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ORIGINAL ARTICLE

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Prey consumption by larval and adult stages of the entomophagous ladybird *Serangium parcesetosum* Sicard (Col., Coccinellidae) of the cotton whitefly, *Bemisia tabaci* (Genn.) (Hom., Aleyrodidae), at two different temperatures

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Abstract The entomophagous ladybird, *Serangium parcesetosum* Sicard (Col., Coccinellidae) appears to be a promising predator against the cotton whitefly, *Bemisia tabaci* (Genn.) (Hom., Aleyrodidae). Knowledge about its consumption of *B. tabaci* is incomplete. The present study was undertaken to determine the potential use of this predator in biological control programs. The daily and total prey consumption of *S. parcesetosum* through the entire development of the larval instars as well as during three different periods of longevity of adult females and males feeding on nymphs or puparia of *B. tabaci* as prey was examined. In addition, the daily prey consumption of the adult females where the number of *B. tabaci* puparia was altered was studied at two different temperatures in the laboratory. The results showed that the mean daily prey consumption of nymphs or puparia of *B. tabaci* by larval instars of *S. parcesetosum* increased gradually as development progressed at both temperatures. Significant differences were found in the mean total prey consumption among the different predatory larval instars. In total, *S. parcesetosum* consumed during its entire larval development significantly more nymphs than puparia; at 18°C it consumed a mean of 1,566.1 (♀) and 1,443.9 (♂) nymphs or 280.0 (♀) and 250.8 (♂) puparia, while at 30°C, it consumed a mean of 1,119.1 (♀) and 979.9 (♂) nymphs or 188.2 (♀) and 171.6 (♂) puparia. Over the three studied periods of the adult stage of *S. parcesetosum*, the mean daily prey consumption by the females and males fluctuated irregularly at both temperatures. At 18°C and 30°C, both females and males consumed significantly more nymphs than puparia. No significant differences were found between females and males with respect to consumption of nymphs, although significant differences were found between the sexes with respect to consumption of puparia, but at 18°C only. The mean total prey consumption over the three studied adult stages was 2,188.4 (♀) and 1,994 (♂) nymphs or 727.1 (♀) and 624.8 (♂) puparia at 18°C, while at 30°C the mean values were 3,947.7 (♀) and 3,577.3 (♂) nymphs or 1,600.5 (♀) and 1,448.8 (♂) puparia. *S. parcesetosum* adapted smoothly to fluctuating prey availability, where the mean daily prey consumption became higher when 50 puparia/day was offered. In contrast, the predator consumed most individuals when the number of prey supplied was 10 or 5 puparia/day. Prey consumption decreased during the second experimental week in the trial, before which 50 puparia/day had been offered. In the other trials, before which 20, 10 and 5 puparia/day had been offered, a considerable increase in prey consumption was noted.

Keywords *Serangium parcesetosum* · *Bemisia tabaci* · Prey consumption · Predator · Ladybird

This paper is dedicated to Prof. Dr I. Akif Kansu, University of Ankara, Turkey on his 80th birthday.

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Introduction

The entomophagous ladybird, *Serangium parcesetosum* Sicard (Col., Coccinellidae) is an important predator of whiteflies. It was recorded for the first time in India as a predator of the cotton whitefly, *Bemisia tabaci* (Genn.) (Hom., Aleyrodidae) (Kapadia and Puri 1992), and of the sugarcane whitefly, *Aleurolobus barodensis* Mask. (Shah et al. 1986; Patel et al. 1996). It was imported and used to control the citrus whitefly, *Dialeurodes citri* (Ashmead) in Georgia (Timofeyeva and Nhuan 1979), France and Corsica (Malausa et al. 1988) and Turkey (Yigit 1992a, 1992b; Uygun et al. 1997; Yigit et al. 2003). It was also introduced into the United States (Lacey and Kirk 1993) and its action against the silverleaf whitefly, *Bemisia argentifolii* Bellows and Perring was investigated (Cohen et al. 1995; Legaspi et al. 1996, 2001; Ellis et al. 2001). In Israel, it was released against the woolly whitefly, *Aleurothrixus floccosus* (Maskell) (Argov 1994) and has been reported in Syria on *B. tabaci* and *D. citri* (Abboud and Ahmad 1998).

The biological characteristics of *S. parcesetosum* on some whitefly species have been studied. Timofeyeva and Nhuan (1979) determined its development, mortality and fecundity with *D. citri* on citrus at 20–23°C. Kapadia and Puri (1992) studied its biology with *B. tabaci* on eggplant and cotton at 23.7°C. Its longevity at different temperatures on different plant species when feeding on *B. argentifolii* was investigated (Legaspi et al. 1996). Patel et al. (1996) studied the development and longevity of the predator with *A. barodensis* on sugarcane at 27°C. Studies were performed on the effect of temperature and whitefly species on its development (Abboud and Ahmad 1998). Furthermore, some investigations documented the influence of plant species on its fecundity and mortality as well as temperature on its development with *B. tabaci* (Ahmad and Abboud 2001). Sengonca et al. (2004) observed the life table parameters of *S. parcesetosum* on *B. tabaci* at different temperatures and on different plant species, while Al-Zyoud et al. (2005) recorded its biology on different plant species at 30°C.

The relationship between populations of *S. parcesetosum* and *A. barodensis* was also studied (Shah et al. 1986). Kapadia and Puri (1992) found that *S. parcesetosum* is very host-specific to *B. tabaci*. Its prey consumption and preference as a biological control agent of *B. argentifolii* were investigated (Legaspi et al. 1996). It was observed that this predator is highly specific and feeds voraciously on *A. barodensis* (Patel et al. 1996). The preference of *S. parcesetosum* for different species of whiteflies was determined (Abboud and Ahmad 1998). According to Ahmad and Abboud (2001), it could feed on all developmental stages of *B. tabaci*. Moreover, Ellis et al. (2001) recorded the effect of release rates of *S. parcesetosum* on the population dynamics of *B. argentifolii*. *S. parcesetosum* is not as voracious when feeding on citrus blackfly, *Aleurocanthus woglumi* Ashby, eggs as on silverleaf whitefly nymphs (Legaspi et al. 2001). Al-Zyoud and Sengonca (2004) noted that it shows a preference for *B. tabaci* and the greenhouse whitefly, *Trialeurodes vaporariorum* Westwood over the non-whitefly species offered, that it can feed on all developmental stages of *B. tabaci*; and tended to avoid *B. tabaci* puparia parasitized by *Encarsia formosa* Gahan. It seems to occupy a number of host plant species of *B. tabaci* for oviposition (Al-Zyoud et al. 2005). However, little research interest has been shown in the consumption by *S. parcesetosum* larval instars and adults of different developmental stages of *B. tabaci* as prey.

Therefore, the present study was undertaken to investigate the daily and total consumption of nymphs or puparia of *B. tabaci* as prey by *S. parcesetosum* through the entire development of the larval instars as well as during three different periods of the adult stage of females and males, as well as the daily prey consumption of adult females in response to a changing number of *B. tabaci* puparia at two different temperatures in the laboratory.

Materials and methods

S. parcesetosum was reared on cotton plants, *Gossypium hirsutum* L. cv. Caroline Queen infested with *B. tabaci*, from approximately ten individuals provided by the Plant Protection Research Institute, Adana, Turkey. The substrate-potted plants were placed in cylindrical plexiglas cages covered with mesh (19 cm diameter, 40 cm high) and fresh plants were supplied when necessary. In order to increase only the *B. tabaci* colony as prey, a few potted cotton plants infested with whitefly were obtained from Bayer (Monheim, Germany) and placed with fresh ones in cages covered with mesh (80×50×60 cm). Both colonies were kept in climatically controlled chambers at 25 ± 2°C, 60 ± 10% relative humidity and a photoperiod of 16:8 h (light:dark) with an artificial light intensity of about 4,000 lux as well as daylight for the predator only.

Round plexiglas cages (11 cm diameter, 3 cm high) were used to obtain the appropriate stages of *S. parcesetosum* for the experiments. They were partially filled with a 0.5-cm-thick layer of wetted cotton pad and the lid of each had three holes covered with mesh to allow ventilation. Cotton leaves infested with > 300 eggs, nymphs and puparia of *B. tabaci* were placed upside down on the cotton pads for the predator to feed on. Thereafter, five to six mated adult females of *S. parcesetosum* were transferred into each round plexiglas cage for 24 h only to lay eggs. The adults were then removed and the round plexiglas cages were kept in an incubator under the same conditions mentioned above until *S. parcesetosum* reached the desired stage for the experiments. In order to obtain the nymphs or puparia of *B. tabaci* required, cotton plants were exposed to the whitefly infestation in the colony for 24 h. Thereafter, only the eggs laid on the plants were incubated at the same climatic conditions and observed daily until the individuals reached the appropriate stage for the experiments.

The experiments on prey consumption by *S. parcesetosum* larval instars during their entire development as well as during three adult stages were studied in the laboratory at 18 ± 1°C and 30 ± 1°C and the same conditions described above. The experiments on the consumption of a changing supply of *B. tabaci* puparia were set up at 18 ± 1°C. All the experiments were conducted on cotton leaf discs (3 cm diameter) in small round plexiglas cages (5.5 cm diameter, 2 cm height), filled with a 0.5-cm-thick agar gel layer. The lid of each cage had a hole covered with mesh to allow aeration.

In order to determine the prey consumption by the larval instars of *S. parcesetosum*, newly hatched L_1larvae were collected with a camel-hair brush and kept individually in the abovementioned small round plexiglas cages. The predatory larvae were offered to *S. parcesetosum* daily on one cotton leaf disc, i.e. >125 nymphs or >25 puparia for L_1–L_2 as well as >200 nymphs or >45 puparia for L_3–L_4 instars of *S. parcesetosum* at 18°C. At 30°C, the number offered was >175 nymphs or >30 puparia for L_1–L_2 as well as >300 nymphs or >60 puparia for L_3–L_4instars. During the experiments, the larvae were transferred daily into new cages with fresh prey and the number of consumed prey in the old cages was noted. There were 20 replicates in the experiments per prey stage at each temperature for both sexes.

Freshly emerged females and males (maximum 24 h) were used to investigate the prey consumption by *S. parcesetosum* adults. Each predatory individual was kept singly in round plexiglas cages like those used for the predatory larvae and offered >80 nymphs or >30 puparia of *B. tabaci* daily at 18°C as well as >120 nymphs or >60 puparia daily at 30°C on a cotton leaf disc. *S. parcesetosum* individuals were transferred daily into new round plexiglas cages with fresh prey and the number of nymphs or puparia consumed was recorded. The experiments were conducted on the 1st–20th, 61st–80th and 121st–140th days after emergence of adults for females and males at 18°C. At 30°C, they were carried out on the 1st–20th, 41st–60th and 81st–100th days after emergence of adults for females as well as the 1st–20th, 31st–50th and 61st–80th days after emergence for males. During the non-experimental days, the females and males were provided daily with >150 nymphs or >80 puparia of *B. tabaci* and were kept at the same temperature and checked daily for the availability of prey as well as mortality of the predatory individuals. There were ten replicates for male and female predators and for each prey stage at each temperature.

Prey consumption where the number of *B. tabaci* puparia offered was changed was determined in another set of experiments. Seven-day-old adult females of *S. parcesetosum* were used over a period of 3 weeks. Each female was placed singly on one cotton leaf disc in the small round plexiglas cages mentioned above and offered daily 50, 20, 10 or 5 puparia during the 1st experimental week. During the 2nd week of the experiment, the number of prey offered was changed to 30 puparia/day, while in the 3rd experimental week it was 50, 20, 10 or 5 puparia/day. The females were transferred daily to new cages, containing the appropriate number of *B. tabaci* puparia and the number of consumed prey was counted. All the experiments were replicated 10 times.

A two-factor ANOVA was performed. Significant differences among means were determined utilising a LSD test at $P<0.05$. A *t*-test was used for comparisons between two means (Winstat 1996).

Results

Prey consumption by larval instars

Figure 1 shows the mean daily prey consumption by the immature stages of *S. parcesetosum* of nymphs or puparia of *B. tabaci* at 18°C. The mean daily consumption of nymphs was 22.7 (♀) and 19.7 (♂) on the 1st day after hatching and then it increased gradually to reach a peak of 148.7 (♀) and 161.0 (♂) by the L_4 instar on the 19th and 20th days after hatching, respectively. When puparia were offered, the daily mean prey consumption on the 1st day was 6.1 (♀) and 5.8 (♂) and increased thereafter to reach a maximum of 27.4 (♀) and 26.7 (♂) on the 17th and 15th days, respectively. At 30°C when feeding on nymphs, the L_1instar consumed 46.1 (♀) and 47.1 (♂) on the 1st day (Fig. 2), and this rate increased gradually thereafter to reach a peak of 234.6 (♀) and 220.1 (♂) for the L_4 instar on the 9th and 7th days, respectively. With puparia, a mean of 8.6 (♀) and 10.6 (♂) was determined for the 1st day which increased thereafter to 36.3 (♀) and 29.8 (♂), the highest numbers recorded, on the 9th and 6th days, respectively.

The mean total prey consumption by the separate larval instars of *S. parcesetosum* feeding on nymphs or puparia of *B. tabaci* at 18°C is summarized in Fig. 3. The L_1instar consumed a mean total of 115.4 (♀) and 103.4 (♂) nymphs or 26.6 (♀) and 23.5 (♂) puparia. The

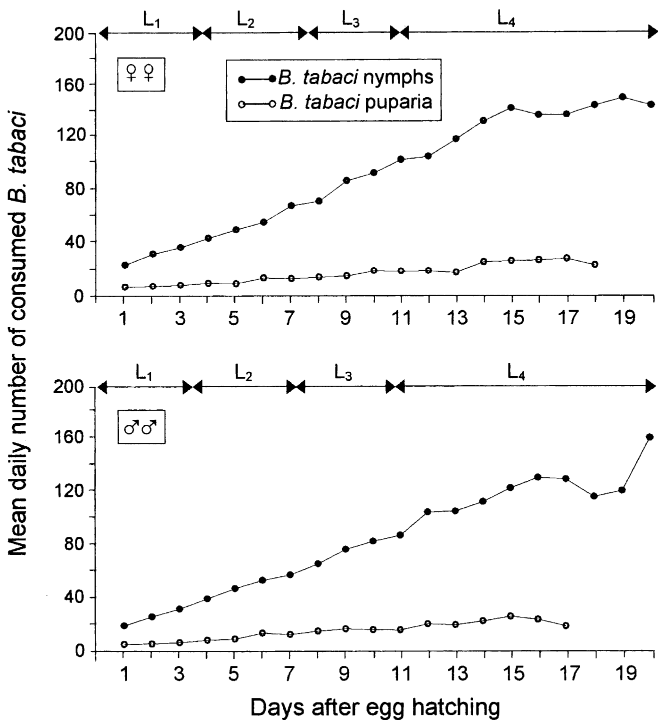

Fig. 1 Mean daily consumption of nymphs or puparia of *Bemisia tabaci* offered on cotton leaf discs at 18 ± 1°C by immature stages of *Serangium parcesetosum*

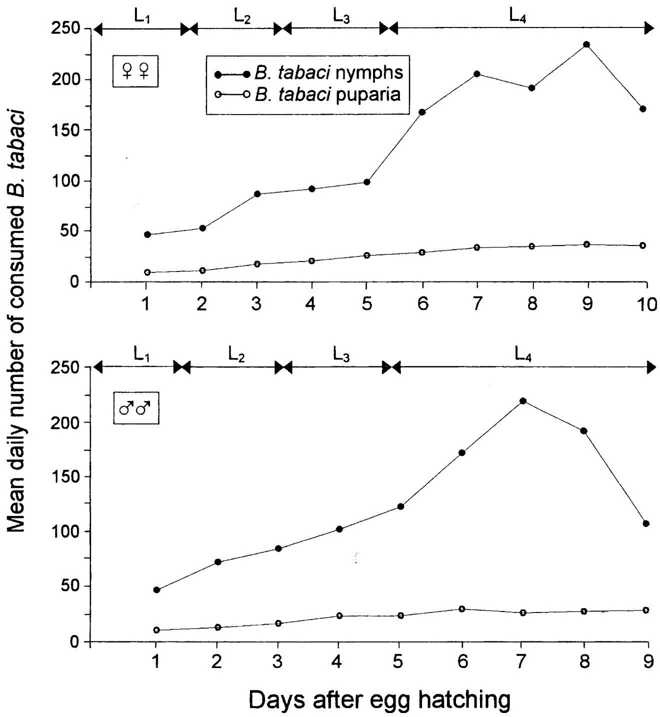

Fig. 2 Mean daily consumption of nymphs or puparia of *B. tabaci* offered on cotton leaf discs at 30 ± 1°C by immature stages of *S. parcesetosum*

mean total prey consumption increased with development till it was highest for the L_4 instar, i.e. 963.9 (♀) and 896.6 (♂) nymphs or 151.5 (♀) and 135.9 (♂) puparia. In total, *S. parcesetosum* consumed during its entire larval development significantly more nymphs than puparia, i.e. a mean of 1,566.1 (♀) and 1,443.9 (♂) nymphs or 280.0 (♀) and 250.8 (♂) puparia. At 30°C, the L_1 instar fed on a mean total of 78.9 (♀) and 75.3 (♂) nymphs, while for puparia it was 17.5 (♀) and 13.1 (♂) (Fig. 4). The total mean prey consumption continued to increase with development and was highest in the L_4 instar, i.e. 675.9 (♀) and 592.2 (♂) nymphs or 101.7 (♀) and 86.2 (♂) puparia. In total, *S. parcesetosum* consumed during its whole larval development significantly more nymphs than puparia, a mean of 1,119.1 (♀) and 979.9 (♂) nymphs or 188.2 (♀) and 171.6 (♂) puparia was consumed. At both temperatures, there were significant differences in the mean total prey consumed among the different larval instars, and as their development progressed significantly more nymphs or puparia were consumed by both predatory sexes. Also, significant differences were found in the mean total prey consumption between females and males feeding on nymphs, while there were no significant differences for puparia.

Prey consumption by adults

The mean daily prey consumption by *S. parcesetosum* adult females and males fluctuated irregularly over the three studied stages at both temperatures. At 18°C, females consumed a mean of 14.6 nymphs or 10.3 puparia on the 1st day after adult emergence (Fig. 5), and the mean consumption increased thereafter to reach a peak of 49.2 nymphs or 21.6 puparia on the 10th and 9th days, respectively. On the 61st day, the females consumed a mean of 29.4 nymphs or 9.8 puparia and then the numbers fluctuated to reach a maximum of 42.4 nymphs or 13.4 puparia on the 78th and 70th days, respectively. The mean consumption was 44.0 nymphs or 9.0 puparia on the 121st day, and then it fluctuated and reached the highest number of 46.4 nymphs or 13.1 puparia on the 132nd and 128th days, respectively. After that, there was an irregular, decreasing trend in prey consumed till the last day of the experiments. In contrast, on the 1st day males consumed a mean of 12.7 nymphs or 8.6 puparia, which thereafter increased to reach a maximum of 43.6 nymphs or 17.5 puparia on the 14th and 9th days, respectively. On the 61st day, the males consumed a mean of 30.4 nymphs or 10.1 puparia, then their consumption fluctuated and reached a mean of 36.3 nymphs on the 71st and 75th days, respectively or 12.5 puparia on the 63rd day. Thereafter, males consumed a mean of 35.8 nymphs or 8.7 puparia on the 121st day, which then fluctuated to give 44.3 nymphs or 11.3 puparia consumed on the 123rd and 127th days, respectively. Afterwards, the numbers consumed fluctuated till the end of the experiments. The mean total prey consumption by *S. parcesetosum* over the three studied

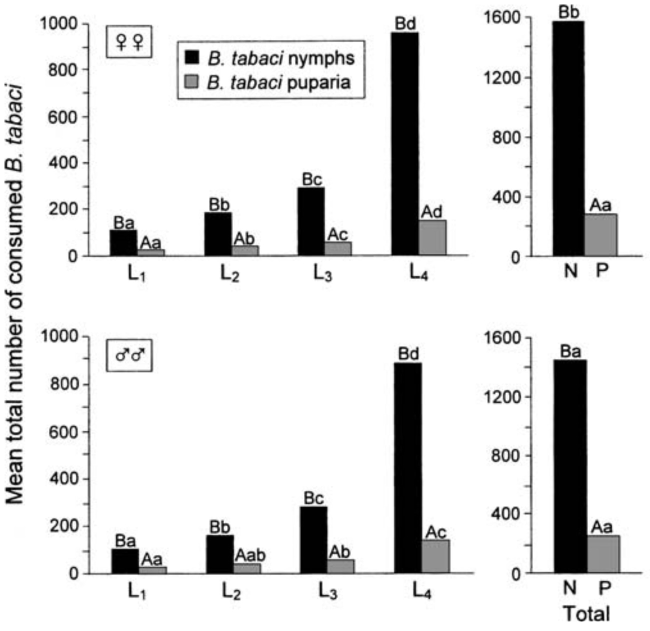

Fig. 3 Mean total prey consumption by female and male *S. parcesetosum* larval instars feeding on nymphs (*N*) or puparia (*P*) of *B. tabaci* offered on cotton leaf discs at 18 ± 1°C. *Bars with different small letters* indicate significant differences among the different larval instars within the same sex and prey stage. *Bars with different capital letters* indicate significant differences between the different prey stages within the same larval instar and sex at $P < 0.05$ (two-factor ANOVA)

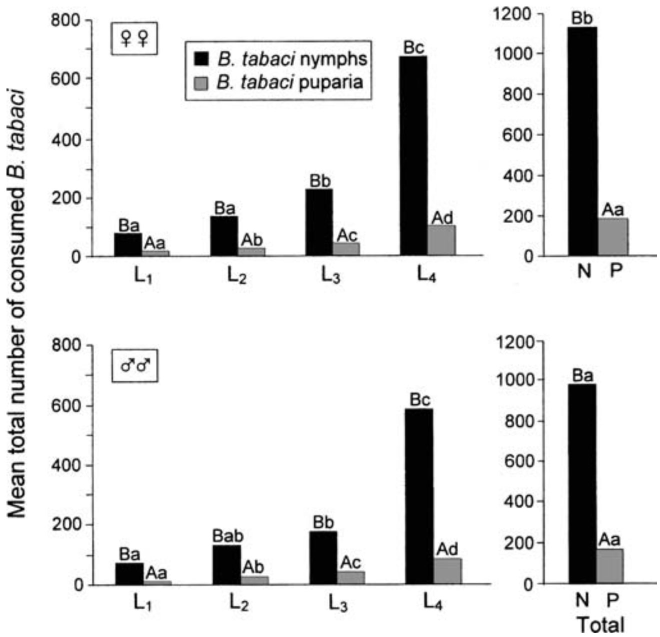

Fig. 4 Mean total prey consumption by female and male larval instars of *S. parcesetosum* feeding on nymphs (N) or puparia (P) of *B. tabaci* offered on cotton leaf discs at 30 ± 1°C. *Bars with different small letters* indicate significant differences among the different larval instars within the same sex and prey stage. *Bars with different capital letters* indicate significant differences between the different prey stages within the same larval instar and sex at $P < 0.05$ (two-factor ANOVA)

periods of the adult stage was 2,188.4 (♀) and 1,994 (♂) nymphs or 727.1 (♀) and 624.8 (♂) puparia.

At 30°C, a mean of 40.5 nymphs or 23.8 puparia was consumed by females on the 1st day after adult emergence (Fig. 6), and the rate increased thereafter to reach a peak of 73.6 nymphs or 39.6 puparia on the 6th and 8th days, respectively. The mean prey consumption was 64.6 nymphs or 26.0 puparia on the 41st day, which then fluctuated and was highest at 82.9 nymphs or 29.8 puparia on the 54th and 48th days, respectively. On the 81st day, females consumed a mean of 70.5 nymphs or 17.0 puparia, and after that the mean number fluctuated to reach a maximum of 77.3 nymphs or 32.5 puparia on the 87th and 86th days, respectively. Afterwards, the consumption of prey fluctuated irregularly till the experiments finished. In contrast, males consumed a mean of 30.5 nymphs or 22.6 puparia on the 1st day, which increased thereafter to reach a peak of 70.9 nymphs or 32.5 puparia consumed on the 13th and 4th days, respectively. A mean of 64.1 nymphs or 26.1 puparia was consumed on the 31st day, which then fluctuated to give 71.7 nymphs or 28.3 puparia on the 45th and 34th days, respectively. On the 61st day, a mean of 68.3 nymphs or 15.8 puparia was consumed, and this fluctuated thereafter until a maximum mean of 73.0 nymphs or 32.7 puparia consumed was reached on the 67th day. The prey consumption decreased irregularly till the last day of the experiments. The mean total prey consumption by *S. parcesetosum* over the three studied periods of longevity was 3,947.7 (♀) and 3,577.3 (♂) nymphs or 1,600.5 (♀) and 1,448.8 (♂) puparia. At both temperatures, females and males consumed significantly more nymphs than puparia. There were no significant differences between females and males with respect to consumption of nymphs, although for puparia there were significant differences, but at 18°C only.

During the 1st week of the experiments, when the daily number of prey offered was 50 puparia/day, a range of 25.0–30.1 puparia was consumed daily (Fig. 7).

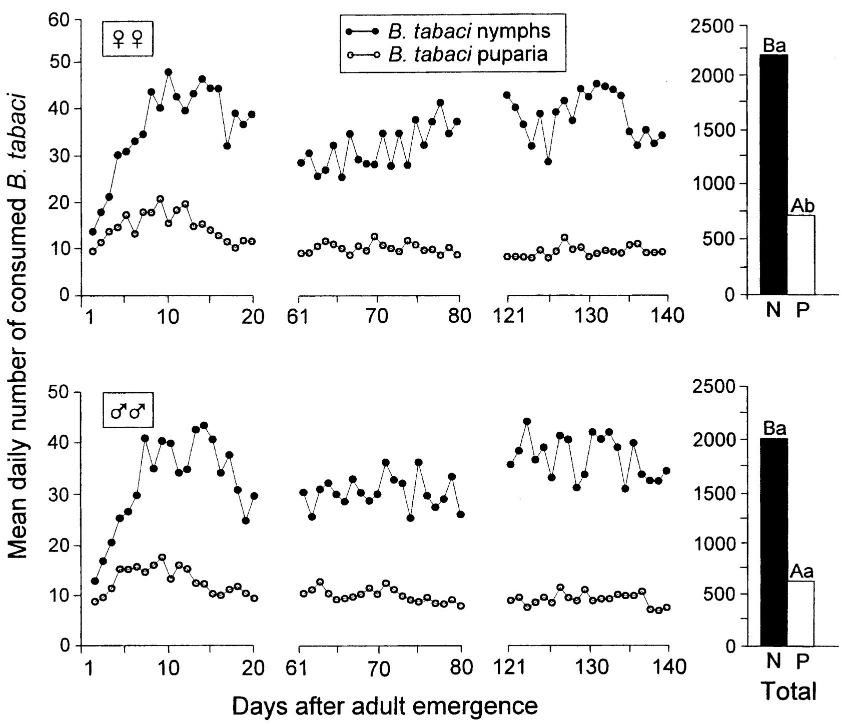

Fig. 5 Mean daily and total prey consumption by female and male *S. parcesetosum* during three different periods of longevity of nymphs (N) or puparia (P) of *B. tabaci* offered on cotton leaf discs at 18 ± 1°C. *Bars with different small letters* indicate significant differences between sexes within the same prey stage. *Bars with different capital letters* indicate significant differences between the different prey stages within the same sex at $P < 0.05$ (two-factor ANOVA)

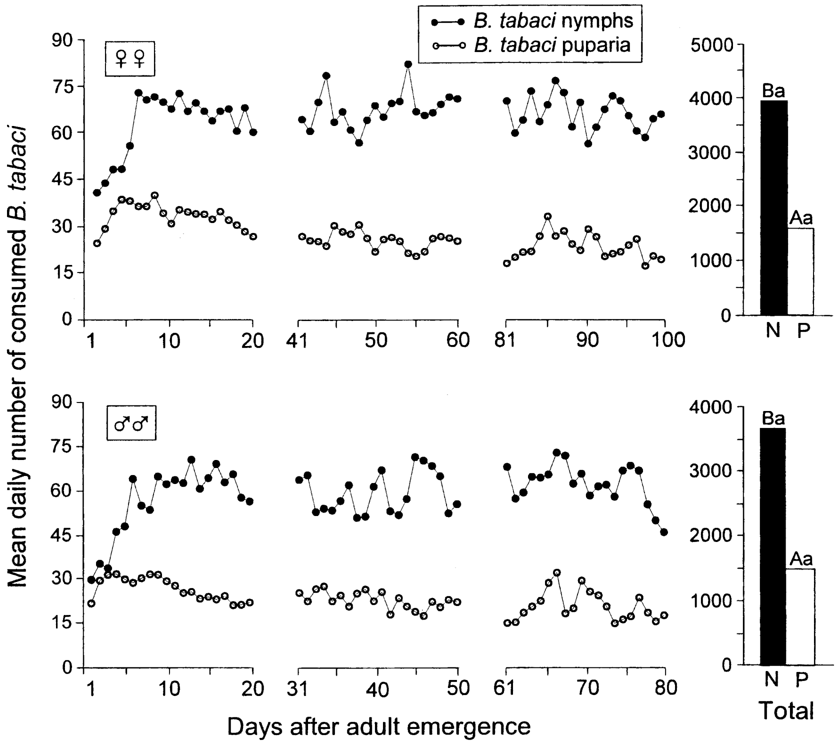

Fig. 6 Mean daily and total prey consumption by females and males of *S. parcesetosum* at three different periods of longevity feeding on nymphs (N) or puparia (P) of *B. tabaci* offered on cotton leaf discs at 30 ± 1°C. *Bars with different small letters* indicate significant differences between males and females within the same prey stage. *Bars with different capital letters* indicate significant differences between the different prey stages within the same sex at $P < 0.05$ (two-factor ANOVA)

The range was 13.9–17.0 and 5.8–9.3 puparia/day consumed when 20 and 10 puparia/day were offered, respectively. The lowest mean prey consumption of 2.8–4.5 puparia/day was recorded when only five puparia were offered per day. The mean consumption decreased during the 2nd experimental week in the trial, before which 50 puparia/day had been offered. In the other trials, subsequent to those in which 20, 10 and 5 puparia/day had been offered, an increase in prey consumption was noted. Such an increase was clear in the trials prior to which 5, 10 puparia/day had been offered. During this week, the mean number of puparia consumed by female *S. parcesetosum* per day ranged between 15.0 and 23.4. During the 3rd experimental week, with a daily number of prey offered of 50 puparia, *S. parcesetosum* females also consumed 23.2–28.4 puparia/day, which is more than that consumed during the 2nd week. In the other trials, the prey consumption showed a clear decreasing trend, especially in the trials where 10 and 5 puparia/day were offered, in which a mean of 8.7–9.6 and 3.8–4.9 puparia/day was consumed, respectively.

Discussion

Successful biological control of a pest species depends on the fact that a natural enemy destroys, kills or consumes a sufficient number of the pest to keep its density at a low level. The predator examined here, *S. parcesetosum*, was able to prey successfully upon *B. tabaci* nymphs or puparia at both the low and high temperature tested. The predatory larvae consumed higher numbers of nymphs or puparia per day at 30°C than 18°C. Despite this, the mean total number of nymphs or puparia consumed by *S. parcesetosum* during development was lower at 30°C than 18°C. This can be explained by the fact that the developmental period of *S. parcesetosum* supplied with *B. tabaci* at 30°C was only about half of that at 18°C (Sengonca et al. 2004), so that at the lower temperature the larval stage was longer and thus the larvae consumed prey over a much longer period. The mean daily consumption of nymphs or puparia of *B. tabaci* by the successive larval instars of the predator increased with their development. This increase in prey consumption is in agreement with results obtained by Kapadia and Puri (1992), Patel et al. (1996) as well as Ahmad and Abboud (2001). Also, at both temperatures, a significantly higher number of nymphs was consumed in preference to puparia. Timofeyeva and Nhuan (1979) reported that *S. parcesetosum* larval instars consumed a total of 900–1,000 eggs of *D. citri* at 20–23°C. According to Kapadia and Puri (1992), *S. parcesetosum* consumed during its larval stage a mean total of 89.2 nymphs on cotton and 105.7 nymphs of *B. tabaci* on eggplant at 23.7 ± 2°C and 93.2 ± 2% relative humidity. Also, Patel et al. (1996) reported that *S. parcesetosum* consumed during its entire larval development a mean total of 671.0 nymphs and puparia of *A. barodensis* on sugarcane at 27 ± 1°C. These rates are lower than those of the present study, which might be due to the fact that different prey stages, prey species or even strains, host plants, temperatures and relative humilities were used in the different studies. Ahmad and Abboud (2001) found that for the entire duration of its larval stage, *S. parcesetosum* consumed a mean of 1,677.8 eggs or 194.8 puparia of *B. tabaci* on cabbage at

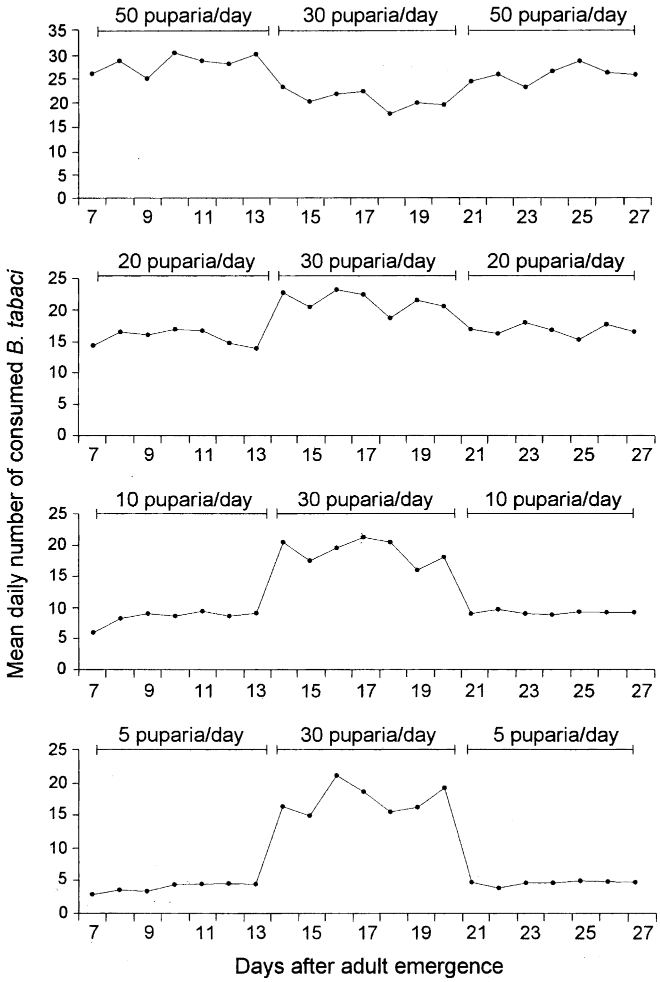

Fig. 7 Mean daily prey consumption by 7-day-old adult female *S. parcesetosum* of *B. tabaci* offered on cotton leaf discs at 18 ± 1°C with changing number of puparia offered per day

27 ± 1°C, and for puparia their results agreed with our current results.

Prior studies reported that female *S. parcesetosum* during their entire adult stage consumed a mean of 2,94.4 nymphs of *B. tabaci* on eggplant at 23.7 ± 2°C and males 178.0 nymphs (Kapadia and Puri 1992). The mean daily prey consumption increased with temperature, where the mean number of immature *B. argentifolii* consumed by *S. parcesetosum* adults was 138.9 at 20°C, 180.8 at 30°C, and 187.4 at 40°C, while mean total prey consumption was 4,909.5, 2,586.1 and 224.9 whiteflies at the three temperatures, respectively, on cantaloupe (Legaspi et al. 1996). This agrees with the present results, where the mean daily consumption at the higher temperature is more than at the lower temperature. *S. parcesetosum* adults consumed a mean of 98.7 nymphs and puparia/day when feeding on *A. barodensis* on sugarcane leaves at 27 ± 1°C (Patel et al. 1996). Ahmad and Abboud (2001) reported that *S. parcesetosum* adults consumed a mean of 270.6 eggs or 22.6 puparia/day of *B. tabaci*. Some differences in prey consumption were found between the present and previous results. But, as is well known, differences in prey species, prey stages, host plants, temperatures and feeding periods in different studies might explain such variation. However, in the present study at both temperatures, the females and males consumed significantly more nymphs than puparia of *B. tabaci*. Also, the females reached the maximum rate of prey consumption in the first studied period of adult stage on the 10th and 9th days at 18°C as well as on the 6th and 8th days at 30°C with nymphs or puparia. Such an increase in prey consumption by the females at both temperatures can be explained as they started oviposition at 13 days at 18°C and 6 days at 30°C after their emergence (Sengonca et al. 2004), which justifies a stronger need for nutrients.

A prey population in an agro-ecosystem used against a natural enemy will never be constant and will fluctuate in response to many factors. To be considered as an efficient natural enemy, a predator is expected to be able to adapt to such fluctuations in prey availability. The consumption of *B. tabaci* puparia by *S. parcesetosum* increased when more prey were offered. In addition, most of the *B. tabaci* individuals offered were consumed when the number offered daily was 5 or 10 puparia; this indicates that *S. parcesetosum* was able to adapt smoothly to fluctuating prey availability. Information on prey consumption where the number of prey changes is lacking in prior studies. The present results agree with Alvarado et al. (1997), who reported a considerable increase in daily prey consumption in relation to prey density.

In conclusion, *S. parcesetosum* preys successfully upon *B. tabaci* and can smoothly adapt to a fluctuating number of prey. Thus this ladybird seems to be a promising biological control agent for *B. tabaci*.

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