Potato virus S (PVS): Puzzling Virus for Potato Breeders and Seed Producers

P. DĚDIČ[1], J. PTÁČEK[1], V. HORÁČKOVÁ[1], V. MATOUŠEK[2], N. ČEŘOVSKÁ[3] and M. FILIGAROVÁ[3]*

[1]Potato Research Institute, 580 01 Havlíčkův Brod, Czech Republic; [2]Institute of Plant Molecular Biology, Czech Academy of Sciences of the Czech Republic, 370 05 České Budějovice; [3]Institute of Experimental Botany, Czech Academy of Sciences of the Czech Republic, 160 00 Prague, Czech Republic

[*]E-mail: dedic @vubhb.cz

Abstract

In the framework of PVS eradication from breeding materials of Czech potato cultivars, the systematic research was devoted to: susceptibility of cultivars, occurrence of PVS in imported and domestic materials, and to maintenance of virus-free basic grades potatoes on breeding stations. In the field-exposure trials was proved high level of susceptibility of most cultivars to PVS and by contraries, gradualy increased proportion of maintained virus-free cultivars of foreign, as well as domestic origin. Nevertheless severe infestation still persist in some of them. The contemporary situation with maintenance of virus-free basic material in CR was demonstrated.

Keywords: *Potato virus S*; eradication; susceptibility

INTRODUCTION

Potato virus S (PVS) was first described in 1951 from the Netherlands and later proved to be widespread everywhere potatoes are grown (e.g. BEEMSTER & DE BOKX 1987). Till now PVS still belongs to the most frequently found virus in potato (DĚDIČ *et al*. 1998). Yield reduction is usually low, not exceeding 10–20%, but might be worse in combination vith other potato viruses. Reliable diagnosis is possible only by laboratory methods like ELISA or molecular techniques (MATOUŠEK *et al*. 1998; DĚDIČ *et al*. 1999; PTÁČEK *et al*. 1999).

PVS-free seed-potato material is currently developed by using heat- and chemotherapy of *in vitro* tissue cultures and subsequent combination of rapid multiplication techniques with limited-generation certification programs (HORÁČKOVÁ *et al*. 1998). Since PVS causes mild or no symptoms, often also the highest classes of seed potatoes in the field could be severely infested (DĚDIČ 1998).

MATERIAL AND METHODS

Our work was initially aimed at technological questions of micropropagation, on laboratory diagnosis (Indicator plants, DAS-ELISA, molecular hybridisation, RT-PCR) and therapy. In the new research project directed to the elimination of PVS from breeding materials following tasks were examined since1996.

Susceptibility of cultivars to PVS. Virus-free materials, 25 to 40 cultivars each year, were planted into field-exposure trials with natural sources of PVS infection and also 30 plantlets of each cultivar were mechanicaly inoculated in the greenhouse. Proportion of infected progeny tubers was detected and compared.

Occurrence of PVS in imported lots of basic-seed. Samples were checked by ELISA in post-harvest test

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and infestation of more than 70 cultivars/each year was evaluated.

Reinfection with PVS in pre-basic and basic materials in the course of maintenance breeding in CR. Virus-free nuclear stocks of several cultivars were obtained using thermo- and/or chemotherapy, micropropagated by a rapid stem multiplication technique and tubers of nuclear stock were produced in artificial isolators. Five to seven cultivars were multiplied for four years on four localities (breeding stations), starting with new virus-free nuclear stocks each year. The health state of selected cultivars was checked in detail in the field and post harvest test by ELISA.

RESULTS AND DISCUSSION

Susceptibility of cultivars to PVS. Proportion (%) of progeny tubers infected with PVS in the field-exposure trials are summarised in Table 1. Repeated results of field evaluation proved different level of susceptibility of cultivars to PVS. In total 14 genotypes showed mostly high degree of susceptibility to infection, on the contrary 20 cultivars were more resistant. High degree of resistance (based on hypersensitivity or extreme resistance) was noticed at two cultivars only. Mechanical inoculation method could be utilise for preliminary screening of resistance to PVS (results not presented).

Table 1. Proportion (%) of progeny tubers infected with PVS in the field-exposure trials

Cultivar	2000	1999	1998	1997	Cultivar	2000	1999	1998	1997
Adéla	14	12			Krista		14	85	77
Adora	7		92		Krumlov	16	15	29	14
Amylex	56	31	90	15	Krystala	8	7		
Apolena	16		43		Lukava				9
Arnika		6			Magda	3		0	
Asterix		72	93	99	Marabel	14	13		
Cinja	0	2			Oreb				48
Colette	6	3			Ornella	7	9	76	9
Dali		4	69		Pacov		12	87	19
Desirée			65		Quarta	30	12		
Filea	8	2			Rosara		30	80	77
Folva			56		Samantha	8	3	44	
Gloria			40		Satina		13		
Granola		5			Saturna		33		
Hr16/7				9	Secura		11		
Impala		14	94		Solara	63		57	
Javor	0		12		Tábor		5	33	0
Karin	35	16	38	53	Tara		1		10
Karmela		11	65	89	Tegal	0	1	12	4
Katka	31	17			Vaneda		0	0	2
K. rohlíčky		0	24	78	Ve59/30			8	
Kobra			95	50	Vera	11	12	39	26
Kora		8	0	26	Veronika	49	9	78	47
Kordoba	34	15	87		Vilma	19	8		44
Korela		16	60	62	Vy10/10			40	
Korneta	9	5			Zlata		6		9
Krasa	28	23	46	71	Average (%)	20	12	51	39
Kréta		2	42	66	Number of cvs.	25	40	34	26

Table 2. Occurrence of PVS in directly imported potato cultivars

Number of cultivars	1996–1998	1999	2000	2001
Total	125	95	86	74
PVS-free	81	70	64	54
Low infection	26	18	12	13
Severe infection	18	7	10	7

Table 3. Degree of PVS reinfection of pre-basic materials of two cultivars in the course of maintenance breeding (% of PVS in post-harvest samples)

Cultivar	After years	1998	1999	2000	2001	1998	1999	2000	2001
		Velhartice				Keřkov			
	1st	0	0	3	0	4		0	
Karin	2nd	7	1	4			2	4	9
	3rd			35	15			100	7–24
	1st	2	0	6	0	0	4	0	
Krasa	2nd	18	3	2			4	11	0
	3rd			2	11			16	10–20
		Pacov							
	1st	12		14		45	0	0	
Karin	2nd	7	46			100	100	9	11
	3rd			87	75			96	24
	1st	3	19	3		4	5	0	
Krasa	2nd		8	42		16	0	3	
	3rd							9	10

PVS in imported lots of basic-seed. Most foreign cultivars in the basic-grades are PVS-free, but severe infestation with PVS still persists in some of them (Table 2). There was evident improvement of health state of many cultivars, but not any clear correlation between resistance rating and maintenance of virus-free seed-potato materials.

The severe PVS infection was found in those foreign cultivars :

1996–1998: Bionta A, Calla G, Colette G, Ditta A, Eba G, Granola G, Helena G, Helios G, Jaqueline G, Marene G, Norika G, Pepo G, Rosara G, Satina G, Secura G, Serafina G, Sibu G, Stamm G

1999: Freya G, Jaqueline, LS 2590565 G, Rosara, Secura, Serafina, Stamm120909 A

2000: Asterix NL, Dura NL, Jaqueline, K3419 G, Norika, Rosara, Rosita G, Satina, Secura, Serafina

2001: Albatros G, Ivana A, K3419, Rosara, Serafina, Sonate G, Viola SK.

Reinfection with PVS in pre-basic and basic materials in the course of maintenance breeding in CR. Degree of PVS reinfection (percentage of PVS in post-harvest samples of two cultivars) in the course of maintenance breeding on four localities is shown in Table 3. In spite of strict adhering to good seed-potato maintenance system on breeding stations, the reinfection with PVS at some localities was considerably fast.

The main reason seems to be:

- high numbers of infection sources in the vicinity and/or directly in the fields
- severe infection pressure in some years
- low degree of resistance of most cultivars to PVS
- less effective direct protective provisions.

The PVS reinfection was mostly limited by consistent spatial separation of virus-free materials since the first years of field multiplication. Contribution of resitance degree of cultivars was less distinct (also results not presented here).

Table 4. Incidence of PVS in basic grades of domestic potato varieties in post-harvest tests since 1998

	1998	1999	2000	2001
Total	27/141	40/218	35/202	40/248
PVS-free	2/2	6/11	7/8	6/19
Low infection	16/31	28/78	24/94	29/152
Severe infection	23/108	26/129	17/100	13/77

numerator – number of varieties; denominator – number of samples

Official underrating and tolerance of this latent virus in the certification scheme of seed-potato in CR till now, also resulted in the finding of high occurrence of PVS in basic grades of Czech potato cultivars in the previous years. The increased proportion of PVS-freee and low-infested samples of domestic cultivars in the last few years is still far from satisfaction, but promising for the future (see Table 4).

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