive capacity (fecundity) of *M. persicae.* The results revealed that the rate of reproduction varied from 1 to 8 with an average of 4.00 ± 2.23 nymphs/day. The results further revealed that the number of young ones produced by female aphids (reproductive capacity fecundity) throughout its entire reproductive period varied from 10 to 28 with an average of 18.52 ± 4.27 nymphs per female (Table 1). As per the report of Meena (1993) [8], *M. persicae* produced 22.30 young ones during its entire life span on cumin at Bikaner (Rajasthan), while it as 79.74 ± 2.76 on tomato, 70.44 ± 1.30 on brinjal and 66.68 ± 1.77 days on potato at Meerut, Uttar Pradesh (Khajuria *et al.*, 2008) [6]. It ranged from 11 to 24 nymph/female with an average of 17.76 ± 6.48 on cumin at Sardarkrushinagar, Gujarat (Jid, 2011) [4] and 3 to 4 individuals per day on *Beta vulgaris var.* cicla (L) at Mayabeque, Cuba (Leticia *et al*., 2011) [7].

Adult longevity

The result presented in Table 1 indicated that the longevity of adult was ranged from 5 to 12 days with an average of 8.36 ± 1.82 days. Jid (2011) [4] reported the average longevity of adult as 8.68 ± 1.86 days on cumin at Sardarkrushinagar (Gujarat), while it as 16.3 days *on Beta vulgaris* var. *cicla* (L) at Mayabeque, Cuba (Leticia *et al*., 2011) [7].

Entire life span

The data on entire life span presented in Table 1 indicated that the entire life span (birth to death of individual) of cumin aphid 9 to 25 days with an average of 14.92 ± 2.00 days. Khajuria *et al.* (2008) [6] reported the total life span of *M. persicae* on brinjal, potato and tomato was completed in 36.55 ± 1.10, 42.60±2.00, and 44.90 ± 1.24 days, respectively at Meerut (Uttar Pradesh), while it was 14.86 ± 2.11 days on cumin at Sardarkrushinagar, Gujarat (Jid, 2011) [4] and it was 20.6 days on *Beta vulgaris* var. *cicla* (L) at Mayabeque, Cuba (Leticia *et al*., 2011) [7].

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