

RESISTANCE AND SUSCEPTIBILITY OF SOLANACEOUS PLANTS TO VIRUSES

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ABSTRACT

Resistance and susceptibility of 21 accessions of 11 South-American tuber bearing wild *Solanum* species (*Solanum abacajense* P.I. 442700, 458403, *S. acroglossum* P.I. 498204, *S. alandiae* P.I. 243501, 498085, 498087, *S. astleyi* P.I. 545848, 545959, *S. iopetalum* P.I. 275181, *S. morelliforme* P.I. 545720, 545775, *S. moscopanum* P.I. 570629, 570630, 570632, 570633, *S. multiinterruptum* P.I. 498265, 498266, 498267, *S. orophilum* P.I. 590894, *S. piruae* P.I. 473501, *S. santolallae* P.I. 195168) were studied to Maradona isolate of PVY^{NTN}.

Out of the studied accessions *S. moscopanum* (P.I. 570630) showed extreme resistance to PVY^{NTN}. Therefore this accession could be used in the potato breeding program for resistance to PVY^{NTN}.

Key words: wild *Solanum* species, resistance, susceptibility, *Potato virus Y*

IZVLEČEK

ODPORNOST IN OBČUTLJIVOST RASTLIN IZ DRUŽINE RAZHUDNIKOV (SOLANACEAE) NA VIRUSE

Preučevali smo odpornost in občutljivost 21 akcesij 11 severno-ameriških divjih vrst iz roda *Solanum*, ki oblikujejo gomolje (*S. abacajense* P. I. 442700, 458403, *S. acroglossum* P. I. 498204, *S. alandiae* P. I. 243501, 498085, 498087, *S. astleyi* P. I. 545848, 545959, *S. iopetalum* P. I. 275181, *S. morelliforme* P. I. 545720, 545775, *S. moscopanum* P.I. 570629, 570630, 570632, 570633, *S. multiinterruptum* P.I. 498265, 498266, 498267, *S. orophilum* P.I. 590894, *S. piruae* P.I. 473501, *S. santolallae* P.I. 195168) na krompirjev virus Y (PVY^{NTN}). Sedem rastlin iz vsake akcesije smo mehanično okužili, v fazi 8 – 10 listov. Pri okuženih rastlinah smo spremljali pojav znamenj lokalnih in sistemskih okužb. Pet tednov po okužbi smo rastline testirali z direktno serološko metodo DAS-ELISA. Na rastlinah vrste *N. tabacum* 'Xanthi-nc' smo izvedli ponovno okužbo (reinfekcijo). Akcesije smo ocenili kot najbolj odporne (imune), če simptomi niso bili vidni, biotični testi neuspešni (negativni) in absorpcijske vrednosti okuženih vzorcev niso presegale dvakratne vrednosti neokužene kontrole. Glede na rezultate je na krompirjev virus Y (PVY^{NTN}) najodpornejša vrsta *S. moscopanum* (P. I. 570630) in se lahko uporablja kot vir odpornosti na PVY pri žlahtnjenju krompirja.

Ključne besede: divje vrste iz rodu *Solanum*, odpornost, dovzetnost, *Potato virus Y*

1 INTRODUCTION

Potato is the fourth most important crop on the world, because of its role supplying with food. World potato production stands at on estimated 295 million tonnes for the year 1999 (Askew 2001). Wild *Solanum* species occur in the pedigree of many potato cultivars. Genes from several wild species are introduced into potato cultivars. The yield loss caused by diseases and pests in potato is estimated at 22 % per year. Viruses have high priority not

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only in Europe but also in the whole world (Ross 1986, Beemster and de Bokx 1987, Jeffries 1998, Loebenstein *et al.*, 2001). The most effective protection against viruses is the breeding for resistance (Ross 1986, Brown and Corsini 2001, Solomon and Barker 2001b). In the mid 1980s, partly as a result of advances in plant transformation, it also became apparent that pathogen-derived resistance could be used against virus infection. Transgenic resistance to potato viruses has been the topic of many recent publications (Huisman *et al.*, 1992, Martin 1994, Berger and Gernan 2001, Solomon and Barker 2001a, 2001b).

The NTN strain of *Potato virus Y* (PVY^{NTN}) was first isolated in Hungary and is associated to potato tuber necrotic ringspot disease (PTNRD) characterised by superficial ring necrosis on potato tubers (Beczner *et al.*, 1984 Horváth 1998). PVY^{NTN} causing severe yield losses and degeneration of the potato cultivars. Due to the destructive and resistance breaking nature of potato tuber necrotic ringspot disease, the identification of sources of resistance is of great importance.

The objective of our work was to study the susceptibility or resistance of new wild *Solanum* species to PVY^{NTN} to identify potential resistance sources in the *Solanum* genus that could be used in the potato breeding program.

2 MATERIALS AND METHODS

Resistance and susceptibility of 21 accessions of 11 South-American tuber bearing wild *Solanum* species (*Solanum abacajense* P.I. 442700, 458403, *S. acroglossum* P.I. 498204, *S. alandiae* P.I. 243501, 498085, 498087, *S. astleyi* P.I. 545848, 545959, *S. iopetalum* P.I. 275181, *S. morelliforme* P.I. 545720, 545775, *S. moscopanum* P.I. 570629, 570630, 570632, 570633, *S. multiinterruptum* P.I. 498265, 498266, 498267, *S. orophilum* P.I. 590894, *S. piruae* P.I. 473501, *S. santolallae* P.I. 195168) were studied to original Maradona isolate of PVY^{NTN}. All seeds originated from Sturgeon Gene Bank (Bamberg *et al.*, 1996). Wild *Solanum* species, were grown from seeds in normal greenhouse conditions. Seven plants from each accession were mechanically inoculated at 8-10 leaves stages. Sørensen phosphate buffer (pH 7.2) in the ratio 1:1 was used for inoculation. Inoculated plants were symptomatologically checked for local and systemic symptoms. Five weeks after inoculation plants were tested using direct DAS-ELISA (double-antibody sandwich) serological method after Clark and Adams (1977) with anti-PVY immunoglobulins of Loewe Biochemica. Serological reactions were measured at 405 nm on Labsystem Multiscan RC spectrophotometer. Back inoculation was also made to *Nicotiana tabacum* 'Xanthi-nc' plants. Accessions were considered extreme resistant (immune), if the symptoms could not be seen, biological tests were unsuccessful and the absorbance values of the infected samples did not exceed twice that of the healthy control ones.

3 RESULTS AND CONCLUSIONS

Among different genotypes *S. moscopanum* (P.I. 570630) showed extreme resistance to PVY^{NTN}. Neither the inoculated nor the non-inoculated leaves showed symptoms and the virus could not be detected in them by serological and biological tests. This accession could be used in a potato breeding program for resistance to PVY^{NTN} (Table 1).

Other species and accessions showed systemic symptoms (mosaic, chlorotic lesions, leaf deformation, vein clearing, vein necrosis, necrotic lesions), due to PVY^{NTN} infection and the absorbance values exceeded twice that of the healthy control samples during the serological tests. There were no accessions showed local hypersensitivity to PVY^{NTN} (Table 1).

Gene centres are rich in viruses, which means a real threat in the exchange programmes of genetic materials. For example the tobacco vein necrosis strain of PVY originated from South America from *Solanum cardenasii* and *S. andigena* and caused the degradation of many potato varieties in Europe (Kahn and Monroe 1963). Recent survey of the PVY strains in Hungarian potato production demonstrated that the resistant-breaking NTN strain

is the most distributed one (Wolf and Horváth 2000). According to our previous study (Takács 2001) Hungarian PVY^{NTN} isolates still showed high nucleotide sequence homology to the original isolate (Thole *et al.*, 1993) in the coat protein gene and 3' non-translated region, but further related to other non necrotic strains. The abovementioned results suggest to use the new immune *Solanum* species and accessions in potato breeding programs to PVY^{NTN}.

Table 1: Tested accessions of wild *Solanum* species to PVY^{NTN}

<i>Solanum</i> species	Accessions	Symptoms*		Absorbance	Biotest**
		Local	Systemik		
<i>Solanum abacajense</i>	442700	Nl	Nl, Mo	3,455	+
<i>Solanum abacajense</i>	458403	Mo	Mo	3,756	+
<i>Solanum acroglossum</i>	498204	-	Mo	3,386	+
<i>Solanum alandiae</i>	243501	Nl	Nl	2,971	+
<i>Solanum alandiae</i>	498085	-	Mo	3,306	+
<i>Solanum alandiae</i>	498087	Nl, Mo	Nl, Mo, Vn	1,868	+
<i>Solanum astleyi</i>	545848	-	Mo	3,129	+
<i>Solanum astleyi</i>	545959	Nl, Mo	Nl, Mo	3,180	+
<i>Solanum iopetalum</i>	275181	-	-	1,656	+
<i>Solanum morelliforme</i>	545720	-	Ldef	1,053	+
<i>Solanum morelliforme</i>	545775	-	Mo, Vc, Bli	1,093	+
<i>Solanum moscopanum</i>	570629	-	-	1,333	+
<i>Solanum moscopanum</i>	570630	-	-	0,127	-
<i>Solanum moscopanum</i>	570632	-	Mo	0,526	+
<i>Solanum moscopanum</i>	570633	-	-	0,961	+
<i>Solanum multiinterruptum</i>	498265	-	Ldef, Mo	0,684	+
<i>Solanum multiinterruptum</i>	498266	-	Ldef, Mo	0,958	+
<i>Solanum multiinterruptum</i>	498267	-	Ldef, Mo	0,891	+
<i>Solanum orophilum</i>	590894	-	Ldef, Mo, Vc	0,667	+
<i>Solanum piurae</i>	473501	Chl	Mo, Chl, Ldef,	3,476	+
<i>Solanum santolallae</i>	195168	Chl	Mo	2,913	+
+ controll				4,000	
- controll				0,123	

*Mo: mosaic, Chl: chlorotic lesions, Ldef: leaf deformation, Vc: vein clearing, Vn: vein necrosis, Nl: necrotic lesions, (-): no symptoms

**(-): negative reaction, (+): positive reaction

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