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Comparison of greenbug, *Schizaphis graminum* (Rondani) biology on broomcorn, grain sorghum and wheat

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Abstract. Greenbug, *Schizaphis graminum* (Rondani) is one of the injurious aphid pests of cereals in Iran. In the present study, the population increase potential of greenbug were estimated on its three different host plants at 23 ± 2°C, 60–70% RH in greenhouse of Miyaneh Branch, Islamic Azad university in 2009. The experiment was conducted as completely randomizes design and a cohort of 50 greenbugs' first instar nymphs were reared on broom corn (*Sorghum bicolor* var. *technichum*), grain sorghum (cv. KGS20) and wheat (cv. Niknezhad) using leaf cages. The reared aphids were visited daily for recording mortality and reproduction. Jackknife method was used for analysis of the differences in the means of estimated parameters. Results revealed significant effect of different tested host plants on estimated stable population parameters of the aphid. According to the data, the aphid net reproductive rate was significantly higher on wheat than its values on broom corn and grain sorghum. Intrinsic rate of increase and finite rate of increase were also higher for the aphids reared on wheat (0.310 female per female per day and 1.35 per day, respectively) because of a higher net reproductive rate (R_0) values of greenbugs reared on the mentioned host plant. Based on the results, intrinsic rate of increase of greenbug was greater and mean generation time and doubling time of the aphid were lower on wheat and so, extension of wheat cultivated area may result in greenbug population increase. Knowledge on greenbug performance on different host plants vis a fundamental component of integrated pest management programs. Hence, present results may provide helpful information for comprehensive IPM program of greenbug in Miyaneh region.

Key words: Greenbug, *Schizaphis graminum,* Sorghum, Stable population, Biology.

1. Introduction

The greenbug, *Schizaphis graminum* (Rondani), is one of the most important cereal pests all over the world. At least 60 species of grasses including cereal crops are the host plants of this cosmopolitan aphid (McCauley *et al.,* 1990). Greenbug feeding on the plant phloem and injecting toxic salivary enzymes induces chlorosis around the feeding site and reduces yield loss. In Iran, cereals are grown in large areas, and both crops are infested with greenbug (Rezvani 2001).

Reproduction and population growth of aphids depend on their ability to feed on various host plant tissue. Aphid control is mainly executed with insecticide applications. Development of an effective IPM program for greenbug will depend upon an understanding of the effect of this pest on host plants. There are only a few reports on the population increase potential of greenbug on sorghum species and wheat. In the present study we evaluated the effects of three different host plants on the fertility life parameters of *S. graminum*. The life history studies of aphids and examine the estimating host plant effect on aphid population growth as a measure of host suitability are essential to improve integrated pest management (IPM) strategy. Several reports were published on the effects of host plants on greenbug life history (Webster and Porter 2000; Lage *et al.,* 2003). However, there is little information about the demographic parameters of greenbugs on different host plants in Iran. Therefore, this study was conducted to assess the effect of three host plants on the biology and life history parameters of greenbug.

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2. Material and method

2.1. Host plants

Three greenbug's host plant including broom corn (*Sorghum bicolor* var. *technichum*), grain sorghum (cv. KGS20) and wheat (cv. Niknezhad) were tested to determine host plant effect on population increase potential of greenbug. The seeds were obtained from the Cereal Research Department of Iranian Research Institute of Plant Breeding in Karaj and were planted in 20 cm diameter pots containing a mixture of sand, clay and peat moss. The plants were placed in a greenhouse at 23 ± 2 ºC and 60–70% relative humidity (RH) with ambient light.

2.2. Aphid colony

Aphids were collected from naturally infested sorghum and wheat-grown fields in Miyaneh region, Iran in the spring of 2009. The stock aphid population was cultured on the tested sorghum species and wheat for three or four generations before they were used in the experiments.

2.3. Greenhouse experiments

For each experiment, young apterous adult females from the stock colony were transferred on experimental host plants s for nymph production. After four hours, the adults were removed and newly emerged first instar nymphs were collected and transferred individually on leaf cages using a camel's-hair brush. 100 nymphs were reared on each host plants studied. The test plants were placed in a greenhouse at 23 ± 2°C, 60–70% RH. All nymphs were checked daily until the emergence of adults. The number of offspring produced by each adult aphid were counted and removed daily and the survivorship of adults was recorded every 24 h.

2.4. Statistical analysis

Life table construction was done using age-specific fecundity (m_x) and survival rates (l_x) for each age interval (x) per day (Andrewartha and Brich 1954). To estimate the standard error of all calculated parameters, a jackknife method was used (Maia *et al.,* 2000). One-way analysis of variance (ANOVA) was conducted to analysis of the differences in the means of estimated parameters by jackknife method and the means were compared by Duncan's multiple range test at 0.05 probability level using SAS software.

3. Results and discussion

Table (1) presents stable population parameters of *Schizaphis graminum* on three host plants. As the table showes, the aphids reared on three different host plants were significantly different in all the stable population parameters calculated.

Table 1. Stable population parameters of greenbug on three host plants.

Host plant	Net reproductive rate (R_0)	Finite rate of increase (λ)	Intrinsic rate of increase (r_m)	Mean gene ration time (T)	Doubling time (DT)
Wheat (cv. Niknezhad)	49.913±2.550 a	1.358±0.014 a	0.310±0.010 a	12.403±0.198 c	2.266±0.071 c
Broom corn	28.961±1.988 b	1.293±0.007 b	0.257±0.009 b	13.095±0.512 b	2.696±0.079 b
Grain sorghum (KGS19)	25.969±2.911 c	1.263±0.009 c	0.233±0.007 c	13.949±0.494 a	2.961±0.091 a

Means with the same letters in each column have not significant difference at 5% probability level.

According to the data, the aphid net reproductive rate was significantly higher on wheat than on broom corn and grain sorghum. Intrinsic rate of increase and finite rate of increase were also higher for the aphids reared on wheat (0.310 female per female per day and 1.35 per day, respectively) because of a higher age-specific fecundity (m_x) (fig. 1, 2 3) and net reproductive rate (R_0) (table 1) values of greenbugs reared on wheat. The shape of age-specific fecundity curves of greenbug varied on its different host plants. According to Figure (1), the age-specific fecundity of the aphids was higher on wheat than other host plants studied. Population doubling time and mean generation time values of greenbug on wheat was significantly lower than those on broom corn and grain sorghum.

The effect of host plants on the life history parameters for *S. graminum* are presented by Lazer *et al.* (1995), Webster and Porter (2000) and Nuessly *et al.* (2008). Intrinsic rate of increase values of greenbug reported by Nuessly *et al.* (2008) reared on *Paspalum vaginatum* was 0.235–0.262 female per female per day. The intrinsic rate of natural increase can be used as population growth potential index of an aphid on different host plants. The most important factors that can influence r_m value are reproduction, mortality and nymphal development time (McCauley *et al.*, 1990).

Webster and Porter (2000) reported a lower r_m value (0.14–0.23) of greenbugs reared on resistant wheat cultivars than those obtained in this study. Lage *et al.* (2003) also reported a lower r_m value (0.019–0.198) of greenbugs reared on synthetic hexaploid wheat varieties than those estimated in this study. Nuessly *et al.* (2008) have also reported a lower R_0 value of greenbugs on seashore paspalum. In contrast, McCauley *et al.* (1990) reported higher R_0 values for greenbugs reared on sorghum at 23°C.

The mean generation time and population doubling time of greenbugs reared in these experiments were lower than those reported on corn and sorghum at 24°8C by McCauley *et al.* (1992). In addition, McCauley *et al.* (1990) reported 1.19–1.41 per day finite rate of increase of greenbug when reared on sorghum and corn hybrids and germplasms.

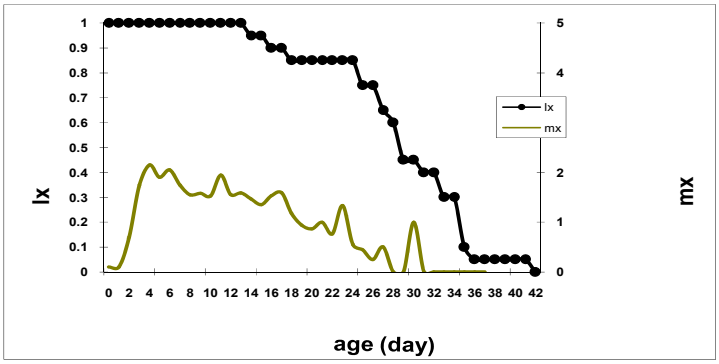

Fig.1. Age specific survival (lx) and fecundity (mx) curves of greenbug on grain sorghum.

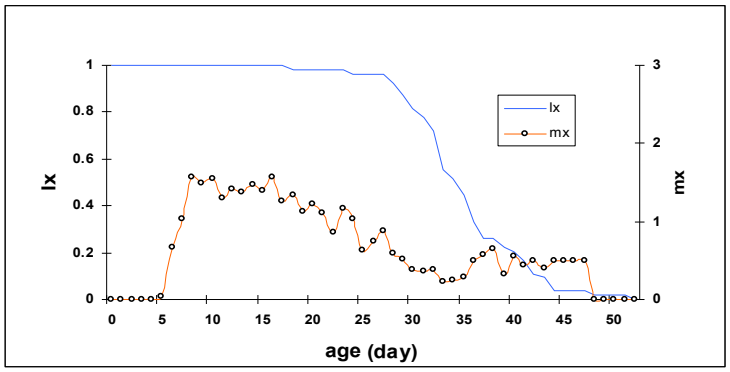

Fig.2. Age specific survival (lx) and fecundity (mx) curves of greenbug on broom corn.

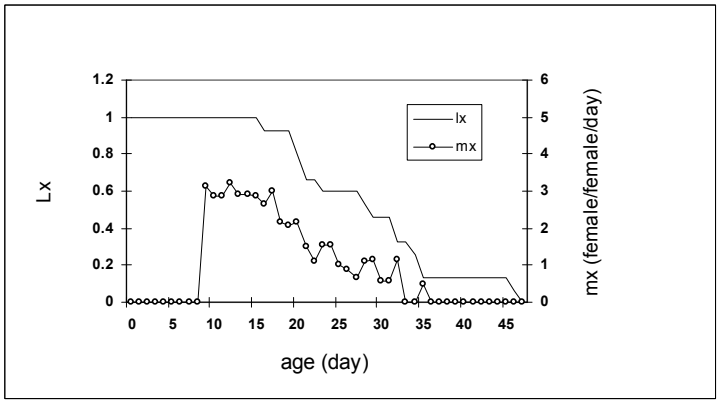

Fig.3. Age specific survival (lx) and fecundity (mx) curves of greenbug on wheat.

Based on the results, wheat was recognized as the most suitable host plant to the greenbug. Broom corn also was susceptible than grain sorghum (table 1). It seems that higher age-specific fecundity (m_x) and net reproductive rate of the aphid on wheat and broomcorn than on grain sorghum resulted in increased values of intrinsic rate of increase and finite rate of increase of greenbugs reared on two mentioned host plants. High intrinsic rate of increase reduces the values of mean generation time and doubling time for aphids reared on wheat.

According to Tofangsazi (2008), greenbug intrinsic rate of increase was 0.26-0.30 female per female per day on six barley cultivars. Shahrokhi (2002) reported a range of 0.23-0.27 female per female per day for this parameter on six wheat cultivar. Differences in life table parameters obtained in different studies could be resulted by geographical region, using different varieties, and applying different methodology.

Lower or equal intrinsic rate of increase of an aphid species on a certain host plant shows that its farming extension most probably will not cause aphid population increase. Based on the results, intrinsic rate of increase of greenbug was greater and mean generation time and doubling time of the aphid were lower on wheat than on other host plants tested and so, extension of wheatT cultivated area may result in greenbug population increase.

Knowledge on the demography of greenbug on its host plants is a fundamental component of integrated pest management programs. Hence, present results may provide helpful information for comprehensive IPM program of greenbug in Iran.

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