EFFECTS OF DIFFERENT VARIETIES OF PEPPER (*CAPSICUM ANNUM* L.) ON THE BIOLOGICAL PARAMETERS OF THE GREEN PEACH APHID *MYZUS PERSICAE* SULZER (HEMIPTERA, APHIDIDAE) IN TUNISIA

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ABSTRACT

The green peach aphid *Myzus persicae* Sulzer (Hemiptera, Aphididae) is an important pest of pepper, *Capsicum annum* (Solanaceae), with infestations by this aphid resulting in serious economic damage. Commonly, biological parameters are used to compare insect fitness on different varieties of pepper. Effect of rearing *M. persicae* on nine varieties of pepper (Anamex, Balconi, Bami, Chargui, Garn ghzel, Italico, J27, Starter and Torero) on the population density and percentage infestation it achieves, and its mean relative growth rate (MRGR) and generation time were studied under laboratory conditions. The highest population density, maximum percentage infestation (92.93%), minimum generation time (10.95 days) and highest MRGR (0.063) were recorded on the variety Chergui and the lowest population density, minimum percentage infestation (51.4%), minimum MRGR (0.043) and maximum generation time on the variety Anamex.

Keywords: green peach aphid, pepper, plant varieties, biological parameters, Tunisia

Introduction

Myzus persicae (Sulzer) (Hemiptera: Aphididae) is an extremely polyphagous aphid with more than 400 secondary host plants belonging to more than 40 families but only one primary host, peach *Prunus persica* L. (Rosaceae), on which sexual reproduction occurs (Bernays and Chapman 1994). This aphid causes considerable damage when abundant and infesting young plant tissues, which results in water stress, wilting and reduced growth (Saljoqi et al. 2009). In addition to direct injury they can cause plants, aphids are able to transmit more than 200 plant viruses (Blackman and Eastop 2000). Apterous aphids can transmit viruses between adjacent plants and their alate offspring are often responsible for the transmission of viruses from one region to another (Raboudi et al. 2002). The ability of aphids to transmit viruses is linked to their feeding exclusively on phloem sap (Sandström et al. 2000). Indeed, aphids are very selective feeders, which choose their host plants based on visual, mechanical, and chemical stimuli (Bernays 1998). The acceptance or rejection of a plant by aphids can involve the nature of the plant's volatile chemicals, surface waxes, intercellular polysaccharides, mesophyll and phloem constituents (Niemeyer 1990; Caillaud and Via 2000). Therefore, the size of aphid populations varies from host to other. In fact, in Tunisia, *M. persicae* is reported infesting pepper, potatoes and artichoke as secondary hosts and peach as its primary host (Ben Halima Kamel 1991, 2005; Ben Halima Kamel and Ben Hamouda 1993; Guesmi et al. 2010). On pepper, *M. persicae* seriously affects the yield and quality of the crop (Ben Halima Kamel 2011), but can be controlled by spraying pesticides and plant extracts (Ben Halima Kamel et al. 2001) and releasing *Coccinella algerica* Kovar (Ben Halima Kamel 2005). However, these methods are not very effective control measures. The development of a comprehensive pest management program for pepper in Tunisia is dependent on having good estimates of the demographic parameters of *M. persicae* on different cultivars of pepper. Indeed, there are several studies of the effect of host plants on the development rates and fecundities of various pest insects (Morgan et al. 2001). For this, we need to know the behaviour of this aphid on different cultivated varieties of pepper in Tunisia and the susceptibility or resistance of these varieties to this aphid. This is a fundamental component of an integrated pest management program for any crop.

In the present paper, the biological parameters of *M. persicae* reared under controlled conditions were studied in order to describe this aphid's behaviour on nine varieties of pepper.

Materials and Methods

Biological Material

Aphids were collected from a parthenogenetic population on pepper in a field at Chott Mariem in Tunisia (36°48′N, 10°11′E) and reared for several generations on sweet pepper in a green house at 21 ± 2 °C, HR: 60–80% and under a long day photoperiod (L:D 14:10) (Troncoso et al. 2005). These aphids were needed to infest the pepper plants used in the experiments.

Nine varieties of *Capsicum annum* L. pepper (Anamex, Balconi, Bami, Chargui, Garn ghzel, Italico, J27, Starter and Torero) were used as host plants, which were established from seed sown in 12 cm diameter plastic pots filled with suitable soil. At the 8th leaf stage, plants were infested with *M. persicae.*

Table 1 *MRGR*, generation time (*T*) and percentage infestation by *Myzus persicae* of nine varieties of pepper.

Variety	*MRGR*	*T* (days)	Percentage infestation (%)
Anamex	0.043	16.04	51.4[d]
Bami	0.051	13.52	87.6[a]
Belconi	0.058	11.89	84.5[a]
Chergui	0.063	10.95	92.93[a]
Garn ghzel	0.057	12.10	78.8[b]
Italico	0.048	14.37	69.5[c]
J27	0.046	15	69.9[c]
Starter	0.052	13.26	62.4[c]
Torero	0.053	13.01	65.64[c]

(Different letters associated with the mean values in a column indicate significant differences between varieties based on a Duncan test and $p = 0.05$.)

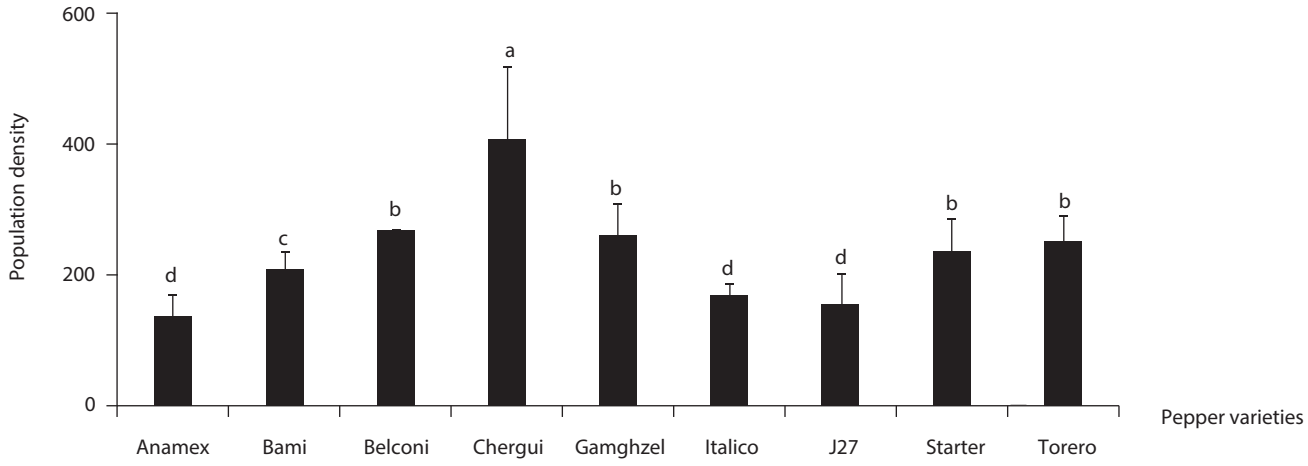

Fig. 1 The number of *Myzus persicae* recorded on nine varieties of pepper 20 days after the initial infestation (Different letters at the tops of the columns indicate significant differences between treatments based on a Duncan test and $p = 0.05$).

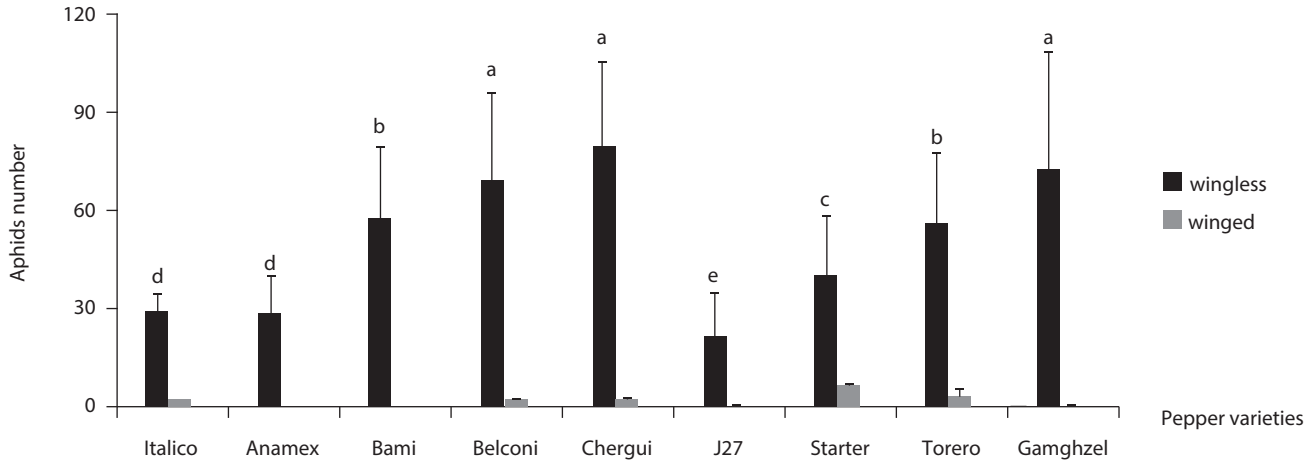

Fig. 2 Numbers of winged and wingless individuals of *M. persicae* recorded on nine varieties of pepper 20 days after the initial infestation (different letters at the tops of the columns indicate significant differences between treatments based on a Duncan test and $p = 0.05$).

Methods of Survey

At the 8th leaf stage, five apterous *M. persicae* were placed on each of the plants. The plants were then placed in cages to prevent contamination by other aphids. For each treatment (variety) there were 20 replicates (plants). The plants were checked daily in order to determine the mean numbers of wingless and winged adults, overall fecundity (total number of larvae produced), the mean relative growth rate (MRGR), which was calculated according to Fisher (1920) and Radford (1967), as cited in Leather and Dixon (1984) using the formula

$$MRGR = \ln(N_t/N_{t-1})/\Delta t,$$

where N_{t-1} is the size of the population at time $t-1$, N_t is the size of the population at time t, Δt is the interval of time between the two evaluations of the size of the population (5 days).

Also, we determined the generation time (T) according to Ramade (2003) using the equation

$$T = \ln(2/MRGR)$$

and the percentage infestation (number of leaves infested / total number of leaves).

Statistical Analysis

For the laboratory assays, the experimental results were statistically analyzed using SPSS 17 program, a one-way analysis of variance and a Duncan test, with statistical significance set at $\alpha = 0.05$. The population density, number of winged and wingless individuals and the percentage infestation of the different pepper varieties were compared.

Results

Effect of Different Varieties of Pepper on the Abundance of *Myzus persicae*

Results of the effect of the different varieties of pepper on the abundance of *M. persicae* are presented in Table 1. The largest aphid populations were recorded successively in decreasing order on the varieties Chergui, Belconi, Starter and Torero (Fig. 1). There was a significant difference between the levels of infestations after 20 days ($F = 22.94$, df = 8, $p = 0.026$) of the varieties Anamex, Bami, Belconi, Garn ghzel, Italico, J27, Starter and Torero. a significant difference was also recorded in numbers of wingless individuals on the different pepper varieties (Fig. 2) ($F = 48.55$; df = 8; $p = 0.003$). The highest numbers of wingless individuals of *M. persicae* were recorded on Chergui, Belconi and Garn ghzel, and the lowest numbers on Italico, Anamex and J27. In terms of the numbers of winged individuals there were no significant differences in the numbers recorded on the different varieties.

Effect of Different Varieties of Pepper on the Mean Relative Growth Rate and Generation Time of *Myzus persicae*

The pepper plant varieties differed in their effect on the MRGR of *M. persicae*. The highest MRGR was recorded on variety Chergui (0.063) and lowest on variety Anamex (0.043). On all the other varieties the MRGRs range between 0.058 and 0.047 (see Table 1). The shortest generation time (T) was recorded on variety Chergui (10.95 days) and longest on variety Anamex (16.04) (see Table 1). The percentage infestation also differed significantly ($F = 7.22$, df = 8, $p = 0.018$) between varieties. The highest percentage infestation was recorded on variety Chergui (92.83) and the lowest on Anamex.

Discussion and Conclusions

The results indicate that the development and reproduction of the green peach aphid differed significantly on the nine varieties of pepper studied. *M. persicae* developed faster on Chergui than on the other varieties. Significant differences were recorded in population density, mean relative growth rate, generation time and percentage infestation of the different varieties of pepper by *M. persicae*. The variety Chergui was a more susceptible host than Anamex, Bami, Belconi, Garn Ghzel, Italico, J27, Starter or Torero. This indicates that the variety Chergui is the best of these plants as a host of *M. persicae* in terms of the demographic parameters measured. Several studies similarly indicate that host plant variety can affect the reproductive performance of several species of aphids (Saikia and Muniyappa 1989). Indeed, Nikolalkakis et al. (2003) report a significant effect of the variety of the host plant on intrinsic rate of increase, fertility and generation time of *M. persicae* feeding on pepper and tobacco, with the intrinsic rate of increase 0.24–0.29 and 0.23–0.29, and fecundity 32.2 and 37.7 on pepper and tobacco, respectively. Fecundity also ranged from 28.9 to 45.5 on the different varieties of tobacco. Similarly, Goundoudaki et al. (2003) studies in Greece also revealed an effect of host plant variety on the performance of *M. persicae* and that its performance on 11 varieties of oriental tobacco and 5 of Virginia tobacco at 20 °C and under a 16 hours photophase differed significantly. In addition, Goundoudaki et al. (2003) report that the longevity of the green peach aphid ranges from 9.1 and 9.6 days, the intrinsic rate increase is 0.23 and percentage mortality between 27.9 and 52.5% on different varieties of Virginia tobacco, whereas, on oriental varieties longevity is between 7.3 and 9 days, intrinsic rate of increase ranges from 0.28 to 0.33 and percentage mortality between 10 and 47.9%. Similarly, Sauge et al. (1998) working in France report that the intrinsic rate of increase of *M. persicae* on four varieties of peach (GF305; Summer grand, Molo konare and Wild) are respectively 0.2; 0.28; 0.26 and 0.36.

The effect of different host plant varieties on the per-

formance of other species of aphids is also well documented. Buriro et al. (1997) report significant difference in terms of adult longevity, generation time and fertility of *Schizaphis graminum* Rondani, with of the four wheat cultivars tested Zagros the most resistant and Tajan the most susceptible. Similarly, the effect of host plant variety on biological parameters of aphids is reported by Razmjou et al. (2006) for five cultivars of cotton in which the highest offspring production per female of 29.6 was recorded on cultivar Sahel and lowest on Sealand. Goldasteh et al. (2012), in a similar study of *S. graminum* on four commercial cultivars of wheat grown under laboratory conditions, report that the development times of viviparous wingless aphids, total number of offspring produced per female and adult longevity differed significantly on the four wheat cultivars. In conclusion, resistant plants play a key role in IPM programs. Identification of resistant varieties of host plant is therefore the first step in the development of an IPM program. The results obtained in this study revealed that of the nine varieties of pepper studied, Anamex is the most resistant and Chargui the most susceptible. For the mass rearing of the natural enemies of *M. persicae,* in insectaries or under laboratory conditions, for release in augmentative biological control programs, Chargui would be the best choice for mass producing aphid prey based on our results.

However, more studies are needed on the chemical composition of the sap and the performance of *M. persicae* on different varieties of pepper in the field, and the effect of the variety of pepper on effectiveness of the natural enemies of *M. persicae*.

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