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Comparative development and demographic parameters of *Euphyllura pakistanica* on four olive cultivars

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Abstract

The development, reproduction and growth population parameters of the olive psyllid, *Euphyllura pakistanica* Loginova (Rhynchota Psyllidae) were determined on four olive cultivars, Fishomi, Oil, Yellow and Shenge, under controlled laboratory conditions at 20 ± 1 °C, 60 ± 5% RH and a photoperiod of 16:8 (L:D). There were significant differences in the egg and pre-oviposition period and female longevity on the four olive cultivars. The life span was longest on Yellow (51.71 ± 1.01 days) among the four cultivars. The survival rates (lx) in newly emerged adults were 72.89, 72.85, 63.72 and 51.81% on Shenge, Fishomi, Yellow and Oil cultivars, respectively. The gross and net fecundity rates were significantly higher on Yellow cultivar (397.94 ± 18.42 and 234.87 ± 8.80 eggs/lifetime). The net reproduction rate (R_0) was significantly affected by different olive cultivar being highest on Yellow (82.84 ± 3.98) and lowest on Oil (42.01 ± 1.43). The highest and lowest intrinsic rates of increase (r_m) were observed on Yellow (0.167 ± 0.001) and Oil (0.144 ± 0.001) cultivars, respectively. Our findings showed that the development and demographic parameters of olive psyllid *E. pakistanica* were influenced by different cultivars. This implies that morphological and biochemical mechanisms may be involved in the defence strategies of olive trees against this olive psyllid.

Key words: Olive, *Euphyllura pakistanica*, demography, development, reproduction, cultivar.

Introduction

Four of the eight currently recognized *Euphyllura* species (Rhynchota Psyllidae) are considered economically important pests on olive. *Euphyllura olivina* (Costa) has been reported from various countries in the Mediterranean basin, the Caucasus and the Middle East (Klimaszewski, 1973) but the records from the eastern Mediterranean and the Middle East are likely misidentifications (Burckhardt, 2009). Reliable records are from Spain (mainland, Canary Islands and Mallorca), France, Italy, Malta, Morocco, Algeria, Tunisia and possibly Slovenia (Burckhardt, 2009; 1989; Ksantini *et al*., 2002; Loginova, 1972; 1976; Sekkat, 2001; Seljak, 2006; Zouiten and El Hadrami, 2001). *E. olivina* was also introduced into the UK, Germany and the USA (California) (Anonymous, 2008a; Burckhardt, 2009; Burckhardt and Hodkinson, 1985). *Euphyllura straminea* Loginova was originally described and subsequently reported from Cyprus, Israel and Lebanon (Loginova, 1973), Iran (Halperin *et al*., 1982), Iraq (Baki and Ahemed, 1985), Croatia, Greece, Jordan and Montenegro (Lauterer *et al*., 1986), Turkey (Önuçar and Ulu, 1991), Syria (Abau-Kaf and Hamnoudi, 1999) and Egypt (Elwan, 2001). This species is an important native pest of olive in the northern parts of Iran. *Euphyllura phillyreae* Foerster is known from the entire Mediterranean Basin (Klimaszewski, 1973) and is a pest particularly in Greece, Turkey and the Black Sea area (Kovanci *et al*., 2005; Kumral *et al*., 2008; Lauterer *et al*., 1986; Prophetou-Athanasiadou, 1997; Tzanakakis, 2003). Apart from *Olea europaea*, *E. phillyreae* has also been reported on *Osmanthus fragrans* and *Osmanthus ilicifolius* as well as *Phillyrea angustifolia* and *latifolia* (including its synonym *media*) (Lauterer *et al*., 1986). *Euphyllura pakistanica* Loginova, the subject of this paper, is regarded as one of the most important pest of olive**s** in Pakistan, India and Syria (Loginova, 1972; Thakur *et al*., 1997; Virender *et al*., 2007).

The olive, *O. europaea*, is an economically important crop in Iran. There are approximately 25 olive cultivars are currently cultivated in Iran. The indigenous olive cultivars including Fishomi, Yellow, Oil and Shenge are cultivated in more than 13,000 hectares in the Fars province (Anonymous, 2008b; Mir Mansoury, 1998) and were used in this study as representative of common olive cultivars. Four names have been used for olive psyllids in Iran (*E. olivina*, *E. pakistanica*, *E. phillyreae* and *E. straminea*), but only two species actually occur in this country. During field surveys, *E. straminea* was found in northern Iran (Gilan, Qazvin and Zanjan provinces) and *E. pakistanica* in the Fars Province. The latter species completes two distinct generations per year in spring and autumn under field condition. The females remain in diapause through winter and aestivate in the hottest summer months (Asadi *et al*., 2009).

E. pakistanica is a serious pest which occurs ubiquitously in the Fars province of Iran and it was reported for the first time in 2004 from Shiraz (Alemansour and Fallahzadeh, 2004). With the increase of olive cultivation in different areas of the Fars province, *E. pakistanica* is now widely distributed throughout the olive growing areas of the province (Shiraz, Fasa, Jahrom, Khafr, Daryoon, Sadra and Beiza). Owing to its continuous presence, its high infestation and propagation rates resulting in fruit and bud losses, this species is considered as one of the most important pests of olive trees. *E. pakistanica* is especially harmful in the nymphal stages by sucking plant sap and excreting honeydew, which supports sooty mould fungi thereby reducing photosynthesis (Zouiten and El Hadrami, 2001). Attacked trees are easily recognized by the white waxy accumulations excreted by the nymph**s** (Abau-Kaf and Hamnoudi, 1999).

Every year, different pesticides are used to control olive psyllids *E. pakistanica* and *E. straminea* in Iran (Anonymous, 2008b) but the use of broad spectrum pesticides against olive psyllid has strong negative effect**s** on the environment (Kovanci *et al*., 2005). Insecticide residue and insect resistance to conventional insecticides are serious problems that caused researchers to investigate alternative ways to chemical control including host plant resistance (Li *et al*., 2004).

Host plant varieties significantly affect the growth and development of phytophagous insects either through nutritional quality or the effects of plant defensive compounds (Awmack and Leather, 2002). Evaluation of host plant resistance/sensitivity in integrated pest management control programmes requires the study of different biological parameters specially life history, fecundity and mortality of the pest on different cultivars.

Some studies were carried out with regard to the biology of *E. olivina* and *E. phillyreae* species (Hodkinson, 2009; Kumral *et al*., 2008; Tzanakakis, 2003; Zouiten and El Hadrami, 2001). Different sensitivity of the cultivars of olive tree to *E. olivina* was investigated in Morocco (Zouiten and El Hadrami, 2001). However, currently no data are available on the demographic parameters of *E. pakistanica* and the resistance/susceptibility of different olive cultivars. The purpose of this paper is to provide information on the effects of four olive cultivars on the biology, reproduction, survival, longevity and population growth parameters of *E. pakistanica* which have not been studied previously.

Materials and methods

Rearing methods and experimental conditions

The experimental population of *E. pakistanica* was originally collected from olive orchards in Shiraz, Iran in January-June 2007. A breeding of *E. pakistanica* was established in a growth chamber at a temperature of 20 ± 1 °C, relative humidity of 60 ± 5% and a photoperiod of 16:8 (L:D) on four olive cultivars: 'Fishomi', 'Shenge', 'Oil' and 'Yellow'. Approximately 500 adult individuals of *E. pakistanica* used to establish laboratory cultures on each olive cultivar. The olive psyllids were reared on each cultivar for 3 generations (about 4 months) before they were used in the experiments. Regular introduction of wild psyllids from orchards into the colony were made to reduce inbreeding affects. Olive rooted stem transplants of the same age were used in all experiments, which were conducted under the above conditions using leaf cages (48 mm diameter and 10 mm height).

Life history and fecundity

Developmental periods of individuals were determined for the egg stage and each nymphal instars (N1-N5), total pre-imaginal development, pre-oviposition, oviposition and post-oviposition periods on each of the four olive cultivars. To synchronize the age of eggs, 15 pairs of adult psyllids were collected from the rearing and transferred into leaf cages (15 cm diameter and 2 cm height) on different plants of each cultivar to lay eggs. After 12 h, as a cohort of 100-110 newly laid eggs were collected for the experiments on each olive cultivar. The leaf cages with psyllid eggs were checked every 24 h to determine the egg incubation period. The emerged nymphs were transferred individually to new leaf cages. The presence of exuviae and body size were used to determine nymphal stages. The nymphs were checked daily until adult emergence, after which the sexes were determined.

Fecundity and longevity on four cultivars were measured using 30-40 pairs of newly emerged male and female adults in different leaf cages on each cultivar. Newly emerged adults were separated into female and male pairs, which were then placed into separate leaf cages (48 mm diameter and 20 mm height). Each day and at the same time, a pair of adults was carefully transferred to a new leaf cage, and the eggs laid in the old leaf cage were counted. Dead males were replaced. Four categories of data were collected: (i) life cycle survivorship; (ii) adult longevity, pre-oviposition, oviposition and post-oviposition periods; (iii) population growth parameters, fecundity and fertility; and (iv) population age structure. Standard demographic parameters were calculated from daily records of mortality, fecundity, and fertility of cohorts of *E. pakistanica* females. The parameter symbols, formulae and calculations according with Carey (1993; 2001). The daily measurements of mortality and fecundity were arranged as a life table (Carey, 1993) and used to calculate net reproductive rate (R_0), intrinsic rate of increase (*rm*), finite rate of increase (λ), mean generation time (*T*) and doubling time (*DT*).

Statistical analysis

A jackknife technique was used to calculate the variance of the *rm* and other population growth parameters (Maia *et al*., 2000; Meyer *et al*., 1986). This method removes one observation at a time from the original data set and recalculates the statistic of interest from the truncated data set. These new estimates, or pseudovalues, form a set of numbers from which mean values and variances can be calculated and compared statistically. This jackknife method is well suited for estimating variance for population growth statistics (Maia *et al*., 2000). Mean jackknife estimates of demographic parameters were compared among olive cultivars by using one-way ANOVA and Student Newman Keuls test (SNK) ($P < 0.05$). The significant effects of olive cultivars on fecundity, longevity and oviposition rate of *E. pakistanica* were determined by one-way analysis of variance (ANOVA). If significant differences were detected, multiple comparisons were made using the SNK test ($P \leq 0.05$). Statistical analysis was carried out using SPSS software (SPSS, 2004). Data were checked for normality prior to analysis.

Results

Development time and adult longevity

The effect of olive cultivar on egg and nymphal development time, pre-oviposition and oviposition period and adult longevity of *E. pakistanica* are presented in table 1. Egg incubation was significantly longer on Oil than on other cultivars (F = 21.03, df = 3, 392; p < 0.01). Development period was significantly longer on Yellow and Oil (F = 42.07; df = 3, 269; p < 0.05). The duration of the preoviposition and oviposition period of females differed significantly among olive cultivars (F = 11.64, df = 3, 140; p < 0.01 and F = 25.17, df = 3, 140; p < 0.01). The longest and shortest pre-oviposition periods were recorded on Fishomi (5.70 ± 0.30 days) and Yellow cultivar (4.21 ± 0.12 days), respectively. Cultivars type also significantly affected longevity of both adult females and males (F = 8.23, df = 3, 140; p < 0.01 and F = 6.63, df = 3, 124, p < 0.01, respectively). Longevity was greatest on Fishomi (32.15 ± 1.40 and 13.50 ± 0.50 days for females and males, respectively) and shortest on Oil (25.72 ± 1.00 and 10.50 ± 0.40 days, respectively). Females generally lived longer than males on all four cultivars (table 1). Analysis of variance showed that adult longevity was significantly affected by sex and cultivar (F = 3, df = 3.22; p < 0.05). Statistically significant differences between female and male longevity were found on all cultivars (t =1 2.17, df = 75, p < 0.01 for Fishomi; t = 14.69, df = 74, p < 0.01 for Shenge; t = 13.57, df = 63, p < 0.01 for Yellow and t = 13.09, df = 52, p < 0.01 for Oil).

The longest oviposition period was on Yellow (23.70 ± 0.80 days) which together with Fishomi differed significantly from the two remaining cultivars (F = 25.17, df = 3, 140; p < 0.01). Pre-imaginal development time (from egg to adult emergence) differed significantly among cultivars (F = 42.07, df = 3, 269; p < 0.01). Life span varied from 45.75 ± 1.17 to 53.00 ± 1.24 days and was significantly longer on Yellow compared with other cultivars (F = 5.55, df =3, 141; p < 0.01).

Survival

Mortality of *E. pakistanica* differed among the cultivars. The age-specific survival rates (*lx*) of *E. pakistanica* on the four olive cultivars are presented in figure 1. No egg mortality was observed on Fishomi but it was 6, 10 and 13% on Oil, Yellow and Shenge, respectively. Lowest and highest mortality rates for pre-imaginal developmental stages occurred on Fishomi, Shenge (28%) and Oil (50%), respectively. Adult emergence was 73, 73, 64 and 52% on Shenge, Fishomi, Yellow and Oil, respectively.

Life expectancy

Life expectancy (*ex*) of one-day-old eggs was estimated to be 35.4, 33.4, 31.8 and 26.7 days on Fishomi, Yellow, Shenge and Oil, respectively. The *ex* values of newly emerged adults (male and female together) were 23.6, 27.8, 22.3 and 23.1 days on Fishomi, Yellow, Shenge and Oil, respectively. Highest and lowest values of life expectancy (*ex*) in newly emerged females were 33.0 days on Fishomi and 25.3 days on Shenge (figure 2).

Table 1. Developmental time, oviposition period and adult longevity in days (mean ± SE) of olive psyllid, *E. pakistanica* reared on four olive cultivars.

Parameters	Olive cultivars							
	Fishomi	N	Yellow	N	Oil	N	Shenge	N
Egg incubation period	4.9 ± 0.1c	108	4.7 ± 0.1c	92	6.2 ± 0.2a	103	5.7 ± 0.2b	93
Pre-imaginal development period	16.5 ± 0.3c	78	20.3 ± 0.2a	65	21.1 ± 0.4a	54	19.0 ± 0.3b	76
Pre-oviposition period	5.7 ± 0.3a	40	4.2 ± 0.1b	37	4.6 ± 0.2b	30	5.2 ± 0.15a	37
Oviposition period	22.2 ± 1.0a	40	23.7 ± 0.8a	37	15.6 ± 0.5b	30	15.4 ± 0.5b	37
Female longevity	32.1 ± 1.4a	40	31.4 ± 1.2a	37	25.7 ± 1.0b	30	26.0 ± 0.90b	37
Male longevity	13.5 ± 0.5a	37	11.8 ± 0.5b	28	10.5 ± 0.4b	24	11.3 ± 0.5b	39
Life span	48.9 ± 1.4ab	41	53.0 ± 1.2a	37	49.2 ± 1.1ab	30	45.7 ± 1.2b	37

Means followed by the different letters within rows are significantly different (*P* < 0.05, SNK after one-way ANOVA).

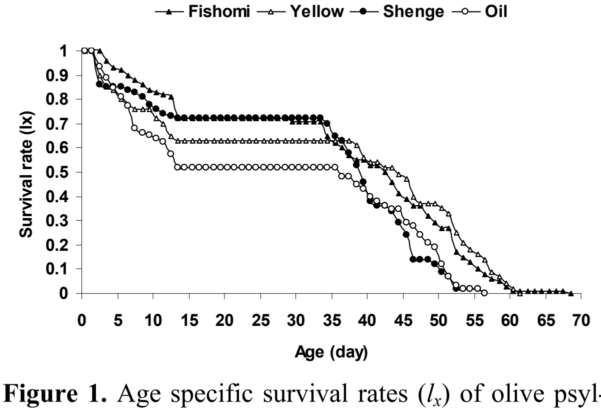

Figure 1. Age specific survival rates (l_x) of olive psyllid, *E. pakistanica* reared on four olive cultivars. Population size was 100-110 eggs on each cultivar.

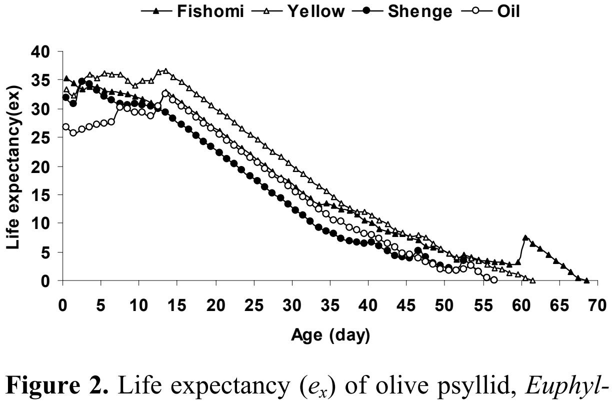

Figure 2. Life expectancy (e_x) of olive psyllid, *Euphyllura pakistanica* reared on four olive cultivars. Population size was 100-110 eggs on each cultivar.

Reproduction

Gross and net fecundity rates of *E. pakistanica* were significantly influenced by olive cultivar (F = 76.06, df = 3, 123, p < 0.01 and F = 83.15, df = 3, 124, p < 0.01, respectively). Gross fecundity rate was significantly higher on Yellow (398 ± 18 eggs/lifetime) than for the other olive cultivars. Highest and lowest values of net fecundity rate were on Yellow (235 ± 9 eggs/lifetime) and Oil (75 ± 3 eggs/lifetime). Net fertility rates similarly differed significantly among cultivars (F = 66.21, df = 3, 124; p < 0.05), the highest and lowest values being on Yellow (209 ± 8) and Oil (70 ± 3), respectively. The mean number of fertile eggs per female per day showed significant differences among cultivars (F = 47.94; df = 3, 124; p < 0.05), being highest on Yellow (11.73 ± 0.57) and lowest on Shenge (5.46 ± 0.27) (table 2). Furthermore oviposition patterns were modified on different cultivars. The following trends were apparent: Fishomi showed a peak on day 13 after adult emergence and then a gradual decline; Yellow peaked on days 9 and 12, decreased rapidly on day 13 after adult emergence and then declined gradually. Shenge and Oil cultivars showed an earlier peak on day 7 after adult emergence (figure 3). Highest number of mean eggs per female per day was observed on day 27 on Yellow (13.42 ± 1.55) day 26 on Fishomi (8.01 ± 0.71) day 24 on Shenge (8.79 ± 0.88) and day 27 of life history on Oil (8.29 ± 0.81).

Population growth parameters

The population growth parameters of *E. pakistanica* (R_0, *rm*, λ, *T* and *DT*) on four different cultivars are given in table 3. Net reproductive rate (R_0) was significantly affected by cultivar (F = 11.57, df =3, 124; p < 0.01), being highest on Yellow (82.8 ± 3.9) and lowest on Oil (42.0 ± 1.4). Intrinsic and finite rates of increase were significantly lower on Oil cultivar compared to other cultivars. Mean generation time of *E. pakistanica* was not significantly different among cultivars but mean estimates for population doubling time was significantly higher on Oil (4.80 ± 0.04 days) (F = 17.1, df =3, 124; p < 0.01).

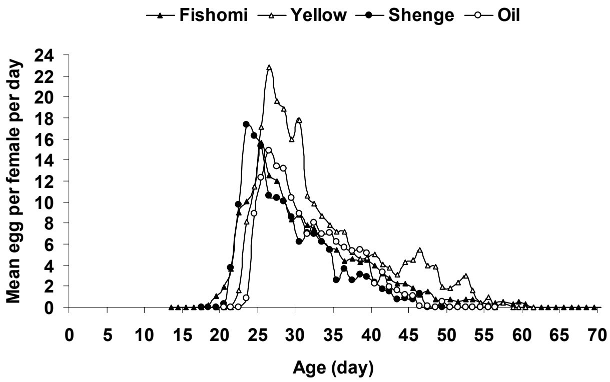

Figure 3. Age specific egg production (M_x) of olive psyllid, *Euphyllura pakistanica* reared on four olive cultivars in laboratory condition. Population sizes were N= 40 (Fishomi), N= 37 (Yellow), N=30 (Oil) and N=37 (Shenge).

Discussion and conclusion

Development time, survivorship, reproduction and population growth parameters of the olive psyllid *E. pakistanica* were significantly influenced by different olive cultivars. The overall development times of *E. pakistanica* were shorter than those reported for

Table 2. Reproduction parameters (mean ± SE) of olive psyllid, *E. pakistanica* reared on four olive cultivars.

Parameters	Units	Olive cultivars Fishomi (N = 40)	Yellow (N = 37)	Oil (N = 30)	Shenge (N = 37)
Gross fecundity rate	Eggs/female	189.1 ± 14.0b	397.9 ± 18.4a	151.2 ± 6.8b	156.2 ± 5.2b
Gross fertility rate	Eggs/female	189.1 ± 14.0b	353.2 ± 16.0a	141.5 ± 6.3c	135.8 ± 4.5c
Net fecundity rate	Eggs/female	97.0 ± 9.5b	234.9 ± 8.8a	74.9 ± 3.1c	106.5 ± 3.3b
Net fertility rate	Eggs/female	97.0 ± 9.5b	209.5 ± 7.8a	70.2 ± 2.9c	92.5 ± 2.9b
Mean eggs per day	Eggs/day	5.7 ± 0.4b	13.1 ± 0.7a	6.1 ± 0.3b	6.3 ± 0.3b
Mean fertile eggs per day	Eggs/day	5.7 ± 0.4b	11.7 ± 0.6a	5.7 ± 0.3b	5.5 ± 0.3b

Means followed by the different letters within rows are significantly different (*P* < 0.05, SNK after one-way ANOVA).

Table 3. Population growth parameters (mean ± SE) of olive psyllid, *E. pakistanica* reared on four olive cultivars.

Parameters	Units	Olive cultivars Fishomi (N = 40)	Yellow (N = 37)	Oil (N = 30)	Shenge (N = 37)
Net reproductive rate (R_0)	♀/gen.	62.62 ± 5.95b	82.84 ± 3.86a	41.96 ± 1.36c	65.23 ± 4.26b
Intrinsic rate of increase (r_m)	1/day	0.165 ± 0.001a	0.167 ± 0.001a	0.144 ± 0.001b	0.160 ± 0.001a
Finite rate of increase (λ)	1/day	1.18 ± 0.00a	1.18 ± 0.00a	1.15 ± 0.001b	1.18 ± 0.00a
Mean generation time (*T*)	Day	25.08 ± 0.23a	26.42 ± 0.35a	25.9 ± 0.24a	25.24 ± 0.63a
Doubling time (*DT*)	Day	4.20 ± 0.10b	4.14 ± 0.04b	4.81 ± 0.04a	4.18 ± 0.04b

Means followed by the different letters within rows are significantly different (*P* < 0.05, SNK after one-way ANOVA).

E. olivina by Tzanakakis (2003) and Kumral *et al.* (2008) (incubation period: 10-15 days; young nymph to adult: 24-35 days at optimum conditions). Pre-imaginal development time of *E. pakistanica* under natural conditions was longer than that under laboratory conditions on Fishomi cultivar (Asadi, 2010).

Among other psyllid pest species the average duration of egg and nymphal stages of the citrus psyllid, *Diaphorina citri* Kuwayama varied little among orange jessamine (*Murraya paniculata*), grapefruit, rough lemon and sour orange except in the fifth instar (Tsai and Liu, 2000). By contrast different cultivars of tomato showed variable resistance to the tomato psyllid, *Bactericerca cockerelli* (Šulc) (Hemiptera Triozidae) with development rate and survivorship significantly reduced on a resistant cultivar (PI 134417) (Liu and Trumble, 2005). Stage of host-plant growth cycle may also influence the development rate, as in the leucaena psyllid, *Heteropsylla cubana* Crawford (Geiger and Gutierrez, 2000). *E. pakistanica* complete only 2-3 generations per year in natural conditions in the Fars province, but under laboratory conditions, this olive psyllid is able to complete 8 generations per year (Asadi, 2010).

Egg incubation period and pre-imaginal development period of *E. pakistanica* was affected by cultivar. Female longevity of *E. pakistanica* was similar on Fishomi (32.15 days) and Yellow (31 days), and was similar to that of *E. straminea* (32 days) at 22 ºC (Abau-Kaf and Hamnoudi, 1999), but shorter than *D. citri* females adults on several hosts (40-48 days). Adult female and male longevity under natural condition were 24.95 ± 1.93 and 8.83 ± 0.65 on Fishomi cultivar, which was shorter than that under laboratory conditions (Asadi, 2010). Longevity may also differ between seasons, as in *Cacopylla pyri* (L.) on different host plants, in which longevity ranged from 22 to 28 days under spring and autumn field conditions (Kapatos and Stratopoulou, 1996). The longest oviposition period in *E. pakistanica* was on Yellow (24 days), which is shorter than that of *E. olivina* (37 days) (Ksantini *et al.,* 2002).

Pre-imaginal mortality of *E. pakistanica* differed among cultivars. Survival rates of *D. citri* immatures were similarly affected by the different citrus hosts (69-85%) (Tsai and Liu, 2000) and high temperature may also increased mortality and reduced female body size and consequently egg size, as in *H. cubana* (Geiger and Gutierrez, 2000).

The net fecundity rate of *E. pakistanica* was 234, 106, 97 and 74 on Yellow, Shenge, Fishomi and Oil, respectively. This compares with the highest value of fecundity in *E. olivina* at 20 ºC (156.75 eggs per female) and 25 ºC (138.00 eggs per female) (Ksantini *et al*., 2002), although Chermiti (1994) and Chermiti and Onillon (1993) reported higher fecundity rates. These values are much lower than the net fecundity rate of *C. pyri* in spring (343 to 407 eggs per female) (Kapatos and Stratopoulou, 1996). Mean number of eggs per female under natural condition was 103.26 ± 10.39 on Fishomi cultivar, which was lower than that under laboratory condition (Asadi, 2010).

The effects of different olive cultivars on the life time reproductive rate of *E. pakistanica* mirror those observed in *E. olivina* in which the maximum fecundity rate was on cultivars Santa Catharina and Gordale but lower on cultivars Frontoio and Arbequine which was related to various content of phenolic compunds in different cultivars (Zouiten and El Hadrami, 2001). The highest and lowest intrinsic rates of increase for *E. pakistanica* were 0.167 on Yellow and 0.144 on Oil values similar to that of *D. citri* (0.162) on rough lemon (Tsai and Liu, 2000). However, the intrinsic rate of increase and mean generation time of the citrus psyllid was generally higher than for the olive psyllid mentioned that the phenology of different olive cultivars is known to exert strong influence on *E. olivina* under field conditions (Zouiten and El Hadrami, 2001), possibly related to morphological and chemical differences of the olive cultivars. Whereas cuticle thickness, shape and colour of leaves and density of side shoots vary among the tested olive cultivars and may play a major role in the resistance of olive plants to psyllids, may be related to the effect of antixenosis or non-preference mechanism. Food quality and quantity can also directly affect its survival and reproduction. The success of plant-feeding insects depends on the nutrient content of their host plants. A common hypothesis for host choice by herbivores is that adults select hosts that maximize their offspring's performance. However, host preference can vary under different ecological conditions (Thompson, 1988). For example, the concentration of phenolic compounds, play an important role in plant defence against phytophagous insects (Harborne, 1990; Heidin *et al*., 1983; Metraux and Raskin, 1993; Michaleck *et al*., 1996; Zouiten and El Hadrami, 2001). These compounds constitute a protective barrier against the attack by phytophagous insects (Mackeix *et al*., 1990; Ride, 1983). Few data however, exist on the morphological and biochemical mechanisms involved in the olive-psyllid interactions, particularly the role of phenolic compounds in the processes of attraction or repulsion (Zouiten and El Hadrami, 2001).

Our research, nevertheless, demonstrates that olive cultivars have a significant effect on several biological parameters of *E. pakistanica*. Such information allows a better understanding of olive – psyllid interactions and is useful for developing Integrated Pest Management (IPM) strategies. Resistant or partially resistant cultivars may enhance the efficacy of natural enemies and insecticides. They can contribute to biological and chemical control methods as a part of IPM strategy (Adebayo and Omoloyo, 2007; Du *et al*., 2004; Razmjou *et al*., 2006). While our laboratory studies revealed that different cultivars influence the demographic patterns of *E. pakistanica*, this requires further validation under field conditions. Nevertheless, in conclusion, the cultivar Yellow appears to be the most susceptible host for *E. pakistanica*, supporting higher female longevity, life span, oviposition period, fecundity and intrinsic rate of increase. By contrast, the lowest values of these parameters were usually observed on cultivars Oil and Shenge. These cultivars are grown mostly for the oil industry. Therefore, we tentatively recommend the Oil and Shenge as the most suitable cultivar for olive growers. These results we present here suggest further studies on biological and behavioral parameters of *E. pakistanica* on olive cultivars under natural conditions will be needed for a thorough evaluation. Extensive investigations about chemical criteria of different olive cultivars and their subsequent effects on the biological characteristics of *E. pakistanica* would be expected.

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