Evaluation of tomato rootstocks to *Ralstonia solanacearum* and *R. pseudosolanacearum* in Mata mesoregion, PE

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**ABSTRACT**

Bacterial wilt limits tomato production and resistant rootstocks could be important for the integrated management of the disease. Since there is an interaction between local bacterial strains and tomato genotype, this study aimed to evaluate 14 tomato rootstocks to bacterial wilt in the Mata mesoregion of Pernambuco state, Brazil. The rootstocks reaction to two sequevars of *Ralstonia solanacearum* and two of *R. pseudosolanacearum* was evaluated in four experiments carried out in the greenhouse using the completely randomized experimental design, with four replications composed of four plants each. Seven genotypes were selected to evaluate the reaction to bacterial wilt as rootstocks grafting in tomato plants ‘Tomini F1’ in a production area with disease history in the Chã Grande municipality, using randomized block design with four plants per treatment in each block. In the field experiment, disease symptoms were not observed in the grafted plants in ‘Guardião’, ‘Woodstock’, and ‘Yoshimatsu’. Regarding all experiments, ‘Guardião’ and ‘Muralha’ showed the best resistance levels and could be used in the integrated management of bacterial wilt and studied in plant breeding programs.

**Keywords:** Solanum lycopersicum, grafting, genetic resistance, resistance.

**Received on June 2, 2020; accepted on November 11, 2020**
Brazil (Safni et al., 2014; Prior et al., 2016; Santiago et al., 2017; Lopes & Rossato, 2018) and several sequevars of the two first bacteria have been found causing bacterial wilt in Solanaceae in the Mata mesoregion of Pernambuco state, Brazil, turning the disease control difficult (Garcia et al., 2013).

The use of resistant or tolerant cultivars is one of the measures to control bacterial wilt of the Solanaceae, which is considered of extreme importance within the integrated management of the disease (Lopes et al., 2015). However, marketable resistant tomato cultivars are not available and resistant rootstocks have been used to suppress infection of susceptible plants (Nakah et al., 2004). In turn, resistant rootstocks may significantly reduce the incidence and severity of bacterial wilt in tomato plantations and the genotypes ‘Hawaii 7998’, ‘Cheong Gang’, ‘BHN 1054’, ‘BHN 998’, ‘RST-04-106-T’ (McAvoy et al., 2012), ‘Hawaii 7996’ (Lopes et al., 2015; Caldwell et al., 2017), ‘Guardião’, ‘Muralha’ (Lopes et al., 2015), ‘Green-guard’ (Uehara & Nakho, 2018), and ‘Yoshimatsu’ (Costa et al., 2018, 2019) have been reported as resistant or tolerant. On the other hand, different studies have shown that some hybrids may show a susceptibility when infected by different strains of Ralstonia spp., evidencing the importance of selecting new sources of resistance as well as the need to evaluate hybrids due to the different performance of rootstocks according to the strain and the environmental conditions (Rivard et al., 2012; Lopes et al., 2015; Kim et al., 2016; Lopes & Mendonça, 2016).

The resistance of the available rootstocks is not considered an immune response because it is only able to retard the pathogen development in xylem vessels (Grimault et al.,1994; Lopes et al., 2015; Caldwell et al., 2017), as for instance the genotype Hawaii 7996, which difficult the bacterial colonization in the vascular cylinder (Caldwell et al., 2017). Thus, this study aimed to assess the specificity reaction of 14 tomato rootstocks to bacterial wilt, caused by different sequevars of R. solanacearum and R. pseudosolanacearum, representative of the local variability, in the environmental conditions of the Mata mesoregion of Pernambuco state and to provide to the tomato producers a background about the rootstocks that may be used in this region.

**MATERIAL AND METHODS**

**Ralstonia spp. strains and pathogenicity test**

The strains used in this work were obtained from the Rosa Mariano Culture Collection of the Laboratory of Phytopathology (LAFIBAC) of Universidade Federal Rural de Pernambuco (UFRPE). Two R. solanacearum (RS) and two R. pseudosolanacearum (RP) strains were used, of different sequevars (Table 1). These strains were obtained from tomato plants at production regions in previous studies (Albuquerque et al., 2021).

The four strains of Ralstonia were grown in triphenyl tetrazolium chloride medium incubated at 30°C for 48 h, for selection of virulent colonies (Kelman, 1954). The preparation of bacterial suspensions was carried out in sterile distilled water (SDW), adjusting the concentration to 10^6 CFU mL^{-1} with the aid of a photocolorimeter (Analyzer®).

The pathogenicity of the strains was evaluated in tomato seedlings cultivar IPA 6, grown in styrofoam trays with 200 cells. The seedlings were transplanted individually after 15 days into 500 mL plastic pots containing soil and commercial substrate (Basaplant®), in proportion to 3:1. After 30 days of sowing, the plants were inoculated with the deposition of 15 mL of the bacterial suspension (1.5 x 10^6 CFU mL^{-1}) on the substrate, where semicircle root injuries were performed. For comparative purposes, plants treated only with SDW were used as absolute control.

The plants were evaluated at 25 days after inoculation to determine the disease severity, when the wilt symptoms stabilized in the plants, according to Lopes et al. (2015). The evaluation was carried out with the aid of the scale descriptive of grades of Nielsen & Haynes (1960), ranging from 0 to 5, in which grade 0 was attributed to plants without symptoms, 1 to plants with a wilted leaf, 2 to plants with 1/3 of wilted leaves, 3 to plants with 2/3 of wilted leaves, 4 to wilted plants, and 5 to dead plants. The values obtained were transformed into disease index (DI), on what DI = [Σ (disease grade x grade frequency) / (total number of plants x maximum disease grade)] x 100 (McKinney, 1923). The experimental design used was completely randomized, with four replications composed of four plants each. The obtained data were checked according to ANOVA assumptions and the means compared by the LSD test (P <0.05) with the aid of the program AgroEstat v.1.1.0.712 (Barbosa & Maldonado Júnior, 2015).

**Tomato rootstocks reaction to bacterial wilt in greenhouse**

The reaction of the 14 rootstocks was evaluated in relation to bacterial wilt (Table 2). For comparative purposes, the genotypes Hawaii 7996 and L390 were used as universal standards of resistance and susceptibility, respectively (Wang et al., 1998). The reaction of all 14 tomato genotypes was evaluated individually for each Ralstonia strain (Table 1), in four different experiments carried out from November to December 2017 (30°C±2; RH 57%) and repeated from March to April 2018 (34°C±2; RH 65%). The steps of planting, inoculation and evaluation were realized according to the previously described. These experiments were set up in a completely randomized design, using four replications composed of four plants each.

The incidence (INC) was calculated by the percentage of plants with disease symptoms in relation to the total number of plants, and the wilt severity, evaluated as previously described. Asymptomatic plants were analysed for latent infection caused by R. pseudosolanacearum and R. solanacearum, following the plate methodology proposed by Lebeau et al. (2011). The plates were incubated at 30°C for 96 h, then the absence or presence of virulent typical colonies of Ralstonia spp. were observed (Kelman, 1954). The data obtained from the isolation of asymptomatic plants were used to calculate the colonization index (CI), on what CI = percentage of
wilted plants + (percentage of plants without symptoms × percentage of plants without symptoms but with latent infection) (Grimault et al., 1994; Prior et al., 1996).

Considering that no significant (P<0.05) differences were observed regarding variance of the two experiments, the data were evaluated as replicates in time. The assumptions of the analysis of variance (ANOVA) were verified by the Shapiro-Wilk and Levene’s tests using the software Statistix 9 (v. 9.0, Tallahassee, Florida, USA). The means of the variables were analysed by the Scott-Knott test (P<0.05), with the aid of the program AgroEstat v.1.1.0.712 (Barbosa & Maldonado Júnior, 2015).

Tomato rootstocks reaction to bacterial wilt in an area with history of disease occurrence

Based on the results with artificial inoculations in the greenhouse, the rootstocks ‘Guardião’, ‘Woodstock’, ‘Yoshimatsu’, ‘Tropithai’, ‘TD1’, and ‘Green Rise’ were selected and grafted with the hybrid genotype cv. Tomini F1 and tested in a tomato with the hybrid genotype cv. Tomini ‘Green Rise’ were selected and grafted ‘Yoshimatsu’, ‘Tropithai’, ‘TD1’, and ‘Green Rise’ were selected and grafted in the greenhouse, the disease occurrence of bacterial wilt in an area with history was studied. The inoculum dispersion has been spread by irrigation water. For comparative purposes, we used the genotypes Hawaii 7996 and L390 as a standard of resistance and a universal standard of resistance (Table 3). In turn, for the variables INC and CI, only the ‘Guardião’ (68.75 and 69.37%) did not differ from ‘Hawaii 7996’ (65.62 and 66.62%). In the experiments carried out with the strain CRMRS183, for DI, INC, and CI, only ‘Guardião’ (39.37, 56.25, and 57.15%) and ‘Muralha’ (51.87, 65.62, and 65.99%) did not differ from ‘Hawaii 7996’ (31.87, 43.75, and 45.00%) and were considered resistant.

Regarding R. pseudosolanacearum and the strain CRMRS126, in the variable DI, the rootstocks ‘Guardião’ (20.62%), ‘BSPE0039’ (46.87%), ‘Woodstock’ (54.37%) and ‘Green Barrier’ (58.75%) did not differ from ‘Hawaii 7996’ (37.5%) (Table 4). However, considering the INC and CI, ‘Guardião’ (25.00 and 25.62%) displayed the least disease when compared to the other genotypes, significantly surpassing ‘Hawaii 7996’. In turn, when the strain CRMRS116 was inoculated, for the variable DI, the ‘Guardião’ (0.00%), ‘Woodstock’ (0.00%), and ‘Muralha’ (0.00%) showed a higher level of resistance in relation to ‘Hawaii 7996’ (10.62%), but did not differ from each other. For the variables INC and CI, the genotypes ‘Guardião’ (0.00%; 0.56%), ‘Woodstock’ (0.00%; 0.31%), and ‘Muralha’ (0.00%; 0.53%)

### Table 1. Description of the strains of Ralstonia solanacearum (RS) and Ralstonia pseudosolanacearum (RP) used in this study for pathogenicity. Recife, UFRPE, 2017.

| Strain      | Species                | City                  | Sequencé | DI (%)² |
|------------|------------------------|-----------------------|----------|---------|
| CRMRS91    | R. solanacearum        | Camocim de São Félix | IIA-58   | 100.00  |
| CRMRS116   | R. pseudosolanacearum  | Gravatá               | I-18     | 98.70   |
| CRMRS126   | R. pseudosolanacearum  | Belém de São Francisco| I-17     | 98.70   |
| CRMRS183   | R. solanacearum        | Petrolina             | IIA-50   | 90.00   |
| CV (%)     | -                      | -                     | -        | 10.0    |

The values represent means of four replications. Means with same letter are not significantly different by LSD test (P<0.05). ¹Source: Albuquerque et al. (2021); ²DI = Disease index.
displayed the least disease, differing from ‘Hawaii 7996’ (25.00%; 25.01%) and the other genotypes. However, although such hybrids have shown symptoms, once some resistance level is observed, it is an indication that the rootstock can be promising, even in areas with soils infested by \textit{Ralstonia} spp. In this context, it is essential to carry out complementary field tests (McAvoy \textit{et al}., 2012; Rivard \textit{et al}., 2012).

The INC was considered high in the four experiments and when the rootstocks were tested with the strains of \textit{R. solanacearum}, a higher mean DI value was observed. The strains of the two species were also able to colonize the xylem of all evaluated genotypes, even in asymptomatic plants, as demonstrated by the CI. Strains of \textit{Ralstonia} spp.

### Table 2. Resistance of the tomato rootstocks to diseases. Recife, UFRPE, 2020.

| Rootstock       | Company       | Resistance¹ |
|-----------------|---------------|-------------|
| Guardião        | Takii Seed    | Rs, Vd, Fol (race 1, 2), For, ToMV, Ma, Mi, Mj |
| Muralha         | Takii Seed    | Rs, Vd, Fol (race 1, 2), For, ToMV, Ma, Mi, Mj |
| TD1             | Takii Seed    | Rs, Vd, Pl, Fol (race 1, 2, 3), For, ToMV, Ma, Mi, Mj |
| Green power     | Takii Seed    | Rs, Vd, Pl, Fol (race 1, 2, 3), For, ToMV, Ma, Mi, Mj |
| Green barrier   | Takii Seed    | Rs, Vd, Pl, Fol (race 1, 2, 3), For, ToMV, Ma, Mi, Mj |
| Green rise      | Takii Seed    | Rs, Vd, Pl, Fol (race 1, 2, 3), For, ToMV, Ma, Mi, Mj |
| Yoshimatsu      | Inpa          | Rs          |
| Woodstock       | Sakata Seed   | Rs, Vd (race 1), Fol (race 1, 2), For, ToMV, Mi (race 1, 2, 3, 4), Mj |
| Defensor F1     | Topseed       | Rs, Vd, Fol (race 2), For, ToMV, Mi |
| RZ01            | Rijk Zwaan    | NI          |
| RZ02            | Rijk Zwaan    | NI          |
| BSPE0039        | Blue seeds    | NI          |
| BSPE0041        | Blue seeds    | \textit{Ralstonia, Verticillium} (race 1), Fol (race 1, 2, 3), For, \textit{Phytophthora} root rot, \textit{Meloidogyne} |
| Tropithai F1    | East-West SeedNI |                   |

¹Informations obtained on the company’s websites. Rs = \textit{Ralstonia solanacearum}; Vd = \textit{Verticillium dahliae}; Pl = \textit{Pyrenochaeta lycopersici}; Fol = \textit{Fusarium oxysporum} f. sp. \textit{lycopersici}; For = \textit{Fusarium oxysporum} f. sp. \textit{radicis-lycopersici}; ToMV = \textit{Tomato mosaic virus}; Ma = \textit{Meloidogyne arenaria}; Mj = \textit{Meloidogyne javanica}; Mi = \textit{Meloidogyne incognita}; NI = No information obtained on the company website.

### Table 3. Reaction of tomato rootstocks to bacterial wilt caused by two sequevars of \textit{Ralstonia solanacearum}. Recife, UFRPE, 2017/2018.

| Genotype       | CRMRS91 (IIA-58) | CRMRS183 (IIA-50) |
|----------------|------------------|------------------|
|                | DI (%)¹          | INC (%)          | DI (%)          | INC (%)          | CI (%)          |
| BSPE0039       | 75.62 b²         | 87.50 a          | 87.50 a         | 81.87 b          | 84.37 a         |
| BSPE0041       | 66.87 c          | 87.50 a          | 87.50 a         | 75.00 b          | 84.37 a         |
| Defensor       | 100.00 a         | 100.00 a         | 100.00 a        | 100.00 a         | 100.00 a        |
| Green Barrier  | 71.87 b          | 90.62 a          | 90.62 a         | 74.37 b          | 90.62 a         |
| Green Power    | 61.87 c          | 84.37 a          | 84.37 a         | 65.62 b          | 93.75 a         |
| Green Rise     | 74.37 b          | 90.62 a          | 90.62 a         | 83.12 b          | 93.75 a         |
| Guardião       | 48.12 c          | 68.75 b          | 69.37 b         | 39.37 c          | 56.25 b         |
| Hawaii 7996    | 36.87 c          | 65.62 b          | 66.62 b         | 31.87 c          | 43.75 b         |
| L 390          | 100.00 a         | 100.00 a         | 100.00 a        | 100.00 a         | 100.00 a        |
| Muralha        | 58.12 c          | 84.37 a          | 84.37 a         | 51.87 c          | 65.62 b         |
| RZ01           | 73.75 b          | 93.75 a          | 93.75 a         | 81.25 b          | 96.87 a         |
| RZ02           | 79.37 b          | 87.50 a          | 87.50 a         | 88.75 a          | 93.75 a         |
| TD1            | 83.12 b          | 90.62 a          | 90.62 a         | 80.62 b          | 93.75 a         |
| Tropithai      | 100.00 a         | 100.00 a         | 100.00 a        | 100.00 a         | 100.00 a        |
| Woodstock      | 47.50 c          | 84.37 a          | 84.37 a         | 66.87 b          | 84.37 a         |
| Yoshimatsu     | 91.25 a          | 93.75 a          | 93.75 a         | 86.25 b          | 96.87 a         |
| CV (%)         | 30.00            | 21.00            | 20.00           | 29.00            | 22.00           |

Means of eight replications. Means with same letter are not significantly different by Scott-Knott test (P<0.05). ¹Epidemiological variables analysed. DI = disease index, INC = incidence of bacterial wilt, and CI = colonization index.
penetrate the host root systems through wounds and move to the root vessels, reach the xylem, and subsequently spread into the shoot (Digonnet et al., 2012). In the xylem, the colonization is critical to disease progress and strains of *R. solanacearum* defective in xylem colonization do not cause wilting in plants (Plener et al., 2010). On the other hand, the colonization of the root vascular cylinder is delayed in resistant ‘Hawaii 7996’ and although bacteria may enter the root vascular tissues, the colonization in the vessel is spatially restricted. These dynamics occur partly due to the ability of the resistant cultivar to restrict bacterial root colonization in space and time (Caldweel et al., 2017). This could explain why asymptomatic tomato plants used in this study showed vessels colonized. The presence of the bacterium in the vessels of resistant genotypes explain why grafted plants may show symptoms whenever conditions favor bacterial wilt, such as high temperatures and humidity.

The results obtained in the present study also showed that the level of resistance of the genotypes was specific for each strain, regardless of the species involved, in agreement with the results found in previous studies (Lebeau et al., 2011; Lopes et al., 2015; Kim et al., 2016).

The level of resistance of tomato rootstocks to bacterial wilt is highly related to environmental factors and the high genetic variability of *Ralstonia* species (Rivard et al., 2012; Santiago et al., 2017), especially in Brazil, which is considered an important center of genetic variability for those bacteria (Santiago

### Table 4. Reaction of tomato rootstocks to bacterial wilt caused by two sequevars of *Ralstonia pseudosolanacearum* strains. Recife, UFRPE, 2017/2018.

| Genotype       | CRMRS126 (I-17) | CRMRS116 (I-18) |
|----------------|-----------------|-----------------|
|                | DI (%)¹       | INC (%)         | CI (%)       | DI (%)       | INC (%)         | CI (%)       |
| BSPE0039       | 46.87 c        | 46.87 b         | 47.25 b      | 46.25 b      | 65.62 b         | 65.62 b      |
| BSPE0041       | 65.00 b        | 75.00 a         | 75.25 a      | 34.37 c      | 56.25 b         | 56.28 b      |
| Defensor       | 100.00 a       | 100.00 a        | 100.00 a     | 100.00 a     | 100.00 a        | 100.00 a     |
| Green Barrier  | 58.75 c        | 81.25 a         | 81.25 a      | 25.00 c      | 31.25 c         | 31.25 c      |
| Green Power    | 68.12 b        | 84.37 a         | 84.37 a      | 23.12 c      | 50.00 b         | 50.23 b      |
| Green Rise     | 61.87 b        | 71.87 a         | 72.24 a      | 82.5 a       | 90.62 a         | 90.62 a      |
| Guardião       | 20.62 c        | 25.00 c         | 25.62 c      | 0.00 d       | 0.00 d          | 0.56 d       |
| Hawaii 7996    | 37.50 c        | 53.12 b         | 53.50 b      | 10.62 d      | 25.00 c         | 25.01 c      |
| L 390          | 100.00 a       | 100.00 a        | 100.00 a     | 100.00 a     | 100.00 a        | 100.00 a     |
| Muralha        | 66.87 b        | 93.75 a         | 93.87 a      | 0.00 d       | 0.00 d          | 0.53 d       |
| RZ01           | 68.12 b        | 90.62 a         | 90.62 a      | 30.00 c      | 37.50 c         | 38.50 c      |
| RZ02           | 78.75 b        | 96.87 a         | 96.87 a      | 53.75 b      | 75.00 b         | 75.37 b      |
| TD1            | 75.00 b        | 90.62 a         | 90.62 a      | 93.75 a      | 96.87 a         | 96.87 a      |
| Tropithai      | 85.00 a        | 87.50 a         | 87.50 a      | 83.75 a      | 96.87 a         | 96.87 a      |
| Woodstock      | 54.37 c        | 78.12 a         | 78.25 a      | 0.00 d       | 0.00 d          | 0.31 d       |
| Yoshimatsu     | 81.87 a        | 87.50 a         | 87.50 a      | 40.00 b      | 62.50 b         | 62.50 b      |
| CV (%)         | 41.00          | 31.00           | 31.00        | 43.00        | 41.00           | 40.00        |

Means of eight replications. Means with same letter are not significantly different by Scott-Knott test (P<0.05). ¹Epidemiological variables analysed. DI = disease index, INC = incidence of bacterial wilt, and CI = colonization index.

### Table 5. Reaction of tomato rootstocks to bacterial wilt caused by *Ralstonia* spp. in an area with history of bacterial wilt occurrence. Chã Grande, UFRPE, 2019.

| Genotype       | AUDPC¹ | DI (%)       | INC (%)       |
|----------------|--------|--------------|--------------|
| Green Rise     | 7.22 bc2 | 6.25 b      | 6.25 bc      |
| Guardião       | 0.00 c            | 0.00 b           | 0.00 c               |
| Hawaii 7996    | 14.45 bc        | 12.50 b      | 12.50 bc      |
| L390           | 89.50 a         | 56.25 a      | 56.25 a       |
| Pé Franco (Tomini F1) | 105.90 a | 68.75 a      | 68.75 a       |
| TD1            | 8.10 bc         | 5.00 b       | 6.25 b        |
| Tropithai      | 19.02 b         | 16.25 b      | 18.75 b       |
| Woodstock      | 0.00 c          | 0.00 b       | 0.00 c        |
| Yoshimatsu     | 0.00 c          | 0.00 b       | 0.00 c        |
| CV (%)         | 49.38           | 62.43        | 61.53         |

¹AUDPC = area under the disease progress curve, DI = disease index, and INC = incidence of bacterial wilt. ²Means of four blocks. Means with same letter are not significantly different by LSD test (P<0.05). AUDPC data transformed into $\sqrt{x+0.5}$.
The combinations of rootstock and graft must be tested according to the climatic conditions and isolated from each region, but the high genetic variability found in populations of the pathogen has hampered the use of resistance sources, since the stability of resistance to bacterial wilt in Solanaceae is highly affected by the variability of the pathogen and by factors linked to the environment (Rivard et al., 2012; Ahmed et al., 2013; Albuquerque et al., 2017). Therefore, based on the different responses presented in the experiments carried out with strains of \textit{R. solanacearum} and \textit{R. pseudosolanacearum}, two rootstocks that showed the highest levels of resistance (‘Guardião’ and ‘Woodstock’) and four rootstocks that showed lower levels of resistance (‘Green Rise’, ‘TD1’, ‘Tropitahi’, and ‘Yoshimatsu’) were selected to evaluate the reaction to bacterial wilt in an area with a history of the disease in the Pernambuco state, tropical zone.

**Tomato rootstocks reaction to bacterial wilt in an area with history of disease occurrence**

The plants of cultivar Tomini F1 grafted into the genotypes ‘Green Rise’, ‘Hawaii 7996’, ‘Guardião’, ‘TD1’, ‘Tropitahi’, ‘Woodstock’, and ‘Yoshimatsu’, used as rootstocks to protect against bacterial wilt differed significantly, in all studied variables, from ‘L390’, the susceptible control, and from non-grafted plants of tomato cv. Tomini F1 (Table 5). There were no symptoms of bacterial wilt observed when plants of tomato cv. Tomini F1 were grafted into ‘Guardião’, ‘Woodstock’, and ‘Yoshimatsu’, which did not differ from those grafted onto ‘Hawaii 7996’, that showed AUDPC, DI, and INC values of 14.45, 12.50%, and 12.50%, respectively. Tomato plants showing symptoms of bacterial wilt randomly selected showed bacterial exudation from the stem in the presence of water. These results are important for disease control, but it may not be compared with experiments carried out in greenhouse because although the presence of different sequevars of RP and RS is known in Châ Grande (Garica et al., 2013, 2014), the identification of the strains causing bacterial wilt was not performed in this experiment. Also, the main objective of this experiment was to analyse the behaviour of the genotypes with the natural inoculum and environmental conditions where the tomato is produced in this mesoregion.

Interestingly, the genotype Yoshimatsu, regarding as susceptible in greenhouse experiments, showed a high resistance in the field experiment. Similarly, in experiments carried out in different regions of the United States, rootstocks grafted with commercial cultivars showed symptoms in greenhouses but were able to produce economically in field tests carried out in areas with soils naturally infested with \textit{Ralstonia} spp. (McAvoy et al., 2012; Rivard et al., 2012). Therefore, the presence of symptoms should not be a determining factor in the selection of rootstocks tolerance, because inoculum doses might be different in the two environments. Thus, it is necessary to carry out complementary field tests to evaluate the productive capacity of the grafted hybrids (McAvoy et al., 2012; Rivard et al., 2012).

‘Guardião’ and ‘Muralha’ were found to be resistant in greenhouse experiments, while ‘Guardião’ was also resistant in an area with historical of the disease, showing potential for use as rootstocks for control of the disease. Therefore, this technique associated with other control measures could contribute to the integrated management of bacterial wilt of Solanaceae in fields with history of the disease, and should not be used isolated, especially when conditions are favourable to the development of bacterial wilt (Marouelli et al., 2005; Lopes et al., 2015).

Based on the data obtained, it is concluded that the resistance of rootstocks to bacterial wilt varied according to the strains and the experimental conditions performed, as already described in other studies (Ahmed et al., 2013; Albuquerque, et al., 2021; Santiago et al., 2017). In addition, these results reinforce the importance to evaluate combinations of rootstock and grafting according to the climatic conditions and isolate from each region. In turn, ‘Muralha’ and ‘Guardião’ genotypes showed a more stable level of resistance and they could be used as rootstocks in the management of bacterial wilt and as sources of resistance in plant breeding programs.

**ACKNOWLEDGEMENTS**

We thank the Brazilian National Council for Scientific and Technological Development (Conselho Nacional de Desenvolvimento Científico e Tecnológico - CNPq), for the financial support to Géssyka Rodrigues de Albuquerque.

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