

## RESISTANCE OF GREEN PEAS TO LEGUME VIRUSES

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**Summary.** – A total of 16 green pea cultivars (*Pisum sativum* L.) were screened for resistance to bean yellow mosaic virus (BYMV), pea enation mosaic virus (PEMV), and alfalfa mosaic virus (AMV). Cvs. Avola, Midget, Wawerplus, Wawerex, Bunny and Banff were found immune to BYMV infection. Cvs. Marx and Pion exhibited a high level (above 95 %) of resistance to BYMV, but they were highly susceptible to PEMV and AMV. It is recommended to use BYMV-immune or highly BYMV-resistant cultivars for further breeding. There were no significant differences in AMV levels among the respective pea cultivars.

**Key words:** bean yellow mosaic virus; pea enation mosaic virus; alfalfa mosaic virus; green pea cultivars; resistance

### Introduction

A prerequisite for successful green pea breeding for resistance to legume viruses is good knowledge on susceptibility and resistance of current cultivars as well as choice of suitable resistance sources. In Czech and Slovak Republics BYMV, PEMV, and PSbMV represent the most serious risk to green pea crops followed by AMV, which is, however, less frequent. The current Czech and Slovakia assortment comprises four green pea cultivars that were found immune to BYMV. There are hardly any cultivars resistant to PEMV, PSbMV and AMV (Musil and Jurík, 1990).

Much effort has been made to find out suitable source of resistance to the aforementioned viruses (Hagedorn and Hampton, 1975; Blaszcak *et al.*, 1984; Hagedorn, 1985; Lewis and Mathews, 1985; Kherptal *et al.*, 1990; Schmidt *et al.*, 1990; Wang *et al.*, 1993).

The goal of our work was to test a set of cultivars of different origin for resistance to BYMV, PEMV and AMV isolates and reveal sources of resistance to be further employed in practical breeding. Some of preliminary results have been already reported (Jurík *et al.*, 1991).

### Materials and Methods

A set of 16 green pea cultivars were tested for resistance to BYMV, PEMV and AMV infestation. The cultivars originated

from Netherlands (Wawerex, Wawerplus, Bunny, Tiny, Scout, Solara, Wawertop, Tessa), United Kingdom (Marx, Progreta, Early Thirty days, Banff) and Germany (Avola, Midget, Pion).

The experiments were repeated three times with approximately 100 plants per one experiment using the following viruses: BYMV B (Jurík, 1981), PEMV HS (kindly supplied by Dr. M. Musil, Institute of Virology, Bratislava) and AMV T6 (Gallo, 1980). The plants were infected either by means of mechanical inoculation or by aphid-facilitated transmission of viruses. For aphid vector transmission five specimens of *Acyrtosiphon pisum* (Harris) were used per plants 6 to 7 days after sowing the seeds. A 15 mins acquisition feeding on infected source plants and 18 – 24 hrs inoculation were conducted for transmission of nonpersistent viruses (BYMV, AMV). In circulative (persistent) PEMV both acquisition and inoculation feeding lasted 24 hrs, afterwards the aphids were killed using the insecticide Pirimor. The experimental plants were grown in a glasshouse for 3 – 5 weeks and treated weekly with insecticidal and fungicidal sprays.

The infection symptoms as well as the number and percentage of diseased plants were recorded. The pea and bean cultivars Junák and Alfa served as indicator plants for re-inoculation with BYMV, PEMV and AMV. Besides that the absence of BYMV antigen in pea cultivars resistant to BYMV infection was proved by means of drop precipitation reaction on slides (Musil *et al.*, 1981). In the experiments with AMV virus levels in the infected pea plants of all the cultivars under consideration were compared. The presence of AMV and PEMV antigen in pea cultivars was assessed by means of ELISA (Clark and Adams, 1977).

Table 1. Resistance some green pea cultivars to BYMV infection

Cultivar	Resistance (%)	
	Mechanical transmission	Aphid transmission
Avola	100	100
Midget	100	100
Wawerex	100	100
Wawerplus	100	100
Bunny	100	100
Banff	100	100
Marx	97.8	98
Pion	94.4	96.3
Tiny	36.6	55.3
Progreeta	30.4	58.0
Scout	30.6	37.3
Solara	25.5	34.8
Wawertop	21.8	46.4
Bohdan	21.3	29.2
Early T.D.	13.7	31.0
Tessa	12.7	23.3
Moravan <sup>a</sup>	100	100
Junák <sup>b</sup>	0	10

a – resistance control

b – susceptible control

Table 2. Effect of virus transmission using *A. pisum* aphids and mechanical inoculation in determination of resistance of pea cultivars to AMV or PEMV infection

Cultivar	Resistance (%)			
	AMV		PEMV	
	Aphid transmission	Mechanical transmission	Aphid transmission	Mechanical transmission
Avola	95	0	0	53
Midget	91	0	0	0
Wawerex	92	0	0	3
Bunny	91	0	0	0
Banff	90	0	0	27
Marx	95	0	0	51
Pion	95	0	0	10
Tiny	90	0	0	29
Progreeta	94	0	0	37
Scout	95	0	0	5
Solara	95	0	0	2
Wawertop	91	0	0	29
Early T.D.	90	0	0	2
Tessa	85	0	0	15
Bohdan	88	0	0	0
Moravan <sup>a</sup>		0		0

a – susceptible control

## Results and Discussion

Our study on the resistance of 16 green pea cultivars to virus infection revealed differences in the case BYMV using both mechanical inoculation and aphid transmission (Table 1). Cvs. Avola, Midget, Wawerex, Wawerplus, Bunny and Banff showed 100% resistance to the BYMV isolate and they could be considered as non-susceptible (immune). The above mentioned cultivars exhibited symptoms of BYMV infection neither after mechanical inoculation nor aphid-facilitated transmission of the virus. None of the cultivars under study was resistant to PEMV transmitted by aphids (100% susceptibility) (Table 2). Similarly there were no resistant cultivars in the trials with mechanical AMV transmission. AMV infection caused stem browning, extinction of inoculated leaves and vegetative point rolling. Cvs. Pion and Marx showed no symptoms of the infection in spite of evident presence of the virus itself and its antigen (Table 2). There were no remarkable differences in the infectious AMV titer among 16 cultivars under study irrespective of the infection symptoms. In the test on beans, reached the final dilution point of  $10^{-3}$  to  $10^{-4}$  fourteen days after inoculation.

Table 3 gives the infection symptoms of the respective green pea cultivars following BYMV and PEMV inoculation. Most of the experimental cultivars showed the symptoms of mosaic (BYMV) or enation mosaic (PEMV) as a reaction to the infection except for cv. Solara carrying no signs of infection in spite of the obvious presence of the virus in reinoculated indicator pea plants.

Based on our results cvs. Avola, Midget, Wawerex, Wawerplus, Bunny and Banff can be considered immune to the BYMV isolate. Cvs. Marx and Pion were highly resistant showing more than 95 % resistance and cvs. Wawertop, Tessa, Scout, Progreeta and Bohdan were characterized by low and/or medium (10–50 %) resistance. There were some more BYMV resistant pea and bean cultivars in the world assortment (Schroeder and Providenti, 1964; Providenti and Schroeder, 1973; Schmidt *et al.*, 1990). BYMV resistance was also detected within the Czecho-Slovak assortment by Musil and Jurik (1990), and Kvičala (1975); the latter used BYMV strain named pea mosaic virus for the resistance testing. Aphids (*A. pisum*) were efficiently involved in the transmission of some viruses that could not be transmitted mechanically, e.g. broad bean leafroll virus (Spaar and Kleinhempel, 1985). Our findings are in a good agreement

**Table 3. Symptoms of virus infection on some pea cultivars resistant or susceptible to BYMV, PEMV and AMV**

Cultivar	Symptoms		
	BYMV	PEMV	AMV
Avola	0	EM	B, D
Midget	0	EM	B, D
Wawerex	0	EM	D
Wawerplus	0	EM	B
Bunny	0	EM	B, D
Banff	0	EM	N, D
Pion	M	EM	L
Scout	M	EM	B, D
Progreta	M	EM	B, D
Wawertop	M	EM	B, D
Early T.D.	M	EM	B, D
Tessa	M	EM	D
Bohdan	M	EM	D
Tiny	M	EM	D
Marx	M	EM	L
Solara	L	EM	D
Junák <sup>a</sup>	M	EM	B, D, N

a – susceptible control; M – mosaic; EM – enation mosaic; B – browning of stem; D – extinction of leaves; N – necrosis of leaves; L – latent infection; 0 – no symptoms

with the results of Musil and Jurík (1990) indicating that virus transmission by aphids is more effective in the determination of the PEMV resistance in pea cultivars in contrary to AMV which is better transmitted mechanically (Table 2). It seems promising to use BYMV-immune pea cultivars (Avola, Midget, Wawerex, Wawerplus, Bunny, Banff) or highly resistant ones (Marx, Pion) for further breeding, but it is also inevitable to seek for new sources of resistance to PEMV and other legume viruses.

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