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Research Article

Life history and life table parameters of the *Tuta absoluta* (Lepidoptera: Gelechiidae) on twelve commercial tomato cultivars under laboratory conditions

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Abstract: *Tuta absoluta* (Meyrick) is a serious pest of tomato throughout the world. The life history and the life table parameters of *T. absoluta* were studied on 12 different commercial tomato cultivars. The longest larval developmental period (12.92 ± 0.11 days), the longest total developmental time (26.20 ± 0.22 days), the longest total pre-oviposition period (29.31 ± 0.63 days) and the shortest oviposition period (5.08 ± 0.43 days) were recorded on Korral cultivar. The highest pupal mortality was found on Korral (23.53%) and the lowest larval and pupal growth indices were observed on Korral (6.57and 8.87, respectively). The highest and the lowest overall mortalities were observed on Korral (35.00%) and on Valouro (21.67%), respectively. The lowest and the highest intrinsic rate of increase (r_m) were found on Korral (0.1046 ± 0.0005 day^{-1}) and on Valouro (0.1584 ± 0.0002 day^{-1}) cultivars. Also the lowest finite rate of increase (λ) (1.1102 day^{-1}) and the highest doubling time (6.63 days) of the tomato leafminer were observed on Korral cultivar. Therefore, it was concluded that among the 12 tomato cultivars that were studied in this research, Korral was relatively unsuitable to *T. absoluta* and can be used in the integrated control programs (IPM) of this pest.

Keywords: *Tuta absoluta,* life history, life table parameters, tomato cultivars

Introduction

Tomato, *Lycopersicon esculentum* (Miller), is the second most important vegetable crop after potato in the world (Sajjad *et al.*, 2011). Like many other crops its production is constrained by both abiotic and biotic factors. One of the most important biotic constraints is the tomato leafminer, *Tuta absoluta* (Meyrick) (Lepidoptera: Gelechiidae) which is a multivoltine and oligophagous insect that attacks many solanaceous crops leading to considerable damage in the field and greenhouse conditions (Suinaga *et al.*, 1999; Siqueira *et al.*, 2000; Torres *et al.*, 2001). This insect is native to South America with up to 12 generations per year depending on the environmental conditions. Its larvae feed intensively on the leaf mesophyll, stems, as well as the fruits of tomato (Vargas, 1970; Picanço *et al.*, 1996; EPPO, 2005; Silva *et al.*, 2011).

Currently, chemical control methods are used for *T. absoluta* control (Siqueira *et al.*, 2001; Galdino *et al.*, 2011). However, to control the pest several insecticide applications are needed in a single growing season that substantially increases production costs and leads to the development of insecticide resistant

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populations of the insect. Even though the chemical control is effective in most cases and reduces the damage caused by this insect, inefficiency to control *T. absoluta* has been demonstrated in many cases, besides their harmful effects for man and the environment (Siqueira *et al.*, 2001).

The use of insect-resistant cultivars can be an effective strategy in managing the insect populations (Painter, 1951), which reduces the usage of insecticides and is compatible with other control tactics and is safe to the environment. Host plant's quality affects the growth, survival, fecundity and population growth of phytophagous insects (Scriber and Slansky, 1981; Slansky, 1993; Browne and Raubenheimer, 2003). Development of resistant cultivar to control *T. absoluta* will require a good knowledge of life history and life table parameters of the insect on various tomato cultivars. Life table parameters express the potential of population growth in the present and in the future generations (Frel *et al*,. 2003; Sauvion *et al*., 2005).

Pereyra and Sanchez (2006) studied the life history of *T. absoluta* on tomato and potato in Argentina. The biology of this insect has also been studied in Turkey by Erdogan and Babaroglu (2014) on tomato. However, despite its economic importance on tomato, there is no information regarding the life history of the pest in Iran and its life table parameters on commercial cultivars of tomato. The aim of this research has been to study the life history and the life table parameters of this cosmopolitan pest on some common commercial tomato cultivars and to determine if any of these cultivars are sufficiently unsuitable to *T. absoluta* to be used in the integrated management of the pest.

Materials and Methods

Plant and insect sources

The seeds of 12 commercial tomato cultivars (Cal JN3, CH Falat, Chef, HAS 2274, Infinity, Korral, Meshkin, Pellmech, Super H, Synda RZ, Valouro and Y Falat) were obtained from the Plant and Seed Improvement Research Institute of Iran. They were planted in 3 L pots, in a greenhouse set at 25 ± 5 ^{o}C, 60 ± 5% RH and 14L: 10Dh in the early spring of 2013. The tomato leafminer moths used in the experiments were collected at larval stage from a tomato greenhouse at Moghan region in northwest Iran during July 2013 and reared until emergence of adult moths. The larvae were reared on leaves of different tomato cultivars for two generations in a growth chamber to eliminate previous host effects.

Life history and life table parameters studies

Adult moths emerged from larvae reared on leaves of different tomato cultivars were used in the experiments. In order to obtain the same age eggs, 15 pairs of both sexes of the moth reared on each tomato cultivar were kept inside a plastic oviposition container (11.5 cm diameter, 9.5 cm height), which was sealed at the top with a fine mesh net. After 12 h, the eggs laid were collected from the container and used in the experiments. Each cultivar of tomato was considered a treatment and each treatment was replicated 60 times in a completely randomized design experiment. Each egg was transferred into an 8 cm Petri dish with a hole covered by a fine mesh net for ventilation and was monitored to determine the incubation period. When the tomato cultivars reached the six leaf stage, the second fully expanded leaf from the top of the plants was cut and used for larval feeding. Fresh leaves were provided for larval feeding in dishes and were replaced every other day. Fourth instar larvae were transferred into small plastic tubes (3 cm diameter, 5 cm depth) for pupation. During the experiment, incubation period, duration of larval and pupal developmental times, total developmental time, larvae, pupae and overall percent mortalities were recorded. Also, the larval growth index (LGI), pupal growth index (PGI) and overall immature growth index (OIGI) were calculated by dividing the survival rate of each growth stage by development time (Setamou *et al.* 1999).

To determine the fecundity, longevity and life table parameters of *T. absoluta,* on different cultivars, a pair of newly emerged female and male moths reared on each tomato cultivar, were introduced into a plastic oviposition container (11.5 cm diameter, 9.5 cm depth), which was sealed at the top with a fine mesh net for ventilation in a growth chamber set at 25 ± 1 °C, 65 ± 5 % RH and 16: 8 (L: D) h. Each container was supplied with a 10% honey solution for adults feeding. Also the oviposition containers were equipped with window screen as oviposition substrate to prevent eggs being laid on the container wall. The number of eggs laid in each day and the adult longevity were recorded until the death of the last adult to determine the life table parameters of *T. absoluta*. This experiment was conducted in a completely randomized design with 20 replications for each cultivar.

The life table parameters of *T. absoluta* including, net reproductive rate (R_0), the intrinsic rate of natural increase (r_m), finite rate of increase (λ), mean generation time (T) and doubling time (DT) on different tomato cultivars were calculated by the formulae described by Brich (1948) and Carey (2001).

Statistical analysis

Before analysis, all data were tested for normality. Data were analyzed by one-way analysis of variance (ANOVA) followed by comparison of the means with Student–Newman–Keuls (SNK) test at α = 0.05 using statistical software SPSS ver. 19.0. Differences in r_m and the other population parameters were tested by the method described by Maia *et al.* (2000).

Results

Life history traits

The incubation period and the longevity of *T. absoluta* male moth were not significantly different among 12 tomato cultivars ($F = 1.02$, df = 11, 701, $P = 0.43$ and $F = 0.85$, df = 11, 168, $P = 0.59$, respectively) (Table 1), but there were significant differences among the tomato cultivars in the developmental time of larva ($F = 15.37$, df = 11, 617, $P < 0.0001$), pupa ($F = 18.96$, df = 11, 511, $P < 0.0001$), total development time ($F = 26.79$, df = 11, 511, $P < 0.0001$) and the female moth longevity ($F = 2.18$, df = 11, 168, $P < 0.05$) (Table 1). The longest larval development time of *T. absoluta* were observed on Korral (12.92 ± 0.11 days) and HAS 2274 (12.88 ± 0.12 days) cultivars; while the shortest larval development time (10.73 ± 0.15 days) was observed on Valouro cultivar. The longest pupal development time (8.62 ± 0.14 days) was on Korral; while the shortest pupal development time were recorded on Infinity (7.07 ± 0.11 days) and Valouro (7.11 ± 0.08 days). Also, the longest and shortest total development time (egg to adult) were recorded on Korral (26.20 ± 0.22 days) and Valouro (21.87 ± 0.26 days), respectively. The male moth longevity did not differ significantly among the tomato cultivars, but there were significant differences on female moths longevity among the cultivars. The shortest female longevity of *T. absoluta* was on Korral (8.47 ± 0.72 days) and the longest was on Valouro (12.13 ± 0.47 days).

The adult pre-oviposition period (APOP) ($F = 1.07$, df = 11, 168, $P = 0.38$) and post-oviposition period ($F = 0.67$, df = 11, 149, $P = 0.77$) were not significantly different on the 12 tomato cultivars (Table 2), but there were significant differences among the tomato cultivars in the total pre-oviposition periods (TPOP) ($F = 11.28$, df = 11, 168, $P < 0.0001$), oviposition period ($F = 2.13$, df = 11, 168, $P < 0.05$) and fecundity (number of eggs/female) ($F = 5.81$, df = 11, 168, $P < 0.0001$) of *T. absoluta* on different tomato cultivars (Table 2). The TPOP periods were longest on Korral (29.31 ± 0.63 days) and shortest on Valouro (24.13 ± 0.27 days). The shortest (5.08 ± 0.43 days) and longest (8.13 ± 0.47 days) oviposition period were recorded on Korral and Valouro, respectively. The numbers of eggs per female were lowest (47.54 ± 6.21 eggs) on Korral and highest (119.53 ± 9.82 eggs) on Valouro cultivars.

Table 1 The mean (± SE) development stages and adult longevity of *Tuta absoluta* on12 tomato cultivars under laboratory conditions.

Cultivars	Incubation period (days)	Larval period (days)	Pupal period (days)	Development time (days)	Longevity (days)	
Cal JN3	4.22 ± 0.15 a	11.13 ± 0.30 ef	7.21 ± 0.09 c	22.65 ± 0.33 d	7.53 ± 0.48 a	11.73 ± 0.42 ab
CH Falat	4.62 ± 0.21 a	12.45 ± 0.14 ab	8.57 ± 0.12 a	25.65 ± 0.27 a	6.33 ± 0.64 a	9.00 ± 0.95 ab
Chef	4.48 ± 0.17 a	11.71 ± 0.14 cde	7.91 ± 0.19 b	24.45 ± 0.19 b	7.20 ± 0.81 a	10.27 ± 0.93 ab
HAS 2274	4.52 ± 0.14 a	12.88 ± 0.12 a	8.39 ± 0.17 a	25.95 ± 0.28 a	6.40 ± 0.44 a	9.80 ± 0.88 ab
Infinity	4.33 ± 0.13 a	12.04 ± 0.15 bcd	7.07 ± 0.11 c	23.56 ± 0.24 cd	7.07 ± 0.40 a	10.73 ± 0.71 ab
Korral	4.53 ± 0.11 a	12.92 ± 0.11 a	8.62 ± 0.14 a	26.20 ± 0.22 a	6.13 ± 0.59 a	8.47 ± 0.72 b
Meshkin	4.42 ± 0.11 a	12.27 ± 0.17 bc	7.83 ± 0.12 b	24.64 ± 0.27 b	6.47 ± 0.54 a	10.53 ± 0.80 ab
Pellmech	4.25 ± 0.12 a	11.35 ± 0.16 ef	7.18 ± 0.10 c	22.84 ± 0.24 cd	7.67 ± 0.56 a	11.53 ± 0.82 ab
Super H	4.32 ± 0.12 a	11.30 ± 0.18 ef	7.24 ± 0.12 c	23.00 ± 0.25 cd	6.73 ± 0.84 a	10.60 ± 0.43 ab
Synda RZ	4.28 ± 0.16 a	11.42 ± 0.19 de	7.33 ± 0.13 c	23.17 ± 0.32 cd	7.40 ± 0.92 a	11.00 ± 0.65 ab
Valouro	4.13 ± 0.16 a	10.73 ± 0.15 f	7.11 ± 0.08 c	21.87 ± 0.26 e	7.93 ± 0.47 a	12.13 ± 0.47 a
Y Falat	4.45 ± 0.12 a	11.64 ± 0.21 cde	7.78 ± 0.18 b	23.78 ± 0.29 bc	6.80 ± 0.67 a	11.20 ± 0.73 ab

Means in a column followed by different letters are significantly different (SNK; $P < 0.05$).

Table 2 The mean (± SE) of adult pre-oviposition period (APOP), total pre-oviposition period (TPOP), ovipostion period, post-oviposition period and fecundity of *Tuta absoluta* reared on12 tomato cultivars.

Cultivars	APOP (days)	TPOP (days)	Oviposition period (days)	Post-oviposition period (days)	Number of eggs/female
Cal JN3	2.73 ± 0.18 a	25.47 ± 0.51 cd	7.20 ± 0.46 ab	1.93 ± 0.24 a	95.87 ± 11.15 ab
CH Falat	2.85 ± 0.32 a	28.31 ± 0.52 ab	5.61 ± 0.70 ab	1.50 ± 0.27 a	57.92 ± 7.67 cd
Chef	2.93 ± 0.32 a	27.07 ± 0.35 bc	6.29 ± 0.62 ab	1.77 ± 0.12 a	66.86 ± 6.19 bcd
HAS 2274	2.85 ± 0.22 a	28.62 ± 0.55 ab	6.54 ± 0.57 ab	1.64 ± 0.20 a	60.38 ± 8.12 bcd
Infinity	2.53 ± 0.27 a	25.67 ± 0.55 cd	6.73 ± 0.71 ab	1.69 ± 0.21 a	82.07 ± 8.46 bc
Korral	3.00 ± 0.47 a	29.31 ± 0.63 a	5.08 ± 0.43 b	1.54 ± 0.16 a	47.54 ± 6.21 d
Meshkin	3.14 ± 0.21 a	28.00 ± 0.39 ab	6.57 ± 0.54 ab	1.67 ± 0.19 a	77.29 ± 7.41 bcd
Pellmech	2.57 ± 0.34 a	25.64 ± 0.48 cd	7.57 ± 0.53 ab	1.86 ± 0.14 a	93.43 ± 6.73 abc
Super H	2.73 ± 0.15 a	25.60 ± 0.33 cd	6.47 ± 0.40 ab	1.75 ± 0.18 a	85.40 ± 6.42 bc
Synda RZ	2.64 ± 0.13 a	25.86 ± 0.50 cd	6.93 ± 0.46 ab	1.85 ± 0.14 a	86.57 ± 7.72 bc
Valouro	2.13 ± 0.09 a	24.13 ± 0.27 d	8.13 ± 0.47 a	2.00 ± 0.18 a	119.53 ± 9.82 a
Y Falat	3.07 ± 0.35 a	27.21 ± 0.43 bc	6.79 ± 0.60 ab	1.92 ± 0.19 a	79.00 ± 8.04 bcd

Means in a column followed by different letters are significantly different (SNK; $P < 0.05$).

The growth index of larvae, pupae and percentage larval mortality of *T. absoluta* on the 12 tomato cultivars are given in Table 3. The lowest (6.47) and the highest (8.70) larval growth indices were observed on cultivars HAS 2274 and Velouro, respectively. The highest (18.33%) and the lowest (6.67%) percentage of larval mortality were recorded on cultivar CH Falat and Velouro, respectively. The lowest (8.87) and the highest (12.11) growth index for the pupal stages were observed on cultivars Korral and Cal. JN3, respectively. The highest and the lowest percentage pupal mortalities were observed on Korral (23.53%) and Synda RZ (11.54%) cultivars, respectively. Also the highest (35.00%) and the lowest (20.00%) percentage of overall mortalities were observed on Korral and Cal. JN3, respectively. The lowest (2.48) and the highest (3.58) growth index for the overall immature stages were observed on Korral and Valouro cultivars, respectively.

Life table parameters

There were significant differences among the cultivars in the net reproductive rate (R_0), intrinsic rate of increase (r_m), finite rate of increase (λ), doubling time (*DT*) and generation time (*T*) of *T. absoluta* (Table 4). The R_0 values varied from 25.54 ± 0.30 to 81.28 ± 0.48 female/female/generation on Korral and Valouro cultivars, respectively. The intrinsic rate of increase (r_m) varied from 0.1046 to 0.1584 day^{-1}. The lowest and highest values were otained on Korral and Valouro, respectively. The slowest (1.1102 ± 0.0005 per day) and the fastest (1.1716 ± 0.0002 per day) finite rate of increase (λ) values were obtained on Korral and Valouro cultivars, respectively. The longest and the shortest doubling time (*DT*) was obtained on Korral (6.63 ± 0.029 days) and, on Valouro (4.38 ± 0.006 days) cultivarrespectively. The longest mean generation time (*T*) was observed on HAS 2274 (31.61 ± 0.032 days) and the shortest on Valouro (27.76 ± 0.019 days).

Discussion

According to our finding, the tomato leafminer had four larval instars on all of the12 tomato cultivars, which is in agreement with findings of Torres *et al.* (2001), Pereyra and Sanchez (2006) and Erdoghan and Babaroglu (2014). In the current study, the mean larval periods varied between 10.73 to 12.92 days on different tomato cultivars. Pereyra and Sanchez (2006) found that at 25 ± 1 °C the larval periods of the tomato leafminer were 12.14 and 14 days on tomato and potato plants, respectively. Erdoghan and Babaroglu (2014) reported that total larval period of *T. absoluta* was 10.97 days at 25-26 °C which is nearly similar to our results. The relatively longer developmental time of larva of *T. absoluta* on potato may be due to the higher concentration of glycoalkaloids in the leaves of potato that can negatively affect larval development of the leafminer. Variation in the larval developmental periods of *T. absoluta* on different tomato cultivars may be attributed to the nutritional quality of host plants and differences in rearing conditions of the herbivore insect (Bernays and Chapman, 1994).

Table 3 The growth index (GI) and mortality of immature stages of *Tuta absoluta* on12 tomato cultivars.

Cultivars	Larvae		Pupae		Overall immature	
	Mortality (%)	GI	Mortality (%)	GI	Mortality (%)	GI
Cal. JN3	8.33	8.24	12.73	12.11	20.00	3.53
CH Falat	18.33	6.56	18.37	9.52	33.33	2.59
Chef	13.33	7.40	15.38	10.70	26.67	3.00
HAS 2274	16.67	6.47	18.00	9.77	31.67	2.63
Infinity	11.67	7.34	15.09	12.01	25.00	3.18
Korral	15.00	6.57	23.53	8.87	35.00	2.48
Meshkin	13.33	7.06	19.23	10.31	30.00	2.84
Pellmech	13.33	7.64	13.46	12.06	25.00	3.28
Super H	10.00	7.97	16.67	11.50	25.00	3.26
Synda RZ	13.33	7.59	11.54	12.07	23.33	3.31
Valouro	6.67	8.70	16.07	11.81	21.67	3.58
Y Falat	11.67	7.59	22.64	9.94	31.67	2.87

Table 4 The mean (± SE) of intrinsic rate of increase (r_m), net reproductive rate (R_0), finite rate of increase *(λ)*, doubling time (*DT)* and generation time (*T*) of *Tuta absoluta* on12 tomato cultivars.

Cultivars	r_m (day^{-1})	R_0	λ (day^{-1})	*DT* (day)	*T* (day)
Cal JN3	0.1454 ± 0.0003 b	62.31 ± 0.52 b	1.1565 ± 0.0004 b	4.77 ± 0.011 g	28.42 ± 0.034 f
CH Falat	0.1108 ± 0.0004 g	31.12 ± 0.37 h	1.1171 ± 0.0004 g	6.26 ± 0.022 b	31.03 ± 0.044 b
Chef	0.1238 ± 0.0003 f	39.94 ± 0.33 g	1.1318 ± 0.0003 f	5.60 ± 0.012 c	29.78 ± 0.031 d
HAS 2274	0.1100 ± 0.0004 g	32.45 ± 0.39 h	1.1163 ± 0.0004 g	6.30 ± 0.022 b	31.61 ± 0.032 a
Infinity	0.1386 ± 0.0003 d	52.53 ± 0.39 e	1.1487 ± 0.0004 d	5.00 ± 0.011 e	28.58 ± 0.045 f
Korral	0.1046 ± 0.0005 h	25.54 ± 0.30 i	1.1102 ± 0.0005 h	6.63 ± 0.029 a	30.98 ± 0.037 bc
Meshkin	0.1242 ± 0.0003 f	46.16 ± 0.39 f	1.1323 ± 0.0003 f	5.58 ± 0.012 c	30.85 ± 0.031 c
Pellmech	0.1404 ± 0.0003 c	58.42 ± 0.42 c	1.1508 ± 0.0003 c	4.94 ± 0.010 ef	28.96 ± 0.028 e
Super H	0.1410 ± 0.0002 c	55.51 ± 0.30 d	1.1515 ± 0.0002 c	4.91 ± 0.006 f	28.48 ± 0.024 f
Synda RZ	0.1388 ± 0.0004 d	52.52 ± 0.43 e	1.1489 ± 0.0004 d	4.99 ± 0.014 e	28.53 ± 0.042 f
Valouro	0.1584 ± 0.0002 a	81.28 ± 0.48 a	1.1716 ± 0.0002 a	4.38 ± 0.006 h	27.76 ± 0.019 g
Y Falat	0.1291 ± 0.0003 e	46.45 ± 0.41 f	1.1378 ± 0.0003 e	5.37 ± 0.013 d	29.74 ± 0.039 d

Means followed by the same letters are not significantly different using pairwise comparisons (the student t-test for independent samples) at $P < 0.05$ when one tailed test was employed (Maia *et al.,* 2000).

The pupal development time of the tomato leafminer varied from 7.07 to 8.62 days on Infinity and Korral cultivars, respectively. Torres *et al.* (2001) found the pupal developmental time of *T. absoluta* as 7-9 days, which is close to our results.

In our study, the total development time of *T. absoluta* varied from 21.87 days on Valouro to 26.20 days on Korral at 25 ± 1 °C under the laboratory conditions. According to the reports of EPPO (2005) the total development time of the tomato leafminer is about 30 days under normal conditions. Cuthbertson (2011) showed that in England under greenhouse conditions the mean total development time of *T. absoluta* was 76.3, 39.8, 35 and 8 days at 14 °C, 19.7 °C, 25 °C and 27.1 °C, respectively. Also, Erdoghan and Babaroglu (2014) showed that the mean total development time of *T. absoluta* was 30.18 days on tomato at 25-26 °C. *T. absoluta* developed slightly faster in our studies compared to the results obtained by the others which might be in part attributed to the cultivar differences and possible differences in the population of *T. absoluta* in these researches. The developmental time of the herbivore insects are strongly affected by the nutritional qualities of the host plant, which in turn influences its population growth (Du *et al*., 2004). On the other hand, the chemical components of host plants can also affect survival, growth and reproduction of herbivore insects (Wilson and Huffaker, 1976; Bernays and Chapman, 1994; Adebayo and Omoloyo 2007).

Our findings revealed that the mean oviposition period of *T. absoluta* varied from 5.08 days on Korral to 8.13 days on Valouro. Also, the mean total pre-oviposition period (TPOP) was 24.13 days on Korral and 29.31 days on Valouro. According to Erdoghan and Babaroglu (2014) the oviposition period of the tomato leafminer was 7.88 days on tomato at 25-26 °C. Our findings are nearly similar to the results of these researchers. The defensive compounds and nutritional qualities of host plants can influence the fecundity and oviposition duration of herbivore insects.

We found that the mean number of eggs produced per female ranged from47.54 on Korral to 119.53 on Valouro. According to Uchoa-Fernandes *et al*. (1995) the fecundity (number eggs/female) of *T. absoluta* was 260 eggs, while Pereyra and Sanchez (2006) noted that the mean fecundities of this insect were 132.78 and 97.73 eggs on tomato and potato plants, respectively. Erdoghan and Babaroglu

(2014) reported that the mean fecundity of this insect was 141.16 eggs on tomato. The lower fecundity of *T. absoluta* in our study may have resulted from the lower nutritional qualities or some other factors of the studied cultivars.

The lowest adult female longevity (8.47 days) was observed on those females that were reared on Korral cultivar during their larval stage and the highest (12.13 days) was observed on Valouro cultivar. In Erdoghan and Babaroglu (2014) research, the mean adult female longevity was 18.16 days. The lower longevity of *T. absoluta* in our study may be due to the physical, chemical and nutritional differences of the cultivars in these two studies.

The growth index (GI) of immature stages of an insect reflects both its survival rate and development time (Setamou *et al.*, 1999). In this study, the lowest and highest larval as well as overall immature growth index of the tomato leafminer were recorded on Korral and Valouro cultivars, respectively. The higher survival rate and the shorter developmental time result in higher growth index which is an indication of the suitability of the given cultivar to insect (Greenberg *et al.*, 2001).

In our research, the lowest intrinsic rate of increase (r_m) (0.1046 day^{-1}) and the lowest finite rate of increase (λ) (1.1102 day^{-1}) and highest (6.63 days) doubling time (*DT*) of the tomato leafminer were observed on Korral cultivar in comparison with other cultivars. The $r_{m,}$, λ and *DT* are key demographic parameters used to compare the fitness of population across diverse food-related conditions (Smith, 1991). When the insect feed on the suitable host plant in their larval stages, they grow more rapidly and their generation time becomes shorter compared with less preferred host plants. The fecundity and population growth parameters are also highest on more suitable host (Price, 1997). The highest values of r_m (0.1584 day^{-1}) and λ (1.1716 day^{-1}) and the lowest *DT* (4.38 days) were observed on Valouro cultivar, which indicates that this cultivar is the most suitable of the studied tomato cultivar for *T. absoluta*. Pereyra and Sanchez (2006) reported the value of r_m, of *T. absoluta* 0.14 day^{-1} on tomato plant. According to Erdoghan and Babaroglu (2014) the values of r_m and λ of the *T. absoluta* were 0.132 day^{-1} and 1.141 day^{-1}, respectively on tomato. The small differences observed between our findings and the results of other scientists in population growth parameters may be attributed to the morphological, physiological and nutritional properties of the different tomato cultivars used in these studies. Therefore, it can be concluded that Korral and Valouro cultivars are the less suitable of the tomato cultivars to *T. absoluta* and can be a choice in its management program.

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چرخه زندگی و پارامترهای جدول زندگی *Tuta absoluta* (Lepidoptera: Gelechiidae) روی دوازده رقم تجاری گوجه‌فرنگی در شریط گلخانه

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چکیده: شب‌پره مینوز گوجه‌فرنگی، *Tuta absoluta* (Meyrick)، یک آفت جدی گوجه‌فرنگی در سراسر جهان است. در این تحقیق چرخه زندگی و پارامترهای جدول زندگی حشره روی ۱۲ رقم از ارقام تجاری گوجه‌فرنگی در شرایط گلخانه مورد مطالعه قرار گرفت. طولانی‌ترین دوره لاروی (۰/۱۱ ± ۱۲/۹۲)، طولانی‌ترین دوره نشوونمای کل (۰/۲۲ ± ۲۶/۲۰)، طولانی‌ترین دوره پیش از تخم‌ریزی (۰/۶۳ ± ۲۹/۳۱) و کوتاه‌ترین دوره تخم‌ریزی (۰/۴۳ ± ۵/۰۸) روی رقم Korral مشاهده شد. بیش‌ترین درصد تلفات مرحله شفیرگی روی رقم Korral (۲۳/۵۳ درصد) و کم‌ترین شاخص‌های رشدی مراحل لاروی و شفیرگی روی رقم Korral (به‌ترتیب ۶/۵۷ و۸/۸۷) به‌دست آمد. بیش‌ترین و کم‌ترین تلفات کل به‌ترتیب روی رقم Korral (۳۵/۰۰ درصد) و رقم Valouro (۲۱/۶۷ درصد) مشاهده شد. کم‌ترین و بیش‌ترین نرخ ذاتی افزایش جمعیت (r_m) به‌ترتیب روی رقم Korral (۰/۰۰۰۵ ± ۰/۱۰۴۶ ماده /ماده /روز) و رقم Valouro (۰/۲۰۰۰ ± ۰/۱۵۸۴ ماده /ماده /روز) محاسبه گردید. هم‌چنین کم‌ترین نرخ متناهی رشد جمعیت (λ) (۰/۱۱۰۲ بر روز) و طولانی‌ترین زمان دو برابر شدن جمعیت (۶/۶۳ روز) روی رقم Korral به‌دست آمد. لذا نتیجه‌گیری شد که در میان ۱۲ رقم گوجه‌فرنگی مورد بررسی در این پژوهش رقم Korral برای شب‌پره مینوز گوجه‌فرنگی نامطلوب می‌باشد و می‌توان از آن در برنامه‌های کنترل تلفیقی این آفت استفاده نمود.

واژگان کلیدی: *Tuta absoluta*، چرخه زندگی، پارامترهای جدول زندگی، ارقام گوجه‌فرنگی