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Population Increase Potential of *Schizaphisgraminum* (Rondani) on Three Different Sorghum Varieties

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Abstract. Stable population parameters of greenbug, *Schizaphisgraminum* (Rondani) were estimated on three different sorghum varieties todetermine its population increase potential. The experiment was conducted as completely randomizes design and a cohort of 50 greenbugs' first instar nymphs were reared on three sorghum cultivars including KGS17, KGS19 and KGS20 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 sorghum varietieson estimated stable population parameters of the aphid. According to the data, the aphid net reproductive rate was significantly higher on KGS20 than on KGS19. Intrinsic rate of increase and finite rate of increase were also higher for the aphids reared on KGS20 variety (0.308 female per female per day and 1.36, respectively) because of a higher net reproductive rate (R_0) values of greenbugs reared on the mentioned variety. 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 KGS20 than on other varieties tested and so, extension of KGS20 cultivated area was not recommended because it may result in greenbug population increase.Knowledge onperformance of greenbug on different host plant varieties is a fundamental component of integrated pest management of the aphid in sorghum fields. Hence, present results may provide helpful information for comprehensive IPM program of greenbug in sorghum fields.

Keywords: greenbug, *Schizaphisgraminum,* Sorghum, Stable population, Demography.

1. Introduction

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

Reproduction and population growth of aphids depend on their ability to feed onvarious host plant tissue. Aphid control is mainly executed with insecticide applications. Development of an effective IPM program for greenbugwill depend upon an understanding of the effect of this pest on host plants. There are only a fewreports on the populationincrease potential of greenbug on sorghum varieties. In current studywe report the result of greenhouse experiments on theeffects of three different sorghum varieties on the fertility life parameters of *S.graminum*. The life history studies of aphids and examine the effects of plant varieties 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 hostvarieties on greenbug life history (Webster and Porter 2000; Lage*et al.* 2003).However, there is no information about the demographic parameters of greenbugs onthe common sorghum varieties in Iran. Therefore, this study was conducted to assessthe effect of three common sorghum varieties on the biology and life historyparameters of greenbug.

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2. Material and method

2.1. Host plants

Three commercial sorghum varieties including KGS17, KGS19 and KGS20were tested to determine the effect of host plant varieties on population increase potentialof greenbug. The seeds of varieties were obtained from the Cereal Research Department of Iranian Research Institute of Plant Breeding in Karaj andwere planted in 20 cm diameter pots containing a mixture of sand, clay and peatmoss. The plants were placed in a greenhouse at 23± 2 ºC and 60–70% relativehumidity (RH) with ambient light.

2.2. Aphid colony

Aphids were collected from naturally infested sorghum-grown fields in Miyaneh region, Iran in the spring of 2010. The stock aphid population was cultured on the tested sorghum varieties for three or four generations beforethey were used in the experiments.

2.3. Greenhouse experiments

For each experiment, young apterous adult females from the stock colony weretransferred on experimental host plant varieties for nymph production. After four hours,the adults were removed and newly emerged first instar nymphs were collectedand transferred individually on leaf cages using a camel's-hair brush. 100 nymphs were reared on each of sorghum varieties studied. Thetest plants were placed in a greenhouse at 23±2°C, 60–70% RH. All nymphs were checked daily until theemergence of adults. The number of offspring produced by each adult aphid were counted and removeddaily 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 jackknifemethod was used (Maia *et al.,* 2000). One-way analysis of variance (ANOVA) wasconducted to analysis of the differences in the means of estimated parameters by jackknife methodand themeans 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 *Schizaphisgraminum*on three sorghum varieties. All stable population parameters were significantly influenced byhost plant varieties.

Table 1.Stable population parameters of greenbug on three sorghum varieties.

Variety	Net reproductive rate (R_0)	Finite rate of increase (λ)	Intrinsic rate of increase (r_m)	Mean gene ration time (T)	Doubling time (DT)
KGS17	35.502±1.625^{ab}	1.280±0.007^{b}	0.247±0.005b^{c}	14.432±0.320^{a}	2.801±0.062^{ab}
KGS19	25.969±2.911^{c}	1.263±0.009^{b}	0.233±0.007^{c}	13.949±0.494^{a}	2.961±0.091^{a}
KGS20	41.805±2.504^{a}	1.361±0.012^{a}	0.308±0.009^{a}	12.086±0.342^{b}	2.242±0.065^{c}

According to the data, the aphid net reproductive rate was significantly higher on KGS20 than on KGS19. Intrinsic rate of increase and finite rate of increase were also higher for the aphidsreared on KGS20 variety (0.308 female per female per day and 1.36 per day, respectively) because of a higher age-specific fecundity (m_x) (fig. 1) and net reproductive rate (R_0)(table 1) values of greenbugs reared on this variety. The shape of age-specific fecundity curves varied with the host plant species. According to Figure (1), theage-specific fecundity of the aphids was higher on KGS20 than other varieties studied.Population doubling time and meangeneration time values of greenbug on KGS20 was significantlylower than those on KGS17 and KGS19.

The effect of host plants on the life history parameters for *S. graminum* arepresented by Lazer*et al.* (1995), Webster and Porter (2000) and Nuessly*et al.*(2008).Intrinsic rate of increasevalues of

greenbugreported by Nuesslyet al.(2008) reared on *Paspalumvaginatum*was 0.235–0.262 female per female per day.

The intrinsic rate of natural increase can be used as population growth potentialindex of an aphid ondifferent host varieties. The most important factors that caninfluence r_m value are reproduction, mortality and nymphaldevelopment 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 in this study.Lageet al. (2003) also reported a lower r_m value (0.019–0.198) of greenbugs reared onsynthetic hexaploid wheat varieties than those obtained in this study. Nuesslyet al.(2008) also reported a lower R_0value of greenbugs on seashore paspalum. In contrast,McCauley *et al.* (1990) reported higher R_0 values for greenbugs reared on sorghumat 23°C.

The mean generation time and population doubling time of greenbugsreared inthese experiments were lower than those reported on corn and sorghum at 24°8C byMcCauley *et al.* (1992). In addition, McCauley *et al.* (1990) reported 1.19–1.41 per day finiterate of increase of greenbug when reared on sorghum and corn hybrids andgermplasms, which was similar to the results obtained in this study.

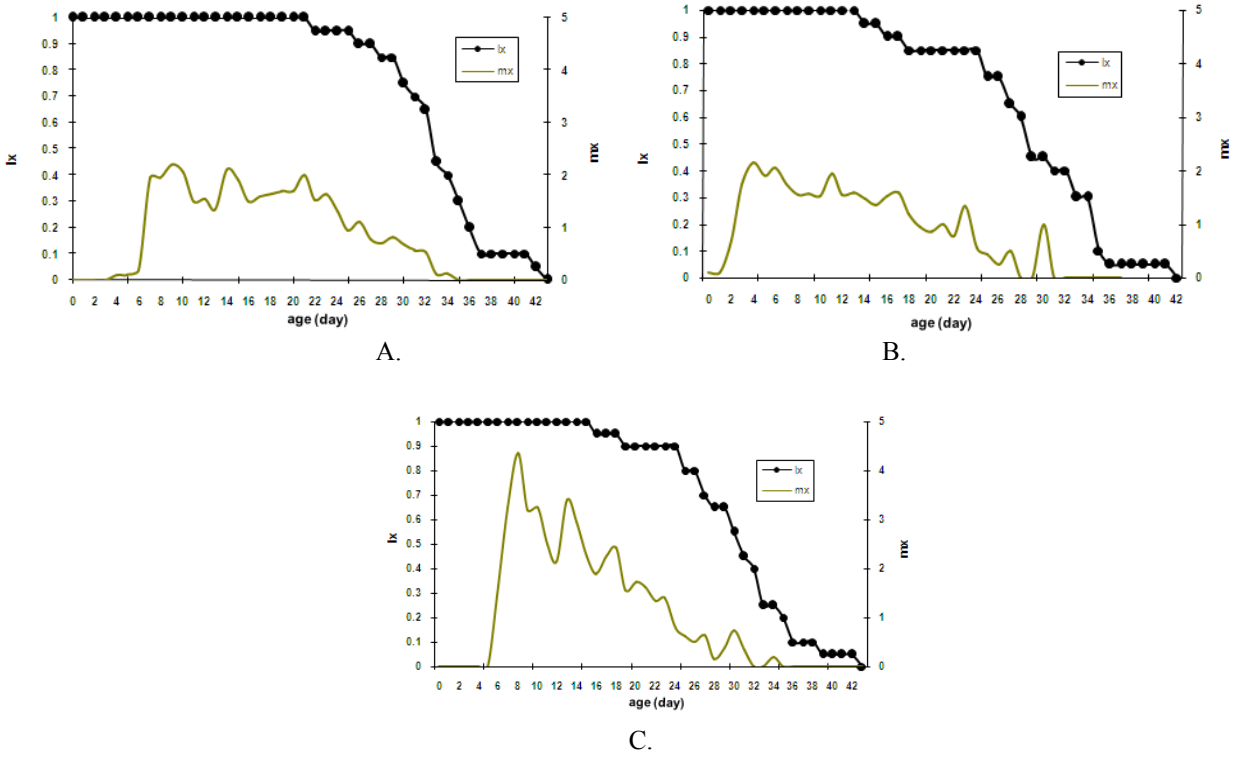

Fig. 1. Age specific survival (l_x) and fecundity (m_x) curves of greenbugon KGS17 (A), KGS19 (B) and KGS20 (C) sorghum varieties.

Present ourresults showed that the developmental time of greenbugin all varieties were close to what was recorded forthis species when fed on *Paspalumvaginatum* Swartz.To contrary, ourvalues were higher than those reported by McCauleyet al. (1990) for the same species, reared on sorghumat 23ºC (6.66).

KGS20 was recognized as the most suitable sorghum variety to the greenbug. It seems that higher age-specific fecundity (m_x)and net reproductive rate of the aphid on this variety resulted in increased values of intrinsic rate of increase and finite rate of increase of greenbugs reared on this variety. High intrinsic rate of increase reduces the values of mean generation time and doubling time for aphids reared on KGS20.

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. Khodabandeh (2007) was also reported that greenbugcould increase its

population by rate of 0.257 female per female per day.Differences in life table parameters obtained in differentstudies could be resulted by geographical region, using different varieties, and applying differentmethodology.

Lower or equal intrinsic rate of increase of an aphid species on a new variety of crops shows that extension its farming 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 KGS20 than on other varieties tested and so, extension of KGS20 cultivated area may result in greenbug population increase and so was not recommended.

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

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