INHERITANCE OF PAPAYA RINGSPOT VIRUS-W STRAIN (WATERMELON MOSAIC VIRUS-1) RESISTANCE IN THE INTERSPECIFIC HYBRID BETWEEN *Cucurbita ecuadorensis* x *C. maxima*

Seikoh Tasaki* and André Nepomuceno Dusi**

**ABSTRACT**

Resistance of interspecific hybrids between *C. ecuadorensis* and *C. maxima* cv. Kurokawa Delicious against the papaya ringspot virus was tested by greenhouse planting with artificial inoculation of young seedlings. PRSV-w resistance in *C. ecuadorensis* was considered to be controlled by a single dominant gene.

**Introduction**

Papaya ringspot virus-w disease which was previously called Watermelon Mosaic Virus-1 (WMV-1) disease is one of the most important diseases of commercial Cucurbitaceous crops cultivated in Brazil (Avila, 1982). The occurrence of this disease in Brazil was first reported in 1972 in the region of Belem in Para State (Albuquerque, 1972) which located in the northeastern part of Brazil, followed by São Paulo, Piauí and Rio Grande do Norte States in 1982, (Cost, 1972 ; Lima, 1980) and in the region of Rio São Francisco Valley in 1982 (Chioudhoury, 1982). It is considered that the use of resistant varieties is the most appropriate measure to control the disease.

Maluf *et al.* (1986) tested the resistance against the disease of thirty lines/varieties which belong to four kinds of species, and found that *C. ecuadorensis* was highly resistant. Igarashi *et al.* (1986) also showed that *C. ecuadorensis* was most resistant against several viruses such as cucumber mosaic, watermelon mosaic and zucchini yellow mosaic viruses among twenty six materials belonging to eleven different Cucurbitaceous species. Meanwhile, Thomas suggested the possibility of interspecific crossing with *C. maxima* and the use of this hybrid as breeding material. This study was, therefore, initiated to analyse the mode of inheritance of resistance of *C. ecuadorensis* against PRSV-w in order to obtain breeding materials for resistance to the virus disease.

**Materials and methods**

1 Materials

The materials shown in Table 1 such as F₁, F₂, and BC₁P₂ which were developed from an interspecific cross between *C. ecuadorensis* as resistant parent (P₁), and *C. maxima* cv. Kurokawa Delicious as susceptible parent (P₂) were used in this study.

The first interspecific crossing was carried out in May 1988 under greenhouse conditions, and the seeds of the F₁ generation were sown in August 1988, but, did not germinate well (10% only) despite the use of mature seeds. However, seeds which easily germinated showed an extremely vigorous growth (twenty liter earthen pots in the greenhouse for

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and bore twenty seven fruits from two plants which were to be used as \( F_2 \) and \( BC_1P_2 \) materials. Therefore, the \( F_1 \) materials used in this experiment were propagated by cuttings in using a medium mixed with 50% of vermiculite and 50% of carbonized rice chaff.

### 2 Methods

#### 1) Experimental schedule

The varieties shown in Table 1 were sown in boxes filled up with a medium consisting of a mixture of carbonized rice chaff, subsoil and fully fermented compost at a rate of 1 : 2 : 1 on 4 April 1989 and, 5 days after, transplanted in 9 cm diameter plastic pots placed on a bench in the greenhouse. Therefore the whole experiment was carried out under greenhouse conditions with a temperature ranging between 32°C in the day time and 24°C during the night.

- Cutting propagation of \( F_1 \) scions (25/March, 1989)
- Sowing \( P_1, P_2, F_2 \) and \( BC_1P_2 \) (4/April)
- Transplanting all the materials to pots (9/April)
- 1st inoculation (11/April)
- 2nd inoculation (14/April)
- 3rd inoculation (18/April)
- Visual evaluation (10/May)
- ELISA test (13/May)

#### 2) Inoculum preparation

PRSV-\( v \) isolated at Anápolis in Goias State was mechanically inoculated to \( C. pepo \) cv. Caserta plants at the cotyledon leaf stage. The plants were grown under greenhouse conditions from 15 to 20 days after being used as an inoculum source.

#### 3) Method of inoculation

“Caserta” leaves showing severe mosaic symptoms were triturated at the rate of 1 : 10 (weight volume) in 0.02 M phosphate buffer, pH 7.0 with 0.1% of sodium sulfite. The plants were dusted with carborundum before inoculation. The tested materials were first

<table>
<thead>
<tr>
<th>Symptoms</th>
<th>Grade value</th>
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<tbody>
<tr>
<td>Mosaic</td>
<td>+ Severe systemic mosaic</td>
</tr>
<tr>
<td></td>
<td>− No symptoms</td>
</tr>
<tr>
<td>Chlorotic spots</td>
<td>+ Systemically spreading</td>
</tr>
<tr>
<td></td>
<td>± Few chlorotic spots scattered on the upper leaves inoculated</td>
</tr>
<tr>
<td></td>
<td>− No symptoms</td>
</tr>
</tbody>
</table>
inoculated to the first unfolded leaves and re-inoculated twice to the second and third leaves at four day intervals.

4) Evaluation

The symptoms of the tested plants were visually evaluated one month after the first inoculation. The plants that exhibited doubtful symptoms were tested by indirect ELISA for the presence of PRSV-w infection. The classification of symptoms and susceptibility index based on visual evaluation is shown on Table 2.

Results and discussion

The results of the inoculation test on the F₁, F₂, and BC₁P₂ of the interspecific hybrid between C. ecuadorensis and C. maxima are presented in Table 2. None of the plants of C. ecuadorensis used as resistant parent showed any symptoms and they grew well. On the contrary, C. maxima cv. Kurokawa Delicious used as susceptible parent showed severe systemic mosaic symptoms.

As shown in Table 2 in the case of the F₁ plants, most of the plants showed a sound growth, two inoculated plants showed faint chlorotic spots on the upper leaves and PRSV-w was not detected by ELISA.

Segregations of susceptible and resistant individuals in the F₂ and BC₁P₂ were 29 : 10 (for 3 : 1 50<P<70) and 18 : 16 (for 1 : 1 70<P<80) respectively, and agreed with the ratio expected from single dominant gene. Therefore, PRSV-w resistance derived from C. ecuadorensis was estimated to be controlled by a single dominant gene based on the segregation ratios in the F₁, F₂ and BC₁P₂ generations. C. ecuadorensis, which has been known to be a promising material for breeding for resistance to several major viruses such as cucumber mosaic (CMV), tomato ringspot (TRSV), papaya ringspot (PRSV) (Thomas and Robium 1986), was able to hybridize with the cultivar C. maxima which is hardly resistant to those viruses. Fertility as well as germinability of the F₂ and BC₁P₂ generations was similar to those of other C. maxima cultivars. Moreover distinct segregations of flesh colour and reduction of bitterness were observed in the F₂ and BC₁P₂ populations. Therefore, it is considered that it may be possible to utilize these interspecific progenies as breeding materials to develop C. maxima varieties resistant to virus diseases and/or use them as bridge materials to hybridize with other species like C. moschata in order to develop a variety like 'Tetsukabuto' in future.

<table>
<thead>
<tr>
<th>Symbols</th>
<th>Mosaic (+)</th>
<th>Chlorotic S (+)</th>
<th>No. of plants</th>
<th>Chi square value probability</th>
</tr>
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<tbody>
<tr>
<td>P₁</td>
<td>0</td>
<td>0</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>P₂</td>
<td>20</td>
<td>0</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>F₁</td>
<td>0</td>
<td>2</td>
<td>19</td>
<td></td>
</tr>
<tr>
<td>F₂</td>
<td>5</td>
<td>6</td>
<td>28</td>
<td>3 : 1 0.213 50&lt;P&lt;70</td>
</tr>
<tr>
<td>BC₁P₂</td>
<td>18</td>
<td>0</td>
<td>34</td>
<td>1 : 1 0.116 70&lt;P&lt;80</td>
</tr>
<tr>
<td>F₂</td>
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<td>0</td>
<td>39</td>
<td>3 : 1 0.281 50&lt;P&lt;70</td>
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<tr>
<td>BC₁P₂</td>
<td>19</td>
<td>15</td>
<td>34</td>
<td>1 : 1 0.470 50&lt;P&lt;70</td>
</tr>
</tbody>
</table>

Table 2 Reactions of progenies of interspecific hybrid crossed with C. ecuadorensis and C. maxima to inoculation of PRSV-w using carborundum rubbing method
References