

## Susceptibility, Oviposition Preference, and Biology of *Grapholita molesta* (Lepidoptera: Tortricidae) in *Prunus* Spp. Rootstock Genotypes

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### Abstract

Studying the susceptibility of peach trees to *Grapholita molesta* (Busck) is one of the major steps in the development of pest-resistant peach varieties. This work evaluated the susceptibility of 55 genotypes of the “*Prunus* Rootstock Collection” (“Coleção Porta-enxerto de *Prunus*”) of Embrapa Temperate Climate (Pelotas, Rio Grande do Sul, Brazil) to the natural infestation of *G. molesta*, assessed the oviposition preference of *G. molesta* in choice and no-choice bioassays, and estimated the biological parameters and the fertility life table on different *Prunus* spp. genotypes in the laboratory. Genotypes *Prunus kansuensis* (Rehder), I-67-52-9, and I-67-52-4 were the most susceptible to *G. molesta* infestation in the field (>60% of branches infested), while ‘Sharpe’ (*Prunus angustifolia* × *Prunus* spp.) and *Prunus sellowii* (Koehne) were the least infested (0% of branches infested). In choice and no-choice bioassays, *G. molesta* preferred to oviposit on *P. kansuensis* when compared with Sharpe. The Sharpe genotype also showed an antibiosis effect, resulting in negative effects on the fertility life table parameters when compared with the genotypes *P. kansuensis* and ‘Capdeboscq.’ The results found in the present study can provide information to initiate a long-term breeding program moving desired *G. molesta* resistance traits from the rootstock into the *Prunus* spp. cultivars.

**Key words:** Rosaceae, insect resistance, antibiosis, antixenosis, oriental fruit moth

In Brazil, 18,091 ha are cultivated with peach trees [*Prunus persica* (L.) Batsch]. The state of Rio Grande do Sul is the largest producer, cultivating 13,164 ha of *Prunus persica* (Agriannual 2016). Commercially, the plants used to establish new orchards are produced by grafting scion cultivars onto peach seedling rootstock. The seedling rootstock material is mostly from peach pits discarded by the peach canning industry (Mayer et al. 2009, Mayer and Ueno 2012). This practice does not allow for identification and control of the genotype that is being used as the rootstock and promotes considerable unknown genetic diversity among the root systems of the plants, favoring the occurrence of peach tree short life (PTSL), a disease that compromises the roots and causes early plant death, reducing the useful life of the orchards (Mayer et al. 2009, Mayer and Ueno 2012).

As of 2007, Embrapa Temperate Climate (Pelotas, Rio Grande do Sul-RS, Brazil) resumed research with rootstocks of the genus *Prunus* spp. including different peach, nectarine, and plum tree species grown in the field, focusing mainly on tolerance to PTSL, which leads to sprouting collapse (Beckman et al. 2008; Mayer et al. 2009,

2013). However, during these studies, a lack of uniformity with respect to the level of infestation and sprouts damaged by oriental fruit moth larvae, *Grapholita molesta* (Busck) (Lepidoptera: Tortricidae), during feeding was observed. This species is considered one of the main pests of the peach tree in Brazil (Botton et al. 2011) and worldwide (Myers et al. 2007). This observation led to the hypothesis of the existence of genetic variability in terms of resistance factors (i.e., antixenosis [the insect does not chose the plant to oviposit] or antibiosis [the insect does oviposit, but their larvae have a reduced development or death]) associated with some *Prunus* spp. genotypes, owing to their different genetic composition (Smith 2005, Arge 2012), as observed in the United States for *Synanthedon pictipes* (Grote and Robinson) (Lepidoptera: Sesiidae) (Cottrell et al. 2011).

The use of resistant host plants is recommended in integrated pest management programs (Kogan 1998). However, owing to the high efficiency of chemical insecticides (Arioli et al. 2004, Chaves et al. 2014) or mating disruption (Pastori et al. 2012, Arioli et al. 2014), genetic improvement programs aimed at finding sources of peach resistance to *G. molesta* are scarce. The identification of

potential sources of peach resistance to *G. molesta* would help in the definition of new management strategies in the field and in nurseries, leading to a reduction in the application of insecticide for the control of the species. *Grapholita molesta* infestations in peach seedling multiplication centers can be serious enough by fruit seedling production standards to result in nurseries closing (Castro 2010), and effective host-plant resistance could have significant implications for this industry. In this work, the following topics were evaluated: 1) the susceptibility of different *Prunus* spp. genotypes to natural infestation with *G. molesta*; 2) the oviposition preference of adults of *G. molesta* in choice and no-choice bioassays; and 3) the biology and fertility life tables of *G. molesta* in different *Prunus* spp. genotypes in the laboratory.

## Materials and Methods

### Susceptibility of *Prunus* Spp. Genotypes to *G. molesta*

In total, 55 *Prunus* spp. genotypes from the “*Prunus* Rootstock Collection” (“Coleção de Porta-enxertos de *Prunus*”) of Embrapa Temperate Climate, Pelotas, Rio Grande do Sul, Brazil (31° 40'41.61" S, 52° 27'03.32" W) were evaluated (Table 1). Seedlings of the different genotypes were planted during the year 2010 in an area of 6.0 by 2.0 m and were trained in a vase-shaped form. In July 2015, a drastic pruning was performed on the plants, cutting all major branches between 1.0 and 1.2 m above ground level, stimulating vigorous regrowth favorable to *G. molesta* infestation (Salles 1991, Botton et al. 2011). No pesticides were applied after pruning or during the evaluation period. Two visual evaluations of *G. molesta* infestation were performed on 20 branches per plant, with three different plants for each genotype during December 2015 and March 2016. Sprouts were considered infested by *G. molesta* larvae if they showed damaged apical meristems and the presence of tunnels and gum exudation (Salles 1991).

### Oviposition Preference of *G. molesta* on *Prunus* Spp. Genotypes

Two genotypes were selected based on pest infestation in the field: 1) *Prunus kansuensis* Rehder (high infestation) and 2) ‘Sharpe’ (no infestation; Fig. 1). To verify the preference of *G. molesta* oviposition in these genotypes, choice and no-choice bioassays were performed in a greenhouse (temperature of  $25 \pm 1^\circ\text{C}$ , relative humidity [RH] of  $60 \pm 10\%$ , and a photoperiod of 14:10 [L:D] h).

### Choice Bioassay

Full branches of *P. kansuensis* and Sharpe that were 20 cm in length (containing eight leaves) were collected in the field and then individually placed in plastic cups (180 ml) containing a 2% agar–water mixture in the greenhouse. The plastic cups were placed randomly and equidistant from each other in semitransparent plastic cages (60.0 cm in length by 39.0 cm in width by 37.0 cm in height) to prevent contact between the leaves. Each cage contained two rectangular openings on the sides (8.0 cm by 10.0 cm) sealed with voile fabric to ensure ventilation. Ten 4-d-old mated *G. molesta* females obtained from laboratory rearing stocks on artificial diet (Arioli et al. 2007) were released into each cage. The adults were fed a 30% aqueous honey solution ad libitum supplied via capillary action using hydrophilic cotton placed in acrylic jars (50 ml). The branches were replaced daily with new ones over a period of 5 d. In the laboratory, the number of eggs present on the leaves and petioles was counted. The experimental design was a randomized block design with 10 replicates (cages), with each replicate composed of three

branches from each genotype per cage, totaling 30 branches per treatment (*P. kansuensis* or Sharpe).

### No-Choice Bioassay

The experiment was conducted in semitransparent plastic cages under the same conditions described for the choice bioassay. In each cage, five branches from each genotype (*P. kansuensis* or Sharpe treatments) were placed equidistant from each other. Subsequently, ten 4-d-old *G. molesta* mated females were released and fed an aqueous honey solution (30%) supplied via capillary action using hydrophilic cotton. The branches were replaced daily with new branches until the females died, and the eggs were counted. The experimental design was a randomized block design with six replicates (cages) per treatment, each replicate consisting of five branches of each genotype, totaling 30 branches per treatment (*P. kansuensis* or Sharpe).

### Biology of *G. molesta* in *Prunus* Spp. Genotypes

Three genotypes (treatments) were used: *P. kansuensis* (high infestation [ $69.2 \pm 3.0\%$ ]), ‘Capdeboscq’ (medium infestation [ $40.8 \pm 2.7\%$ ]), and Sharpe (no infestation [ $0\%$ ]; Fig. 1), which were individually placed in cages made from plastic cups (180 ml) containing a 2% agar–water mixture. Subsequently, one *G. molesta* larva up to 24 h in age was transferred per branch with the aid of a fine-tipped brush. At the end of the larval development, a piece of hydrophilic cotton was placed inside the cage to serve as a pupation site. To avoid escape of the larvae, another plastic cup (100 ml) was placed in the top of each cage in an inverted position, according to Chaves et al. (2014). The experimental design was a completely randomized design with 100 replicates (larvae) per treatment. The biological parameters evaluated were as follows: 1) duration (days) and viability (%) of larval and pupal stages and adult longevity; 2) fecundity of *G. molesta* females and the viability and duration of the embryonic period of the eggs of these females; 3) duration of the oviposition period; 4) sex ratio; and 5) weight of 24-h-old pupae. The duration and viability of the different stages of development were determined through daily observations. The longevity and fecundity were evaluated through observation of 15 mating pairs from each treatment individually placed in cages made from plastic cups (180 ml; oviposition substrate) inverted on a petri dish (1 cm in height by 9 cm in diameter). The adult were fed a 30% aqueous honey solution ad libitum provided by capillary action using hydrophilic cotton placed in glass tubes (10 ml). The number of eggs and adult mortality were recorded daily. The viability and the duration of the embryonic period were obtained from the second laying of each couple. Egg laying was observed daily to determine the duration of the embryonic period and viability.

### Statistical Analyses

For the evaluation of the natural infestation in the field, the experimental design used was a completely randomized design, with 55 treatments (genotypes) and three replicates of one plant each. Because the data conformed to a binomial distribution, they were subjected to nonlinear regression analysis (PROC GENMOD, SAS Institute 2000), with a logit link function to estimate the mean infestation values (%) for each genotype and their respective 95% confidence intervals. In addition, after testing the data residuals for normality by the Shapiro–Wilk test and for homoscedasticity by Hartley’s and Bartlett’s tests (PROC GLM, SAS Institute 2000), a clustering analysis of homogeneous means was performed by the

**Table 1.** Identification, species, and origin of genotypes at “Prunus Rootstock Collection” of the Embrapa Clima Temperado, 2016

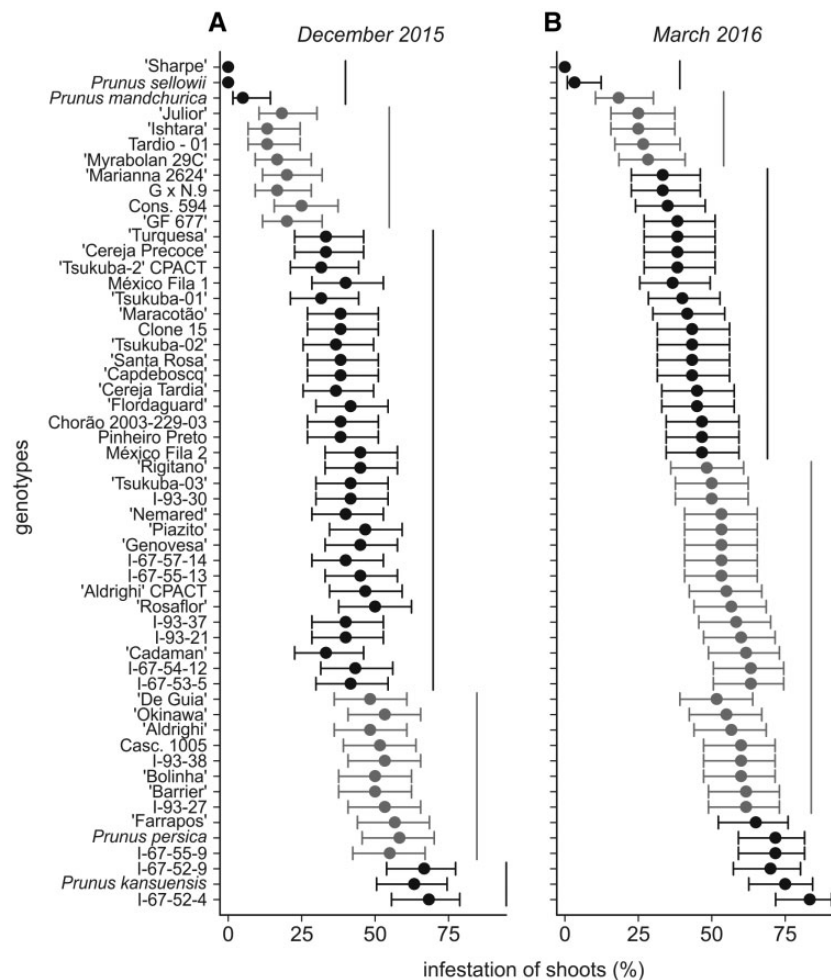
Genotype	Species <sup>a</sup>	Origin <sup>b</sup>
I-67-52-4	<i>P. persica</i>	United States
I-67-52-9	<i>P. persica</i>	United States
I-67-53-5	<i>P. persica</i>	United States
I-67-54-12	<i>P. persica</i>	United States
I-67-55-9	<i>P. persica</i>	United States
I-67-55-13	<i>P. persica</i>	United States
I-67-57-14	<i>P. persica</i>	United States
I-93-21	<i>P. persica</i>	United States
I-93-27	<i>P. persica</i>	United States
I-93-30	<i>P. persica</i>	United States
I-93-37	<i>P. persica</i>	United States
I-93-38	<i>P. persica</i>	United States
'Barrier'	<i>P. persica</i> x <i>P. davidiana</i>	Italy
'Cadaman'	<i>P. persica</i> x <i>P. davidiana</i>	France
'GF 677'	<i>P. persica</i> x <i>P. amygdalus</i>	France
G x N.9	<i>P. persica</i> x <i>P. dulcis</i>	Unknown
'Ishtara'	( <i>P. cerasifera</i> x <i>P. salicina</i> ) x ( <i>P. cerasifera</i> x <i>P. persica</i> )	France
'Julior'	<i>P. insititia</i> x <i>P. domestica</i>	France
'Marianna 2624'	<i>P. cerasifera</i> x <i>P. munsoniana</i>	California, United States
'Myrabolan 29C'	<i>P. cerasifera</i>	Unknown
Tardio - 01	<i>P. persica</i>	Grower from Pelotas—RS/Brazil
'Aldrighi' CFACT	<i>P. persica</i>	GB of Embrapa Clima Temperado
Capdeboscq	<i>P. persica</i>	GB of Embrapa Clima Temperado
'Genovesa'	<i>P. salicina</i>	GB of Embrapa Clima Temperado
'De Guia'	<i>P. persica</i>	GB of Embrapa Clima Temperado
'Rosaflo'	<i>P. persica</i>	GB of Embrapa Clima Temperado
<i>Prunus mandchurica</i>	<i>P. mandchurica</i>	GB of Embrapa Clima Temperado
'Tsukuba-2' CFACT	<i>P. persica</i>	GB of Embrapa Clima Temperado
México Fila 1	<i>P. persica</i>	Mexico
México Fila 2	<i>P. persica</i>	Mexico
'Santa Rosa'	<i>P. salicina</i>	California, United States
'Piazito'	<i>P. persica</i>	GB Embrapa Clima Temperado
'Tsukuba-01'	<i>P. persica</i>	Japan
'Tsukuba-02'	<i>P. persica</i>	Japan
'Tsukuba-03'	<i>P. persica</i>	Japan
'Okinawa'	<i>P. persica</i>	Florida, United States
'Flordaguard'	'Chico 11' x <i>P. davidiana</i>	Florida, United States
Cereja Precoce	<i>Prunus</i> sp.	São Joaquim—SC/Brazil
Cereja Tardia	<i>Prunus</i> sp.	São Joaquim—SC/Brazil
Pinheiro Preto	<i>P. persica</i>	Pinheiro Preto—SC/Brazil
'Nemared'	<i>P. persica</i>	California, United States
<i>Prunus sellowii</i>	<i>P. sellowii</i>	Pelotas—RS/Brazil
<i>Prunus kansuensis</i>	<i>P. kansuensis</i>	GB of Embrapa Clima Temperado
<i>Prunus persica</i>	<i>P. persica</i>	GB of Embrapa Clima Temperado
Cons. 594	<i>P. persica</i>	GB of Embrapa Clima Temperado
Casc. 1005	<i>P. persica</i>	GB of Embrapa Clima Temperado
'Bolinha'	<i>P. persica</i>	GB of Embrapa Clima Temperado
'Farrapos'	<i>P. persica</i>	GB of Embrapa Clima Temperado
Chorão 2003-229-03	<i>P. persica</i>	GB of Embrapa Clima Temperado
'Turquesa'	<i>P. persica</i>	GB of Embrapa Clima Temperado
'Aldrighi'	<i>P. persica</i>	Grower from Pelotas—RS/Brazil
'Maracotão'	<i>P. persica</i>	Grower from Pelotas—RS/Brazil
'Rigitano'	<i>P. mume</i>	FCAV/UNESP, Jaboticabal—SP/Brazil
Clone 15	<i>P. mume</i>	FCAV/UNESP, Jaboticabal—SP/Brazil
Sharpe	Chickasaw( <i>P. angustifolia</i> ) x <i>Prunus</i> spp.	Florida, United States

<sup>a</sup> *P.*—*Prunus*.<sup>b</sup> GB—live germplasm bank.

Scott–Knott test ( $P \leq 0.05$ ) using the software Assistat v.7.7 (Silva and de Azevedo 2016).

For the choice and no-choice bioassays, the experimental design was a randomized block with 10 and 6 replicates per treatment (genotypes), respectively. Data residuals from the number of eggs per

branch were tested for normality by the Shapiro–Wilk test and for homoscedasticity by Hartley’s and Bartlett’s tests. Subsequently, they were subjected to analysis of variance (ANOVA), and the means were compared by Tukey’s test at a 5% significance level ( $P \leq 0.05$ ; PROC UNIVARIATE, SAS Institute 2000).



**Fig. 1.** Natural infestation (%) of *G. molesta* in different *Prunus* spp. genotypes at field. (A) December, 2015 and (B) March, 2016. Note: Error bars represent the 95% confidence interval of the regression analysis. The genotypes grouped by the same vertical bar diagrams form homogeneous groups of susceptibility, according to the Scott-Knott test ( $P \leq 0.05$ ).

The data on the duration of the egg, larval, and pupal stages and the egg-adult period, pupal weight, female and male longevity, and daily fecundity were transformed into  $(x + 0.5)^{-0.5}$ , and significant differences between the treatments were determined using the least squares means at a significance level of  $P \leq 0.05$  (PROC GLM, SAS Institute 2000). The possible deviation in the sex ratio was tested by the chi-squared test ( $\chi^2$ ;  $P \leq 0.05$ ; PROC FREQ, SAS Institute 2000). In addition, the fertility life table was calculated by estimating the interval between generations, the net reproduction rate, the intrinsic growth rate, and the finite growth rate. The parameters of the fertility life table and their standard errors were estimated using the “Lifetable.sas” program (Maia et al. 2000), and the means were compared by a two-tailed *t* test ( $P \leq 0.05$ ; PROC MEANS, SAS Institute 2000).

## Results

### Susceptibility and Oviposition Preference of *G. molesta* in *Prunus* Spp. Genotypes

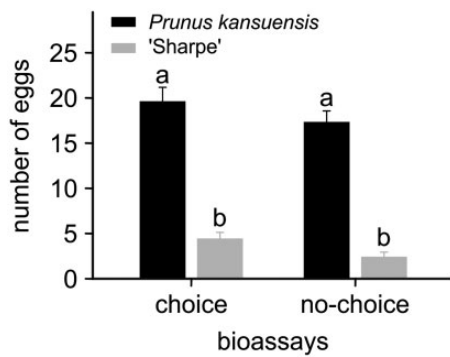
Through clustering analysis, significant differences were observed in the infestation of *G. molesta* in the 55 genotypes evaluated, with the percentage of infested branches varying from 0% to 70% during the two evaluation periods (December 2015 and March 2016; Fig. 1). The genotypes *P. kansuensis*, I-67-52-9, and I-67-52-4 presented the

largest natural infestations of *G. molesta* in the two evaluations performed (Fig. 1). The lowest infestations were observed for Sharpe and *Prunus sellowii* Koehn, in both cases with statistically significant differences ( $P \leq 0.05$ ) from the other genotypes evaluated (Fig. 1). Most of the evaluated genotypes (72% of the total) presented mean infestations between 30% and 60% (Fig. 1).

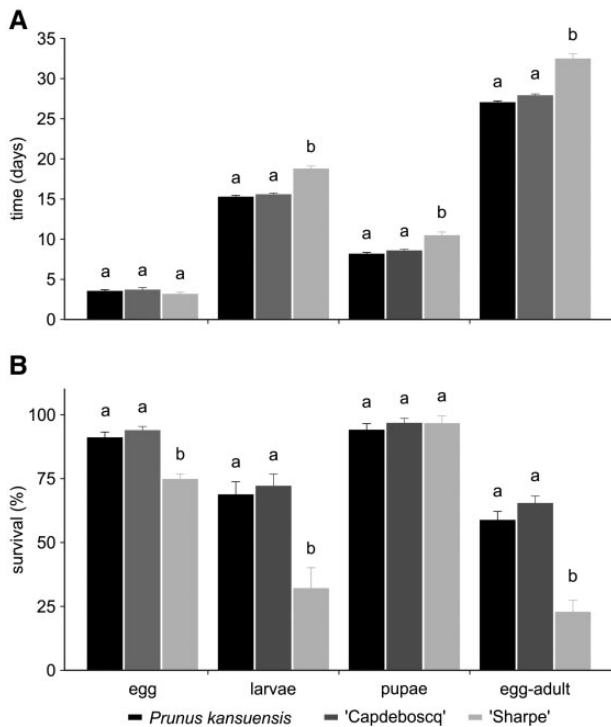
In the choice bioassay, a greater preference of *G. molesta* oviposition in *P. kansuensis* was observed, with a significantly higher number of eggs ( $F = 2.29$ ;  $df = 1, 140$ ;  $P < 0.0001$ ) than Sharpe (Fig. 2). Similarly, in the no-choice bioassay, there was a greater number of eggs deposited in *P. kansuensis* ( $F = 1.14$ ;  $df = 1, 140$ ;  $P < 0.0001$ ).

### Fertility Life Table of *G. molesta* in *Prunus* Spp. Genotypes

There was no significant difference in egg ( $F = 0.954$ ;  $df = 2, 74$ ;  $P = 0.8702$ ) or pupal ( $F = 8.54$ ;  $df = 2, 80$ ;  $P = 0.7526$ ) stage duration for *G. molesta*. However, larvae fed the Sharpe genotype showed a larval stage extension of 3 d ( $F = 17.05$ ;  $df = 2, 74$ ;  $P < 0.0001$ ) compared with larvae that fed on *P. kansuensis* or Capdeboscq (Fig. 3A). The viability of the egg ( $F = 9.47$ ;  $df = 2, 74$ ;  $P = 0.3017$ ) and pupal ( $F = 1.24$ ;  $df = 2, 80$ ;  $P = 0.1256$ ) stages did not differ between the treatments; however, larval viability was significantly lower ( $F = 9.47$ ;  $df = 2, 74$ ;  $P < 0.0001$ ) in the Sharpe rootstock (32%) than in *P. kansuensis* (69%) and Capdeboscq



**Fig. 2.** Number of eggs of *G. molesta* (mean  $\pm$  SE) per shoot in choice and no-choice bioassays. Note: Different letters indicate significant differences between bars within each bioassay type, according to the Tukey test ( $P \leq 0.05$ ).



**Fig. 3.** Time (days) (A) and viability (%) (B) (mean  $\pm$  SE) of the developmental stages of *G. molesta* fed on different *Prunus* spp. genotypes. Note: Different letters indicate significant differences between the bars within each developmental stage, according to the Tukey test ( $P \leq 0.05$ ).

(72%; Fig. 3B). The reduction in larval viability caused by the Sharpe genotype negatively impacted the viability of the egg–adult period, in which only 23% of the insects completed the biological cycle, differing significantly from *P. kansuensis* and Capdeboscq (Fig. 3B).

There was also a significant reduction ( $F=9.47$ ;  $df=2, 74$ ;  $P<0.0001$ ) in pupal weight when the larvae fed on Sharpe rootstock ( $0.0086 \pm 0.003$  g) compared with *P. kansuensis* ( $0.0127 \pm 0.011$  g) and Capdeboscq ( $0.0120 \pm 0.008$  g). However, feeding on the different genotypes during the larval stage did not cause significant differences between the proportions of females in the sample group of each treatment ( $\chi^2=18.78$ ;  $df=2, 74$ ;  $P=0.2802$ ; Table 2).

The development of the immature phase of *G. molesta* in the Sharpe genotype generated lower values of longevity in females

( $F=2.09$ ;  $df=2, 74$ ;  $P=0.0012$ ), males ( $F=3.91$ ;  $df=2, 74$ ;  $P=0.0006$ ), and in the oviposition period ( $F=4.39$ ;  $df=2, 32$ ;  $P=0.0028$ ) than in *P. kansuensis* and Capdeboscq (Table 2). In addition, female adults fed Sharpe when in the larval stage showed lower reproductive performance, with a reduction of  $\sim 60\%$  in the mean daily fecundity ( $F=1.91$ ;  $df=2, 32$ ;  $P<0.0001$ ) compared with *P. kansuensis* and Capdeboscq (Table 2). This reduction negatively affected the fertility life table parameters of the insects that developed in the Sharpe rootstock. The mean interval between generations differed significantly ( $P \leq 0.05$ ) between the genotypes studied (Table 2). The net reproductive rate values indicated a reduction of around 81.7% in females' ability to generate new females, when insects fed on Sharpe branches. Based on these results, after  $\sim 35$  d of development, 973.70 and 791.90 females resulting from each breeding female in *P. kansuensis* and Capdeboscq were expected, respectively (Table 2). For Sharpe, only 1.08 new females were expected. Similarly, insects feeding on Sharpe branches had a lower intrinsic growth rate with a population reduction of  $>90\%$  compared with *P. kansuensis* and Capdeboscq and a smaller finite rate of daily population increase (Table 2).

## Discussion

Knowledge of the biological development of a species is a fundamental strategy for the successful management and control of pest arthropods in the field (Kogan 1998). Based on the months with a higher occurrence (December and March) of *G. molesta* in peach orchards in Brazil (Salles and Marini 1989, Botton et al. 2001), differences were observed in the susceptibility and preference of natural infestation of *G. molesta* in the 55 rootstock genotypes of the genus *Prunus* evaluated in this study. The observed nonpreference for part of the evaluated genotypes, or the discrimination of the pest by its hosts, occurs after the insect lands on the substrate (Edwards and Wratten 1981). This choice is the exact moment that the insect performs an identification of the nutritional and chemical qualities of the plant to colonize it and increase the probability of survival of its offspring (Edwards and Wratten 1981, Myers et al. 2006).

The greater preference of natural infestation of *G. molesta* for the genotypes *P. kansuensis*, I-67-52-9, and I-67-52-4 may be associated with the narrow genetic base of these materials (Arge 2012) because *P. kansuensis* is a species of wild peach but is morphologically similar to the cultivated peach *Prunus persica* (Cao et al. 2011), considered an ideal host species for the development of *G. molesta* (Silva et al. 2010, Chaves et al. 2014). This fact is reinforced by the low infestation observed in the Sharpe genotype, which is supposed to be a natural hybrid between the 'Chickasaw' plum [*Prunus angustifolia* (Marsh.)] and an unknown species of plum (Beckman et al. 2008). In an oviposition preference bioassay, it was observed that Sharpe presented the smallest number of eggs per branch, both in choice bioassays and by demonstrating a lower preference for oviposition in these structures. These results are in line with the field evaluations, in which no pest infestation was observed in the Sharpe rootstock, similar to the results observed for *S. pictipes* in branches of this material (Cottrell et al. 2011).

Because *G. molesta* larvae have low mobility, the choice of the ideal branch for adult oviposition and later feeding of the larvae is of paramount importance for the survival of the population (Myers et al. 2006). Therefore, *P. kansuensis*, which was the most infested genotype in the field and was preferred for greenhouse oviposition, was shown to be an adequate food source for the biological development of the insect when compared with Sharpe, similar to the results

**Table 2.** Biological parameters of *G. molesta* in *Prunus* spp. genotypes

Biological parameter	<i>Prunus kansuensis</i>	Capdeboscq	Sharpe
<b>Adult parameters<sup>a</sup></b>			
Sex ratio ( $\frac{\text{♀}}{\text{♀}+\text{♂}}$ )	0.52 <sup>ns</sup>	0.54 <sup>ns</sup>	0.50 <sup>ns</sup>
Female longevity (d)	13.5 ± 0.3a	13.2 ± 0.2a	5.0 ± 1.3b
Male longevity (d)	14.0 ± 0.25a	13.6 ± 0.21a	5.6 ± 0.67b
Oviposition (d)	9.1 ± 0.2a	9.5 ± 0.1a	4.4 ± 0.4b
Eggs/female/d	41.6 ± 1.4a	39.8 ± 1.2a	13.3 ± 1.7b
<b>Fertility life table parameters<sup>b</sup></b>			
T (d)	35.6 ± 0.11a	34.8 ± 0.16a	41.2 ± 1.25b
$R_o$ ( $\frac{\text{♀}}{\text{♀}}$ )	740.15 ± 32.6a	639.15 ± 29.3a	134.9 ± 11.3b
$r_m$ ( $\frac{\text{♀}}{\text{♀}/\text{d}}$ )	0.158 ± 0.001a	0.167 ± 0.002a	0.012 ± 0.001b
$\lambda$	1.248 ± 0.002a	1.239 ± 0.001a	0.008 ± 0.001b

<sup>a</sup> Means (± SE) followed by the same letter in a line are not significantly different (LS MEANS with Tukey's adjustment;  $P < 0.05$ ); ns—not significant.

<sup>b</sup> T—mean length of a generation;  $R_o$ —net reproductive rate;  $r_m$ —intrinsic rate of population increase;  $\lambda$ —finite rate of population increase.

observed for the lesser peachtree borer *S. pictipes* (Cottrell et al. 2008). Several studies have demonstrated that the source of food may influence the biological parameters of *G. molesta* (Myers et al. 2006, 2007; Joshi et al. 2007, 2015; Silva et al. 2010; Chaves et al. 2014). The lower oviposition preference for Sharpe may be associated with the presence of chemical compounds released by the leaves, the presence of physical barriers (such as hairs or glandular trichomes), and the shape of the leaves that provide an antixenotic or nonpreference effect for oviposition and infestation in the field (Lara 1991, Straub 2003, Al Bitar et al. 2014, Joshi et al. 2015).

In analyzing the biological parameters and the development capacity of *G. molesta* in the laboratory, the Sharpe genotype provided an increase and a reduction in the larval and pupal viability of *G. molesta* compared with *P. kansuensis* and Capdeboscq. These results suggest that the Sharpe rootstock, in addition to having an antixenotic effect on the pest, also presents antibiotic substances that affect the survival of *G. molesta* larvae, leading to a greater larval stunting (Bottger and Patana 1966). According to the fertility life table, which permits evaluations of the performance of a species on a diet or in the host, for all parameters, Sharpe branches provided values lower than the values produced by *P. kansuensis* and Capdeboscq. It can be observed that Sharpe presents nutritional mechanisms that contribute to a reduced insect growth rate in addition to the presence of a deterrent factor or the absence of a stimulant for feeding. In turn, *P. kansuensis* and Capdeboscq were shown to be ideal hosts for the highest population growth of *G. molesta*.

Because Sharpe is considered promising for the management of PTSL, increasing orchard viability (Beckman et al. 2008, Mayer et al. 2013), the use of this cultivar in peach seedling multiplication centers will assist in choosing the best management strategy for the oriental fruit moth in those multiplication centers. This will lead to less use of chemical insecticides and, consequently, less environmental contamination in these specific areas (Castro, 2010). However, it is important to note that currently, outside the seedling centers, Sharpe is present only as a rootstock. Because the roots are not a target of this pest species, no benefits regarding *G. molesta* management should be expected by its use. Nevertheless, it can be a primary source of genes for breeding programs to develop resistant scion cultivars.

Thus, considering the scarcity of resistance information for *Prunus* spp. to *G. molesta*, the results obtained in this work constitute an important step in the search for information regarding potential sources for the isolation of resistance in plants that can provide adverse effects on the preference and development of *G. molesta*. The information obtained will help in determining the

focus of new genetic improvement programs of *Prunus* spp. and in the search for genes of interest that are responsible for negatively influencing the bioecological behavior of the pest.

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