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Obtention of Eligible Genitors for Resistance to ZYMV in *Cucurbita pepo*

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Abstract

This study was carried out between 2008-2010 years, in Alata Horticultural Research Station. The hybrid summer squash variety Otto F_1 was used as donor for resistance source of ZYMV. The resistance of the variety was introduced by backcross method to our pure lines Alata6 and Alata50 to obtain eligible genitors for the breeders. For this purpose we realized the hybridizations and at the end we obtained BC_4 populations. Before establishment of each backcross populations we realized a selection for resistance by mechanical inoculation then plants were screened according to symptom scale classes.

Keywords: ZYMV, Resistance, Summer squash, *Cucurbita pepo*

Introduction

Cucurbita pepo L. belongs to *Cucurbitaceae* family in which there are approximately 115 genera. *Citrullus*, *Cucumis*, *Cucurbita* and *Lagenaria* are four major *cucurbitaceaous* genera. Pumpkins and squash, *Cucurbita* species, are economically important vegetable crops grown on arable land throughout the world. China, Ukraine, Argentina and Turkey are the leader squash and pumpkin producer countries where 45% of world production is realized (Pitrat et al.,1999). In most regions of the world four major viruses affect cucurbit production: Zucchini yellow mosaic virus (ZYMV), Watermelon mosaic virus (WMV), Papaya ringspot virus-W (PRSV-W) and Cucumber mosaic virus (CMV) (Zitter et al., 1996). The most serious threat to production of pumpkins and squash is ZYMV in many regions (Lisa and Lecoq, 1984; Desbiez and Lecoq, 1997). The virus is a highly virulent member of Potyviridae group and transmitted by aphids in non-persistent manner (Lisa et al., 1981; Desbiez and Lecoq, 1997). ZYMV was firstly described on summer squash (Lisa et al., 1981; Lecoq et al., 1981). The severity of this disease led to efforts to identify sources of resistance because of cultural controls show limited effectiveness. No sources of resistance to ZYMV have been found within the *C. pepo*. A wide range of genetic resources was tested including different species of the genus. Resistance to ZYMV has been found in several accessions of two cultivated species, *Cucurbita moschata* Duchesne, referred as "Nigerian Local", and *C. ficifolia* Bouché (Paris et al. 1988). Resistance to ZYMV in *C. moschata* is coferred by a single dominant gene, *Zym* (Munger and Provvidenti, 1987; Paris et al., 1988). Resistance genes in different accessions derived from *C. moschata* were designed as *Zym-0*, *Zym-1* and zym^{mos} (Paris and Brown, 2005). Despite ZYMV resistance is conferred by a single dominant gene, much difficulty has been encountered in

transfer of resistance to *C. pepo* due to barriers to interspecific crossing (Whitaker and Davis, 1962). Level of resistance can be lost during backcrossing, this being attributed to a change in the mode of inheritance through interspecific transfer. We have used a commercial *C. pepo* hybrid variety Otto F_1 to eliminate the barriers in interspecific crossing. In the study we aimed to transfer ZYMV resistance gene/s of Otto F_1 to our summer squash lines Alata6 and Alata50.

Materials and Method

This study was carried out between 2008 and 2010 years in Alata Horticultural Research Institute. Otto F_1 and our Alata6 and Alata50 summer squash lines were used in the experiment.

Otto F_1 has fruits that are cylindrical and light green. The variety is suitable for open field growing in main growing season and carries resistance to Watermelon Mosaic Virus (WMV) and moderately resistance to Zucchini Yellow Mosaic Virus (ZYMV). Our summer squash lines Alata6 and Alata50 are suitable for open field and plastic tunnels and greenhouses carrying light green and dark green colors of fruits respectively and recommended for early spring and spring growing seasons.

F_1, BC_1, BC_2 and BC_3 families were generated from the cross between Alata6 and Alata50 by Otto. Resistance tests were applied for every generation by mechanical inoculation using ZYMV-Ad (Gene bank Ac. N. JF 317296.1) isolate (Özer et. al., 2012).

Seeds were sown to the 1 l pods including soil and sand mixture (1:1 v:v). They were kept in green house condition to germination and emergence.

Virus isolate was mechanically inoculated to the cotyledons at the first true leaf stage of the plant by rubbing Carborundum-dusted with extracts from 1 g of infected plant material prepared in 0.02 M phosphate buffer and containing 0.1% 2-mercaptoethanol (pH:7.0) and added activated carbon. After inoculation cotyledons were washed using tap water. Plants were left to grow in greenhouse conditions.

Symptom evaluation was realized by Yilmaz et al. (1994) according to the following symptom scale; 0: No symptom, 1: very weak vein clearing, 2: very weak mosaic symptom on the leaf, 3: weak vein clearing with weak mosaic, 4: moderately mosaic and light yellowing, 5: mosaic symptoms on the leaves and shorten in plant height, 6: severe mosaic and mild deformations on the leaves with shorten in plant height, 7: severe mosaic, mottling, moderately deformation of leaves, 8: severe mosaic, filamentous appearance of leaves, moderately fruit deformations, 9: severe dwarfing of the plants, very severe mosaic and yellowing, severe fruit deformation, filamentous appearance of leaves.

After symptom evaluation the plants in 0, 1, 2 and 3 classes of symptom scale were used to generate the following generation.

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Results and Discussion

In the study we intended to introduce the ZYMV resistance source from Otto F_1 to our summer squash lines Alata6 and Alata50 by backcross method. For this purpose we obtained BC_1, BC_2 and BC_3 populations between 2008 and 2010 growing seasons. The overall results were summarized in Table 1, Table 2 and Fig. 1.

As we see in Table 1 the percentage of resistant plants increased in the successive backcross generations. While approximately 7.5% of the plants were found symptomless in BC1 generation, it was 11% and 14% in BC_2 and BC_3 generations, respectively.

As shown in Table 2 symptomless plant ratio in Alata50 cross was lower than that of Alata6 cross in BC_3 generation.

The overall results showed that Otto F_1 could be used as donor for ZYMV resistance in summer squash because of hybridization drawbacks with highly ZYMV resistant wild relatives. There is not highly resistance source to ZYMV in *C. pepo* lines. Interspecific hybridization leads inconveniences because of linkage drag. It is very difficult to eliminate undesired characters coming from interspecific hybridization.

Segregation of ZYMV resistance observed at different populations of Otto F1 cross indicates up to four genes responsible for resistance. The fourth gene seems to operate late after infection and provides extended resistance and durability of plant resistance Table 3.

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Table 1. Resistance tests of populations obtained from the cross Alata6 x Otto F1.

	Number of plants												
Population	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**Total**	**%Resistant**	**Ratio of resistance**
F1	5	3	2	3	6	6	1	1	0	0	**27**	%29,6	**3/10**
BC1	14	7	2	3	0	17	16	35	28	66	**188**	%11,0	**1/10**
BC2	6	10	0	2	0	2	1	1	4	30	**56**	%28,5	**3/10**
BC3	25	68	16	15	12	5	17	8	5	5	**176**	%52,0	**1/2**

Table 2. Resistance tests of line Alata50 x Otto F_1

	Plant Numbers												
Population	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**Total**	**%**	
F1	1	3	1	4	15	17	14	8	1	0	**64**	%6,0	**1/16**
BC1	47	17	2	4	10	121	178	168	85	161	**793**	%8,0	**1/12,4**
BC2	15	43	3	8	12	23	14	13	32	103	**266**	%21,8	**1/4,6**
BC3	39	134	38	36	20	25	23	14	4	8	**341**	%51,0	**1/2**

Table 3. Otto segregation

	Plant Numbers												
Scale	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**Total**	**%**	
First observation data at May 10, 2007	5	12	9	6	2	8	-	-	-	-	42	%40,4	1/2,5
Sekond observation data at May 15, 2007	-	2	5	6	12	10	1	2	-	-	38	%5,3	1/19

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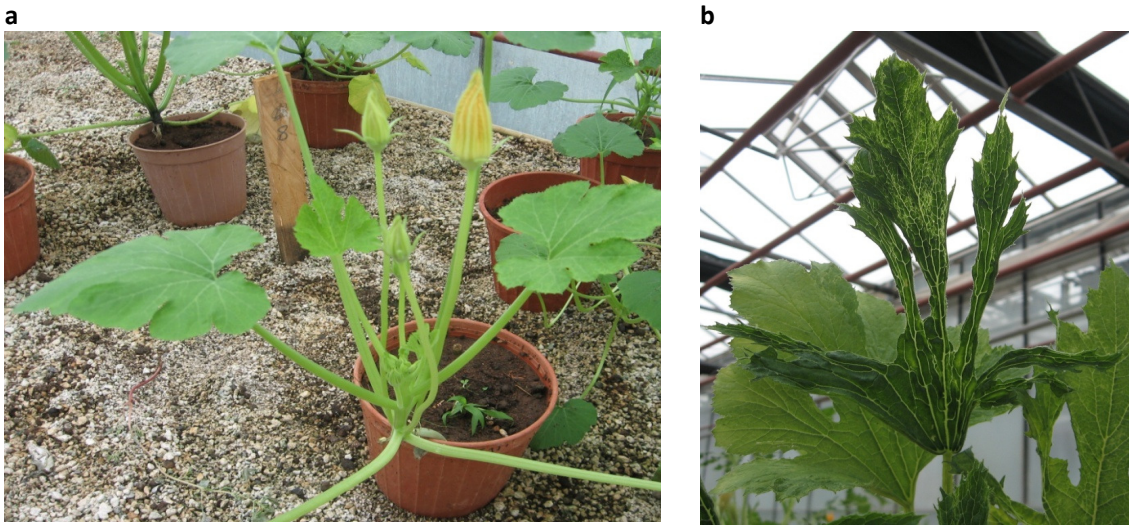


Fig.1 Young plant of squash showing resistant (a) and sensitive (b) symtom