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

D. Bernardi,^{1,2} J. C. Lazzari,¹ F. Andreazza,³ N. A. Mayer,¹ M. Botton,⁴ and D. E. Nava¹

¹Laboratory of Entomology, Embrapa Clima Temperado, BR 392 Km 78, Caixa Postal 403, Pelotas, RS 96010-971, Brazil (dbernardi2004@yahoo.com.br; jose.cesarlazzari@hotmail.com; alex.mayer@embrapa.br; dori.edson-nava@embrapa.br), ²Corresponding author, e-mail: dbernardi2004@yahoo.com.br, ³Department of Entomology, Federal University of Viçosa, Av. Peter Henry Rolfs, s/n, Viçosa, MG 36570-900, Brazil (andreazzafelipe@yahoo.com.br), and ⁴Laboratory of Entomology, Embrapa Uva e Vinho, Rua Livramento, 515 Caixa Postal 130, Bento Gonçalves, RS 95700-000, Brazil (marcos.botton@embrapa.br)

Subject Editor: Heather McAuslane

Received 14 March 2017; Editorial decision 31 June 2017

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 x 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* (Agrianual 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 ± 1 °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

IA7529P persiaUnited StatesIA7529P persiaUnited StatesIA7535P persiaUnited StatesIA75412P persiaUnited StatesIA75573P persiaUnited StatesIA75573P persiaUnited StatesIA75573P persiaUnited StatesIA75573P persiaUnited StatesIA75774P persiaUnited StatesIA75773P persiaUnited StatesIA337P persiaUnited StatesIA337P persiaUnited StatesIA337P persiaUnited StatesIA337P persiaUnited StatesIA337P persia X dualianaHalyCadamaríP persia X PanoglabisFranceG n N.9P persia X PanoglabisFranceIabardP persia X Budiaja XIFranceIabardP persia X PanoglabisFranceJabardP persia X Budiaja XIGonestica XI PanoglabisJabardP persiaConsertica XI Panoglabis	Genotype	Species ^a	Origin ^b
167.52-9P. persiaUnited States167.53-5P. persiaUnited States167.54.12P. persiaUnited States167.55.9P. persiaUnited States167.57.14P. persiaUnited States167.57.14P. persiaUnited States193.21P. persiaUnited States193.32P. persiaUnited States193.33P. persiaUnited States193.34P. persiaUnited States193.35P. persiaUnited States193.36P. persiaUnited States193.37P. persia R. davidiantUnited States193.38P. persia R. davidiantPrance193.47P. persia R. davidiantPrance193.48P. persia R. davidiantPrance193.47P. persiaPrance193.47P. persiaPrance193.47P. persiaPrance193.48P. persiaPrance193.47P. persiaPrance193.47P. persiaPrance193.47P. persiaPrance193.47P. persiaPrance193.47P. persiaPrance193.47P. persiaPrance193.47P. persiaPrance<	I-67-52-4	P. persica	United States
14-7.3-5.5P. persiaUnited States14-7.3-5.7P. persiaUnited States14-7.3-5.9P. persiaUnited States14-7.3-7.14P. persiaUnited States14-7.3-7.14P. persiaUnited States19-3-27P. persiaUnited States19-3-30P. persiaUnited States19-3-37P. persiaUnited States19-3-37P. persiaUnited States19-3-38P. persiaUnited States19-3-37P. persiaUnited States19-3-38P. persiaUnited States19-3-37P. persia at AuridianaIndy'Caduman'P. persia at AuridianaIndy'Caduman'P. persia at AuridianaIndy'Gadiman'(P. censifera x P. auridiana)France'Gi 677'P. persia at AudiciaUnknown'Ishara'(P. censifera x P. auriscia)France'Mariana 25.34'P. censifera x P. monsonianaCalifornia, United States'Mariana 25.34'P. censifera x P. monsonianaCalifornia, United States'Mariana 25.34'P. persicaGib d'Embrapa Clina Temperado'Grecowa'P. persicaGib d'Embrapa Clina Temperado <td>I-67-52-9</td> <td>P. persica</td> <td>United States</td>	I-67-52-9	P. persica	United States
Le7.54.12P. persiaUnited StatesLe7.55.73P. persiaUnited StatesLe7.55.13P. persiaUnited StatesLe7.57.14P. persiaUnited StatesL93.21P. persiaUnited StatesL93.33P. persiaUnited StatesL93.34P. persiaUnited StatesL93.35P. persiaUnited StatesL93.36P. persiaUnited StatesL93.37P. persiaUnited StatesL93.38P. persia R. davidianaFraceCafe GroffP. persia R. davidianaFranceCafe GroffP. persia R. davidianaFranceCafe StatesP. persia R. davidianaFranceCafe CroffP. persia R. PersiaUnited StatesUnited StatesP. persia R. davidianaFranceCafe CroffP. persia R. davidianaFranceCafe CroffP. persia R. davidianaCaficornia, United StatesUnited StatesP. davidianaCaficornia, United StatesUnited StatesP. davidianaCaficornia, United StatesUnited StatesP. davidianaCaficorniaCafe Cropes andP. dersiaCaficorniaCafe Cropes andP. ders	I-67-53-5	P. persica	United States
Le7.55.9P. persicaUnited StatesLe7.57.14P. persicaUnited StatesLe7.57.14P. persicaUnited StatesL93.21P. persicaUnited StatesL93.23P. persicaUnited StatesL93.34P. persicaUnited StatesL93.35P. persicaUnited StatesL93.37P. persicaUnited StatesL93.38P. persicaUnited StatesBarriet'P. persica X. P. davidianaItalyCadaman'P. persica X. P. davidianaItalyYahana 264'P. censifera X. P. downesitaCalifornia, United StatesYahana 264'P. persicaG. Borbarpa Clima TemperadoYahana 2	I-67-54-12	P. persica	United States
Le7.55.13P. persicaUnited StatesL93.21P. persicaUnited StatesL93.21P. persicaUnited StatesL93.23P. persicaUnited StatesL93.30P. persicaUnited StatesL93.33P. persica X. P. davidianaLuited StatesL93.34P. persica X. P. davidianaLuited StatesBarrier'P. persica X. P. davidianaHaryCadaman'P. persica X. P. davidianaFranceCadaman'P. persica X. P. davidianaCatesGr 67.7P. persica X. P. davidianaCates(Gr 67.7P. persica X. P. davidianaCates(Julor'P. persica X. P. davidianaCates(Julor'P. persica X. P. davidianaCates(Julor'P. persica X. P. downeticaFrance(Mariana 26.24'P. censifiera X. P. mussonianaCatherasCadeboscqP. persicaGb of Embrapa Clima Temperado(Jadright'CACT)P. persicaGb of Embrapa Clima TemperadoCadeboscqP. persicaGb of Embrapa Clima Temperado(Cenovera'P. persicaGb of Embrapa Clima Temperado(Decia'P. persicaJapan(Sata Rosa'P. persicaJapan(Sata Rosa'P. persicaJapan(I-67-55-9	P. persica	United States
167-57-14P. persicaUnited States193-21P. persicaUnited States193-30P. persicaUnited States193-37P. persicaUnited States193-38P. persicaUnited States193-39P. persica X. P. davidanaInited States193-37P. persica X. P. davidanaInited States193-38P. persica X. P. davidanaFrance193-17P. persica X. P. davidanaFrance193-18P. persica X. P. davidanaFrance193-19P. persica X. P. davidanaFrance193-10P. persica X. P. davidanaFrance193-10P. persica X. P. davidanaFrance193-10P. persica X. P. davidanaCalifornia, United States193-10P. persicaG. former form PlotasRS/Brazil193-11P. persicaG. former form PlotasRS/Brazil193-12P. persicaG. Bof Innbrapa Clima Temperado193-13P. persicaG. Bof Innbrapa Clima Temperado193-14P. persicaG. Bof Innbrapa Clima Temperado193-15P. persicaG. Bof Innbrapa Clima Temperado193-16P. persicaG. Bof Innbrapa Clima Temperado193-16P. persicaG. Bof Innbrapa Clima Temperado193-16P. persicaG. Bof Innbrapa Clima Temperado194-17P. persicaG. Bof Innbrapa Clima Temperado194-18P. persicaJapan1944-19P. persicaJapan1944-19P. persicaJapan1944-10	I-67-55-13	P. persica	United States
193-21P. persicaUnited States193-327P. persicaUnited States193-33P. persicaUnited States193-34P. persica x P. davidanaIndyCadaman'P. persica x P. davidanaPraceCadaman'P. persica x P. davidanaFraceCadaman'P. persica x P. davidanaFraceStatesP. persica x P. davidanaFraceStatesP. persica X P. advidanaFrace'Mariana 2624'P. cersifera X P. advisorianaCalifornia, United States'Mariana 2624'P. cersifera X P. musocianaCalifornia, United States'Mariana 2624'P. cersifera X P. musocianaGalo Fornepa Clima Temperado'Tardio-01P. persicaGa of Embrapa Clima Temperado'Cenovest'P. persicaGa of Embrapa Clima Temperado'Cenovest'P. persicaGa of Embrapa Clima Temperado'Taus Maba-20'P. persicaGa of Embrapa Clima Temperado'Taus Maba-01'P. persicaJapan'Taus Maba-01'P. persicaGa of Embrapa Clima Temperado'Taus Maba-01'P. persica </td <td>I-67-57-14</td> <td>P. persica</td> <td>United States</td>	I-67-57-14	P. persica	United States
193-27P. persicaUnited States193-30P. persicaUnited States193-37P. persicaUnited States193-38P. persicaUnited States'Barriet'P. persica x P. davidianaItaly'Cadaman'P. persica x P. davidianaItaly'Cadaman'P. persica x P. davidianaPrance'G K NJP. persica x P. davidianaPrance'G K NJP. persica x P. davidianaPrance'G NAJP. persica x P. davidianaPrance'Juliot'P. persica X P. davidianaCalifornia, United States'Mariana 2624'P. cerasifera X P. monsonianaCalifornia, United States'Mariana 2624'P. persica X P. monsonianaCalifornia, United States'Advight' CPACTP. persicaG of embrapa Clima Temperado'Cenovesa'P. persicaG of embrapa Clima Temperado'Cenovesa'P. persicaG of embrapa Clima Temperado'De Guia'P. persicaG of embrapa Clima Temperado'Sana Rosa'P. persicaG of embrapa Clima Temperado'Sana Rosa'P. persicaG of Embrapa Clima Temperado'Sana Rosa'P. persicaJapan'Taskuba-20'P. persicaJapan'Taskuba-20'P. persicaJapan'Taskuba-20'P. persicaJapan'Taskuba-20'PersicaGa de Embrapa Clima Temperado'Sana Rosa'P. persicaG of embrapa Clima Temperado'Sana Rosa'P. persicaJapan'Taskuba-20'P. persica<	I-93-21	P. persica	United States
193-30P. persicaUnited States193-37P. persicaUnited States193-38P. persica x P. davidianaItaly"Cadaman"P. persica x P. davidianaFrance"Cadaman"P. persica x P. davidianaFrance"Gr 677"P. persica x P. davidianaFrance"Gr 677"P. persica x P. davidianaFrance"Ishara"(P. cerasifera X P. salicina) x (P. cerasifera X P. persica)France"Mariana 2624"P. cerasifera X P. salicina) x (P. cerasifera X P. salicina) x (P. cerasifera X P. salicina) x (P. cerasifera X P. salicina) a 2025"Persica"Mariana 2624"P. cerasifera X P. salicina X (P. cerasifera X P. salicina)Ga of tembrapa Clima Temperado"Mariana 2624"P. cerasifera X P. salicinaGa of tembrapa Clima Temperado"Mariana 2624"P. cerasifera X P. salicinaGa of tembrapa Clima Temperado"Mariana 2624"P. cerasifera X P. salicinaGa of tembrapa Clima Temperado"CapdebosqP. persicaGa of tembrapa Clima Temperado"CapdebosqP. persicaGa of tembrapa Clima Temperado"Cenovesa"P. persicaGa of tembrapa Clima Temperado"CapdebosqP. persicaGa of tembrapa Clima Temperado"Santa Rosa"P. persicaGa of tembrapa Clima Temperado"Santa Rosa"P. persicaGa fattorina, United States"Santa Rosa"P. persicaGa fattorina, United States"Santa Rosa"P. persicaGa fattorina, United States"Takuba-01"P. persicaGa fattorina, United States	I-93-27	P. persica	United States
193-37P. persicaUnited States193-38P. persica X. P. davidianaIndry'Barrier'P. persica X. P. davidianaFrance'GF 677'P. persica X. P. anygdahsFrance'GF 677'P. persica X. P. anygdahsFrance'GF 677'P. persica X. P. anygdahsFrance'GF 677'P. persica X. P. anygdahsFrance'Gh 677'P. persica X. P. anygdahsFrance'Juliot'P. institui X. P. domesticaPrance'Juliot'P. institui X. P. domesticaCalifornia, United States'Juliot'P. cerasifera X. PunusonianaCalifornia, United States'Mariana 2624'P. cerasifera X. PunusonianaGali States'Adright' CPACTP. persicaGo 6 Embrapa Clina Temperado'Canovesa'P. persicaGo formarpa Clina Temperado'Cenovesa'P. persicaGo 6 Embrapa Clina Temperado'Cenovesa'P. persicaGo formarpa Clina Temperado'De Guidu'P. persicaGo formarpa Clina Temperado'Pranus mandebriricaP. persicaGo formarpa Clina Temperado'Prauso'P. persicaGo formarpa Clina TemperadoMexico Fila 1P. persicaGo formarpa Clina Temperado'Santa Rosa'P. persicaGo formarpa Clina Temperado'Santa Nosa'P. persicaJapan'Tsukub-01'P. persicaJapan'Tsukub-01'P. persicaJapan'Tsukub-02'P. persicaJapan'Tsukub-03'P. persicaGo formarpa Clina Temperad	I-93-30	P. persica	United States
193-38P. persicaUnited States193-38P. persica x P. davidianaItaly'Cadaman'P. persica x P. davidianaFrance'G F G77'P. persica x P. davidsUnknown'G KaryP. persica x P. davidsUnknown'Ishtrar'(P. cerasifera x P. salicina) x (P. cerasifera x P. persica)France'Juloi'P. institua R. P. domisonianaCalifornia, United States'Marianna 2624'P. cerasifera x P. mussonianaCalifornia, United States'Marianna 2627'P. cerasiferaUnknownTardio -01P. persicaGB of Embrapa Clima TemperadoCapdeboscqP. persicaGB of Embrapa Clima TemperadoCanovesa'P. persicaGB of Embrapa Clima TemperadoCastos FilaP. persicaGB of Embrapa Clima TemperadoCastos FilaP. persicaGB of Embrapa Clima TemperadoTsukuba-2' CPACTP. persicaGB of Embrapa Clima TemperadoVéxico FilaP. persicaGB of Embrapa Clima Temperado'Santa Rosa'P. persicaGB fembrapa Clima Temperado'Santa Rosa'P. persicaJapan'Santa Rosa'P. persicaJapan'Santa Rosa'P. persicaJapan'Tsukuba-04'P. persicaJapan'Tsukuba-04'P. persicaGB of Embrapa Clima Temperado'Tsuk	I-93-37	P. persica	United States
'Barrier'P. persica X. P. davidanaItaly'Cadaman'P. persica X. P. davigdanaFrance'Gr 677'P. persica X. P. davigdanaFranceGx N.9P. persica X. P. davigdanaFrance'Julior'P. instituia X. P. domesticaCalifornia, United Stares'Julior'P. instituia X. P. domesticaCalifornia, United Stares'Marianna 2624'P. cerasifera X. P. mussoinanCalifornia, United Stares'Myrabolan 29C'P. cerasifera X. P. mussoinanCalifornia, United Stares'Myrabolan 29C'P. persicaGB of Embrapa Clima TemperadoCapdebosqP. persicaGB of Embrapa Clima Temperado'Cenovesa'P. persicaGB of Embrapa Clima Temperado'Cenovesa'P. persicaGB of Embrapa Clima Temperado'De Guia'P. persicaGB of Embrapa Clima Temperado'De Guia'P. persicaGB of Embrapa Clima Temperado'De Guia'P. persicaGB of Embrapa Clima Temperado'Pausu mandeburicaP. persicaGB of Embrapa Clima Temperado'Pausu mandeburicaP. persicaGB of Embrapa Clima Temperado'Pausu mandeburicaP. persicaGB Embrapa Clima Temperado'Pausuba-01'P. persicaGB Embrapa Clima Temperado'Pausuba-01'P. persicaGB Embrapa'Pausuba-01'P. persicaGB Embrapa'Pausuba-01'P. persicaGB Embrapa'Pausuba-02'P. persicaGB Embrapa'Pausuba-03'P. persicaGB Embrapa'Pausuba-04'P. pers	I-93-38	P. persica	United States
Cadaman'P. persica x P. davidinaFranceCist For7'P. persica x P. anygdabasFranceGx N.9P. persica x P. dukisUnknown'bharar'(P. cerasifera x P. salicina) x (P. cerasifera X P. persica)France'Mariana 264'P. cerasifera X P. numsonianaCalifornia, United States'Mariana 264'P. cerasifera X P. numsonianaCB of Embrapa Clima Temperado'CadeboscqP. persicaCB of Embrapa Clima Temperado'Cenovesa'P. salicinaCB of Embrapa Clima Temperado'De Guia'P. persicaCB of Embrapa Clima Temperado'Penuss madchuricaP. persicaCB of Embrapa Clima Temperado'Rosaflor'P. persicaCB of Embrapa Clima Temperado'Natusha-2' CPACTP. persicaCB of Embrapa Clima Temperado'Natusha-2' CPACTP. persicaMexico'Satus Road'P. persicaCalifornia, United States'Satus Road'P. persicaGB Embrapa Clima Temperado'Tsukub-01'P. persicaJapan'Tsukub-02'P. persicaJapan'Tsukub-02'P. persicaJapan'Tsukub-02'P. persicaSio Joaquim-SC/Brazil'Tsukub-02'P. persicaCalifornia, United States'Toukinaya'P. persicaCB of Embrapa Clima Temperado	'Barrier'	P. persica x P. davidiana	Italy
'GF 677' P. persica x P. anygdalus France 'Ishtrar' (P. cerasifera x P. salicina) x (P. cerasifera x P. persica) France 'Julior' P. institua x P. domestica California, United States 'Julior' P. cerasifera x P. mursonima California, United States 'Mariana 2624' P. cerasifera x P. mursonima California, United States 'Mariana 2624' P. cerasifera X P. mursonima California, United States 'Mariana 2624' P. cerasifera X P. mursonima California, United States 'Mariana 2624' P. cerasifera X P. mursonima California, United States 'Aldrigh' CPACT P. persica GB of Embrapa Clima Temperado 'Genovesa' P. salicina GB of Embrapa Clima Temperado 'Genovesa' P. persica GB of Embrapa Clima Temperado 'De Guia' P. persica GB of Embrapa Clima Temperado 'Praww mandchurica P. mandschurica GB of Embrapa Clima Temperado 'Prakuba-20' P. persica GB of Embrapa Clima Temperado 'Pixuba-20' P. persica GB of Embrapa Clima Temperado 'Pixuba-20' P. persica Japan 'Tsukuba-20' P. persica Japan 'Tsukuba-20' P. persica Japan 'Tsukuba-20' P. persica Japan </td <td>'Cadaman'</td> <td>P. persica x P. davidiana</td> <td>France</td>	'Cadaman'	P. persica x P. davidiana	France
Gx N.9P. persica x P. dulcisUnknown'Ishtrar'(P. cerasifera x P. sersica)France'Julior'P. institiia x P. domesticaFrance'Mariana 2624'P. cerasifera x P. munsonianaCalifornia, United States'Mariana 2624'P. cerasifera x P. munsonianaCalifornia, United States'Mariana 2624'P. cerasiferaUnknownTardio -01P. persicaGB of Embrapa Clima TemperadoCapdeboscqP. persicaGB of Embrapa Clima TemperadoCapdeboscqP. persicaGB of Embrapa Clima Temperado'Genovesa'P. persicaGB of Embrapa Clima Temperado'De Guia'P. persicaGB of Embrapa Clima Temperado'Rosallor'P. persicaGB of Embrapa Clima Temperado'Ruskuba-2' CPACTP. persicaGB of Embrapa Clima Temperado'Yakuba-2' CPACTP. persicaMexico'Santa Rosa'P. persicaGB Embrapa Clima Temperado'Yakuba-0'P. persicaGB Embrapa Clima Temperado'Tsukuba-0'P. persicaJapan'Tsukuba-0'P. persicaJapan'Tsukuba-0'P. persicaJapan'Tsukuba-0'P. persicaJapan'Tsukuba-0'P. persicaJapan'Tsukuba-0'P. persicaJapan'Tsukuba-0'P. persicaPortida, United StatesCereja PrecocePramus sp.Sao Joaquim-SCBrazilCereja PrecocePramus sp.Sao Joaquim-SCBrazilCreja PrecocePramus sp.Sao Joaquim-SCBrazil	'GF 677'	P. persica x P. amygdalus	France
'Ishtara'(P. cerasifera x P. salicina) x (P. cerasifera x P. persica)France'Marianna 2624'P. cerasifera x P. munsonianaCalifornia, United States'Marianna 2624'P. cerasifera x P. munsonianaCalifornia, United States'Mytabolan 29C'P. cerasifera X P. munsonianaGB of Embrapa Clima TemperadoCapdeboscqP. persicaGB of Embrapa Clima TemperadoCapdeboscqP. persicaGB of Embrapa Clima TemperadoCapdeboscqP. persicaGB of Embrapa Clima Temperado'De Guia'P. persicaGB of Embrapa Clima Temperado'Rosaflor'P. persicaGB of Embrapa Clima Temperado'Pue Guia'P. persicaGB of Embrapa Clima Temperado'Sukuba-2' CPACTP. persicaGB of Embrapa Clima Temperado'Santa Rosa'P. persicaMexico'Santa Rosa'P. persicaGB Embrapa Clima Temperado'Tsukuba-01'P. persicaGB Embrapa Clima Temperado'Tsukuba-02'P. persicaJapan'Tsukuba-02'P. persicaJapan'Tsukuba-02'P. persicaJapan'Chico 11' x P. davidianaFlorida, United States'PiradiaPromus sp.Sio Joaquim—SC/Brazil'Nemared'P. persicaGB of Embrapa Clima Temperado'Sina Rosa'P. persicaJapan'Sukuba-02'P. persicaJapan'Sukuba-03'P. persicaGB forda, United States'Piradigurd''Chico 11' x P. davidianaFlorida, United States'Piradigurd'P. persicaGB of E	G x N.9	P. persica x P. dulcis	Unknown
'Julior'P. institita & P. domesticaFrance'Mariana 2634'P. cerasifera X. P. nunsonianaCalifornia, United States'Myrabolan 29C'P. cerasiferaUnknownTardio - 01P. persicaGrower from Pelotas—RS/Brazil'Adhrigh' CPACTP. persicaGB of Embrapa Clima TemperadoCapdeboscqP. persicaGB of Embrapa Clima Temperado'Genovest'P. salicinaGB of Embrapa Clima Temperado'De Guia'P. persicaGB of Embrapa Clima Temperado'De Guia'P. persicaGB of Embrapa Clima Temperado'NussandchuricaP. mandschuricaGB of Embrapa Clima Temperado'Rosafilor'P. persicaGB of Embrapa Clima TemperadoYaukuba-2' CPACTP. persicaGB of Embrapa Clima TemperadoMéxico Fila 1P. persicaGB fembrapa Clima TemperadoYakuba-01'P. persicaGB Embrapa Clima TemperadoYakuba-02'P. persicaGB Embrapa Clima TemperadoYakuba-03'P. persicaGB Embrapa Clima Temperado'Yakuba-04'P. persicaJapan'Tsukuba-03'P. persicaJapan'Tsukuba-03'P. persicaJapan'Yakuba-03'P. persicaSa Joaquim—SCBrazil'Promus ganca''Chicoi II' x P. davidianaFlorida, United StatesCereja PrecocePrumus sp.Sa Joaquim—SCBrazilPrinbeiro PretoP. persicaGB of Embrapa Clima TemperadoPramus delouiiP. persicaGB of Embrapa Clima TemperadoPrumus kansuensisP. kansidana	'Ishtara'	(P. cerasifera x P. salicina) x (P. cerasifera x P. persica)	France
'Mariana 2624'P. cerasifera & P. munsonianaCalifornia, United States'Myrabolan 29C'P. cerasiferaUnknownTardio - 01P. persiaGrower from Pelotas—RS/Brazil'Aldrigh' CPACTP. persiaGB of Embrapa Clima TemperadoCapdeboscqP. persicaGB of Embrapa Clima Temperado'Cenovess'P. selicinanGB of Embrapa Clima Temperado'De Guia'P. persicaGB of Embrapa Clima Temperado'Nosaflor'P. persicaGB of Embrapa Clima Temperado'Nukuba-2'P. persicaGB of Embrapa Clima Temperado'Santa Rosa'P. gersicaGB of Embrapa Clima Temperado'Tsukuba-02'P. persicaGB fembrapa Clima Temperado'Tsukuba-02'P. persicaJapan'Tsukuba-02'P. persicaJapan'Tsukuba-02'P. persicaJapan'Tsukuba-02'P. persicaSio Joaquim—SCBrazil'Chico 11' x P. davidianaFlorida, United States'Flordaguard''Chico 11' x P. davidianaFlorida, United States'Pindaguard'P. persicaGB of Embrapa Clima Temperado'Nemared'P. persicaGB of Embrapa Clima Temperado'Pramus sellowiiP. persicaGB Joaquim—SCBrazil'Premas ellowiiP. persicaGB Joaquim—SCBrazil'Nemared'P. persicaGB of Embrapa Clima Te	'Julior'	P. insititia x P. domestica	France
'Myrabolan 29C'P. erasiferaUnknownTardio - 01P. persicaGrower from Pelotas—RS/Brazil'Aldrigh' CPACTP. persicaGB of Embrapa Clima TemperadoCapdeboscqP. persicaGB of Embrapa Clima Temperado'Cenovesa'P. salicinaGB of Embrapa Clima Temperado'De Guia'P. persicaGB of Embrapa Clima Temperado'Perusus mandchuricaP. mandschuricaGB of Embrapa Clima Temperado'Rusalhor'P. persicaGB of Embrapa Clima Temperado'Rusuba-2' CPACTP. persicaGB of Embrapa Clima Temperado'Rusuba-2' CPACTP. persicaGB of Embrapa Clima Temperado'Riscio Fila 1P. persicaMexico'Santa Rosa'P. analckinicaCalifornia, United States'Fiazito'P. persicaGB Embrapa Clima Temperado'Pravito'P. persicaJapan'Tsukuba-01'P. persicaJapan'Tsukuba-03'P. persicaJapan'Ckinawa'P. persicaSa'o Joquim—SC/Brazil'Tosluda-03'P. persicaSa'o Joquim—SC/Brazil'Creipa TardiaPronus sp.Sa'o Joquim—SC/Brazil'Creipa TardiaP. persicaCalifornia, United States'Pronus sellouviiP. persicaGB of Embrapa Clima Temperado'Pravito'P. persicaSa'o Joquim—SC/Brazil'Tsukuba-03'P. persicaGa formal clima Temperado'Tsukuba-03'P. persicaGa formal clima Cemperado'Tsukuba-03'P. persicaGa formal clima Temperado'Tsu	'Marianna 2624'	P. cerasifera x P. munsoniana	California, United States
Tardio - 01P. persicaGrower from Peloras—RS/Brazil'Aldrighi' CPACTP. persicaGB of Embrapa Clima TemperadoCapdeboscqP. persicaGB of Embrapa Clima Temperado'Genovesa'P. gensicaGB of Embrapa Clima Temperado'De Guia'P. persicaGB of Embrapa Clima Temperado'Rosaflor'P. persicaGB of Embrapa Clima Temperado'Rosaflor'P. persicaGB of Embrapa Clima Temperado'Tsukuba-2' CPACTP. persicaGB of Embrapa Clima Temperado'Tsukuba-2' CPACTP. persicaGB of Embrapa Clima Temperado'México Fila 1P. persicaGB Embrapa Clima Temperado'Santa Rosa'P. salicinaCalifornia, United States'Piazuto'P. persicaGB Embrapa Clima Temperado'Tsukuba-01'P. persicaJapan'Tsukuba-02'P. persicaJapan'Tsukuba-03'P. persicaJapan'Chicana'P. persicaJapan'Tsukuba-03'P. persicaJapan'Tsukuba-04'P. persicaPersica'Piordaguard''Chico 11' x P. davidianaFlorida, United States'Flordaguard''Chico 11' x P. davidianaFlorida, United States'Promus sp.Sa Joaquim—SC/BrazilCereja PrecocePrumus sp.Sa Joaquim—SC/BrazilPrumus sellowiiP. persicaGB of Embrapa Clima TemperadoPrumus sellowiiP. persicaGB of Embrapa Clima TemperadoCons. 594P. persicaGB of Embrapa Clima Temperado'Parapos'P. pe	'Myrabolan 29C'	P. cerasifera	Unknown
'Aldrigh' CPACTP. persicaGB of Embrapa Clima TemperadoCapdeboscqP. persicaGB of Embrapa Clima Temperado'Cenovesa'P. salicinaGB of Embrapa Clima Temperado'De Guia'P. persicaGB of Embrapa Clima Temperado'Rosaltod'P. persicaGB of Embrapa Clima Temperado'Pue Guia'P. persicaGB of Embrapa Clima Temperado'Pue MandeburicaP. mandschuricaGB of Embrapa Clima Temperado'Pue Maina ChinicaP. persicaGB of Embrapa Clima TemperadoMéxico Fila 1P. persicaMexico'Santa Rosa'P. persicaGB Embrapa Clima Temperado'Santa Rosa'P. persicaGB Embrapa Clima Temperado'Sukuba-01'P. persicaGB Embrapa Clima Temperado'Tsukuba-02'P. persicaJapan'Tsukuba-03'P. persicaJapan'Tsukuba-03'P. persicaJapan'Chicanay'P. persicaJapan'Chicanaya'P. persicaSaio Joaquim—SC/Brazil'Creip ArecoePrunus sp.Saio Joaquim—SC/Brazil'Creip ArecoePrunus sp.Saio Joaquim—SC/Brazil'Pruns sellowiiP. persicaGB of Embrapa Clima TemperadoPruns sellowiiP. persicaGB of Embrapa Clima Temperado'Pruns sellowiiP. persicaCalifornia, United States'Pruns sellowiiP. persicaGB of Embrapa Clima Temperado'Pruns sensensisP. persicaGB of Embrapa Clima Temperado'Pruns sensensisP. persicaGB of Embrapa Clima Temperado	Tardio - 01	P. persica	Grower from Pelotas-RS/Brazil
CapdeboscqP. persicaGB of Embrapa Clima Temperado'Genovesa'P. salicinaGB of Embrapa Clima Temperado'De Guia'P. persicaGB of Embrapa Clima Temperado'Rosaflor'P. persicaGB of Embrapa Clima TemperadoPrunus mandchuricaP. mandschuricaGB of Embrapa Clima Temperado'Tsukuba-2' CPACTP. persicaGB of Embrapa Clima TemperadoMéxico Fila 1P. persicaGB of Embrapa Clima TemperadoMéxico Fila 2P. persicaGB of Embrapa Clima TemperadoSanta Rosa'P. salicinaCalifornia, United States'Piazito'P. persicaGB Embrapa Clima Temperado'Tsukuba-01'P. persicaJapan'Tsukuba-02'P. persicaJapan'Tsukuba-03'P. persicaJapan'Okinawa'P. persicaFlorida, United States'Chico 11' x P. davidiamaFlorida, United StatesCereja PrecocePrunus sp.São Joaquim—SC/Brazil'Phenerad'P. persicaGB of Embrapa Clima Temperado'Nemared'P. persicaPilotion''Prunus sp.São Joaquim—SC/Brazil'Phenerad'P. persicaCalifornia, United StatesPrunus sp.São Joaquim—SC/Brazil'PheneradoP. persicaCons. 594P. persicaGB of Embrapa Clima TemperadoCons. 594P. persicaGB of Embrapa Clima Temperado'Parapos'P. persicaGB of Embrapa Clima Temperado'Parapos'P. persicaGB of Embrapa Clima Temperado'Parapos'	'Aldrighi' CPACT	P. persica	GB of Embrapa Clima Temperado
'Cenovesa'P. salicinaGB of Embrapa Clima Temperado'De Guia'P. persicaGB of Embrapa Clima Temperado'De Guia'P. persicaGB of Embrapa Clima Temperado'Rosaflor'P. persicaGB of Embrapa Clima Temperado'Tsukuba-2' CPACTP. persicaGB of Embrapa Clima TemperadoMéxico Fila 1P. persicaMexico'Santa Rosa'P. salicinaCalifornia, United States'Santa Rosa'P. persicaGB Embrapa Clima TemperadoMéxico Fila 2P. persicaGB Embrapa Clima Temperado'Santa Rosa'P. persicaGB Embrapa Clima Temperado'Tsukuba-Ol'P. persicaJapan'Tsukuba-Ol'P. persicaJapan'Tsukuba-Ol'P. persicaJapan'Okinawa'P. persicaJapan'Okinawa'P. persicaJapan'Okinawa'P. persicaJapan'Okinawa'P. persicaJapan'Okinawa'P. persicaJapan'Okinawa'P. persicaJapan'Okinawa'P. persicaSão Joaquim—SC/BrazilCereja PrecocePrunus sp.São Joaquim—SC/Brazil'Nemared'P. persicaCalifornia, United StatesPrunus sellouřiP. persicaGB of Embrapa Clima Temperado'Nemared'P. persicaGB of Embrapa Clima TemperadoPrunus sellouřiP. persicaGB of Embrapa Clima TemperadoPrunus sellouřiP. persicaGB of Embrapa Clima TemperadoPrunus sellouřiP. persicaGB of Embrapa	Capdeboscq	P. persica	GB of Embrapa Clima Temperado
'De Guid'P. persicaGB of Embrapa Clima Temperado'Rosaflor'P. persicaGB Embrapa Clima Temperado'Rosaflor'P. persicaGB of Embrapa Clima Temperado'Tsukuba-2' CPACTP. persicaGB of Embrapa Clima TemperadoMéxico Fila 1P. persicaMexico'Kisto Fila 2P. persicaMexico'Santa Rosa'P. salicinaCalifornia, United States'Tsukuba-01'P. persicaGB Embrapa Clima Temperado'Tsukuba-01'P. persicaJapan'Tsukuba-02'P. persicaJapan'Tsukuba-03'P. persicaJapan'Tsukuba-04'P. persicaFlorida, United States'Chiraguard''Chico 11' x P. davidianaFlorida, United States'Flordaguard''Chico 11' x P. davidianaFlorida, United States'Cereja TardiaPrumus sp.Sa'o Joaquim—SCBrazilPrumus sellowiiP. persicaCalifornia, United StatesPrumus sellowiiP. persicaGB of Embrapa Clima TemperadoPrumus sellowiiP. persicaGB of Embrapa Clima TemperadoPrumus persicaP. persicaGB of Embrapa Clima TemperadoPrumus sellowiiP. persicaGB of Embrapa Clima TemperadoPrumus persicaP. persicaGB of Embrapa Clima TemperadoPrumus sellowiiP. persicaGB of Embrapa Clima TemperadoChoráo 2003-229-03P. persicaGB of Embrapa Clima Temperado'Fartapos'P. persicaGB of Embrapa Clima Temperado'Fartapos'P. persicaGB of Em	'Genovesa'	P. salicina	GB of Embrapa Clima Temperado
'Rosaflor'P. persicaGB Embrapa Clima TemperadoPrunus mandchuricaP. mandschuricaGB of Embrapa Clima TemperadoTisukuba-2' CPACTP. persicaGB of Embrapa Clima TemperadoMéxico Fila 1P. persicaMexicoMéxico Fila 2P. persicaMexico'Santa Rosa'P. salicinaCalifornia, United States'Piazito'P. persicaGB Embrapa Clima Temperado'Tsukuba-01'P. persicaJapan'Tsukuba-02'P. persicaJapan'Tsukuba-03'P. persicaJapan'Okinawa'P. persicaFlorida, United States'Flordaguard''Chico 11' x P. davidianaFlorida, United StatesCereja PrecocePrunus sp.Sa Joaquim—SC/BrazilCereja TardiaPrunus sp.Sa Joaquim—SC/BrazilPrunus sellowiiP. persicaGB of Embrapa Clima TemperadoPrunus sellowiiP. persicaGB of Embrapa Clima TemperadoCons. 594P. persicaGB of Embrapa Clima Temperado'Barnad'P. persicaGB of Embrapa Clima TemperadoCons. 594P. persicaGB of Embrapa Clima Temperado'Barnad'P. persicaGB of Embrapa Clima Temperado'Barnad'P. persicaGB of Embrapa Clima Temperado'Charia Cons'P. persicaGB of Embrapa Clima Temperado'Sukuba-0'P. persicaGB of Embrapa Clima Temperado'Charia Cons'P. persicaGB of Embrapa Clima Temperado'Charia Cons'P. persicaGB of Embrapa Clima Temperado <tr<< td=""><td>'De Guia'</td><td>P. persica</td><td>GB of Embrapa Clima Temperado</td></tr<<>	'De Guia'	P. persica	GB of Embrapa Clima Temperado
Prunus mandchuricaP. mandschuricaGB of Embrapa Clima Temperado'Tsukuba-2' CPACTP. persicaGB of Embrapa Clima TemperadoMéxico Fila 1P. persicaMexicoMéxico Fila 2P. persicaMexico'Santa Rosa'P. salicinaCalifornia, United States'Piazito'P. persicaGB Embrapa Clima Temperado'Tsukuba-01'P. persicaJapan'Tsukuba-02'P. persicaJapan'Tsukuba-03'P. persicaJapan'Okinawa'P. persicaFlorida, United States'Flordaguard''Chico 11' x P. davidianaFlorida, United StatesCereja PrecocePrunus sp.São Joaquim—SC/BrazilCereja TardiaPrunus sp.São Joaquim—SC/Brazil'Nemared'P. persicaCalifornia, United StatesPrunus sellowiiP. persicaCalifornia, United StatesPrunus sellowiiP. persicaCalifornia, United StatesPrunus sellowiiP. persicaGB of Embrapa Clima TemperadoPrunus sellowiiP. persicaGB of Embrapa Clima TemperadoPrunus sellowiiP. persicaGB of Embrapa Clima TemperadoCons. 594P. persicaGB of Embrapa Clima Temperado'Santa CanadoP. persicaGB of Embrapa Clima Temperado'Partapos'P. persicaGB of Embrapa Clima Temperado'Santa CanadoP. persicaGB of Embrapa Clima Temperado'Partapos'P. persicaGB of Embrapa Clima Temperado'Partapos'P. persicaGB of Embrapa Clima Temperado <td>'Rosaflor'</td> <td>P. persica</td> <td>GB Embrapa Clima Temperado</td>	'Rosaflor'	P. persica	GB Embrapa Clima Temperado
'Tsukuba-2' CPACTP. persicaGB of Embrapa Clima TemperadoMéxico Fila 1P. persicaMexicoMéxico Fila 2P. persicaMexico'Santa Rosa'P. salicinaCalifornia, United States'Piazito'P. persicaGB Embrapa Clima Temperado'Tsukuba-01'P. persicaJapan'Tsukuba-02'P. persicaJapan'Tsukuba-03'P. persicaJapan'Okinawa'P. persicaJapan'Okinawa'P. persicaFlorida, United StatesCereja PrecocePrunus sp.São Joaquim—SC/BrazilCereja TardiaPrunus sp.São Joaquim—SC/Brazil'Nemared'P. persicaCalifornia, United States'Prunus sellowiiP. persicaCalifornia, United StatesPrunus sellowiiP. persicaCalifornia, United StatesPrunus sellowiiP. persicaGB of Embrapa Clima TemperadoOrnas sellowiiP. persicaGB of Embrapa Clima TemperadoPrunus sellowiiP. persicaGB of Embrapa Clima TemperadoCarso, S94P. persicaGB of Embrapa Clima TemperadoChoria 2003-229-03P. persicaGB of Embrapa Clima Temperado'Tarapos'P. persicaGB of Embrapa Clima Temperado'Tarapos'P. persicaGB of Embrapa Clima Temperado'Turquesa'P. persica <td>Prunus mandchurica</td> <td>P. mandschurica</td> <td>GB of Embrapa Clima Temperado</td>	Prunus mandchurica	P. mandschurica	GB of Embrapa Clima Temperado
México Fila 1P. persicaMexicoMéxico Fila 2P. persicaCalifornia, United States'Santa Rosa'P. salicinaCalifornia, United States'Piazito'P. persicaGB Embrapa Clima Temperado'Tsukuba-01'P. persicaJapan'Tsukuba-02'P. persicaJapan'Okinawa'P. persicaJapan'Okinawa'P. persicaFlorida, United States'Erodaguard''Chico 11' x P. davidianaFlorida, United StatesCereja PrecocePrunus sp.São Joaquim—SC/BrazilCereja AradiaPrunus sp.São Joaquim—SC/BrazilCereja AradiaPrunus sp.São Joaquim—SC/BrazilPinheiro PretoP. persicaCalifornia, United StatesPrunus sellowiiP. persicaGB of Embrapa Clima TemperadoPrunus sellowiiP. persicaGB of Embrapa Clima TemperadoPrunus persicaP. persicaGB of Embrapa Clima TemperadoCons. 594P. persicaGB of Embrapa Clima TemperadoCase. 1005P. persicaGB of Embrapa Clima Temperado'Florida 2003-229-03P. persicaGB of Embrapa Clima Temperado'Florida 2003-229-03P. persicaGB of Embrapa Clima Temperado'Huracotao'P. persicaGB of Embrapa Clima T	'Tsukuba-2' CPACT	P. persica	GB of Embrapa Clima Temperado
México Fila 2P. persicaMexico'Santa Rosa'P. salicinaCalifornia, United States'Sinta Rosa'P. persicaGB Embrapa Clima Temperado'Tsukuba-01'P. persicaJapan'Tsukuba-02'P. persicaJapan'Tsukuba-03'P. persicaJapan'Tsukuba-03'P. persicaFlorida, United States'Flordaguard''Chico 11' x P. davidianaFlorida, United States'Cereja PrecocePrunus sp.São Joaquim—SC/BrazilCereja TardiaPrunus sp.São Joaquim—SC/Brazil'Nemared'P. persicaCalifornia, United States'Prunus sellowiiP. persicaCalifornia, United StatesPrunus sellowiiP. persicaCalifornia, United StatesPrunus sensisP. kensuensisGB of Embrapa Clima TemperadoCons. 594P. persicaGB of Embrapa Clima TemperadoCasc. 1005P. persicaGB of Embrapa Clima Temperado'Fartapos'P. persicaGB of Embrapa Clima Temperado'Tarquesa'P. persicaGB of Embrapa Clima Temperado'Tarquesa'P. persicaGB of Embrapa Clima Temperado'Tarquesa'P. persicaGB of Embrapa Clima Temperado'Tartapos'P. persicaGB of Embrapa Clima Temperado'Turquesa'P. persicaGB of Embrapa Clima Temperado	México Fila 1	P. persica	Mexico
'Santa Rosa'P. salicinaCalifornia, United States'Piazito'P. persicaGB Embrapa Clima Temperado'Tsukuba-01'P. persicaJapan'Tsukuba-02'P. persicaJapan'Tsukuba-03'P. persicaJapan'Tsukuba-03'P. persicaFlorida, United States'Flordaguard''Chico 11' x P. davidianaFlorida, United StatesCereja PrecocePrunus sp.São Joaquim—SC/BrazilCereja TardiaPrunus sp.São Joaquim—SC/BrazilPinheiro PretoP. persicaCalifornia, United States'Nemared'P. persicaCalifornia, United StatesPrunus sellowiiP. persicaCalifornia, United StatesPrunus kansuensisP. persicaCalifornia, United StatesPrunus kansuensisP. persicaGB of Embrapa Clima TemperadoCons. 594P. persicaGB of Embrapa Clima TemperadoChorão 2003-229-03P. persicaGB of Embrapa Clima Temperado'Turquesa'P. persicaGB of Embrapa Clima Temperado'Aldrighi'P. persicaGrower from Pelotas—RS/Brazil'Maracotão'P. persicaGB of Embrapa Clima Temperado'Aldrighi'P. persicaGB of Embrapa Clima Temperado'Iurquesa'P. persicaGB of Embrapa Clima Temperado'Aldrighi'P. persicaGB of Embrapa Clima Temperado'Iurquesa'P. persicaGB of Embrapa Clima Temperado'Aldrighi'P. persicaGrower from Pelotas—RS/Brazil'Maracotão'P. persicaGrower from	México Fila 2	P. persica	Mexico
'Piazito'P. persicaGB Embrapa Clima Temperado'Tsukuba-01'P. persicaJapan'Tsukuba-02'P. persicaJapan'Tsukuba-03'P. persicaFlorida, United States'Okinawa'P. persicaFlorida, United States'Cereja PrecocePrunus sp.São Joaquim—SC/BrazilCereja TardiaPrunus sp.São Joaquim—SC/Brazil'Pinheiro PretoP. persicaPinheiro Preto—SC/Brazil'Nemared'P. persicaCalifornia, United StatesPrunus sellowiiP. sellowiiPelotas—RS/BrazilPrunus kansuensisP. kansuensisGB of Embrapa Clima TemperadoCasc. 1005P. persicaGB of Embrapa Clima Temperado'Sarapos'P. persicaGB of Embrapa Clima Temperado'Farrapos'P. persicaGB of Embrapa Clima Temperado'Turquesa'P. persicaGB of Embrapa Clima Temperado'Aldrighi'P. persicaGB of Embrapa Clima Tem	'Santa Rosa'	P. salicina	California, United States
'Tsukuba-01'P. persicaJapan'Tsukuba-02'P. persicaJapan'Tsukuba-03'P. persicaFlorida, United States'Tordaguard''Chico 11' x P. davidianaFlorida, United States'Flordaguard''Chico 11' x P. davidianaFlorida, United StatesCereja PrecocePrunus sp.São Joaquim—SC/BrazilCereja TardiaPrunus sp.São Joaquim—SC/Brazil'Nemared'P. persicaCalifornia, United StatesPrunus sellowiiP. persicaCalifornia, United StatesPrunus kansuensisP. kansuensisCalifornia, United StatesPrunus kansuensisP. kansuensisGB of Embrapa Clima TemperadoCons. 594P. persicaGB of Embrapa Clima TemperadoCasc. 1005P. persicaGB of Embrapa Clima Temperado'Solinha'P. persicaGB of Embrapa Clima Temperado'Yarapos'P. persicaGB of Embrapa Clima Temperado'Turquesa'P. persicaGB of Embrapa Clima Temperado'Aldrighi'P. persicaGrower from Pelotas—RS/Brazil'Maracotão'P. persicaGrower from Pelotas—RS/Brazil'Maracotão'P. persicaGrower from Pelotas—RS/Brazil'Maracotão'P. persicaGrower from Pelotas—RS/Brazil'Maracotão'P. persicaGrower from Pelotas—RS/Brazil'Maracotão' <td>'Piazito'</td> <td>P. persica</td> <td>GB Embrapa Clima Temperado</td>	'Piazito'	P. persica	GB Embrapa Clima Temperado
'Tsukuba-02'P. persicaJapan'Tsukuba-03'P. persicaJapan'Tsukuba-03'P. persicaFlorida, United States'Flordaguard''Chico 11' x P. davidianaFlorida, United States'Ereia PrecocePrunus sp.São Joaquim—SC/BrazilCereja TardiaPrunus sp.São Joaquim—SC/Brazil'Inheiro PretoP. persicaPinheiro Preto—SC/Brazil'Nemared'P. persicaCalifornia, United StatesPrunus sellowiiP. sellowiiPelotas—RS/BrazilPrunus persicaP. persicaGB of Embrapa Clima TemperadoCons. 594P. persicaGB of Embrapa Clima TemperadoCasc. 1005P. persicaGB of Embrapa Clima Temperado'Bolinha'P. persicaGB of Embrapa Clima Temperado'Bolinha'P. persicaGB of Embrapa Clima Temperado'Saratos'P. persicaGB of Embrapa Clima Temperado'Chorão 2003-229-03P. persicaGB of Embrapa Clima Temperado'Turquesa'P. persicaGB of Embrapa Clima Temperado'Aldrighi'P. persicaGB of Embrapa Clima Temperado'Alarcotão'P. persica <td>'Tsukuba-01'</td> <td>P. persica</td> <td>Japan</td>	'Tsukuba-01'	P. persica	Japan
'Tsukuba-03'P. persicaJapan'Okinawa'P. persicaFlorida, United States'Flordaguard''Chico 11' x P. davidianaFlorida, United StatesCereja PrecocePrunus sp.São Joaquim—SC/BrazilCereja TardiaP. persicaPinheiro PretoPinheiro PretoP. persicaCalifornia, United States'Nemared'P. persicaCalifornia, United StatesPrunus sellowiiP. sellowiiPelotas—RS/BrazilPrunus sellowiiP. sellowiiPelotas—RS/BrazilPrunus kansuensisP. kansuensisGB of Embrapa Clima TemperadoCons. 594P. persicaGB of Embrapa Clima TemperadoCasc. 1005P. persicaGB of Embrapa Clima Temperado'Bolinha'P. persicaGB of Embrapa Clima Temperado'Farrapos'P. persicaGB of Embrapa Clima Temperado'Chorão 2003-229-03P. persicaGB of Embrapa Clima Temperado'Aldrighi'P. persicaGrower from Pelotas—RS/Brazil'Maracotão'P. persicaGrower from Pelotas—RS/Brazil'Maracotão'<	'Tsukuba-02'	P. persica	Japan
'Okinawa'P. persicaFlorida, United States'Flordaguard''Chico 11' x P. davidianaFlorida, United StatesCereja PrecocePrunus sp.São Joaquim—SC/BrazilCereja TardiaPrunus sp.São Joaquim—SC/BrazilPinheiro PretoP. persicaCalifornia, United States'Nemared'P. persicaCalifornia, United StatesPrunus sellowiiP. sellowiiPelotas—RS/BrazilPrunus sellowiiP. sellowiiPelotas—RS/BrazilPrunus kansuensisP. kansuensisGB of Embrapa Clima TemperadoCons. 594P. persicaGB of Embrapa Clima TemperadoCasc. 1005P. persicaGB of Embrapa Clima Temperado'Solinha'P. persicaGB of Embrapa Clima Temperado'Farrapos'P. persicaGB of Embrapa Clima Temperado'Chorão 2003-229-03P. persicaGB of Embrapa Clima Temperado'Turquesa'P. persicaGB of Embrapa Clima Temperado'Adarçoño'P. persicaGB of Embrapa Clima Temperado'Maracoño'P. persicaGrower from Pelotas—RS/Brazil'Maracoño'P. persicaGrower from Pelotas—RS/Brazil'Maracoño'P. persicaGrower from Pelotas—RS/Brazil'Maracoño'P. punneFCAV/UNESP, Jaboticabal—SP/Brazil'Maracoño'P. mumeFCAV/UNESP, Jaboticabal—SP/Brazil<	'Tsukuba-03'	P. persica	Japan
'Flordaguard''Chico 11' x P. davidianaFlorida, United StatesCereja PrecocePrunus sp.São Joaquim—SC/BrazilCereja TardiaPrunus sp.São Joaquim—SC/BrazilPinheiro PretoP. persicaPinheiro Preto—SC/Brazil'Nemared'P. persicaCalifornia, United StatesPrunus sellowiiP. sellowiiPelotas—RS/BrazilPrunus kansuensisP. kansuensisGB of Embrapa Clima TemperadoPrunus kansuensisP. persicaGB of Embrapa Clima TemperadoCons. 594P. persicaGB of Embrapa Clima TemperadoCasc. 1005P. persicaGB of Embrapa Clima Temperado'Bolinha'P. persicaGB of Embrapa Clima Temperado'Farrapos'P. persicaGB of Embrapa Clima Temperado'Turquesa'P. persicaGB of Embrapa Clima Temperado'Aldrighi'P. persicaGrower from Pelotas—RS/Brazil'Maracotão'P. persicaGrower from Pelotas—RS/Br	'Okinawa'	P. persica	Florida, United States
Cereja PrecocePrunus sp.São Joaquim—SC/BrazilCereja TardiaPrunus sp.São Joaquim—SC/BrazilPinheiro PretoP. persicaPinheiro Preto—SC/Brazil'Nemared'P. persicaCalifornia, United StatesPrunus sellowiiP. sellowiiPelotas—RS/BrazilPrunus kansuensisP. kansuensisGB of Embrapa Clima TemperadoPrunus persicaP. persicaGB of Embrapa Clima TemperadoCons. 594P. persicaGB of Embrapa Clima TemperadoCasc. 1005P. persicaGB of Embrapa Clima Temperado'Yarrapos'P. persicaGB of Embrapa Clima Temperado'Turquesa'P. persicaGB of Embrapa Clima Temperado'Yarrapos'P. persicaGB of Embrapa Clima Temperado'Yurquesa'P. persicaGrower from Pelotas—RS/Brazil'Yurquesa'P. persicaGrower from Pelotas—RS/Brazil'Yurquesa'P. persicaGrower from Pelotas—RS/Brazil'Yaracotão'P. persicaGrower from Pelotas—RS/Brazil'Yaracotão'P. persicaGrower from Pelotas—RS/Brazil'Yaracotão'P. persicaGrower from Pelotas—RS/Brazil'Yaracotão'P. persicaGrower from Pelotas—RS/Brazil <t< td=""><td>'Flordaguard'</td><td>'Chico 11' x P. davidiana</td><td>Florida, United States</td></t<>	'Flordaguard'	'Chico 11' x P. davidiana	Florida, United States
Cereja TardiaPrunus sp.São Joaquim—SC/BrazilPinheiro PretoP. persicaPinheiro Preto—SC/Brazil'Nemared'P. persicaCalifornia, United StatesPrunus sellouiiP. sellouiiPelotas—RS/BrazilPrunus sellouiiP. kansuensisGB of Embrapa Clima TemperadoPrunus persicaP. persicaGB of Embrapa Clima TemperadoCons. 594P. persicaGB of Embrapa Clima TemperadoCase. 1005P. persicaGB of Embrapa Clima Temperado'Bolinha'P. persicaGB of Embrapa Clima Temperado'Farrapos'P. persicaGB of Embrapa Clima Temperado'Turquesa'P. persicaGB of Embrapa Clima Temperado'Aldrighi'P. persicaGF orwer from Pelotas—RS/Brazil'Maracotão'P. persicaGrower from Pelotas—RS/Brazil'Rigitano'P. persicaGrower from Pelotas—RS/BrazilClone 15P. mumeFCAV/UNESP, Jaboticabal—SP/BrazilSharpeChickasaw(P. angustifolia) x Prunus spp.Florida, United States	Cereja Precoce	Prunus sp.	São Joaquim—SC/Brazil
Pinheiro PretoP. persicaPinheiro Preto—SC/Brazil'Nemared'P. persicaCalifornia, United StatesPrunus sellowiiP. sellowiiPelotas—RS/BrazilPrunus kansuensisP. kansuensisGB of Embrapa Clima TemperadoPrunus persicaP. persicaGB of Embrapa Clima TemperadoCons. 594P. persicaGB of Embrapa Clima TemperadoCasc. 1005P. persicaGB of Embrapa Clima TemperadoCasc. 1005P. persicaGB of Embrapa Clima Temperado'Bolinha'P. persicaGB of Embrapa Clima Temperado'Farrapos'P. persicaGB of Embrapa Clima Temperado'Turquesa'P. persicaGB of Embrapa Clima Temperado'Aldrighi'P. persicaGB of Embrapa Clima Temperado'Aldrighi'P. persicaGB of Embrapa Clima Temperado'Aldrighi'P. persicaGrower from Pelotas—RS/Brazil'Maracotão'P. persicaGrower from Pelotas—RS/Brazil'Rigitano'P. mumeFCAV/UNESP, Jaboticabal—SP/BrazilChora 15P. mumeFCAV/UNESP, Jaboticabal—SP/BrazilSharpeChickasaw(P. angustifolia) x Prunus spp.Florida, United States	Cereja Tardia	Prunus sp.	São Joaquim—SC/Brazil
'Nemared'P. persicaCalifornia, United StatesPrunus sellowiiP. sellowiiPelotas—RS/BrazilPrunus kansuensisP. kansuensisGB of Embrapa Clima TemperadoPrunus persicaP. persicaGB of Embrapa Clima TemperadoCons. 594P. persicaGB of Embrapa Clima TemperadoCasc. 1005P. persicaGB of Embrapa Clima Temperado'Bolinha'P. persicaGB of Embrapa Clima Temperado'Bolinha'P. persicaGB of Embrapa Clima Temperado'Farrapos'P. persicaGB of Embrapa Clima TemperadoChorão 2003-229-03P. persicaGB of Embrapa Clima Temperado'Turquesa'P. persicaGB of Embrapa Clima Temperado'Aldrighi'P. persicaGB of Embrapa Clima Temperado'Aldrighi'P. persicaGB of Embrapa Clima Temperado'Maracotão'P. persicaGrower from Pelotas—RS/Brazil'Rigitano'P. persicaGrower from Pelotas—RS/BrazilClone 15P. mumeFCAV/UNESP, Jaboticabal—SP/BrazilSharpeChickasaw(P. angustifolia) x Prunus spp.Florida, United States	Pinheiro Preto	P. persica	Pinheiro Preto—SC/Brazil
Prunus sellowiiP. sellowiiPelotas—RS/BrazilPrunus kansuensisP. kansuensisGB of Embrapa Clima TemperadoPrunus persicaP. persicaGB of Embrapa Clima TemperadoCons. 594P. persicaGB of Embrapa Clima TemperadoCasc. 1005P. persicaGB of Embrapa Clima Temperado'Bolinha'P. persicaGB of Embrapa Clima Temperado'Bolinha'P. persicaGB of Embrapa Clima Temperado'Farrapos'P. persicaGB of Embrapa Clima TemperadoChorão 2003-229-03P. persicaGB of Embrapa Clima Temperado'Turquesa'P. persicaGB of Embrapa Clima Temperado'Aldrighi'P. persicaGB of Embrapa Clima Temperado'Maracotão'P. persicaGB of Embrapa Clima Temperado'Rigitano'P. persicaGrower from Pelotas—RS/Brazil'Rigitano'P. mumeFCAV/UNESP, Jaboticabal—SP/BrazilClone 15P. mumeFCAV/UNESP, Jaboticabal—SP/BrazilSharpeChickasaw(P. angustifolia) x Prunus spp.Florida, United States	'Nemared'	P. persica	California, United States
Prunus kansuensisP. kansuensisGB of Embrapa Clima TemperadoPrunus persicaP. persicaGB of Embrapa Clima TemperadoCons. 594P. persicaGB of Embrapa Clima TemperadoCasc. 1005P. persicaGB of Embrapa Clima Temperado'Bolinha'P. persicaGB of Embrapa Clima Temperado'Bolinha'P. persicaGB of Embrapa Clima Temperado'Farrapos'P. persicaGB of Embrapa Clima TemperadoChorão 2003-229-03P. persicaGB of Embrapa Clima Temperado'Turquesa'P. persicaGB of Embrapa Clima Temperado'Aldrighi'P. persicaGB of Embrapa Clima Temperado'Maracotão'P. persicaGB of Embrapa Clima Temperado'Rigitano'P. persicaGrower from Pelotas—RS/Brazil'Rigitano'P. mumeFCAV/UNESP, Jaboticabal—SP/BrazilClone 15P. mumeFCAV/UNESP, Jaboticabal—SP/BrazilSharpeChickasaw(P. angustifolia) x Prunus spp.Florida, United States	Prunus sellowii	P. sellowii	Pelotas—RS/Brazil
Prunus persicaP. persicaGB of Embrapa Clima TemperadoCons. 594P. persicaGB of Embrapa Clima TemperadoCasc. 1005P. persicaGB of Embrapa Clima Temperado'Bolinha'P. persicaGB of Embrapa Clima Temperado'Farrapos'P. persicaGB of Embrapa Clima TemperadoChorão 2003-229-03P. persicaGB of Embrapa Clima Temperado'Turquesa'P. persicaGB of Embrapa Clima Temperado'Aldrighi'P. persicaGB of Embrapa Clima Temperado'Maracotão'P. persicaGF orwer from Pelotas—RS/Brazil'Maracotão'P. persicaGrower from Pelotas—RS/Brazil'Rigitano'P. mumeFCAV/UNESP, Jaboticabal—SP/BrazilClone 15P. mumeFCAV/UNESP, Jaboticabal—SP/BrazilSharpeChickasaw(P. angustifolia) x Prunus spp.Florida, United States	Prunus kansuensis	P. kansuensis	GB of Embrapa Clima Temperado
Cons. 594P. persicaGB of Embrapa Clima TemperadoCasc. 1005P. persicaGB of Embrapa Clima Temperado'Bolinha'P. persicaGB of Embrapa Clima Temperado'Farrapos'P. persicaGB of Embrapa Clima TemperadoChorão 2003-229-03P. persicaGB of Embrapa Clima Temperado'Turquesa'P. persicaGB of Embrapa Clima Temperado'Aldrighi'P. persicaGB of Embrapa Clima Temperado'Maracotão'P. persicaGrower from Pelotas—RS/Brazil'Maracotão'P. persicaGrower from Pelotas—RS/Brazil'Rigitano'P. mumeFCAV/UNESP, Jaboticabal—SP/BrazilClone 15P. mumeFCAV/UNESP, Jaboticabal—SP/BrazilSharpeChickasaw(P. angustifolia) x Prunus spp.Florida, United States	Prunus persica	P. persica	GB of Embrapa Clima Temperado
Casc. 1005P. persicaGB of Embrapa Clima Temperado'Bolinha'P. persicaGB of Embrapa Clima Temperado'Farrapos'P. persicaGB of Embrapa Clima TemperadoChorão 2003-229-03P. persicaGB of Embrapa Clima Temperado'Turquesa'P. persicaGB of Embrapa Clima Temperado'Aldrighi'P. persicaGB of Embrapa Clima Temperado'Aldrighi'P. persicaGrower from Pelotas—RS/Brazil'Maracotão'P. persicaGrower from Pelotas—RS/Brazil'Rigitano'P. mumeFCAV/UNESP, Jaboticabal—SP/BrazilClone 15P. mumeFCAV/UNESP, Jaboticabal—SP/BrazilSharpeChickasaw(P. angustifolia) x Prunus spp.Florida, United States	Cons. 594	P. persica	GB of Embrapa Clima Temperado
'Bolinha'P. persicaGB of Embrapa Clima Temperado'Farrapos'P. persicaGB of Embrapa Clima TemperadoChorão 2003-229-03P. persicaGB of Embrapa Clima Temperado'Turquesa'P. persicaGB of Embrapa Clima Temperado'Aldrighi'P. persicaGB of Embrapa Clima Temperado'Maracotão'P. persicaGrower from Pelotas—RS/Brazil'Maracotão'P. persicaGrower from Pelotas—RS/Brazil'Rigitano'P. mumeFCAV/UNESP, Jaboticabal—SP/BrazilClone 15P. mumeFCAV/UNESP, Jaboticabal—SP/BrazilSharpeChickasaw(P. angustifolia) x Prunus spp.Florida, United States	Casc. 1005	P. persica	GB of Embrapa Clima Temperado
'Farrapos'P. persicaGB of Embrapa Clima TemperadoChorão 2003-229-03P. persicaGB of Embrapa Clima Temperado'Turquesa'P. persicaGB of Embrapa Clima Temperado'Aldrighi'P. persicaGrower from Pelotas—RS/Brazil'Maracotão'P. persicaGrower from Pelotas—RS/Brazil'Rigitano'P. mumeFCAV/UNESP, Jaboticabal—SP/BrazilClone 15P. mumeFCAV/UNESP, Jaboticabal—SP/BrazilSharpeChickasaw(P. angustifolia) x Prunus spp.Florida, United States	'Bolinha'	P. persica	GB of Embrapa Clima Temperado
Chorão 2003-229-03P. persicaGB of Embrapa Clima Temperado'Turquesa'P. persicaGB of Embrapa Clima Temperado'Aldrighi'P. persicaGrower from Pelotas—RS/Brazil'Maracotão'P. persicaGrower from Pelotas—RS/Brazil'Rigitano'P. mumeFCAV/UNESP, Jaboticabal—SP/BrazilClone 15P. mumeFCAV/UNESP, Jaboticabal—SP/BrazilSharpeChickasaw(P. angustifolia) x Prunus spp.Florida, United States	'Farrapos'	P. persica	GB of Embrapa Clima Temperado
'Turquesa'P. persicaGB of Embrapa Clima Temperado'Aldrighi'P. persicaGrower from Pelotas—RS/Brazil'Maracotão'P. persicaGrower from Pelotas—RS/Brazil'Rigitano'P. mumeFCAV/UNESP, Jaboticabal—SP/BrazilClone 15P. mumeFCAV/UNESP, Jaboticabal—SP/BrazilSharpeChickasaw(P. angustifolia) x Prunus spp.Florida, United States	Chorão 2003-229-03	P. persica	GB of Embrapa Clima Temperado
'Aldrighi'P. persicaGrower from Pelotas—RS/Brazil'Maracotão'P. persicaGrower from Pelotas—RS/Brazil'Rigitano'P. mumeFCAV/UNESP, Jaboticabal—SP/BrazilClone 15P. mumeFCAV/UNESP, Jaboticabal—SP/BrazilSharpeChickasaw(P. angustifolia) x Prunus spp.Florida, United States	'Turquesa'	P. persica	GB of Embrapa Clima Temperado
'Maracotão'P. persicaGrower from Pelotas—RS/Brazil'Rigitano'P. mumeFCAV/UNESP, Jaboticabal—SP/BrazilClone 15P. mumeFCAV/UNESP, Jaboticabal—SP/BrazilSharpeChickasaw(P. angustifolia) x Prunus spp.Florida, United States	'Aldrighi'	P. persica	Grower from Pelotas-RS/Brazil
'Rigitano'P. mumeFCAV/UNESP, Jaboticabal—SP/BrazilClone 15P. mumeFCAV/UNESP, Jaboticabal—SP/BrazilSharpeChickasaw(P. angustifolia) x Prunus spp.Florida, United States	'Maracotão'	P. persica	Grower from Pelotas-RS/Brazil
Clone 15P. mumeFCAV/UNESP, Jaboticabal—SP/BrazilSharpeChickasaw(P. angustifolia) x Prunus spp.Florida, United States	'Rigitano'	P. mume	FCAV/UNESP, Jaboticabal—SP/Brazil
SharpeChickasaw(P. angustifolia) x Prunus spp.Florida, United States	Clone 15	P. mume	FCAV/UNESP, Jaboticabal—SP/Brazil
	Sharpe	Chickasaw(P. angustifolia) x Prunus spp.	Florida, United States

^a P.—Prunus.

 $^b\,\mathrm{GB}\mathrm{--live}$ germplasm bank.

Scott–Knott test ($P \le 0.05$) 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 ($P \le 0.05$; 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 ($P \le 0.05$).

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 $P \le 0.05$ (PROC GLM, SAS Institute 2000). The possible deviation in the sex ratio was tested by the chi-squared test (χ^2 ; $P \le 0.05$; 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 ($P \le 0.05$; 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 ($P \le 0.05$) 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 ($P \le 0.05$).



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 ± 0.003 g) compared with *P. kansuensis* (0.0127 ± 0.011 g) and Capdeboscq (0.0120 ± 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 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 < 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 ~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 field 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 o	f G	. mo	<i>lesta</i> in	Prunus spp.	genotypes
----------------------------------	-----	------	-----------------	-------------	-----------

Biological parameter	Prunus kansuensis	Capdeboscq	Sharpe	
Adult parameters ^a				
Sex ratio $(\mathcal{Q}/\mathcal{Q}+\mathcal{Z})$	0.52 ^{ns}	0.54 ^{ns}	0.50 ^{ns}	
Female longevity (d)	13.5 ± 0.3a	13.2 ± 0.2a	$5.0 \pm 1.3 b$	
Male longevity (d)	$14.0 \pm 0.25a$	13.6 ± 0.21a	$5.6 \pm 0.67 \mathrm{b}$	
Oviposition (d)	9.1 ± 0.2a	9.5 ± 0.1a	$4.4 \pm 0.4b$	
Eggs/female/d	41.6 ± 1.4a	39.8 ± 1.2a	$13.3 \pm 1.7b$	
Fertility life table parameters ^b				
<i>T</i> (d)	35.6 ± 0.11a	34.8 ± 0.16a	$41.2 \pm 1.25b$	
$R_o (\mathcal{P}/\mathcal{P})$	740.15 ± 32.6a	639.15 ± 29.3a	134.9 ± 11.3b	
$r_m (\mathcal{P}/\mathcal{P}/\mathbf{d})$	$0.158 \pm 0.001a$	$0.167 \pm 0.002a$	$0.012 \pm 0.001b$	
λ	$1.248 \pm 0.002a$	$1.239 \pm 0.001a$	$0.008\pm0.001\mathrm{b}$	

^{*a*} Means (\pm 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.

 b T—mean length of a generation; R_{o} —net reproductive rate; r_{m} —intrinsic rate of population increase; λ —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.

References Cited

- Agrianual. 2016. Pêssego. FNP Consultoria & Comercio, São Paulo, Brazil.
- Al Bitar, L., S. N. Gorb, C.P.W. Zebitz, and D. Voigt. 2014. Egg adhesion of the codling moth *Cydia pomonella* L. (Lepidoptera, Tortricidae) to various substrates: II. Fruit surfaces of different apple cultivars. Arthropod-Plant Interact. 8: 57–77.
- Arge, L.W.P. 2012. Diversidade, estrutura e relação genética de portaenxertos de Prunus avaliados pela análise de caracteres morfológicos e de loci SSR. M.S. Dissertation, Universidade Federal de Pelotas.
- Arioli, C., F. Molinari, M. Botton, and M. Garcia. 2007. Técnica de criação de Grapholita molesta (Busck, 1916) (Lepidoptera: Tortricidae) em laboratório utilizando dieta artificial para a produção de insetos visando estudos de comportamento e controle. Boletim De Pesquisa e Desenvolvimento/ Embrapa Uva e Vinho 13: 14.
- Arioli, C. J., M. Botton, and G. A. Carvalho. 2004. Controle químico da Grapholita molesta (Busck) (Lepidoptera: Tortricidae) na cultura do pessegueiro. Ciência Rural 34: 1695–1700.
- Arioli, C. J., P. L. Pastori, M. Botton, M. S. Garcia, R. Borges, and A. Mafra-Neto. 2014. Assessment of SPLAT formulations to control *Grapholita molesta* (Lepidoptera: Tortricidae) in a Brazilian apple orchard. Chilean J. Agric. Res. 74: 184–190.
- Beckman, T. G., J. X. Chaparro, and W. B. Sherman. 2008. 'Sharpe', a Clonal Plum Rootstock for Peach. HortScience 43: 2236–2337.
- Bottger, G. T., and R. Patana. 1966. Growth, development, and survival of certain lepidoptera fed gossypol in the diet. J. Econ. Entomol. 59: 1166–1168.
- Botton, M., C. J. Ariolli, and V. Colletta. 2001. Monitoramento da mariposa oriental *Grapholita molesta* (Busck, 1916) na cultura do pessegueiro. Embrapa Uva e Vinho/Comunicado Técnico 38: 1–4.
- Botton, M., D. Nava, C. Arioli, A. Grutzmacher, and M. Garcia. 2011. Bioecologia, monitoramento e controle da mariposa-oriental na cultura do pessegueiro no Rio Grande do Sul. Circular Técnica/Embrapa Uva e Vinho 86: 11.
- Cao, K., L. Wang, G. Zhu, W. C. Fang, and C. W. Chen. 2011. Isolation, characterisation and phylogenetic analysis of resistance gene analogues in a wild species of peach (*Prunus kansuensis*). Can. J. Plant Sci. 91: 961–970.
- Castro, L.A.S. 2010. Sistema de produção de material propagativo de pessegueiro com alta sanidade. Embrapa Clima Temperado/Sistema De Produção 18: 109.
- Chaves, C. C., C. A. Baronio, M. Botton, and M. S. Garcia. 2014. Efeito de inseticidas em diferentes fases de desenvolvimento de *Grapholita molesta* (Busck, 1916) (Lepidoptera: Tortricidae) e estruturas vegetais da macieira e do pessegueiro. Revista Brasileira De Fruticultura 36: 842–852.
- Cottrell, T., T. Beckman, and D. Horton. 2011. Lesser peachtree borer (Lepidoptera: Sesiidae) oviposition on *Prunus* germplasm. Environ. Entomol. 40: 1465–1470.

- Cottrell, T. E., J. Fuest, and D. L. Horton. 2008. Influence of *Prunus* spp., peach cultivars, and bark damage on oviposition choices by the lesser peach tree borer (Lepidoptera: Sesiidae). Environ. Entomol. 37: 1508–1513.
- Edwards, P. J., and S. Wratten. 1981. Ecologia das interações entre insetos e plantas.vol. 27. EPU/Editora da Universidade de Sao Paulo, São Paulo, Brazil.
- Joshi, N., L. Hull, C. Myers, G. Krawczyk, and E. Rajotte. 2007. Oviposition preference of Oriental fruit moth [*Grapholita molesta* (Busck), Lepidoptera: tortricidae] for apple cultivars, pp. 308–309. *In* 16th International Plant Protection Congress, 15–18 October 2007 2007, Glasgow. British Crop Protection Council, Glasgow, Scotland, United Kingdom.
- Joshi, N. K., E. G. Rajotte, C. T. Myers, G. Krawczyk, and L. A. Hull. 2015. Development of a susceptibility index of apple cultivars for codling moth, *Cydia pomonella* (L.) (Lepidoptera: Tortricidae) oviposition. Front. Plant Sci. 6: 992.
- Kogan, M. 1998. Integrated pest management: historical perspectives and contemporary developments. Annu. Rev. Entomol. 43: 243–270.
- Lara, F. M. 1991. Princípios de resistência de plantas a insetos. Livroceres, São Paulo, Brazil.
- Maia, A.H.N., A. J. Luiz, and C. Campanhola. 2000. Statistical inference on associated fertility life table parameters using jackknife technique: computational aspects. J. Econ. Entomol. 93: 511–518.
- Mayer, N., and B. Ueno. 2012. A morte-precoce do pessegueiro e suas relações com porta-enxertos. Documentos/Embrapa Clima Temperado 359: 42.
- Mayer, N., B. Ueno, and L. Antunes. 2009. Seleção e clonagem de portaenxertos tolerantes à morteprecoce do pessegueiro. Embrapa Clima Temperado/Comunicado Técnico. 209: 13.
- Mayer, N. A., B. Ueno, C. Fischer, and L. C. Migliorini. 2013. Propagação vegetativa de frutíferas de caroço por estacas herbáceas em escala comercial. Boletim De Pesquisa e Desenvolvimento/Embrapa Clima Temperado 195: 55.

- Myers, C. T., L. A. Hull, and G. Krawczyk. 2006. Seasonal and cultivarassociated variation in oviposition preference of oriental fruit moth (Lepidoptera: Tortricidae) adults and feeding behavior of neonate larvae in apples. J. Econ. Entomol. 99: 349–358.
- Myers, C. T., L. A. Hull, and G. Krawczyk. 2007. Effects of orchard host plants (apple and peach) on development of oriental fruit moth (Lepidoptera: Tortricidae). J. Econ. Entomol. 100: 421–430.
- Pastori, P. L., C. J. Arioli, M. Botton, L. B. Monteiro, L. Stoltman, and A. Mafra-Neto. 2012. Integrated control of two tortricid (Lepidoptera) pests in apple orchards with sex pheromones and insecticides. Revista Colombiana De Entomología. 38: 224–230.
- Salles, L. D. 1991. Grafolita (*Grapholita molesta*): bioecologia e controle. Documentos/Embrapa CNPFT. 42: 13.
- Salles, L. D., and L. Marini. 1989. Etiologia do ataque das lagartas de Grapholita molesta (Busck, 1916)(Lepidoptera: Tortricidae) em pessegueiros. Anais Da Sociedade Entomológica Do Brasil. 2: 337–345.
- SAS Institute. 2000. Statistical analysis system: getting started with the SAS learning computer program. SAS Institute, Carry, NC.
- Silva, F.A.S., and C.A.V. de Azevedo. 2016. The Assistat Software Version 7.7 and its use in the analysis of experimental data. Afr. J. Agric. Res. 11: 3733–3740.
- Silva, O.A. B.N.E., M. Botton, M. S. Garcia, A. Z. Bisognin, and D. E. Nava. 2010. Desenvolvimento e reprodução da mariposa-oriental em macieira e pessegueiro. Pesquisa Agropecuária Brasileira 45: 1082–1088.
- Smith, C. 2005. Factors affecting the expression of plant resistance to arthropods. Plant resistance to arthropods: molecular and conventional approaches, pp. 183–217. Springer, Dordrecht, NL.
- Straub, D. 2003. Susceptibility of new apple cultivars to various arthropod pests. NY Fruit Q. 11: 25–28.