INHERITANCE OF RESISTANCE TO WATERMELON MOSAIC VIRUS 2 (WMV-2) IN SUMMER SQUASH (Cucurbita pepo L.)

ABSTRACT

Interspecific cross was made between C. moschata L. Nigerian local cv. as a source to resistance of some virus diseases and C. pepo L. Eskandroni cv. which is highly susceptible to most virus diseases especially Watermelon mosaic 2 (WMV-2). Genetic materials in this work consists of four genotypes ;i.e., P1(C. pepo L. Eskandroni cv.) as a female parent, P2 (Cucurbita moschata L. Nigerian Local cv.) as a male parent,, F1 and F2 between them. The Interspecific hybrid plants showed intermediate morphological characters between parent leaves and flowers. The inoculated plants of C. pepo L. Eskandroni cv. with WMV-2 showed severe systemic symptoms while plants of C. moschata L. Nigerian local cv. and hybrids were symptomless. The inoculated plants of F2 segregates to 3 resistant :1 susceptible. The resistance to WMV-2 in C. moschata L. is controlled by a single dominant gene. The resistant plants to WMV-2 in F2 generation will be a great hope to combine genes responsible for viral diseases with superior commercial characters.

INTRODUCTION

Squash (C. pepo L.) is one of the most popular vegetable crops in Egypt. According to Ministry of Agriculture statistics 2002, the cultivated area of summer squash was 89,127 fedans that produced 672940 tons.

In the last few years, poor growth and yield quality of cucurbit crops have common complain from the growers in Ismailia and many other governorates in Egypt. This was probably due to the wide spread of virus diseases especially Watermelon mosaic (Abdel-salam et al.,1991). These plant viruses caused severe economic damage to cucurbit crops. In recent years Watermelon mosaic virus is relatively familiar with this virus. In Kafr El-Sheikh, many fields of cucurbits, especially squash, have been affected by Watermelon mosaic virus-2 (Metwally et al., 1994).

The cultivated species of cucurbits was highly susceptible to WMV 1 and 2 , while Cucurbita moschata Nigerian local cv. was highly resistant to the most important and common virus diseases of C. pepo L. (Brown et al.,2003). Therefore, C. moschata L. Nigerian local cv. has been used as a source of resistance to Watermelon mosaic virus-2. Traditional sexual hybridization technique was successful in producing hybrids between C. pepo L. and C. moschata L. (Brown et al., 2003). The present study aimed to transfer resistance to WMV-2 from C. moschata L. Nigerian local cv. to C. pepo L. Eskandroni cv.

MATERIALS AND METHODS

This work was carried out at the Experimental farm of Horticulture Department, Faculty of Agriculture, Kafr El-Sheikh, during 2004 and 2005 years. Ten seeds from C. moschata L. Nigerian local cv. (2n = 40) were planted on march 2004, one month later seeds of C. pepo L. Eskandroni cv.
were planted under the previous condition. At flowering time crosses were made between C. moschata L. Nigerian local cv. as a male parent and C. pepo L. Eskandani cv. as a female parent at morning (7 to 8 AM).

On July 2004, 20 seeds of hybrid (C. pepo L. Eskandani cv. x C. moschata L. Nigerian local cv.) were planted to produce F2 seeds. Therefore, the genetic materials in this work consists of 4 genotypes, i.e., P1 (C. pepo L. Eskandani cv.), P2 (C. moschata L. Nigerian local cv.), F1 and F2 between them.

Watermelon mosaic virus - 2 infection:

WMV-2 (previously isolated and identified in Agriculture Botany Department, faculty of Agriculture, Kafr El-Sheikh) was maintained in C. pepo L. Eskandani cv. which served as a source of WMV-2 virus infection. Twenty seeds from each P1, P2 and F1 (non segregating generation) and 150 seeds from F2 (segregating generation) were sown in seedling tray in March 2005. all seedlings from both parents, C. pepo L. Eskandani cv. and C. moschata L. Nigerian local cv. as well as F1 and F2 hybrid plants between them were inoculated with WMV-2 at cotyledon, first and second leaf stage to ensure infection of all inoculated plants. Inoculation was made by forefinger by rubbing the inoculum on carborundum-dusted leaves. After inoculation, the plants were washed with tap water, controlled against insect and kept to the flowering time.

At the flowering stage time infected and noninfected (healthy) plants in 
P1,F2,F1 and F2 were counted (Omar et al, 1979 and Metwally et al, 1994).

The chi-square test with Yates correction was applied for the analysis of enumeration data using an equation for calculation adjusted chi-square as follows:

\[
\chi^2 = \sum \frac{[(Ob - Ex) - 0.5]^2}{\sum x} \quad (\text{Little and Hills, 1972})
\]

Where:
Ob: is the observed value for each of two or more classes.
EX: is the corresponding value.

RESULTS AND DISCUSSION

1. morphological characters:

Figures 1,2 and 3 show that the morphological characters of the hybrid plants (leaves and flowers). It seems to have intermediate features between C. pepo L. Eskandani cv. and C. moschata L. Nigerian local cv. Therefore, the obtained plants were really Interspecific hybrids. Traditional sexual hybridization technique was successful in producing hybrid plants between C. pepo L. and C. moschata L. (Brown et al, 2003). Many investigators among them (El-Kewey,1996 and Metwally et al 1996) reported that most fruit characters, i.e., weight, diameter, shape index in C. pepo L. behaved as complete dominant characters, since the mean of the F1 did not differ from that of C. pepo L. therefore, C. pepo L. parent may have preponderance of dominant alleles for fruit characteristics. The species C. pepo L. which bears the cylinder fruits mostly has preponderance of the dominance genes.
Figure 1. Leaves of *C. pepo* L. Eskandrani cv. (left), *C. moschata* L. Nigerian local cv. (right) and interspecific hybrid plant (middle).

Figure 2. Male flowers of *C. pepo* L. Eskandrani cv. (left), *C. moschata* L. Nigerian local cv. (right) and interspecific hybrid plant (middle).

Figure 3. Female flowers of *C. pepo* L. Eskandrani cv. (left), *C. moschata* L. Nigerian local cv. (right) and interspecific hybrid plant (middle).
However, one pair of genes seems to control this character (Robison et al., 1976 and Hassan et al., 1984).

2. WMV-2 infection test:

Data in table (1) show that the twenty inoculated plants of C. pepo L. Eskandrani cv. showed severe systemic virus symptoms while inoculated plants of C. moschata Nigerian local cv. and Interspecific hybrids plants had no symptoms. For F\textsubscript{2} population (120 inoculated plants), 28 plants showed severe systemic virus symptoms while the other plants of F\textsubscript{2} population (92 plants) had no symptoms. These numbers fitted the theoretical expected ratio of 3:1, indicating that, the resistance to WMV-2 in C. moschata L. Nigerian local cv. is controlled by a single dominant gene. This result is in agreement with Brown et al. (2003) who report that C. moschata L. Nigerian local cv. has been used as a source of resistance to zucchini yellow mosaic virus (ZYMV), Watermelon mosaic virus (WMV), papaya ring spot virus W (PRSV-W) and cucumber mosaic virus (CMV) in breeding both C. moschata L. and C. pepo L. They also reported that monogenic dominant resistance to WMV-2.

Table 1: Inheritance of resistance to Watermelon mosaic virus-2 (WMV-2) in parents, F\textsubscript{1} and F\textsubscript{2} generations of the cross between C. pepo L. Eskandrani cv. (P\textsubscript{1}) and C. moschata L. Nigerian local cv. (P\textsubscript{2}).

<table>
<thead>
<tr>
<th>Genotypes</th>
<th>No. of plants</th>
<th>Expected ratio</th>
<th>$X^2$ Value</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Resistance</td>
<td>Susceptible</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. P\textsubscript{1}**</td>
<td>--</td>
<td>20</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>2. P\textsubscript{2}**</td>
<td>20</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>3. F\textsubscript{1}</td>
<td>20</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>4. F\textsubscript{2}</td>
<td>92</td>
<td>28</td>
<td>3:1</td>
<td>0.1</td>
</tr>
</tbody>
</table>

* Cucurbita Pepo L. (Eskandrani Cv.)
** Cucurbita moschata L. (Nigerian local Cv.)

Out of the present study the resistant plants to WMV-2 in F\textsubscript{2} generation will be a great hope to combine genes responsible for viral diseases with superior commercial characters by using backcross programme.

REFERENCES


وراثة صفقة المقاومة لفيروس موزيك البيطيخ - 2 في نباتات قرع الكوسة.

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أجرى التهجين النوعي بين الفرع العلوي (الصنف النبيجري) و المقاوم للعديد من الأضراس الفيروسية وأهمها موزيك البيطيخ - 2 وقرع الكوسة (الصنف الإسكندرى) لجميع الأضراس الفيروسية واستخدام النوع الأول كأب والنوع الثاني كأم. وبعد ذلك تم إنتاج الجيل الثاني من هذا الدهم النوعي و بذلك تكون المادهة الوراثية الموجودة لدينا هي الأب الأول المقاوم لمرض فيروس موزيك البيطيخ - 2 و هو الفرع العلوي (الصنف النبيجري) والأب الثاني محسس لداء المرض وهو قرع الكوسة (الصنف الإسكندرى) وكذلك الدهم النوعي بينهما وجميعهما تتم الأجيال غير الإنجذالية. 

كذلك تم إنتاج الجيل الثاني (ويو الحنة الإنجذالية الأول). وكانت نباتات الدهم انتاج ذات صفات مورفولوجيا ونوعية لكلا الأبوين من حيث الأوراق والأزهار. و يُليثع كل من الأبوين وكذلك الدهم الناتجة منها و نباتات الكومة الإسكندرى منزوعة أعراضًا جياسية نتيجة لإصابتها في حين أن كل من الفرع النبيجري والدهم نباتات بين وين الإسكندرى لم يظهر أي أعراض نتيجة للتثقيف الفيروس. وبالنسبة للنواتات الدهم نباتات الجيل الثاني ظهرت عليها أعراض سلبية 3: 1 كمعدل وهذا يدل على أن صفة المقاومة المولدة لمرض فيروس البيطيخ - 2 في الفرع العلوي (الصنف النبيجري) صفة سائدة وأنها صفة ضدية بصورة متتالية يتحكم فيها زوج واحد من الفرعيان الإنجذالية.

وفهم هذه الدراسة يمكن استخدام النباتات اللغز معاً فرع الفرع الثاني الحاملة لصفة المقاومة في برنامج تهجين رجعي مع الأدب التجاري (السكندرى) للحصول على صفة المقاومة للمرض مع الصفات التجارية.