

## Maize Resistance to *Sugarcane Mosaic Virus*

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### Abstract

Under greenhouse conditions 12 maize hybrids derived from crosses of four resistant lines with several lines of different level of susceptibility were evaluated for resistance to Czech isolate of *Sugarcane mosaic virus* (SCMV). These hybrids were not fully resistant to isolate of SCMV, but the symptoms on their newly growing leaves usually developed 1 to 3 weeks later in comparison with particular susceptible line, the course of infection was significantly slower and rate of infection lower. As for mechanisms of resistance, the presence of SCMV was detected by ELISA in inoculated leaves both of resistant and susceptible lines, but virus was detected 7 days later in resistant line. Systemic infection developed only in susceptible lines. These results indicate restriction of viral long distance movement in the resistant line.

**Keywords:** *Sugarcane mosaic virus*; *Zea mays* L.; resistance; mechanisms

### INTRODUCTION

*Sugarcane mosaic virus* (SCMV) is a widespread pathogen of maize (*Zea mays* L.) in the Czech Republic. This virus occurred in 98.7% of isolates of the genus *Potyvirus* obtained from different localities throughout 3-year observations. A close relative, *Maize dwarf mosaic virus* (MDMV) was only identified in 1.3% of isolates (POKORNÝ & PORUBOVÁ 2000). In greenhouse tests 65 maize lines of different origin were evaluated for resistance and by their response to inoculation with one SCMV isolate they were divided into 6 resistance groups. The most susceptible lines developed symptoms on most plants as early as 8 days after inoculation. Resistant lines were those which remained symptomless even 35 days after inoculation (POKORNÝ & PORUBOVÁ 2001). Resistance to virus pathogens may be inherited in a different way and therefore the understanding of the genetic basis of this character may be of great importance to further breeding.

The genetics of resistance to virus pathogens of maize from the genus *Potyvirus* was studied predominantly in MDMV. In contrast to extensive results of

research into MDMV, the genetics of resistance to SCMV was only investigated in several studies (e.g. KOVÁCS *et al.* 1984; MELCHINGER *et al.* 1998; LÜBERSTEDT *et al.* 1999).

The aim of the work was to detect resistance of maize hybrids derived from lines with different level of resistance to the Czech isolate of SCMV and possible mechanisms of this resistance.

### MATERIAL AND METHODS

Four lines with determined resistance to SCMV were possibly crossed (identical time of anthesis) with eight lines showing a different level of susceptibility to this virus. The result was that 12 hybrids were developed and their resistance to SCMV was evaluated under greenhouse conditions. Twenty to twenty-four plants of each hybrid at the stage of 3–4 leaves were mechanically inoculated with an isolate of SCMV 190Tr. Simultaneously the same technique was used to inoculate 10–12 plants of paternal and maternal lines of each hybrid. The experiment was repeated three times. The symptoms of infection on newly developing leaves of individual materials were evaluated at one-

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week intervals 8–63 days after inoculation (DAI) when most of the hybrids were in the stage of anthesis. To determine the mechanisms of resistance three lines were involved. They were TR65 (highly susceptible), TR51 (susceptible) and TR42 (resistant). In two replications five plants of these lines at the stage of 3–4 leaves or 5–6 leaves were inoculated with an isolate of SCMV Tr190. Inoculated were always the youngest leaves. The presence of the virus in the inoculated and newly developing leaves was determined by ELISA (CLARK & ADAMS 1977) 4, 11, 18 and 28 DAI.

## RESULTS AND DISCUSSION

**Resistance of maize hybrids to SCMV.** Tables 1 and 2 give results of the tests of resistance of paternal (resistant) and maternal (susceptible) lines and their hybrids to the Czech isolate SCMV. It is evident that in the susceptible lines the development of infection was different. The resistant lines existed symptomlessly until 35 DAI, which corresponds with the previous observations (POKORNÝ & PORUBOVÁ 2001). After this date some plants showed the symptoms but the infection never exceeded 20%. There was no hybrid without any symptoms to infection with SCMV. The symptoms developed on hybrids 1 to 3 weeks later

compared with the susceptible line. In most cases the start of infection was very slow and the percentage of infection never reached 100%. These traits were dependent on both susceptible and resistant parents. For example, in the TR65 × TR61 hybrid the development of infection was relatively fast, in the TR65 × TR59 hybrid the development of infection was much slower. The present results suggest that the resistance to the Czech isolate of SCMV is not inherited completely dominantly. The similar control of maize resistance to SCMV is described by KOVÁCS *et al.* (1984).

**Mechanisms of resistance.** In all three lines the presence of SCMV was found in the inoculated leaves – in the susceptible lines 4 DAI, in the resistant line 11 DAI. In the newly developing leaves the virus was detected only in the two susceptible lines – in the highly susceptible line 4 DAI and in the susceptible line 18 DAI. In the resistant line the virus was not identified even 28 DAI. There were no marked differences between individual growth stages during which maize was inoculated. These results indicate restriction of viral long distance movement in the resistant lines. Similar mechanisms of resistance are described in other combinations of host plants with different species of viruses of the genus *Potyvirus* (REVERS *et al.* 1999).

Table 1. Reaction of maternal (susceptible) and paternal (resistant) maize lines to inoculation with SCMV

Line	% of infection (DAI)								
	8	15	22	28	35	42	49	56	63
<b>Susceptible</b>									
TR12	61.0	71.0	90.7	90.7	94.4	100.0	100.0	100.0	100.0
TR33	25.0	88.9	100.0	100.0	100.0	100.0	100.0	100.0	100.0
TR44	66.7	91.7	100.0	100.0	100.0	100.0	100.0	100.0	100.0
TR47	0.0	68.4	73.9	88.9	100.0	100.0	100.0	100.0	100.0
TR50	0.0	42.4	83.3	100.0	100.0	100.0	100.0	100.0	100.0
TR51	0.0	43.0	88.8	95.8	100.0	100.0	100.0	100.0	100.0
TR56	56.4	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
TR65	87.8	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
<b>Resistant</b>									
TR42	0.0	0.0	0.0	0.0	0.0	3.0	12.1	12.1	18.2
TR59	0.0	0.0	0.0	0.0	0.0	0.0	5.6	11.1	11.1
TR61	0.0	0.0	0.0	0.0	0.0	7.4	12.2	12.2	12.2
TR64	0.0	0.0	0.0	0.0	0.0	0.0	8.3	12.5	12.5

Table 2. Reaction of F<sub>1</sub> hybrids of susceptible and resistant maize lines to inoculation with SCMV

Hybrid	% of infection (DAI)								
	8	15	22	28	35	42	49	56	63
TR12 × TR42	0.0	5.6	12.5	27.8	32.9	48.9	51.5	71.5	71.5
TR47 × TR42	0.0	5.6	16.7	38.9	41.7	47.3	55.9	60.2	60.2
TR56 × TR42	0.0	0.0	2.8	9.7	22.0	26.4	38.9	54.2	54.2
TR33 × TR59	0.0	18.2	40.5	68.1	86.1	90.3	95.8	95.8	97.2
TR44 × TR59	0.0	0.0	0.0	2.8	7.1	12.6	21.1	25.2	25.2
TR65 × TR59	0.0	0.0	0.0	4.2	11.1	22.2	23.6	26.4	30.6
TR47 × TR61	0.0	20.2	59.5	77.6	84.5	84.5	85.9	89.7	92.7
TR50 × TR61	0.0	0.0	1.4	5.6	5.6	6.9	6.9	19.4	21.4
TR51 × TR61	0.0	0.0	0.0	4.2	8.3	11.1	14.2	17.0	21.3
TR65 × TR61	1.4	56.9	72.2	79.2	83.3	86.1	90.3	90.3	93.1
TR50 × TR64	0.0	0.0	3.5	8.4	13.9	18.6	20.4	23.2	24.7
TR51 × TR64	0.0	0.0	0.0	0.0	15.0	20.0	20.0	21.4	21.4

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