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Biology of green apple aphid, *Aphis pomi* De Geer on high density apple plantations in Kashmir province of J&K UT, India

[1] Rehana Akbar, [2]Sajad Mohi-ud-din, [1]Mohd Ayoub Mantoo, [1]Mudasir Gani, [3]Nazir Ahmad Ganaie, [4]Fehim Jeelani Wani and Khalid Rasool Dar

[1]Division of Entomology Sher-e-Kashmir University of Agricultural Sciences and Technology of Kashmir, J & K, India
[2]KVK, Srinagar Sher-e-Kashmir University of Agricultural Sciences and Technology of Kashmir, J &K, India
[3]Division of Horticulture, Sher-e-Kashmir University of Agricultural Sciences and Technology of Kashmir, J &K, India
[4]Division of Statistics, Sher-e-Kashmir University of Agricultural Sciences and Technology of Kashmir, J &K, India

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ABSTRACT

As *Aphis pomi* is one of the important and emerging pest especially on apple plants from past few years as its huge incidence has attracted the attention of research workers across the globe especially in apple growing regions. Currently the most important constraint for apple producers is that its management becomes difficult due to resurgence problems and also their high fecundity rate, complex life cycle. So our motive to study biology of *Aphis pomi* is to find a better management strategy as biological study of insect is one of the key factor for its management. In the present study the biological parameters evaluated were duration and survival% of nymphal instars, daily and total fecundity and adult longevity by various methods under laboratory conditions. Also the data on pre-oviposition, oviposition and post-oviposition was recorded. We found that duration of total nymphal period, pre-ovipositional period, ovipositional period, post ovipositional period and total life period varied from 13.5-15.5(14.52±0.070), 10.3-12.5(14.52±0.07), 10-20(13.4±0.65), 2.0-3.0(2.4±0.17), and 22-35(30.28±1.51) days respectively. The morphometric were also studied during the period of nymphal development till adults. The morphometric analysis showed gradual developmental variations from first instar to adult stage in size, shape, colour and number of characters.

Key words: *Apple, Aphis pomi, Biological cycle, Fecundity*

Introduction

Apple (*Malus×domestica* Borkh) is one of the most economically important fruit crops of the temperate zones of the world (Harris *et al*., 2002). It belongs to family Rosacea and is grown in temperate and sub-tropical regions of the world. In india apple is grown in Jammu and Kashmir, hills of Utter Pradesh, Tamil-Nadu, Himachal Pradesh, Nagaland, Meghalaya Sikkim and Manipur. The Jammu and Kashmir UT is a home of temperate fruits and apple is the major fruit crop of Jammu and Kashmir as its production is one of the important sources of economy in J&K. Apple plants are

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attacked by a number of insect pests. Among these green apple aphid *Aphis pomi* (Hemiptera: Aphididae) is considered a pest damaging apple plants severely from past few years as it inhabits the leaves and green shoots where it feeds and causes different morphological and physiological changes. Apple aphids damage plants as a result of feeding, both directly by ingesting plant juices and indirectly by spreading plant viruses. DeGeer initially mentioned the aphis pomi in 1773, coming from Sweden. This insect attacks apple trees all year long, which is a problem for apple growers because it causes significant losses in nurseries and orchards. The enormous fecundity, brief lifespan, and parthenogenetic reproduction of aphids are well known characteristics. The life cycle is quite intricate and involves the passing of generations. According to the local environmental conditions, aphid have modified their life cycle to fit various geographic places.. However, despite the fact that many studies on the biology of aphids have been conducted in the past, including those by Baker and Tuner (1916) in North America and Gautum and Kumari (2004) in Shimla and Jammu Gupta and Tara (2015) the Kashmir province of J&K UT lacks detailed knowledge on the biology of this pest. Since effective and environmentally friendly pest management solutions are always based on life cycle studies of the insect, understanding the biology of aphids is crucial for their management. This was taken into consideration when doing the research in order to learn more about the biology of the *Aphis pomi*.

Materials and Methods

Aphis pomi is economically important and widely distributed pest of apple plantations in Jammu and Kashmir. The present investigation on biology of Aphis pomi was carried out during 2021 under the laboratory conditions in the division of Entomology FoA, Wadura Skuast K. The detailed procedure and methods adopted are presented here under:

Maintenance of stock culture: Aphids from the infested apple cultivars were collected from the apple orchards. The initial culture was maintained on small potted apple plants of variety Red delicious inside green house. The Aphids were transferred on the uninfested apple plant maintained in the pots inside green house. Rearing of aphids: Apple leaves were collected from un-infested apple cultivars and were placed on petri-plates. The leaves were kept fresh by placing water soaked cotton around the stem or the filter paper soaked in water was placed at the bottom of the plate before placing apple leaves. After that four adult apterous parthenogenetic viviparous females were taken from the stock culture and were placed on the leaves. The leaves were replaced every 2-3 days. Plates were observed daily for presence of off-springs when the off-springs start emerging the adults and others were removed and only one to two nymphs per plate were kept and observed daily basis. The observations for following parameters were recorded daily.

Duration (days) and survival of nymphal stages

Duration of each nymphal stage were examined by counting number of days between two moults with the help of microscope by looking the exuvia that had been shed by the nymphs and the survival percentage of each stage was recorded daily by counting number of live aphids in each instar.

Daily and total fecundity

These parameters were recorded daily after the final moulting, as the insect becomes adult, the adult females were transferred on new leaves. As they start giving birth, the number of off-springs produced were recorded daily and discarded until the death of adult.

Adult longevity

Adult longevity was recorded from last moulting until death

Results

The experiment entitled biology of aphis pomi was carried out under laboratory conditions in the division of Entomology, FoA, SKUAST-K and the results obatained from the present study are presented.

Developmental period: The results obtained from the present study showed that Aphis pomi undergoes four moults,

Duration of nymphal Instars: During the present investigation under laboratory conditions the duration of 1st, 2nd, 3rd and 4th instar nymphs were 3.5-4.0 (3.36±0.12), 2.5-3.0 (2.68±0.13), 2.0-3.0 (2.56±0.13) and 2.5-4.0 (3.36±0.14) respectively. The duration of the period between the final moult and starting of ovi-position ranged from 2.5-3.0 (2.56±0.17) days. The total nymphal period ranged from 13.5-15.5 (14.52±0.070) days. The survival rate of 1st, 2nd, 3rd

Table 1. Duration of nymphal stages of *Aphis pomi* on apple plants under laboratory conditions

Stages	Duration of nymphal instars (in days)				Total nympal period	Period between final moult to pre oviposition	Total pre-ovipositional
	I instar	II instar	III instar	IV instar			
Mean±SE	3.36±0.14	2.56±0.13	2.68±0.13	3.36±0.12	11.96 ±0.07	2.56±0.17	14.52±0.07
Range	2.5-4.0	2.0-3.0	2.5-3.0	3.5-4.0	10.3-12.5	2.5-3.0	13.5-15.5

and 4th instar nymphs were 76.7±1.67, 70.2±1.59, 63.6±2.07 and 57.5±2.43 respectively which was recorded daily by counting number of live aphids in each instar. The adult female started giving young-ones after 1-2 days of last moulting. As the aphids reproduce rapidly due to parthenogenetic and viviparous reproduction. The female adult laid 40-70 (63.4±1.58) young-ones during the entire ovipositional period. The average fecundity rate per female per day varied from 5-9 (6.00±0.44) nymphs. The longevity of adult aphid recorded from last moult till death ranged from 10-15 (14.57±2.57) days. The Pre- oviposition period of *Aphis pomi* ranged from 10.3-12.5 (14.52±0.07) days, while as oviposition period ranged from 10-20 (13.4±0.65) days and post-oviposition period ranged from 2.0-3.0 (2.4±0.17) days. Total life period during this experiment was recorded from the date of birth of nymph till death of adult which is ranged from 22-35 (30.28±1.51) days.

Table 2. Survival percentage of different developmental stages of *Aphis pomi* under laboratory conditions.

Stages	Survival %
I instar	76.7±1.67
II instar	70.2±1.59
III instar	63.6±2.07
IV instar	57.5±2.43

Discussion

On apple plants, which serve as its host, Aphis pomi De Geer is monoecious. The life cycle of this aphid is holocyclic throughout North America and Europe (Blackman and Eastop 2000). Our investigation will be compared to the in-depth studies on the biology of aphis pomi that Baker and Turner (1916) and Kumari and Gautam (2007) reported from North America and Himachal Pradesh respectively. Our findings demonstrate parthenogenetic reproduction in apterous adult females.The nymphal development normally completed in four instars as also reported by (Baker, 1916). In the present study the duration of nymphal instars varied significantly as the duration of first instar and 4th instar was considerably longer than 2nd and 3rd instar. These findings are in accordance with Kumari and Gautam (2007) who reported the same duration of nymphal instars while as the findings are in contradiction with Gautam and Verma (1983) who observed equal duration for all the instars. The survival rate was also checked during the study among the instars and the results showed that maximum survival rate was found in Ist instar followed by 2nd , 3rd and minimum in 4th instar and the overall rate of survival declined with each development stage. The reason behind this may be environmental conditions or it may be the host prefrence. The average pre-ovipostion, oviposition and post-oviposition period of aphis pomi

Table 3. Ovipositional- period, post- Ovipositional period, daily and total fecundity and adult longevity of *Aphis pomi* under laboratory condition.

Particulars	Range (In Days)		Mean ±SE (in days)
	Minimum	Maximum	
Ovipositional period	10	20	13.4±0.65
Post Ovipositional period	2.0	3.0	2.4±0.17
Daily fecundity	5	9	6.00±0.44
Total fecundity	40	77	63.4±1.58
Adult longevity	10	15	14.57±2.57
Total life cycle	25	38	30.28±1.51

are 14.52±0.07, 13.4±0.65 and 2.4±0.17 respectively. The ovi-position period starts with the laying of youngones and the progeny produced by adult female varied from 40-70(63.4±1.58) (Table 3). High no. of nymphs laid in a day averaged 6.00±0.44 from a minimum of 5 and maximum of 9. According to studies which are in line with the present study by Gupta and tara 2015 revealed that the average no. of nymphs laid by Aphis pomi is 5.00±0.39 from a min of 4 and maximum of 7, also reported by Baker and Turner 1916 that average reproduction may vary according to season. The present study carried out in Kashmir province on green apple aphid taken as average of 30.53±1.30 days to complete one life cycle on apple plants as host thus our results also fall in accordance to earlier workers such as Tara and Gupta 2015 reported average total duration of life cycle of this pest as 31.22 days while as Baker and Turner (1916) as 30.9 days and Gautam and Kumar (2004) reported 24.15-42.35 days in HP. During the present investigation only apterous morphs were examined but winged morphs also exist in the area of study, consequently a thorough investigation on the biology of this pest is required to reduce its incidence as it may help to identify an effective and eco-friendly management strategy

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