



Research Article

BIOLOGY AND PHYSICAL MEASUREMENTS OF WHITEFLY, *Bemisia tabaci* (GENNADIUS) ON CHILLI IN WEST BENGAL, INDIA

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Abstract- The female and male nymphs of *Bemisia tabaci* (Gennadius) was reared on leaves of potted chilli plants fitted with modified rearing glass vials, at 24-31 °C temperature and 80-85 % RH. The nymphs completed ecdysis at the age of 12.11± 1.00 days. The ratio of male: female was 1: 2.7. The preoviposition, oviposition and incubation period of eggs were 1.14±0.38, 2.50±1.29 and 5.39±1.58 days, respectively. The fecundity was 24.71±3.04. The first, second and third instar nymphs completed ecdysis within 1.68±1.00, 1.78±1.00 and 4.06±1.00 days respectively, and 4th instar or puparium stage lasted for 4.59±1.00 days. Adult longevity of female and male was 4.78±1.00 and 3.29±1.00 days, respectively. Life cycle completed within 23.14±0.69 and 20.85±0.90 days for female and male respectively. The female was larger than male. Length and breadth of 1st, 2nd, 3rd and 4th (puparium) instars were 0.29±0.02 and 0.12±0.01; 0.68±0.03 and 0.67±0.01; 0.72±0.04 and 0.66±0.05; 0.77±0.04 and 0.55±0.05mm, respectively. The length and breadth of eggs were 0.20±0.01 and 0.09±0.02mm, respectively.

Keywords- *Bemisia tabaci*, Chilli, Biology, Ecdysis, Physical measurement, Nymph, Puparium

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Introduction

Chilli, *Capsicum annum* L. is an important solanaceous crop widely cultivated in tropics and subtropics. It is utilized in many ways such as spices, green vegetables, salads and also medicinal purpose. India is a major producer, exporter and consumer of chilli and contributes around 25% of world production over 0.73 million hectares of land. In India Andhra Pradesh, Karnataka, Maharashtra, UP, Punjab, Tamil Nadu, Rajasthan, Orissa, West Bengal and M.P. are leading chilli producing states [1]. Whitefly, *Bemisia tabaci* (Gennadius) (Aleyrodidae; Homoptera) is the most important and notorious pest of chilli. Its infestation reduces the plant growth by sucking cell sap [2] and secretes honey dew [3]. It also transmits more than 90 types of viral diseases in varied commercial crops [4]. Leaf curl virus disease which incurs colossal losses in the crop affecting quantity and quality of the chilli fruits [5]. Incidence and severity of chilli leaf curl virus transmitted by *B. tabaci* have been reported in the tune of 71.11% and 21.84%, respectively in West Bengal [6] and now it is a major threat in chilli cultivation. In order to achieve maximal effects of pest control in minimal use of pesticides, accurate estimation of pest behaviour, life cycle and densities in field condition is a prerequisite [7]. Based on accurate information on pests, the most suitable pest management strategies could be designed. Varied life cycles have been reported on different host in diverse environmental conditions [8].

Accurate information on biological parameters on specific host plant is required for implementing sustainable management practices, which facilitate the present study to determine the development and reproduction of *B. tabaci* under laboratory conditions on chilli crop.

Materials and Methods

The biological study of *Bemisia tabaci* (Genn.) was studied on potted chilli plant (*Capsicum annum* L.) in laboratory at 24-31°C temperature and 80-85% RH at Bidhan Chandra Krishi Viswavidyalaya, Kalyani, West Bengal. Seven pairs of newly emerged adults collected from chilli field were used to study the life cycle of whitefly. Male and female were differentiated examining under microscope [Fig-1 K]. Male is smaller in size than female and terminal portion of abdomen was pointed in female and where as the hind end of male bears a clasping organ for copulation. One pair of adult comprising male and female were released in a modified glass vials fitted on the plants which was open at both end, one end of which covered with muslin cloth and other one covered with paper support with spring metal disc that attached with lower surface of leaf and allowed for egg laying [Fig-1 A]. Glass vials with whiteflies were transfer to a new leaf after every two days interval till their death. Marked leaves for egg laying were examined under stereoscopic binocular microscope (Stemi 2000-C/ZEISS) every day to observe the biological parameters such as preoviposition, oviposition and incubation period as well as moulting of different instars. Physical measurements of different life stages were also taken under microscope (Olympus Bx-51) after preparing slides wherever required.

Results

The result of the present investigation carried out on biology of whitefly, *Bemisia tabaci* (Gennadius) on chilli crop during, 2014. Biological development of *B. tabaci* was indicated by the time required to transform from one life stage to another stage during its life cycle started from egg to adult.

The whitefly had six life stages as egg, four nymphal (fourth one is puparium) and adult [Fig-1 B to K]. Whitefly female prefer to lay eggs on the under surface of young leaves in haphazard manner. Oval shaped eggs were narrowly elongated at one end and other board end having a short peg like pedicel. The ovipositing females inserted this pedicel in to the leaf. Initially the egg was pearly white in colour and before hatching turned to dark brown in colour in distal end of egg as

compared to the proximal leaf attached end [Fig-1 C]. Average length of egg was 0.20 ± 0.014 mm. and width was 0.09 ± 0.015 mm [Table-1]. The incubation period ranged from 04-08 (5.39 ± 1.58) days with 91.27% hatching ability [Table-2], which is closely related with 7.3 ± 0.5 days on tomato [14] and 7.33 ± 0.48 days in *Trialeurodes vaporariorum* on eggplant [10].

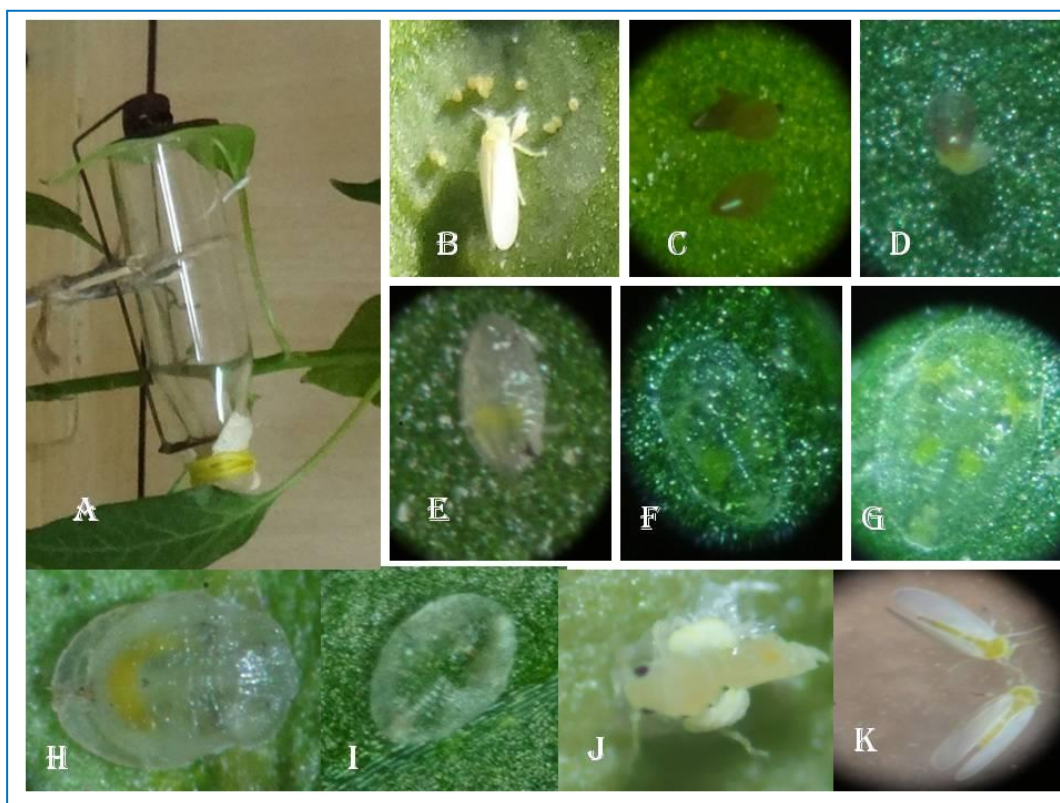


Fig-1 (A) - Vial which is used as case for egg laying.; (B) - Adult whitefly (*Bemisia tabaci*) laying eggs under surface of chilli leaf.; (C- and D) - Eggs and emergence of crawler. (E-, F-, G- and H) -: Ist Instar or crawler, IInd, IIIrd and IVth Instar or puparium., (I)- Puparium exuvie and (J-,K) - Newly emerged adult and Adult of whitefly (*Bemisia tabaci*)

Crawler: Newly emerged first instar nymph also known as crawler, was translucent greenish-yellow in colour, flattened and oval shaped [Fig-1 E]. The crawler moved only a few centimetres in search of a feeding site at lower surface of the leaves and remain attached in the same site and completed consecutive moulting to become adults. The crawler turned in to whitish green in colour and two yellow spot were visible in the abdomen through the skin, after settling on the feeding site. The crawlers were measured about 0.29 ± 0.02 mm and 0.12 ± 0.01 mm in length and breadth, respectively [Table-1] and tallies with that of earlier record of 207.8 ± 5.4 μ m and 120.9 ± 4.4 μ m in length and breadth, respectively [9]. The 1st instar nymph moulted within 1.68 ± 1.0 days [Table-2] which are shorter than 4.2 ± 0.18 days; 3.37 ± 0.52 days and 3.65 ± 0.22 days on weed host, egg plant and tomato, respectively [11-12]. This variation might be due to the host preferences and varied climatological situations.

Second and third instar nymph: Both these two immobile stages were looked like soft scale, translucent, greenish yellow in colour, oval and flattened body [Fig-1 F] and slightly larger and pointed towards the tail in third instar [Fig-1 G]. Legs were shaded during its first moulting. The length and breadth of second instar was recorded 0.68 ± 0.03 and 0.57 ± 0.01 mm and the corresponding values of third instar was 0.72 ± 0.04 and 0.58 ± 0.01 mm, respectively [Table-1]. The size of the second and third instar nymphs in the present study was slightly bigger than the *B. tabaci* strain B on peanut in Georgia which was 314.9 ± 8.8 , 194.0 ± 6.4 and 442.6 ± 11.2 ; 289.1 ± 8.0 μ m respectively [9]. More or less similar variation on size of these two instars was noticed when compared with the population of Amaravati, Ludhiana and Delhi [13]. The variation in measurement might be due to nutritional variation in different food host. The 2nd and 3rd instar nymph moulted

within 1.78 ± 1.00 and 4.06 ± 1.00 days respectively [Table-2] which are little bit shorter than earlier reports i.e. 2.7 ± 1.1 and 2.5 ± 0.7 ; 3.8 ± 0.14 and 3.0 ± 0.0 ; 3.83 ± 7.53 and 4.09 ± 8.64 ; 4.09 ± 8.64 and 4.88 ± 0.10 ; 2.75 ± 0.25 and 2.90 ± 0.29 days respectively [11-15].

Fourth instar nymph or puparium: Red eye stage was evident for fourth instars and referred to as red-eyed nymphs [Fig-1 H]. They were yellowish white in body colour. In fourth instar nymph stopped feeding and pupate, after that yellowish white colour adult emerged [Fig-1 J]. The sides of red-eyed nymphs were boat-shaped or slightly curved upward and measured about 0.77 ± 0.038 , 0.55 ± 0.45 mm [Table-1] in length and breadth, respectively which were more similar with previous records on the size of the puparium i.e. 619.3 ± 9.2 and 428.7 ± 4.4 μ m length and breadth, respectively on peanut in Georgia [9] and 0.725 ± 0.011 and 0.495 ± 0.012 in Asia III genotype [13]. The duration recorded for fourth instar was 4.59 ± 1.00 , days [Table-2], which are in agreement with earlier workers who reported 5.2 ± 0.18 , and 5.8 ± 0.3 days [11 & 14].

Adult: Adult that emerged few hours after sunrise in morning took two to three hours before it could fly. Yellow bodied adults held their white wings vertically tilted [Fig-1 K]. Adult whitefly emerged through a T-shaped mark on the exuviae of the last nymphal instar or puparium [Fig-1 I]. The size of male was smaller than female and recorded 1.11 ± 0.06 and 0.90 ± 0.01 mm in length from head to tip of abdomen and breadth of adult measured at wing expand 3.50 ± 0.13 ; 2.42 ± 0.19 mm in female and male respectively [Table-1]. The pre oviposition period lasted for 1.14 ± 0.37 days and oviposition 2.50 ± 1.29 days. Fecundity recorded was 24.71 ± 3.04 eggs/female [Table-2]. The findings on preoviposition tallies with

1.4±0.7 days, where as oviposition and fecundity are less than earlier records of oviposition period 16.7±3.2 days and fecundity was 194.9±59.1 eggs/female [14]. The average longevity of male and female was recorded as 3.29 ±1.00 and 4.78±1.00 days [Table-2]. The finding on longevity of male and female was more alike to that of 4-7 and 9-18 days, respectively on cotton [16] and 3.30 ± 0.41 days for male and 5.65 ± 0.63 days for female on tomato [17]. The total developmental period from egg to adult recorded was 20.85±0.90 days for male and 23.14±0.69 days for female [Table-2], the results are in conformity with the earlier findings of 21.2 days on soybean and 22.0 days on tomato, respectively [18 & 19] and 20.88±1.54 and 26.44±1.17 days for male and female, respectively [10] on egg plant. The proportion of male: female was 1:2.7 in a population of 115 on chilli which is in agreement with the ratio of 1:2.7 (male: female) on tomato [14] and slightly lower than 1:3.7 and 1:4 on cotton and leucaena, respectively [11]. Variability in the life cycle and other biological aspects were strongly related to climatic factors and the host plant [20]. In the present investigation, little variation on duration of developmental stages of whitefly, *B. tabaci* and their morphometrics was notified as compared to previous findings, which might be due to the different food source and varied microclimatic condition.

Table-1 Physical measurements of different stages of whitefly (*Bemisia tabaci*)

Stages	Measurement of different stages of whitefly	
	Length (mm) Range (Mean ± S.D.)	Breadth (mm) Range (Mean ± S.D.)
Eggs	0.18-0.23 (0.20 ± 0.01)	0.08-0.12 (0.09 ± 0.01)
First instar	0.24-0.31 (0.29 ± 0.02)	0.10-0.13 (0.12 ± 0.01)
Second instar	0.63-0.70 (0.68 ± 0.03)	0.55-0.58 (0.57 ± 0.01)
Third instar	0.64-0.76 (0.72 ± 0.04)	0.57-0.60 (0.58 ± 0.01)
Fourth instar	0.70-0.80 (0.77 ± 0.03)	0.46-0.60 (0.55 ± 0.04)
Adult female	1.02-1.19 (1.11 ± 0.06)	*3.30-3.68 (3.50 ± 0.13)
Adult male	0.88-0.91 (0.90 ± 0.01)	*2.04-2.65 (2.42 ± 0.19)

*breadth with wing expansion

Table-2 Duration and number of different life stages of whitefly (*Bemisia tabaci*)

Stages	Number of individuals observed	Duration in Days Range (Mean ± S.D.)
Pre-oviposition period	7	01-02 (1.14 ± 0.37)
Oviposition period	7	01-04 (2.5 ± 1.29)
Incubation period	126	04-08 (5.39 ± 1.58)
First instar	115	01-03 (1.68 ± 1.00)
Second instar	115	01-03 (1.78 ± 1.00)
Third instar	115	03-05 (4.06 ± 1.00)
Fourth instar	115	04-06 (4.59 ± 1.00)
Adult longevity		
Female	84	04-06 (4.78 ± 1.00)
Male	31	02-03 (3.29 ± 1.00)
Total Life cycle		
Male	31	20-22 (20.85 ± 0.90)
Female	84	22-24 (23.14 ± 0.69)
Fecundity (No. of Eggs/female)	7	20-29 (24.71 ± 3.04)

Conflict of Interest: None declared

References

- [1] Anonymous (2015) *Indian Horticulture Database-2014* NHB. Ministry of Agriculture, Govt of India pp: 1-302.
- [2] Khan M.R., Idris A.G., Khan M.R., Ghaffar A. and Tamkeen A. (2011) *African Journal Biotechnology*, 10 (8), 1467-1472.
- [3] Kakimoto K., Inoue H., Yamaguchi T., Ueda S., Honda K. and Yano E. (2007) *Applied Entomology and Zoology*, 42,63-70.
- [4] Morels F.G. and Jones P.J. (2004) *Virus Research*, 100, 57-65.
- [5] Singh S.J., Sastry K.S. and Sastry K.S.M. (1979) *Indian Horticulture*, 24, 9-10.
- [6] Singh Ranbir and Chowdhury A.K. (2013) *J. Mycopathol Res.*, 51(1),157-161.
- [7] Lin K., Wu K., Zang Y. and Guo Y. (2007) *Crop Protection.*, 26,1831-1838.
- [8] Al-Zeyound F. and Sengonca C. (2004) *Mitteilungen der Deutschen Gesellschaft für Allgemeine und Angewandte Entomologie*, 14,373-376.
- [9] Lynch R.E., Simmons and Alvin M. (1993) *Environmental Entomology.*, 22(2), 375-380
- [10] Ghahari H. and Hatami B. (2000) *Journal of Science and Technology of Agriculture and Natural Resources.*, 4(2), 141-154.
- [11] Thomas A., Chaubey R., Naveen N.C., Kar A. and Ramamurthy V.V. (2011) *International Journal of Tropical Insect Science*, 31(4), 235-241.
- [12] Jamuna B., Bheemanna M., Hosamani A.C., Govindappa M.R., Sushila Nadagouda and Shweta Surpur (2016) *Journal of Experimental Zoology*, 19(1), 475-477
- [13] Chaubey Rahul, Andrew R.J., Naveen N.C., Rajagopal R., Bilal Ahmad and Ramamurthy V.V. (2015) *Annals of the Entomological Society of America*, 1-13.
- [14] Salas J. and Mendoza O. (1995) *Florida Entomologist*, 78(1), 154-160.
- [15] Han D.Y., Liu K., Zhang F.P., Huang W.R., Zhang J.B., Jin Q.A. and Fu Y. G. (2009) *Acta Entomologica Sinica*, 52(3), 281-289.
- [16] Deotale R.O., Nimbalkar S.A. and Jumde Y.S. (1992) *Journal of Soils and Crops*, 2(2), 30-32.
- [17] Jamuna B., Bheemanna M., Hosamani A.C., Govindappa M.R., Sushila Nadagouda and Shweta Surpur (2016) *Journal of Experimental Zoology*, 19(1), 475-477
- [18] Takahashi K.M., Berti F.E. and Lourencao A.L. (2008) *Scientia Agricola*, 65(6), 639- 642.
- [19] Ramazeme L.H., Khader Khan N.S., Vijayakumar and Jagatheeshwari J. (2014) *Trends in Biosciences*, 7(17), 2544-2550.
- [20] Russell L.M. (1975) *In: Workshop on Bean Protection. Cali. Columbia, CIAT.*, pp:21