



POPULATION DYNAMICS OF APHIS GOSSYPHII GLOVER AND ITS NATURAL ENEMIES ON GOURD PLANT

JaharLalSaha¹, Tania Chatterjee² and KoyelChakraborty³

¹Department of Zoology, Women's College, Agartala 799001.

²Department of Zoology, Vidyasagar College, Sector - 2, CL Block, Salt Lake City, Kolkata - 700091, India

³Department of Zoology, Bidhannagar Govt. College, EB- 2, Sector 1, Saltlake, Kolkata-700064

ARTICLE INFO	ABSTRACT
Received 15th, July, 2016, Received in revised form 18 th, August, 2016, Accepted 16th, September, 2016, Published online 28th, October, 2016	<i>Aphis gossypii</i> Glover is the common aphid which infests the gourd plant right from its early stage. Present communication reports the population trends of this aphid species on the plant along with their natural enemies, particularly, predators and parasites. Simple correlation coefficient between aphid and abiotic factors like average temperature, relative humidity and rainfall showed negative correlations ($r = - 0.4$; $r = - 0.55$; and $r = - 0.4$ respectively) and between aphid and biotic factors (predators and mummified aphids) showed strong positive correlations ($r = 0.89$ and $r = 0.79$). Maximum percentage of predators and mummified aphid have been recorded as 1.13% and 32.53% respectively. Seven species of predators and two species of parasites were found during the observation period from this aphid colony in gourd plant (<i>Lagenaria siceria</i>).
Keywords: <i>Aphis gossypii</i> , gourd plant, population trends, predator and parasite.	
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INTRODUCTION

Aphis gossypii Glover is a cosmopolitan aphid species and is well known for its extreme polyphagism, polymorphism and uninterrupted parthenogenetic breeding at least in tropical areas from several parts of the world. The species has widely been recognized as economically important not only for its plant sap sucking habit, but also for its ability to act as vector of many plant viral diseases and to form a large population on seasonal crops under favourable conditions and adaptability to every contingency of the environment and the host. Aphids in general infest almost all kinds of habitat available on terrestrial plants (Basu and Banerjee, 1958; Bisht, 1962; Bodenheimer and Swirski, 1957; Dixon and Wellings, 1982; Ghosh, 1974; Kennedy et.al. 1962; Moritsu, 1954; Nevsky, 1929 and Ebert and Cartwright, 1997).

In India, this aphid species causes damage to grains, a number of vegetables, cereals, fibre crops, pulses, fruit trees, medicinal plants, besides a good number of other host plants (Ayyar, 1932; Basu and Banerjee 1958, Ghosh, 1974; Rao,1969 and Raychaudhuri, 1983). There are also records of several parasites and predators of this aphid (Agarwala and Saha, 1986; Ghosh and Agarwala, 1982; Rao, 1969, Raychaudhuri et. al., 1978; 1979; Saha et al., 1982; Stary and Ghosh, 1983). There is scarce information on population trends of this aphid

on economically important plants, except some sporadic works on different crops in India (Behura et al.,1979; Das, et al., 2006; Devi, et al., 2002; Rao, 1969 and Saha &Agarwala, 1986).

The present work was undertaken to bridge the gap of information on population trends and their natural enemies on few plants, namely, gourd, *Hibiscus rosasinensis* and chillie, in continuation of the first author's earlier works on cotton and egg plants (Agarwala and Saha, 1986 and Saha & Agarwal, 1986). This paper documents the observation on the population trends and their natural enemies only on gourd plants, (*Lagenaria siceria*).

MATERIAL AND METHODS

The study was conducted in a cultivated land of Krishnapur, Haripal in Hooghly district of West Bengal (22°49' N, 88°06' E). The plot remained untreated in respect of pesticides during the observation period. Total aphid population from two twigs measuring 30 cm of each of the 15 randomly selected plant parts in an area of about 400 sq. meter was done at an intervals of 14 days during October 2015 and February, 2016. Counting was done in situ on the selected plants, for total population of aphid, mummified aphid and active stages of predators, usually in the morning between 8.00 and 10.00 hours. Developmental stages of some predators and mummified aphids were collected from the field and brought to the laboratory for their rearing and emergence of adult stages. Natural incidence of predators and

*✉ Corresponding author: JaharLalSaha

Department of Zoology, Women's College, Agartala 799001

parasites were noted by counting the number of active stages of predators and mummified aphids. Meteorological data was also recorded and presented here.

RESULTS

Aphis gossypii Glover infests initially the apical tender twigs and leaves subsequently spreads over the under surface of leaves and extensively infests both the surface of the leaves and flower buds. This insect also forms thick colonies on twigs and damages the reproductive parts of the plant. This results in curling of leaves and stunted growth which in turn reduces production.

From the data presented in Table-1, it can be stated that initial growth of population steadily increases as the plant grows and takes a shoot which reaches its peak on the 6th day of observation and declines sharply on the 8th day of observation, while most of the leaves become light yellowish and tend towards senescence.

Table 1 Population dynamics of *Aphis gossypii* Glover and its natural enemies on Gourd plant (*Lagenariasiceria*)

Sampling date	Total no. of aphids	Total number of predators	Percentage of predators	Total number of mummified aphid	Percentage of parasitism	Temperature (°C)	R.H.	Rainfall (mm)
12.10.2015	126	0	0	0	0	28.8	73.2	5.02
26.10.2015	1284	4	0.31	7	0.55	27.2	73.9	4.22
09.11.2015	2283	27	1.13	59	2.58	25.99	65.35	0
23.11.2015	5271	53	1.05	107	2.03	25.48	62.35	0
07.12.2015	14653	71	0.47	387	2.64	22.56	62.85	0
21.12.2015	20321	192	0.9	1547	7.61	20.62	62.25	0
04.01.2016	8752	8	0.09	1412	16.13	21.12	69.78	0
18.01.2016	252	0	0	82	32.53	19.56	67.85	1.33
01.02.2016	175	0	0	18	10.28	20.93	64.39	0

Population of natural enemies which represents both predators and parasites (Table.2) was recorded on 2nd day of observation i.e., after 14 days of aphid population recorded. Afterwards population growth of aphid species and both groups of natural enemies were seen a gradual increase of predators' number (active stages only) till 6th day of observation, but the maximum percentage (1.13%) of predator was recorded only on 3rd day of observation. Despite the increase of aphid population sudden decline of predator (%) groups were noticed and ultimately no predator was available on 8th and 9th day of observations. Percentage of predators on highest peak population of aphid was only 0.9%.

Table 2 Natural enemies of *Aphis gossypii* Glover.

Order and Family	Species
Predators:	
	<i>Coccinella transversallis</i> Fabricius,1781
Order: Coleoptera	<i>Cheilomenes sexmaculatus</i> (Fabricius, 1781)
Family-Coccinellidae	<i>Micraspis discolor</i> (Fabricius, 1798)
	<i>Scymnus</i> sp.
Order: Diptera	<i>Ischiodon scutellaris</i> (Fabricius,1805)
Family – Syrphidae	<i>Metasyrphus confrater</i> (Weideman,1930)
Order: Neuroptera	
Family – Hemerobiidae	<i>Micromus timidus</i> Hagen, 1853
Parasites:	
Order: Hymenoptera	<i>Trioxys (Binodoxys) indicus</i> Subba Rao & Sharma, 1958
Family – Aphidiidae	
Family – Aphelinidae	<i>Aphelinus mali</i> (Haldman,1851)

On the other hand parasitized aphid population shows gradual increase along with aphid population. Percentage of parasitized

aphid was 0.55% on 1st recorded day i.e., on 2nd day of observation and after that percentage of parasitized aphid increased continuously till last but one day of observation being the maximum 32.53% and on last day of observation it was only 10.28% (Table- 1).

When the simple correlation coefficient (r) of aphid population with abiotic factors like average temperature, relative humidity (in percentage) and rain fall and biotic factors like predators and parasites as well as relation between the biotic factors (between aphid – predators; between aphid-parasite and between predator – parasitized aphid), were worked out (Table -3), the results revealed that relation between aphid population and abiotic factors are negatively correlated at varying degrees. Population of aphid shows maximum negative correlation with R.H.(r= - 0.55), then with average rainfall (r = - 0.48), and least with average temperature (r = - 0.4).

(Table-3). The simple correlation of aphid population with predator and parasitized aphid population (Table-3) revealed reverse results i.e., strong positive correlation between aphid and predators population (r = + 0.89), as well as, for aphid and parasitized aphid population (r = + 0.79).

Table 3 Correlation coefficient between biotic and abiotic factors of *Aphisgossypii*Glover on gourd Plant.

	Aphid	Predator	Parasite	Tem	RH	Rainfall
Aphid		0.89	0.79	-0.4	-0.55	-0.48
Predator			0.64	-0.29	-0.62	-0.4
Parasite2				-0.51	-0.23	-0.41

Similar results were also revealed while workout between the population of predators and parasitized aphid with the abiotic factors like average temperature, average R.H. and average rainfall. The simple correlation coefficient obtained between predators with average R.H. is - 0.62, average rainfall is - 0.40, and with average temperature is - 0.29. Similarly the simple correlation coefficient of parasite with average temperature is - 0.51, with average rainfall is - 0.41 and with average R.H. is - 0.23.

DISCUSSION

Results from Table - 1 shows initial rise of aphid population despite appearance of both parasite and predators and this increase of aphid population continues for a considerable period. During this period temperature gradually declines to

about 19.56°C from 28.8°C. which is most favourable condition for aphid population build up. Therefore, cumulative negative correlation with temperature ($r = -0.4$), R.H. ($r = -0.55$) and rainfall ($r = -0.48$) (Table : 3) helps the aphid population build up. These abiotic factors also favours the activities of parasites and predators and for longer period, particularly for parasite where parasite alone remains active to minimize the aphid population. Results of simple correlation coefficient (r) between aphid-parasite, aphid-predators and between predators-parasitized aphid (Table-3), revealed a strong positive correlation amongst the biotic factors.

As regards the low percentage of predators despite surge of aphid population, it may be explained that less number of suitable prey do not favour predator, mainly Coccinellidae to oviposit in the aphid colony, as in the case of present study it is found that simultaneous appearance of predators and parasites in aphid colony and by latter one minimize the suitable aphid number for the former one to oviposit, therefore, parasite population dominates over predatory population. This may be the reason of less number of predators in aphid colony despite good number of aphid population available on plant. Ebert and Cartwright (1997) also opined that 'problem' with many predators is that they may only lay their eggs in the presence of sufficient aphids to ensure the survival of the larvae to maturity. Although predatory percentage initially shows an increasing trend but on 5th and onwards observations exhibits a reverse trend (Table:-1), though aphid population increase further along with parasitized aphid.

Activities of parasite, *Trioxys (binodoxys) indicus* Subba Rao and Sharma, shows continuous appearance in aphid colony from the 2nd day of observation and the percentage of parasitism also increases with the increase of aphid population and percentage of parasitism was initially 0.55% and subsequently reached to 32.53% when the aphid population declined remarkably. Parasitized aphids (mummified) are seen maximum in aphid colony at this stage. This Hymenopteran parasite species is most common parasites of *Aphis gossypii* besides additional groups of parasites which includes Diptera and some mites (Ebert and Cartwright, 1997).

From Table -1 it emerges out that under climatological conditions in which studies were taken up the aphid population growth depends on abiotic factors as well as biotic factors. Negative correlation with abiotic factors like temperature was 28.8°C on 1st day of observation and gradually goes down to 20.62°C when maximum aphid population was recorded, but maximum number of parasitized aphid (32.53%) was recorded when temperature goes further down to 19.56°C when aphid population was recorded minimum on last but one day of observation. This reflects the activities of parasites on aphid population. Similarly the activities of parasites and predators appear to be favoured by lower temperature and Relative Humidity in the studied area. Such situation at later stage of observation favoured enhanced activity of parasites instead of predator species which leads to higher percentage of parasitized aphid (32.53%) under higher aphid population (Table:-1). This situation can be explained as parasitized aphids (mummified) are unsuitable for predators' consumption.

Works of Luo and Gan, (1986) suggest that changes in parasitism is based on age structure of *A. gossypii* Glover feeding on cotton plants. According to them *Trioxys* spp. and *Aphelinus* spp. rarely parasitized first and second instar aphids. Thus, the percentage of Parasitism increased as the proportion of older aphids increased. Interestingly, this has survival value for both the parasites and aphids because aphids which are parasitized in older nymphs or as adults have a chance to reproduce.

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References

- Agarwala, B.K. & Saha, J.L. 1986. Larval voracity, development and relative abundance of predators of *Aphis gossypii* G. on cotton in India. In: Hodek, I. (ed.) Ecology of Aphidophaga, Academia, Prague & Dr. W. Junk, Dordrecht. pp. 339-344.
- Anjanegulu, A. and Apparo, A. 1968. Natural occurrence of cucumber mosaic virus on Chillie in India. Indian Phytopath., 20(4):380-381.
- Ayyer, T.V.R. 1932. Insects affecting the cotton plants in South India. Bull. Agric. Dept. Madras Government. No.20, 19-20.
- Basu, A.N. and Banerjee, S.N. 1958. Aphids of Economic Plants of West Bengal. Indian Agriculturist., 2 (2): 89-112.
- Behura, B.K., Dash, B.K. and Parida, P.N. 1979. On the life history of *Aphis gossypii* Glover (Homoptera:Aphididae). Symposium abstract, Utkal University. Bhubaneswar. p-V:32.
- Bisht, N.S. 1962. *Aphis gossypii* Glover as a vector of nasturtium ring spot. Curr. Sci., 31(1):23-24.
- Bodenheimer, F.S. and Swirsky, F. 1957. The Aphidoidea of the Middle East. Weizman, Jerusalem.
- Das, S. K., Sahoo, S. K., Jha, S. and Saha, A. (2006). Population fluctuation of *Aphis gossypii* Glover (Homoptera: Aphididae) in relation to weather parameters on cucumber. *J. Aphidol.*, 20 (2): 33 – 36.
- Devi, M. N., Singh, T. K. and Devi, C. (2002). Field density of *Aphis gossypii* Glover on brinjal in relation to predatory and abiotic factors. Uttar Pradesh J. Zool., 22: 67 – 71.
- Dixon, A.F.G. and Wellings, P.W. 1982. Seasonality and reproduction in aphids. *J. Invertebrate Reproduction.*, 5(2):83-89.
- Ebert, T. A. and Cartwright, B. 1997. Biology and ecology of *Aphis gossypii* Glover (Homoptera:Aphididae). Southwestern Entomologist., 22(1):116-153.
- Ghosh, A.K. 1974. Aphids (Homoptera:Insecta) of Economic importance in India. Indian Agriculturist., 18 (2):81-214.
- Ghosh, A.K. and Agarwala, B.K. 1982. A catalogue of Aphidiid parasites of Aphids of India. *J. Bombay Hist. Soc.*, 79(1):125-134.

- Kennedy, J.S., Day, M.F. and Eastop, V.F. 1962. A Conspectus of Aphids as Vectors of Plant Viruses, Wallingford, UK: Cab International.
- Luo, Z. and Gan, G.P. 1986. Population dynamics of cotton aphids on cotton during square-boll stage and the relation between population age structure and parasitization. *Acta Entomologica Sinica.*, 29:56-61.
- Moritsu, M. 1954. Observations on the seasonal abundance of *Aphis gossypii* Glover on egg plants in Japan. *Mushi.*, 27(9): 59-68.
- Nevsky, V.P. 1929 b. The plant lice of Middle Asia III. *Zool. Anz.* 82:197-229.
- Rao, V.P. 1969. Survey for natural enemies of aphids in India. C.I.B.C. U.S. P.L.480 Project. Final Tech. Report. pp.1-93.
- Raychaudhuri, D.N. (ed.) 1983. Food Plant catalogue of Indian Aphididae. The Aphidological Society, India.
- Raychaudhuri, D.N., Dutta, S., Agarwala, B.K., Raha, S.K. and Raychaudhuri, D. 1979. Some parasites and predators of aphids in Northeast India and Bhutan II. *Entomon.*, 4(2): 163-166.
- Raychaudhuri, D.N., Dutta, S., Agarwala, B.K., Raychaudhuri, D. and Raha, S.K. 1978. Some parasites and predators of aphids from Northeast India and Bhutan. *Entomon.*, 3: 91-94.
- Saha, J.L. and Agarwala, B.K. 1986. Population dynamics of *Aphis gossypii* G. and its natural enemies on egg plants, *Solanum melongena* L. In: Agarwala, B.K. (ed). *Aphidology in India: Proceedings of the National Symposium held at Agartala, India*, pp. 13-18.
- Saha, J.L., S. C. Podder, S.K. Das, B.K. Agarwala and Raychaudhuri, D. 1982. Studies on the Aphid parasites (Hymenoptera:Aphidiidae) from Himachal Pradesh, India. *AKITU NS*, 44:1-12.
- Singh, A.B. 1972. Studies on the transmission of Papaya mosaic virus by *Aphis gossypii* Glover. *Curr. Sci.*, 34(3):240-243.
- Stary, P and Ghosh, A. K. 1983. Aphid parasitoids of India and adjacent countries (Hymenoptera:Aphidiidae). *Tech. Monogr. No.7*, pp. 1-75. Zoological Survey of India, Govt. of India publication.
