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

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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. Eskandrani 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., P_1(*C. pepo* L. Eskandrani cv.) as a female parent, P_2 (*Cucurbita moschata* L. Nigerian Local cv.) as a male parent., F_1 and F_2 between them. The Interspecific hybrid plants showed intermediate morphological characters between parent leaves and flowers. The inoculated plants of *C. pepo* L. Eskandrani 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 F_2 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 F_2 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. Eskandrani 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. Eskandrani 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. Eskandrani cv. as a female parent at morning (7 to 8 AM).

On July 2004, 20 seeds of hybrid (*C. pepo* L. Eskandrani cv. x *C. moschata* L. Nigerian local cv.) were planted to produce F_2 seeds. Therefore, the genetic materials in this work consists of 4 genotypes, i.e., P_1 (*C. pepo* . Eskandrani cv.), P_2 (*C. moschata* L. Nigerian local cv.), F_1 and F_2 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. Eskandrani cv. which served as a source of WMV-2 virus infection. Twenty seeds from each P_1, P_2 and F_1(non segregating generation) and 150 seeds from F_2 (segregating generation) were sown in seedling tray in March 2005. all seedlings from both parents, *C. pepo* L. Eskandrani cv. and *C. moschata* L. Nigerian local cv. as well as F_1 and F_2 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 P_1,P_2 ,F_1 and F_2 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:

$$X^2 = \Sigma \frac{[(Ob - Ex) - 0.5]^2}{\Sigma x}$$ (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. Eskandrani 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 F_1 did not differ from that of *C. pepo* L. therefore, *C. pepo* L. parent may have preponderance of dominant allels for fruit characteristics. The species *C. pepo* L. which bears the cylinder fruits mostly has preponderance of the dominance genes.

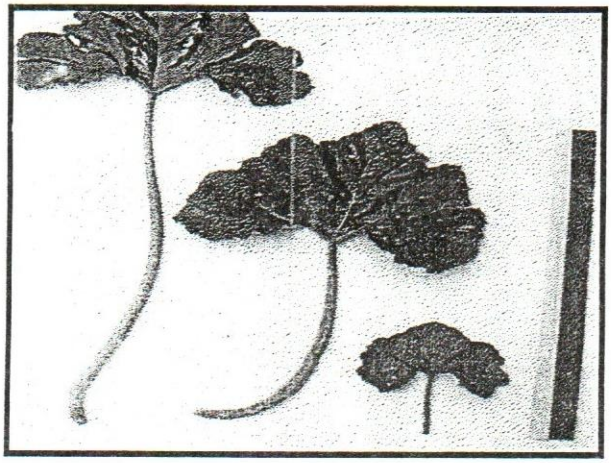

Figure 1. Leaves of *C. pepo* L. Eskandrani cv. (left), *C. moschata* L. Nigerian local cv. (right) and Interspecific hybrid plant (middle).

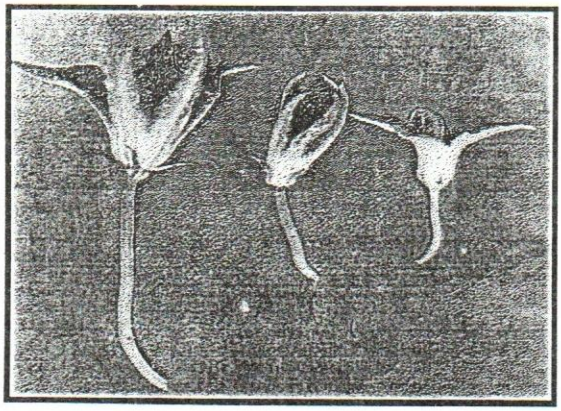

Figure 2. Male flowers of *C. pepo* L. Eskandrani cv. (left), *C. moschata* L. Nigerian local cv. (right) and Interspecific hybrid plant (middle).

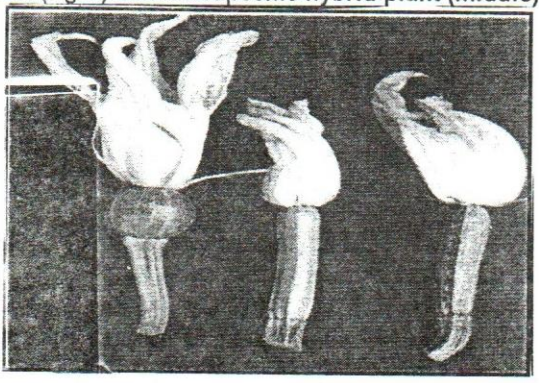

Figure 3. Female flowers of *C. pepo* L. Eskandrani cv. (left), *C. moschata* L. Nigerian local cv. (right) and Interspecific hybrid plant (middle).

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_2 population (120 inoculated plants), 28 plants showed severe systemic virus symptoms while the other plants of F_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_1 and F_2 generations of the cross between *C. pepo* L. Eskandrani cv. (P_1) and *C. moschata* L. Nigerian local cv. (P_2).

Genotypes	No. of plants		Expected ratio Resistant : Susceptible	X^2 Value	P
	Resistance	Susceptible			
1. P_1*	--	20			--
2. P_2**	20	--			--
3. F_1	20	--			--
4. F_2	92	28	3 : 1	0.1	0.50 , 0.10

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

Out of the present study the resistant plants to WMV-2 in F_2 generation will be a great hope to combine genes responsible for viral diseases with superior commercial characters by using backcross programme.

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وراثة صفة المقاومة لفيروس موزيك البطيخ -٢ فى نباتات قرع الكوسة .

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أجْرى التهجين النوعى بين القرع العسلى (الصنف النيجيرى) و المقاوم للعديد من الأمراض الفيروسية وأهمها موزيك البطيخ-٢ وقرع الكوسة (الصنف الإسكندرانى) الحساس لجميع الأمراض الفيروسية وإستخدم النوع الأول كأب والنوع الثانى كأم. وبعد ذلك تم إنتاج الجيل الثانى من هذا الهجين النوعى وبذلك تكون المادة الوراثية الموجودة لدينا هى الأب الأول المقاوم لمرض فيروس موزيك البطيخ-٢ وهو القرع العسلى (الصنف النيجيرى) والأب الثانى الحساس لهذا المرض وهو قرع الكوسة (الصنف الإسكندرانى) وكذلك الهجين النوعى بينهما و جميعها تسمى الأجيال غير الانعزالية.

- كذلك تم إنتاج الجيل الثانى (وهو الجيل الإنعزالى الأول). وكانت نباتات الهجين الناتج ذات صفات مورفولوجية وسطية لكلا الأبوين من حيث الأوراق والأزهار. وبتلقيح كل من الأبوين وكذلك الهجين الناتج منهما و نباتات الكوسة الإسكندرانى المنزرعة أعطت أعراضاً جهازية نتيجة للإصابة فى حين أن كل من القرع النيجيرى والهجين بينه وبين الإسكندرانى لم يُظهر اى أعراض نتيجة للتلقيح بالفيروس. وبالنسبة لنباتات الجيل الثانى ظهرت عليها الأعراض بنسبة ٣ سليم : ١ مصاب وهذا يدل على أن صفة المقاومة الموجودة لمرض فيروس البطيخ-٢ فى القرع العسلى (الصنف النيجيرى) صفة سائدة وأنها صفة مندلية بسيطة يتحكم فيها زوج واحد من العوامل الوراثية .
- ومن هذه الدراسة يمكن استخدام النباتات الغير مصابة فى الجيل الثانى الحاملة لصفة المقاومة فى برنامج تهجين رجعى مع الأب التجارى (إسكندرانى) للحصول على صفة المقاومة للمرض مع الصفات التجارية.