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COMPARATIVE AGE SPECIFIC LIFE PARAMETERS OF WHITEFLY (*BEMISIA TABACI* GENN.,) ON SOME PREFERRED HOST PLANTS.

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A B S T R A C T

Survival and mortality of whitefly (*Bemisia tabaci* Genn.) has been studied on cotton, black gram and green gram under laboratory condition to find out the host preference. Findings have revealed a significant variation among the host plants. Shortest immature life (14.98±0.82 days) and adult survival (26 days) of whitefly was recorded on cotton as compared green gram and black gram. Survival percentage of whitefly was also found to be higher on cotton.

Keywords: *Culex*, container breeders, marshy lands, rice field habitats, turbidity.

INTRODUCTION

The sweet potato whitefly, *Bemisia tabaci* (Homoptera: Aleyrodidae) was described more than a century ago (Oliveira *et al*., 2001) and currently is one of 600 most invasive and destructive species throughout the globe, able to feed agriculturally important crop plants in fields (Lowe *et al*., 2000; Oliveira *et al*., 2001; Hu *et al*., 2011; Kontsedalov *et al*., 2012; Han *et al*., 2012) and in greenhouse cultivation (Oliveira *et al*., 2001). Due to small size, its detection on agricultural trade commodities is difficult hence an invasion is reported from all the continents except countries having cold climate round the year (Dinsdale *et al*., 2010; Han *et al*., 2012). Over 30 biotypes are reported (Liu *et al*. 2012; Chowda-Reddy *et al*., 2012) which differs in biological attributes and preferences among each other, generally feeds on phloem tissues of the host plants. Apart from phloem feeding and excreting honeydew, *B. tabaci* also evolved in vectoring virus causing diseases (Horowitz *et al*., 2002; Han *et al*., 2012). Along with virus transmission, insecticide resistance (Han *et al*., 2013) has posed a new challenge before to growers. A number of pest control agents *viz*., entomo-pathogenic fungi, natural enemies and pesticides, have been employed to manage this viral vector.

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Any change in population structure or unexpected dynamics may affect the efficacy of above pest control methods, hence a thorough understanding of survival and mortality dynamics of whitefly, *B. tabaci* is required (Han *et al*., 2012). Hence an objective of this study was to investigate the biology, survival and mortality of whitefly as affected by the host plants by constructing age specific life tables.

MATERIALS AND METHODS

Seeds of black gram (*Vigna mungo* L.,), green gram (*V. radiata* L.,) and cotton (*Gossypium hirsutum* L.) was sown in thermo-coal pots of 9 cm in top diameter, 6 cm in bottom diameter, with 7 cm in height under laboratory conditions (temperature 26±3ºC, RH: 75±5% and photophase: 14hr) at Department of Protection, Faculty of Agricultural Sciences of Aligarh Muslim University, India and kept screened to avoid further whitefly infestation. Fresh pupae of whitefly (*Bemisia tabaci* Genn.,) were collected from the field to obtain newly emerged adults. The culture was maintained up to four generations on brinjal (*Solanum melongena* L.) plant to get a laboratory adopted strain and F-5 generation was used in present investigation. To obtain fresh eggs, pairs of adult whitefly were released in confined plastic vials fixed on lower surface of leaves. These vials were provided with two square shape ventilation windows at either ventral sides, one at bottom and second one at neck opposite to that of bottom and a fine meshed cloth was pasted as screen on the windows (Plate 1). After 24 hours of confined exposure of male and female whitefly pairs, two eggs from each exposed leaf were selected and marked with black permanent and nontoxic marker and such leaves containing those of eggs were tagged at petiole region to facilitate the infestation identity, while rest of the eggs were discarded. The whole amount of such tagged plants used under the study were screened with fine meshed white cotton cloth to avoid further infestation of whitefly, mites or ants if there were any. This ensured that every leaf chosen remained with a specific number of eggs, all of which had been marked. A total of 100 plants were selected to give a cohort of 200 eggs and rest of the eggs and nymphs were discarded. Settled first-instar nymphs were identified and marked again by making a circle around. These first instars were identified by their translucent color, small size, and characteristic ovoid shape. Marked nymphs were revisited after 1 hr to ensure that they had settled. Any nymph that had crawled out of the circle was replaced by marking new one on another leaf of a new plant. All cohorts in each plot were established on the same day, and were marked between 07:00 and 10:00 hours of the same day. When insect completed its immature life, the red eyed pupae/pseudo-pupae were identified and caged in vials (plat-1) designed for the same. Adult longevity, survival and mortality were observed subsequently. This study will provide essential gap filling information for devising effective management strategies for whitefly by providing information in areas having in vogue cultivation of above mentioned cotton and bean crops.

Plate 1: Exposure vial used to expose the adult whitefly

DATA ANALYSIS

The below given assumptions were used for the documentation of age specific life-table.

x = age of the insect in days

lx = number of individuals that survived at the beginning of each age interval x

d_x = number of individuals that died during the age interval x

$100q_x$ = per cent mortality, computed through the following equation:

$100qx = [d_x / l_x] \times 100$

e_x = expectation of life or mean life remaining for individuals of age x

Life expectation was calculated by using the equation:

$e_x = T_x / l_x$

To obtain ex, two other parameters L_x and T_x were also computed as below

L_x = the number of individuals alive between age x and x+1 and calculated by the equation:

$L_x = l_x+1\ (x+1)/2$

T_x = the total number of individuals of x age units beyond the age x and obtained by the equation:

$T_x = l_x + (l_x + 1) + (l_x + 2)\ldots\ldots\ldots\ldots +l_w$

Where, l_w= the last age interval.

RESULTS

All the host plants used to expose the whitefly, responded varyingly (df-3, 11; p-0.05) (table 1). The biological parameters of whitefly reared on cotton were significantly different (df- 2, 11; p-0.05) from bean reared individuals whereas, the population fed on black gram and green gram did not exhibited a significant difference among each other (df- 2, 11; p-0.05) except the longevity of adult females. The immature life of Bemisia ranged from 14.98±0.82 days on cotton to 20.51±1.00 days on green gram. Females of whitefly reared on all the host plants were long surviving than males (df- 2, 11; p-0.05) while the performance pattern was alike the immature stages. The maximum duration of adult male and female longevity (14.58±0.40 and 18.74±0.99 days) was observed on green gram with shortest respective duration (12.44±0.84 and 15.58±0.84 days) on cotton. The hatching took minimum duration (3.22±0.38 days) on black gram followed by (4.92 ±0.18 days) green gram (table 1).

Table 1: Life parameters of whitefly (*B. tabaci*, Genn.,) on different host plants.

Host	Egg	I instar	II instar	III instar	Pupa	Total	Adult Male	Adult female
Black gram	4.95±0.20	3.24±0.11	3.68±0.18	4.18±0.21	4.22±0.22	20.27±1.22	14.45±0.78	18.44±0.78
Green gram	4.92±0.18	3.26±0.14	3.72±0.13	4.45±0.27	4.16±0.22	20.51±1.00	14.58±0.40	18.74±0.99
Cotton	3.22±0.38	2.48±0.29	2.36±0.32	3.18±0.24	3.74±0.46	14.98±0.82	12.44±0.84	15.58±0.84

The longest pupal duration (4.22±0.22 days) was also recorded on green gram and the lowest on (3.74±0.46 days) cotton. The age specific survival was of stair step like in pattern documenting shortest span (26 days) on cotton and the longest on green gram (fig. 1). On the other hand, mortality of whitefly did not follow a regular/definite pattern on all the host plants. Maximum mortality of whitefly on black gram was recorded at first instar nymphal stage followed by pupal stage, while on green gram and cotton the corresponding peaks were observed at pupal stage of life. Overall highest survival percentage at all the immature stages was observed on cotton as compared to green gram and black gram (fig. 2).

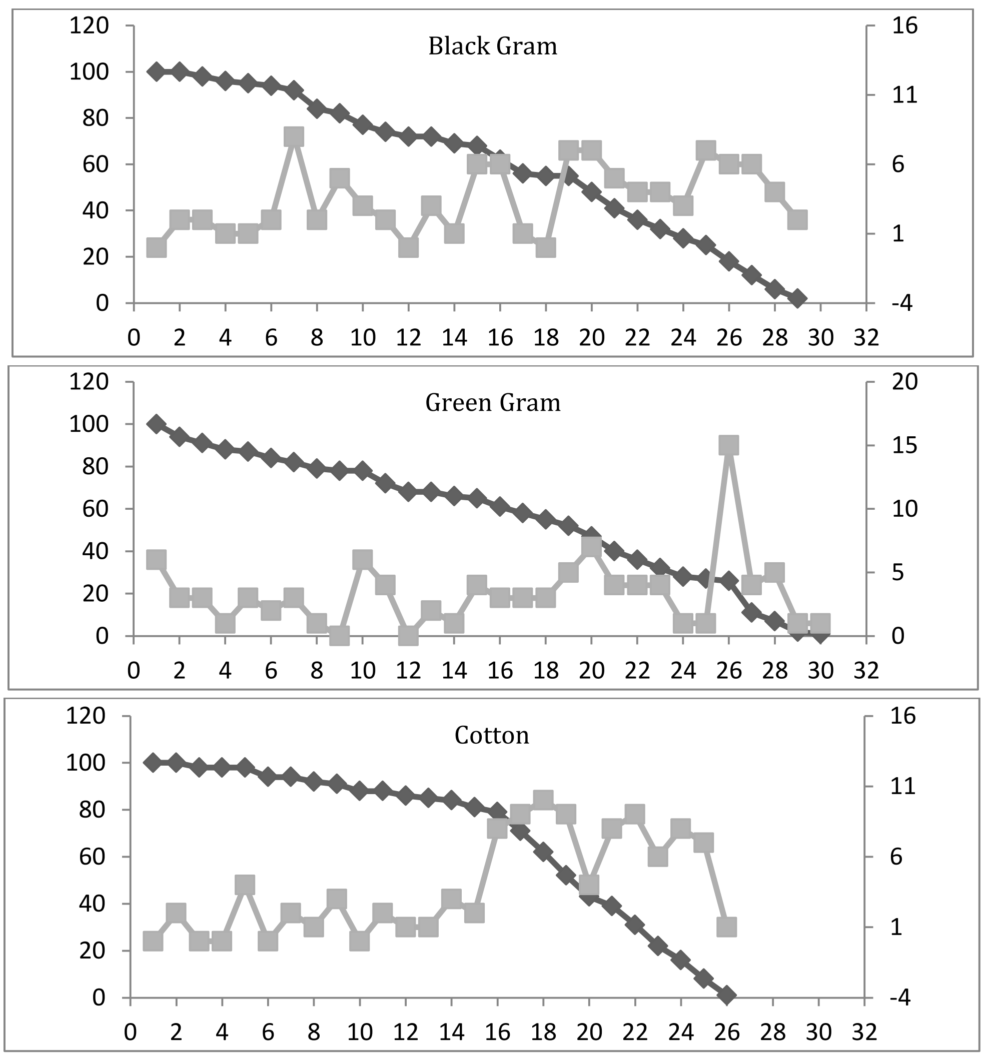

Figure 1. Age specific survival and mortality of whitefly (*B. tabaci* Genn.,) on different host plants (lx-survival; x age in days; dx-mortality).

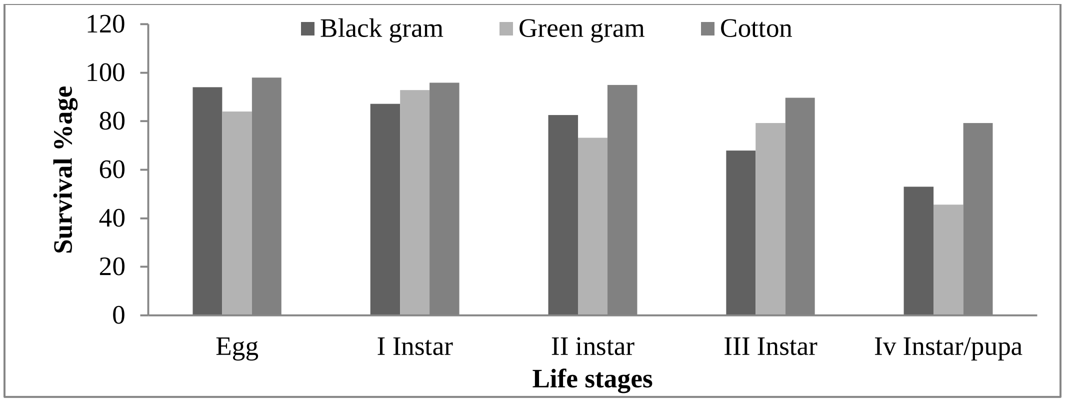

Fig. 2: Age specific survival (in percent) of whitefly (*B. tabaci*, Genn.,) on different host plants.

DISCUSSION

Our data showed that the host plants played a more important role in determining the whitefly life parameters. Egg hatchability and nymphal survival was on cotton as compared to bean crops and the results are comparable with Baky *et al*., (2004). The research on biology and ecology from recent past reveals that the development of immature *Bemisia tabaci* is dependent on type of whitefly population or biotype (Muniz and Nombela, 1997; Bonato*et al*, 2007) or host plants (Zalom*et al*, 1995; Tsai & Wang, 1996; Muniz and Nombela, 1997; Nava-Camberos*et al*, 2001; Lin and Ren, 2004; Bonato*et al*, 2007). The host plant preference in case of whitefly (*Trialeurodes vaporariorum*West.) is directly related to biological performance on the plant (Van Lenteren and Noldus, 1990). Elevated rate of reproduction, low mortality rate and shorter development time of insects on a particular host points toward greater suitability of a host plant (Costa *et al*, 1991a & b; Coudriet *et al*, 1985; Awmack and Leather, 2002; Hasan and Ansari, 2011). In present investigation, whitefly documented short life and high percentage of survival on cotton as compared to green gram and black gram. This behavior has probably resulted from the facility of better nutrition on cotton. The outcomes have a great proximity with the findings of Abdel Baky *et al*., (2004). The overall variation in host preference in this study may attributed to the variation in nutritive traits of the host plants, however the difference in leaf surfaces of the host plants cannot be ignored.

CONCLUSION

Whitefly (*B. tabaci* Genn.,) has shown a greater host preference for cotton as compared to green gram and black gram by documenting a short life and a comparative lower mortality rate.

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