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Population parameters of the tomato leaf miner *Tuta absoluta* (Lepidoptera: Gelechiidae) on wild tomato species

Baran Aslan[1]**, *Ali Kemal Birgücü*[2]

[1]*Burdur Food Agriculture and Livestock Vocational School, Burdur Mehmet Akif Ersoy University, Burdur, Turkey*
[2]*Plant Protection Department, Agriculture Faculty, Isparta University of Applied Sciences, Isparta, Turkey*

**Corresponding author: aslanb@mehmetakif.edu.tr*

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Abstract: In this study, the effects of five wild tomato species (*Solanum chilense, Solanum corneliomulleri, Solanum neorickii, Solanum huaylesense* and *Solanum pennellii*) on the life table parameters of *Tuta absoluta* were determined for the first time, and the larval development time, lifespan, pupal period, fecundity, and female/male longevity were also estimated. According to the data obtained from the study, *S. chilense* was determined as the most suitable species for the development of *T. absoluta*. Among the wild tomato species, *S. corneliomulleri* and *S. neorickii* were determined as the most effective hosts against *T. absoluta* in terms of the intrinsic rate of increase, net reproductive rate, mean generation time, gross reproduction rate, population doubling time, and finite rate of increase than the other species. These two species were also effective against the pest on the egg, larval development, total longevity, and fecundity. According to these results, *S. corneliomulleri* and *S. neorickii* are viable candidates for the development of new resistant tomato genotypes to *T. absoluta*.

Keywords: wild tomatoes; *Solanum*; life table; resistance

The tomato leaf miner, *Tuta absoluta* (Meyrick) (Lepidoptera: Gelechiidae) is one of the most destructive pests of tomato plants in tropical and subtropical regions of the world (Picanço et al. 2007). The development of resistance by *T. absoluta* against a wide variety of insecticides has been suggested as an obstacle to the chemical control methods (Desneux et al. 2021).

The larval stage of *T. absoluta* is harmful and feeds on all parts of the tomato plant (leaf, stem, and fruit) except the root (Biondi & Desneux 2019). The females lay their eggs on the leaves, stems, and petioles of host plants. The larvae emerge from the eggs and feed in the galleries opened between the leaf epidermis tissues (Simmons et al. 2018). The dry tissues caused by these galleries reduce the plant's photosynthetic ability and production. The larvae have four instars, feed and develop in the leaf mines, and may damage the fruit and stem of the host plant (Duarte et al. 2015). Adults can fly great distances, but are sometimes carried away by the wind (Van Deventer 2009). Under greenhouse conditions, the pest survives and reproduces throughout the year (Santana et al. 2019).

It is known that the development of tomato varieties resistant to *T. absoluta* reduces yield losses in both organic and traditional tomato production and the use of environmentally harmful pesticides (Biondi et al. 2018). Wild tomato species contain thousands of valuable genetic resources, which probably disappeared in the process of domestication (Zeist et al. 2018). In other words, wild species have a high level of genetic diversity compared to their modern varieties (Zhang et al. 2016). Genes cloned from wild relatives of plants have been frequently used in classical and molecular breeding studies to increase the resistance of various plant species to biotic and abiotic stress conditions (Tanksley & McCouch 1997; Hajjar & Hodgkin 2007; Maxted et al. 2013). Commercial tomato varieties with resistance to *T. absoluta* can be developed by using genes from wild tomato species (Biondi et al. 2018). Wild tomato species seem to be good gene-sources for developing resistant commercial tomato varieties.

The continuing use of limited genetic sources, disease agents' rapid adaptation and behavioural developments of insects have limited the long-term usability of the resistant cultivars. Life table studies provide valuable data such as the growth, survival, and fecundity of the studied insects (Lewis 1942; Rostami et al. 2016). This information corresponds to the question of how the biological performance of the pest is affected by the host plants.

This study aimed to determine the population parameters of *T. absoluta* in wild tomato plants, including the species *Solanum chilense*, *Solanum corneliomulleri*, *Solanum neorickii*, *Solanum huaylesense*, and *Solanum pennellii*. The life curves for each wild tomato species are determined by the Weibull distribution model on an age-specific survivor rate (l_x).

MATERIAL AND METHODS

Plant rearing

For the bioassays, *Solanum chilense* (LA 0130), *Solanum corneliomulleri* (LA0103), *Solanum neorickii* (LA 0735), *Solanum huaylesense* (LA 1358), and *Solanum pennellii* (LA 0716) wild tomato species were used. The Tomato Genetic Resource Centre (TGRC, Davis, USA) supplied all the seeds.

The wild tomato species and the control (commercial tomato cultivar; *Solanum lycopersicum* cv 'Depar') were grown together. The plant seedlings were grown in Styrofoam cell trays filled with peat + vermiculite. After 30 days, they were transplanted into 15 × 9 cm pots (4 L) containing a mixture of peat + perlite (1:1). During the tomatoes' growing period, no chemical fertilisers or pesticides were used. In the presence of any disease or pest contamination event, the whole plant was immediately removed from the plant growing cabin.

Rearing of *Tuta absoluta*

The larvae and pupae of the *T. absoluta* samples were collected from tomato growing greenhouses around Antalya, Turkey, and were placed in a climate room with a temperature of 25 ± 1 °C, and a relative humidity (RH) of 65 ± 5%, and 16/8 light/dark conditions. To get a stock culture, individuals of *T. absoluta* were reared on a commercial tomato cultivar (cv 'Depar') for at least three generations and then used in the experiments.

Survival experiments

Twenty *T. absoluta* adults randomly taken from the stock culture were placed in 10 × 8 × 8 cm plastic boxes, covered with a net with a complete compound leaf of the desired tomato species to lay eggs on. Only the stem part of the leaf was wrapped with cotton and placed in Eppendorf tubes containing water to prevent evaporation. The eggs laid on tomato leaves were transferred into Petri dishes, and clean tomato leaves were left in the plastic boxes again with daily checks (Figure 1A). The leaf particles laid with eggs were moved and left on the examined tomato species on the 4th day.

After hatching, the larvae were placed into Petri dishes covered with a net together with the leaflet. Each larva was considered a separate replication (Figure 1B). All the treatments were carried out with 30 replications for each plant with a total of 180 replications. The development and survival of the pest species were checked daily by writing the replication numbers, hatching and larval instar period dates on the Petri dishes. The sexes of the individuals were distinguished as male or female at the pupae stage. After determining the sexes, the adults, one female and at least two males were left in a plastic box with clean tomato leaves. For the adult feeding, a sugar-water solution (5%) soaked in blotting paper was left in the box (Figure 1C). The tomato leaves were removed from the boxes, the eggs that were laid were counted, and clean tomato leaves of the same species were transferred to the boxes daily. The study continued until the last adult in the box died. All the survival experiments were performed in a climate chamber.

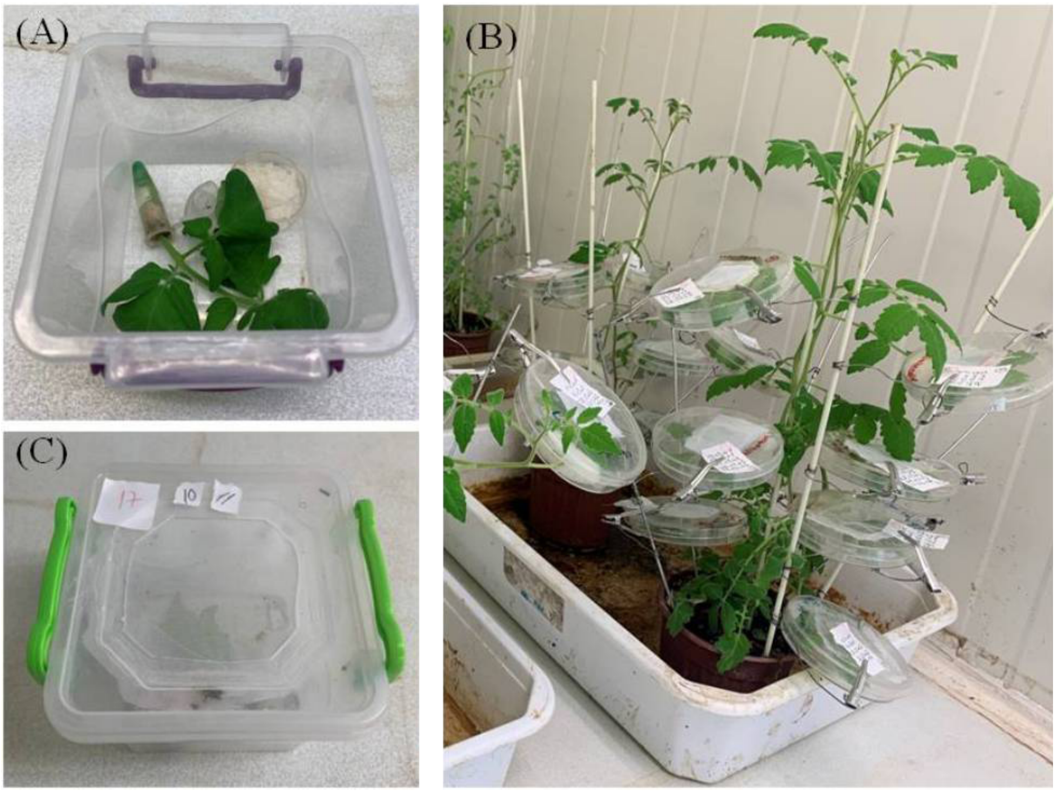

Figure 1. Survival experiment techniques of *Tuta absoluta* on tomato plants

(A) Preparation for egg-laying; (B) survival experiments on host plants; (C) mating box containing male and female individuals

Life table analyses

The life tables were constructed with daily data according to the age stage and two-sex life table (Chi & Liu 1985; Chi 1988). According to this theory, the calculated parameters are:

- Age-specific survivor rate (l_x) and fecundity rate (m_x)
- Mean fecundity (F) (eggs/female):

$$F = \frac{\sum_{x=1}^{N_f} E_x}{N_f} \tag{1}$$

- Net reproductive rate (R_0) (females/female):

$$R_0 = \sum_{x=0}^{\infty} l_x \times m_x \tag{2}$$

- Intrinsic rate of increase (r) (female/female/day):

$$1 = \sum_{x=0}^{\infty} \left(e^{-r(x+1)} \sum_{j=1}^{m} f_{xj} s_{xj}\right) \tag{3}$$

- Mean generation time (T) (day):

$$T = \frac{\ln R_0}{r} \tag{4}$$

- Gross reproduction rate (GRR) (larvae/female):

$$GRR = \Sigma m_x \quad \text{(Birch 1948)} \tag{5}$$

- Finite rate of increase (λ) (larvae/female/day):

$$1 = \sum_{x=0}^{\infty} \left(\lambda^{-(x+1)} \sum_{j=1}^{m} f_{xj} s_{xj}\right) \tag{6}$$

- Population doubling time (DT) (day):

$$DT = \frac{\ln 2}{r} \quad \text{(Kairo \& Murphy 1995)} \tag{7}$$

The mean and standard errors (ME; SE) of the intrinsic rate of increase (r) values computed on the data obtained from these populations, to be used in the comparison test, were calculated by the Bootstrap resampling method with an estimated repetition of 100 000 times (Lawo & Lawo 2011; Huang & Chi 2012; Yu et al. 2013a, b). Before Tukey's multiple comparison tests (Tukey 1949), a one-way analysis of variance (ANOVA) was applied to the bootstrap values of the intrinsic rates. The IBM® SPSS® Statistics (version 20.0) and MS

Excel 2010 (version 14.0) package programs were used for the statistical analyses.

A two-parameter Weibull distribution model was used to describe the age-specific survival rate (l_x) of the individuals on the control and wild tomato species (Pinder et al. 1978; Tingle & Copland 1989; Wang et al. 2000). The parameters of this distribution model's formula are:

$$S_p(x) = e^{\left[-\left(\frac{x}{b}\right)^c\right]} \quad x, b, c > 0 \qquad (8)$$

The probability of survival at x age $S_p(x)$ "x" is the female's age in days, "b" is a scale parameter, and "c" is a shape parameter. The parameters and curves of the Weibull distributions were performed by using the SigmaPlot® (version 11.0) package program.

RESULTS

The age-specific survival rates (l_x) and fecundity (m_x) curves of *T. absoluta* on the control and five different wild tomato species are given in Figure 2. In the life table curves, the l_x values decrease rapidly in all the species. However, the decrease in the m_x value of *S. neorickii* is significant compared with the others ($P > 0.05$). The curves of *S. corneliomulleri* and *S. huaylesense* are similar, and the rates of change in the m_x and l_x values are close to each other ($P > 0.005$) (Table 1).

The pre-adult development period of *T. absoluta* on the wild and control tomato species is shown in Table 1. The larval stages, pupal stages, and lifespan of *T. absoluta* on the different wild tomato species were all affected by the host plant species. The egg hatching period of the pest on the different tomato species varied between 4.63 to 5.50 days, which is statistically significant ($P > 0.05$) (Table 1).

Solanum corneliomulleri had the longest larval period (34.429 days), followed by *S. neorickii* (33.220 days), and the control (*S. lycopersicum* cv 'Depar') (32.767 days). The shortest *T. absoluta* larval period was 29.214 days on *S. huaylesense*. The development period of *T. absoluta* in the 1st and 4th larval stages (4.567 and 6.667 days, respectively) was longer on *S. neorickii* compared to the other species. However, the development periods of the 2nd and 3rd larval stages were the longest on *S. corneliomulleri*. While *S. huaylesense* had the shortest lifespan (29.214 days) and pupal period (7.172 days) (Table 1).

The results showed there was no significant difference among the adult pre-oviposition periods (APOPs), oviposition periods, and adult female longevity of *T. absoluta*. The only statistically significant difference was present in the post-oviposition period of *S. corneliomulleri* compared to the values of the other species. *Solanum corneliomulleri* had the longest post oviposition period. The male adult longevity values were statistically divided into three groups; (1) control and *S. chilense* (10.875 days each), (2) *S. corneliomulleri* and *S. pennellii* (9.765 days each), and (3) *S. neorickii* and *S. huaylesense* (9.714 and 9.235 days, respectively). The total longevities of *S. pennellii* (34.800 days) and *S. chilense* (34.833 days) were close to each other. *S. pennellii* had the shortest total longevity and *S. corneliomulleri* (40.091 days) had the longest total longevity when compared to all species (Table 2).

The fecundity of *T. absoluta* females reared on different tomato species was found to have the highest daily and total egg numbers on *S. chilense* (11.281 and 172.667 eggs/female, respectively). The lowest daily and total fecundities were observed on *S. corneliomulleri* (5.690 and 70.182 eggs/female, respectively). There were no statistical differences between the control, *S. huaylesense*, *S. neorickii*, and *S. pennellii* in both the daily and total fecundities (Table 3).

The highest r, R_0, GRR, and λ were determined for *S. chilense* (0.096 days^{-1}, 33.174 female/female, 52.497 females/female and 1.101 days^{-1}, respectively). *Solanum chilense* had the shortest intervals between the mean generation (T) and population doubling time (DT) values. Among the studied wild tomato species, the r value of *S. corneliomulleri* was statistically significant ($P > 0.05$) and the λ and GRR values were the lowest (1.058 days^{-1}, and 23.048 female/female, respectively). Moreover, the T (43.391 days) and DT (12.336 days) values of *S. corneliomulleri* were the highest compared to the other species. *Solanum neorickii* (9.938 females/female) had the lowest net reproductive rate ($P > 0.05$) (Table 3).

The Weibull distribution models were applied to the age-specific survival rate of *T. absoluta* reared on the different wild tomato species (Figure 3). In this model, the c value represents the slope shape; $c > 1$ represents the developing populations; $c = 1$ represents the stable populations; and $c < 1$ represents the regressed populations. When these

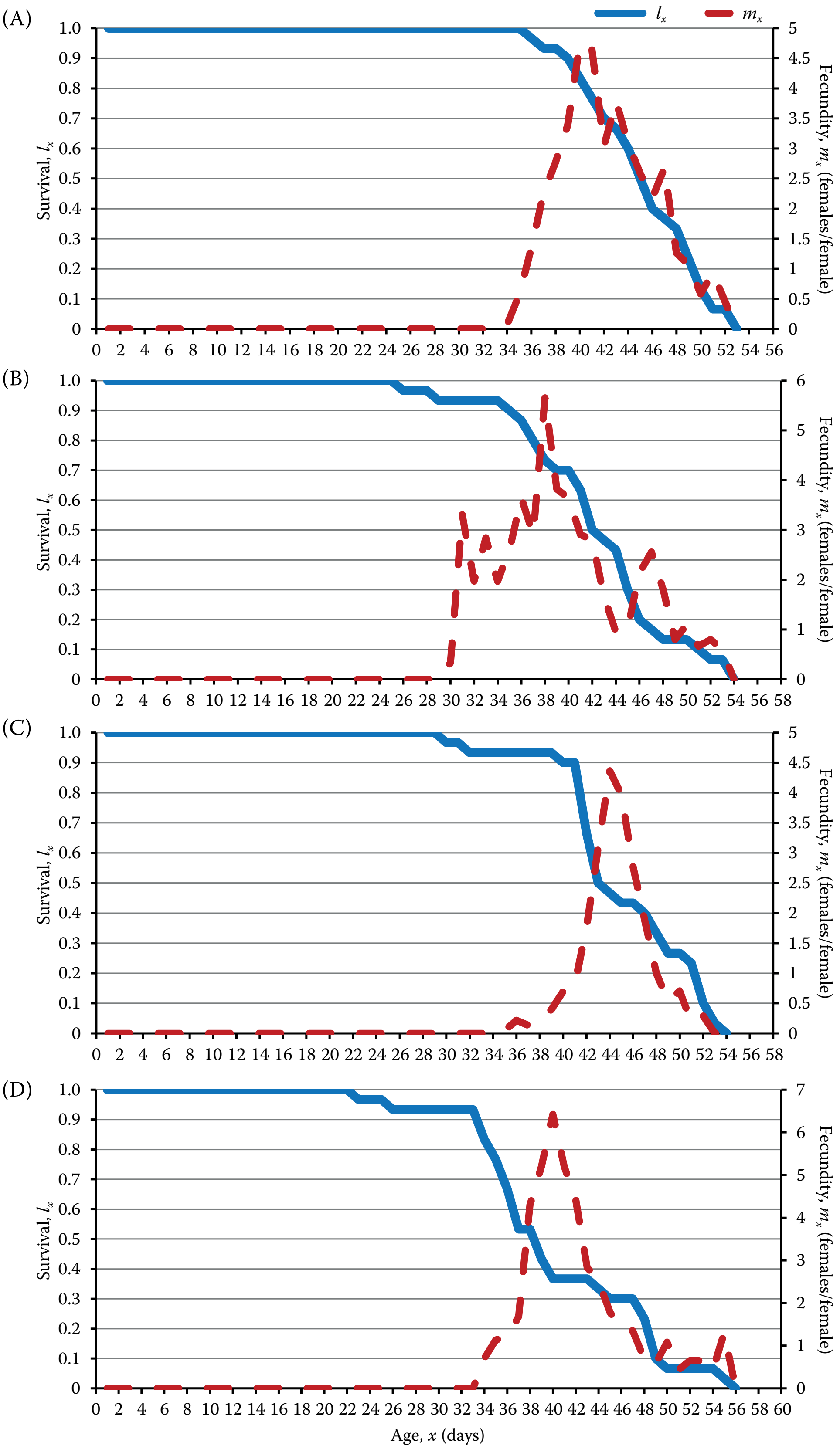

Figure 2. Age-specific survival rates (l_x) and fecundity (m_x) curves of the *Tuta absoluta* individuals reared on the control (*Solanum lycopersicum* cv 'Depar'; A) and five wild tomato species: *Solanum chilense* (B), *Solanum corneliomulleri* (C), *Solanum huaylesense* (D), *Solanum neorickii* (E), *Solanum pennellii* (F)

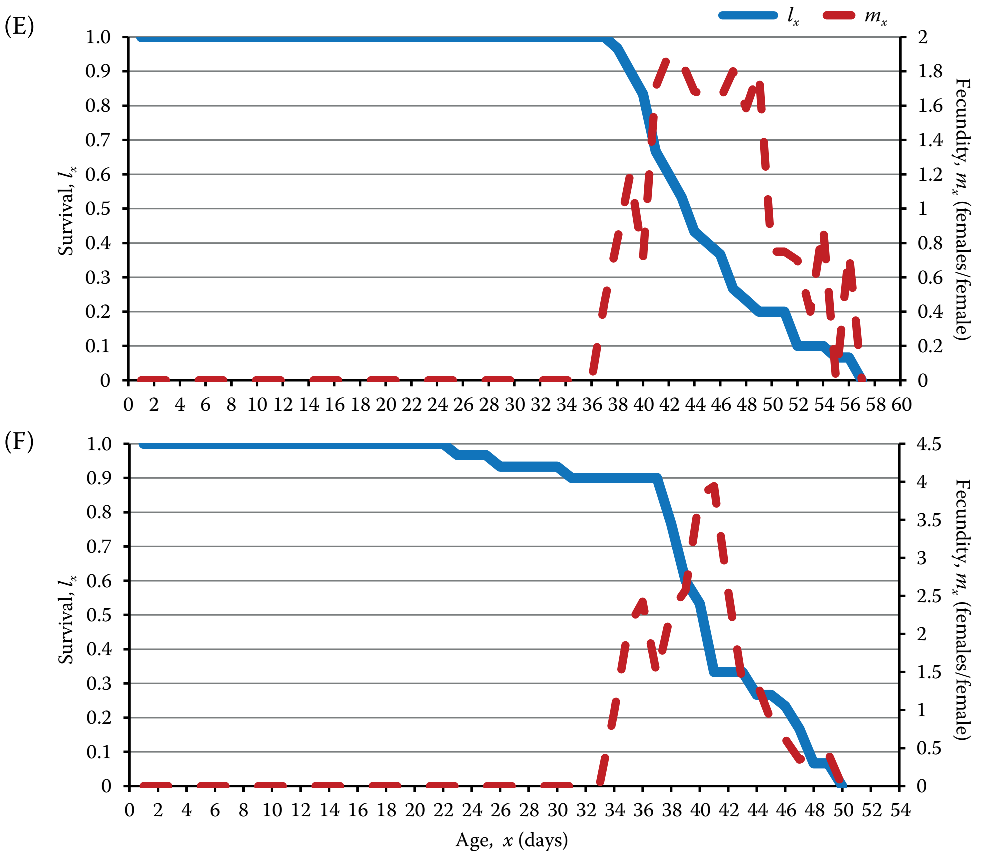

Figure 2 to be continued

c values are examined, the *T. absoluta* population showed an increasing population on the five wild tomato and control species, and *S. pennellii* had the lowest values of the age (day). Among the wild tomato species, the highest b values were found in *S. corneliomulleri*, the control, *S. neorickii*, *S. chilense*, *S. huaylesense*, and *S. pennellii*, respectively. The classification of the c values from the highest to lowest were control, *S. neorickii*, *S. corneliomulleri*, *S. pennellii*, *S. chilense*, and *S. huaylesense* (Table 4). According to the results of the present study, the control species was found to be the most suitable

Table 1. Preadult development periods (days) of *Tuta absoluta* on the control and five different wild tomato species

Species	n	Egg	L_1	L_2	L_3	L_4	Pupal period	Lifespan
Control	30	4.633 ± 0.089^{cd}	3.800 ± 0.101^{b}	4.667 ± 0.175^{ab}	4.867 ± 0.142^{a}	5.767 ± 0.238^{ab}	9.033 ± 0.443^{a}	32.767 ± 0.686^{a}
Solanum chilense	30	5.200 ± 0.121^{ab}	3.700 ± 0.119^{b}	4.167 ± 0.118^{bc}	4.133 ± 0.157^{b}	5.067 ± 0.166^{bc}	7.567 ± 0.266^{b}	30.071 ± 0.593^{b}
Solanum corneliomulleri	30	5.500 ± 0.093^{a}	4.333 ± 0.111^{a}	5.100 ± 0.162^{a}	5.467 ± 0.115^{a}	5.967 ± 0.305^{ab}	7.767 ± 0.367^{ab}	34.429 ± 0.614^{a}
Solanum huaylesense	30	4.900 ± 0.088^{bc}	3.833 ± 0.118^{b}	4.133 ± 0.142^{bc}	3.800 ± 0.194^{b}	5.233 ± 0.310^{bc}	7.172 ± 0.318^{b}	29.214 ± 0.702^{b}
Solanum neorickii	30	4.767 ± 0.092^{c}	4.567 ± 0.092^{a}	4.067 ± 0.126^{c}	5.033 ± 0.162^{a}	6.667 ± 0.264^{a}	8.100 ± 0.289^{ab}	33.200 ± 0.568^{a}
Solanum pennellii	30	4.267 ± 0.082^{d}	4.133 ± 0.142^{ab}	4.233 ± 0.133^{bc}	5.100 ± 0.205^{a}	4.500 ± 0.229^{c}	7.552 ± 0.320^{b}	29.963 ± 0.398^{b}

Control – *Solanum lycopersicum* cv 'Depar'; L_1 – first instar larvae; L_2 – second instar larvae; L_3 – third instar larvae; L_4 – fourth instar larvae

$^{a–d}$Different letters in each column show significant differences among the biological periods at a 5% level (Tukey's HSD test, $P > 0.05$)

Table 2. Total longevity, adult pre-oviposition period, oviposition and post-oviposition periods, adult (female, male) longevity of *Tuta absoluta* on the control and five different wild tomato species (days)

Species	Total longevity	APOP	Oviposition period	Post-oviposition period	Adult longevity	
					female	male
Control	38.000 ± 0.514^{ab}	1.357 ± 0.133^{a}	10.571 ± 0.803^{a}	0.571 ± 0.228^{ab}	12.500 ± 0.661^{a}	10.875 ± 0.455^{a}
Solanum chilense	34.833 ± 0.903^{c}	2.917 ± 0.965^{a}	11.417 ± 1.807^{a}	0.417 ± 0.193^{ab}	14.750 ± 1.102^{a}	10.875 ± 0.417^{a}
Solanum corneliomulleri	40.091 ± 0.768^{a}	1.231 ± 0.201^{a}	8.846 ± 1.372^{a}	0.692 ± 0.175^{a}	12.727 ± 1.019^{a}	9.765 ± 0.202^{ab}
Solanum huaylesense	36.091 ± 0.456^{bc}	1.462 ± 0.268^{a}	11.000 ± 1.557^{a}	0.154 ± 0.104^{ab}	14.909 ± 0.977^{a}	9.235 ± 0.219^{b}
Solanum neorickii	39.111 ± 0.676^{a}	1.222 ± 0.222^{a}	12.778 ± 0.846^{a}	0.111 ± 0.111^{ab}	14.111 ± 0.841^{a}	9.714 ± 0.250^{ab}
Solanum pennellii	34.800 ± 0.389^{c}	1.462 ± 0.332^{a}	9.538 ± 1.567^{a}	0.000 ± 0.000^{b}	14.300 ± 0.517^{a}	9.765 ± 0.235^{ab}

APOP – adult pre-oviposition period; Control – *Solanum lycopersicum* cv 'Depar'

$^{a-c}$Different letters in each column show significant differences among the biological periods at a 5% level (Tukey's HSD test, $P > 0.05$)

Table 3. Fecundity and the population parameters (mean ± SE) of *Tuta absoluta* on the control and five different wild tomato species

		Control	*Solanum chilense*	*Solanum corneliomulleri*	*Solanum huaylesense*	*Solanum neorickii*	*Solanum pennellii*
Fecundity (eggs/female)	daily	9.562 ± 0.727^{ab}	11.281 ± 2.221^{a}	5.690 ± 0.332^{b}	7.698 ± 1.633^{ab}	7.540 ± 0.423^{ab}	7.347 ± 1.045^{ab}
	total	120.643 ± 13.104^{ab}	172.667 ± 31.188^{a}	70.182 ± 4.451^{b}	107.545 ± 17.292^{ab}	107.667 ± 10.298^{ab}	103.500 ± 14.304^{ab}
n		30	28	30	30	30	30
The intrinsic rate of increase (day^{-1})		0.082 ± 0.004^{b}	0.096 ± 0.004^{a}	0.056 ± 0.003^{e}	0.072 ± 0.003^{c}	0.054 ± 0.003^{f}	0.071 ± 0.003^{d}
Net reproductive rate		27.706 ± 0.306^{b}	33.174 ± 0.242^{a}	11.447 ± 0.122^{e}	17.421 ± 0.14^{c}	9.938 ± 0.074^{f}	15.085 ± 0.135^{d}
Mean generation time (day)		40.516	36.321	43.391	39.824	42.464	38.127
Gross reproductive rate		41.463	52.497	23.048	45.948	23.055	27.562
Population doubling time (day)		8.455	7.190	12.336	9.684	12.819	9.738
Finite rate of increase (day^{-1})		1.085	1.101	1.058	1.074	1.056	1.074

Control – *Solanum lycopersicum* cv 'Depar'

$^{a-f}$Differences between the fecundity, the intrinsic rate of increase and net reproductive rate (± standard errors) with different letters in the same rows are statistically significant (Tukey's HSD test, $P > 0.05$)

host for the development of *T. absoluta* (c = 10.583, R^2 = 0.994) (Table 4).

DISCUSSION

In the last decade, tomato leaf miners' population parameters have been investigated in many studies on different tomato cultivars (Gharekhani & Salek-Ebrahimi 2014; Çekin & Yaşar 2015; Duarte et al. 2015; Rostami et al. 2016). However, this is the first study to describe *T. absoluta* population parameters on wild tomato species such as *S. chilense* (LA 0130), *S. corneliomulleri* (LA 0103), *S. neorickii* (LA 0735), *S. huaylesense* (LA 1358), and *S. pennellii* (LA 0716). The results showed significant dif-

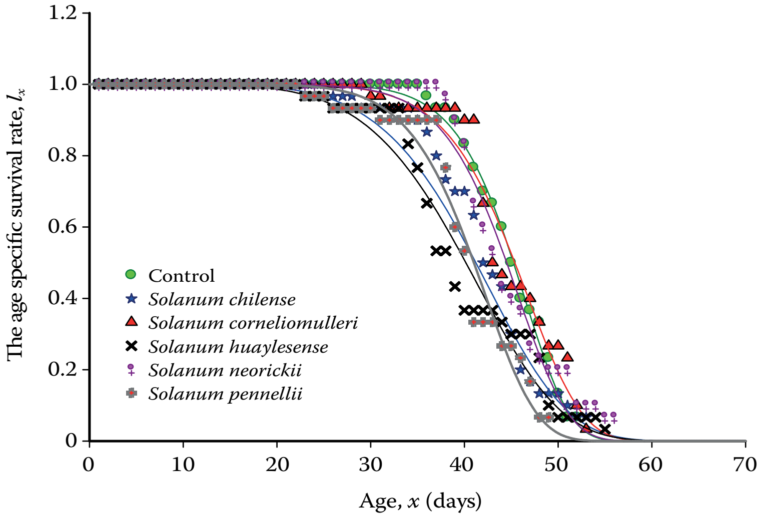

Figure 3. Weibull distribution models applied to the age-specific survival rate (l_x) of *Tuta absoluta* on the control (*Solanum lycopersicum* cv 'Depar') and five different wild tomato species

ferences in the life table parameters of *T. absoluta* on different wild tomato species. *Solanum huaylesense* was determined as having the shortest development time in the 3rd larval stage, pupal period, and lifespan. However, *S. chilense* had the shortest development period in the 1st larval stage and the second shortest values in the 3rd and 4th larval stages. *Solanum chilense* shows different resistant properties against different pathogens (Stam et al. 2017). In their study, Vitta et al. (2016) reported that *S. chilense* had the highest larval survival of *T. absoluta* among the tomato species. However, they also determined that *S. chilense* was resistant to *T. absoluta*. These results showed that the resistance cannot be determined with a single data point, so the resistance level may vary depending on the pest response.

The longest development periods of the pest in the 2nd and 3rd larval stages were observed on *S. corneliomulleri*, while for the 1st and 4th larval stages, the longest development periods were determined on *S. neorickii*. However, these two wild tomato species have similar results for all the developmental stages of *T. absoluta*. As a result of the present study, the response of the pest in all the developmental stages may change depending on the host plants. A similar result was found in a recent study (Sridhar et al. 2019a) reporting that *S. corneliomulleri* was resistant to *T. absoluta*. Nevertheless, we are unable to compare our life table results with the previous study of Sridhar et al. (2019a) because they did not include these parameters.

Previous studies have reported that *T. absoluta* lays an average of 136 eggs, varying between 60 to 120 and the studies indicated that this number can rise to 260 (Fernandez & Montagne 1990; Torres et al. 2001; Pereyra & Sánchez 2006). In our study, the number of eggs obtained is lower because the females mated with only one or two males. Among the examined species, the lowest daily and total fecundities were observed in *S. corneliomulleri*. In addition, *S. corneliomulleri* had the longest total longevity compared with other tomato species. Although *S. chilense*, *S. huaylesense*, and *S. corneliomulleri* have been re-

Table 4. Weibull distribution model's parameters applied on the age-specific survival rate (l_x) of *Tuta absoluta* on the control (*Solanum lycopersicum* cv 'Depar') and five different wild tomato species

Species	b	c	R^2	RSS
Control	46.837 ± 0.108	10.583 ± 0.308	0.994	0.227
Solanum chilense	43.843 ± 0.255	5.965 ± 0.269	0.978	0.753
Solanum corneliomulleri	47.304 ± 0.234	8.866 ± 0.494	0.972	0.114
Solanum huaylesense	42.863 ± 0.302	5.635 ± 0.288	0.979	0.145
Solanum neorickii	46.270 ± 0.226	9.485 ± 0.546	0.980	0.129
Solanum pennellii	42.801 ± 0.236	8.605 ± 0.492	0.975	0.108

The values of parameters b and c are given with their standard errors ($P < 0.000\ 1$)

ported as closely related species according to a previous phylogenetic study (Dodsworth et al. 2016), we have found a significant difference in terms of the fecundity values of *T. absoluta*.

Tuta absoluta had the lowest *r*, $R_{0,}$ and *DT* values on *S. neorickii*. The lowest *T* and *GRR* values found on *S. corneliomulleri* were parallel with the previous study of Sridhar et al. (2019b). They reported that *S. corneliomulleri* and *S. pennellii* were resistant to *T. absoluta*. In another study, similar findings were reported for *S. neorickii* as well (Kayahan et al. 2018).

The *S. chilense* species had negative results based on the life table data and pre-adult periods in all the examined species. *Solanum chilense* was found to be the most susceptible species to *T. absoluta* based on the life table parameters (*r*, R_0, *T*, *GRR*, *DT*), even when compared to the control.

In previous studies, it was reported that *S. pennellii* showed resistance to pest insects and arachnids (Baier et al. 2015; Zeist et al. 2018). The underlying mechanism of this resistance would be the high acyl sugar (AA) content, such as acylglycosis and acylsucrose, which is present in a higher amount in *S. pennellii* (Maluf et al. 2010a; Leckie et al. 2012). These allelochemicals are found in the leaf trichomes; therefore, they serve as a morphological defence in the *Solanum* genus (Cho et al. 2017; Mata-Nicolás et al. 2021). Wild tomato species, especially *S. pennellii*, have glandular trichomes. Although many studies reported that *S. pennellii* was resistant to *T. absoluta* (Goncalves Neto et al. 2010; Maluf et al. 2010b; Bitew 2018; Sridhar et al. 2019b), it showed moderate resistance among the wild tomato species examined in our study.

The results of the present study demonstrated that the tomato leaf miner is able to lay eggs on the leaves of all the studied tomato species, but there were differences in the population parameters between the hosts. The *Solanum corneliomulleri* and *S. neorickii* species were found to be more resistant to the pest than the other wild species. The differences may be related to insect feeding deterrents present in these plants. Tomato species, especially wild tomatoes, have a high density of trichome type IV structures, which could contribute to the pest resistance (Zhang et al. 2019). This trichome structure may have adversely affected the egg-laying ability of *T. absoluta*. Trichomes are a common morphological defence against pests; in particular, type IV glandular trichomes have been associated with resistance against different invertebrates (Mata-Nicolás et al. 2021). The development of resistant tomato cultivars by transferring resistance factors could be beneficial in pest management programmes against *T. absoluta* (Sohrabi et al. 2016).

CONCLUSION

In the present study, we aimed to answer the question of how *T. absoluta* responds to various wild tomato species. The results of the present study showed that the effects of the population parameters of the pest were diverse on the wild tomato species. In future breeding programmes, studies conducted using commercial tomato varieties with resistance genes to *T. absoluta* obtained from *S. corneliomulleri* and *S. neorickii* would be useful. Intensive studies on the mechanism of resistance need to be conducted to reveal the reason behind the differences.

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