Spectrum of resistance of potato cultivar Sárpo Mira against *Phytophthora infestans*

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Life & style › Plant of the week

Series: Plant of the week

Plant of the week: Potato 'Sarpo Mira'

At last – a spud that's very resistant to blight

Jane Perrone
The Guardian, Saturday 23 February 2013

Potato 'Sarpo Mira' is very resistant to the devastating fungal disease blight

What is it? If you've given up growing potatoes after repeated knockbacks from disease, don't despair. Hope comes in the form of the 'Sarpo Mira' spud, (pronounced "sharpo"), which is very resistant to the devastating fungal disease blight. Expect generous yields of red-skinned, floury tubers that are perfect for mash, chips and roasting.

SÁRVÁRI RESEARCH TRUST

Sárpo Mira

What is on the basis of Sárpo Mira's resistance?

Five genes:

- *R3a*
- *R3b*
- *R4*
- ***Rpi-Smira1* confer qualitative resistance**
- *Rpi-Smira2*, has only been detected under field conditions

(Rietman et al. 2012)

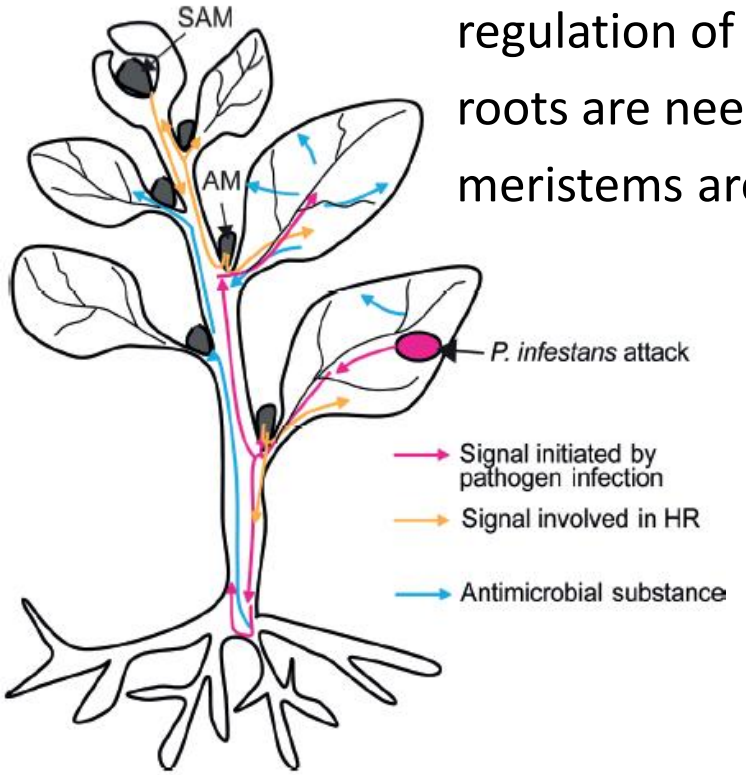
Defence against *P. infestans* Sárpo Mira as a model plant

- Plants integrity

regulation of *PR* genes in detached leaves /leaves of whole plants

roots are needed to achieve full pathogen resistance

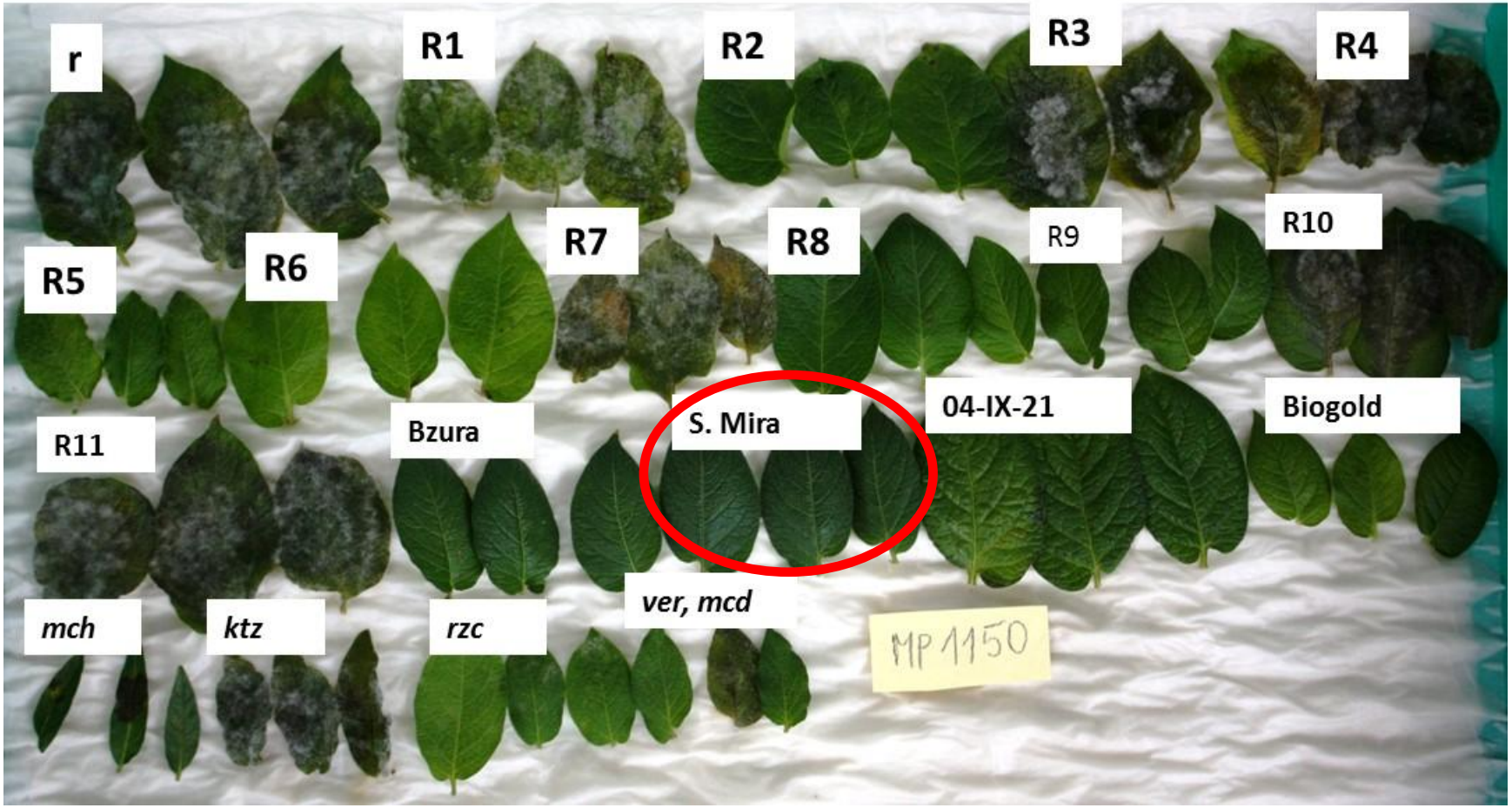
meristems are involved in formation of HR lesions



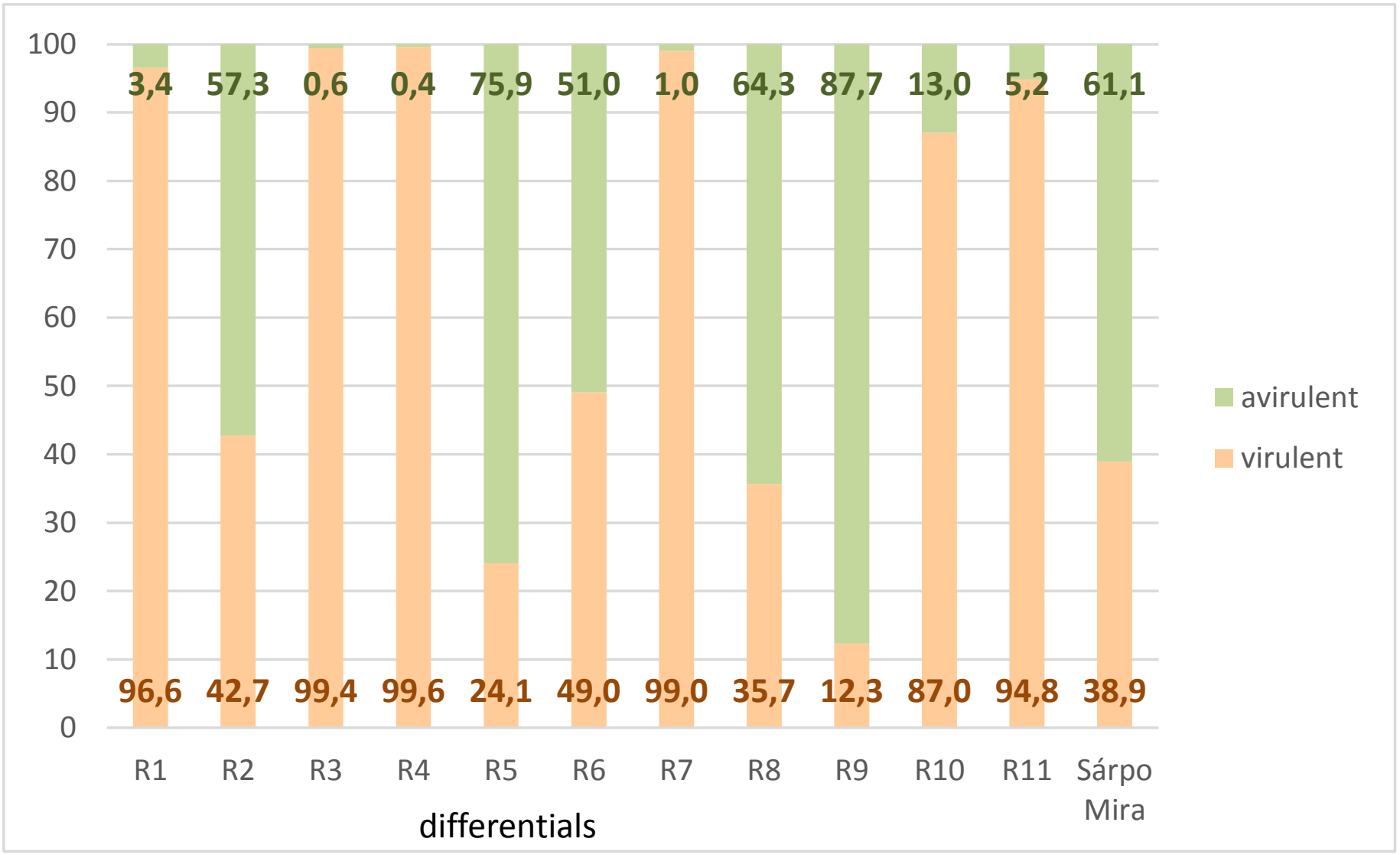
(Orłowska et al. 2012)

- Antimicrobial activity of plant extracts

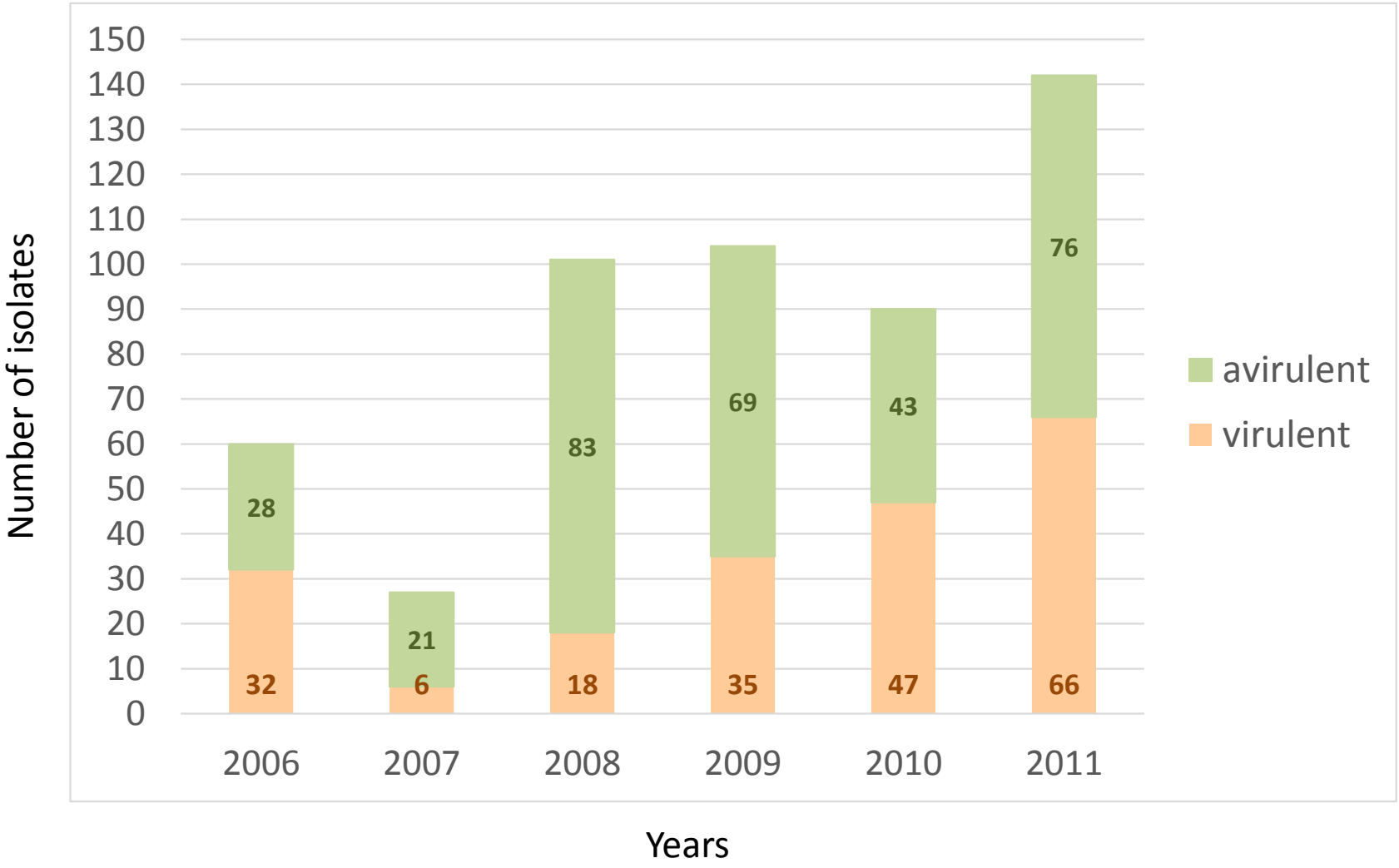
Black's differential set R1-R11 and resistant/susceptible standards



Percentage of virulent isolates in years 2006-2011
N=524



Virulence on Sarpo Mira (2006-2011) N=524



What is responsible for effective foliar resistance in cultivar Sárpo Mira?

Plant material for mapping study

Sárpo Mira (SM) x Maris Piper (MP)

137 F1 individuals (SM x MP) 4x segregating for resistance

Alison Lees
John Bradshaw
The James Hutton Institute

Resistance tests with three *P. infestans* isolates

- droplet inoculation
- 2 dates × 2 replications × 3 detached leaflets in 2010, 2011 and 2012

Isolate	Year, place of origin	Mating type	Race	Resistance	
				cv. Sárpo Mira	cv Maris Piper
MP324	1997, Koszalin	A1	1.2.3.4.5.6.7.8.10.11	8.6 ± 0.6	3.0 ± 1.9
MP618	2005, Nowy Sącz	A2	1.2.3.4.(5).6.7.10.11	8.6 ± 0.8	3.4 ± 1.4
MP650	2005, Nysa	A2	1.2.3.4.5.(6).7.(8).10.11	8.4 ± 1.0	4. 0 ± 1.0

Pearson correlation coefficients- mean resistance values 2010-2012

	MP324	MP618	MP650
MP324	1.00		
MP618	0.97*	1.00	
MP650	0.87*	0.89*	1.00

A

B

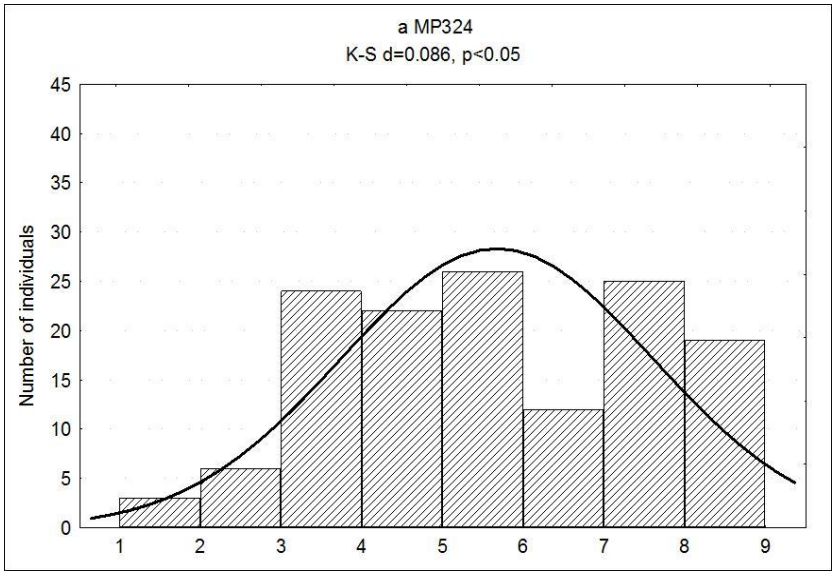
MP 324

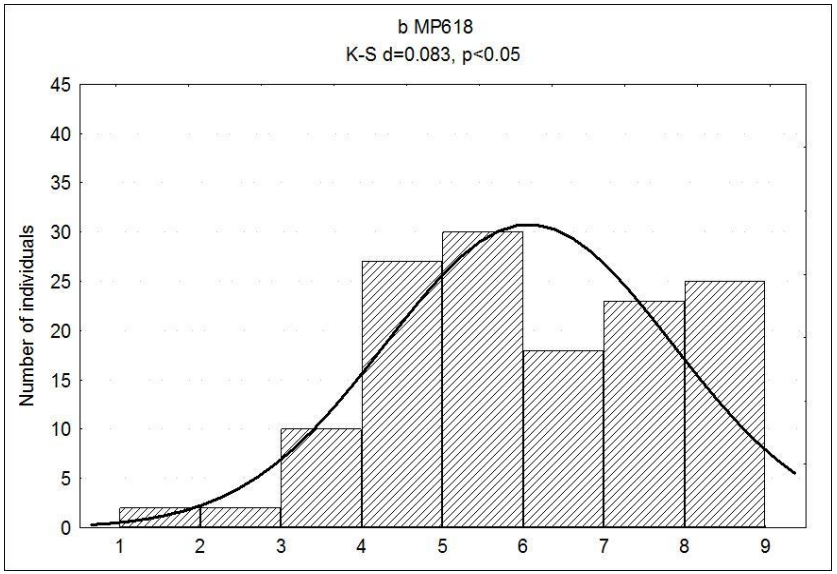
MP 618

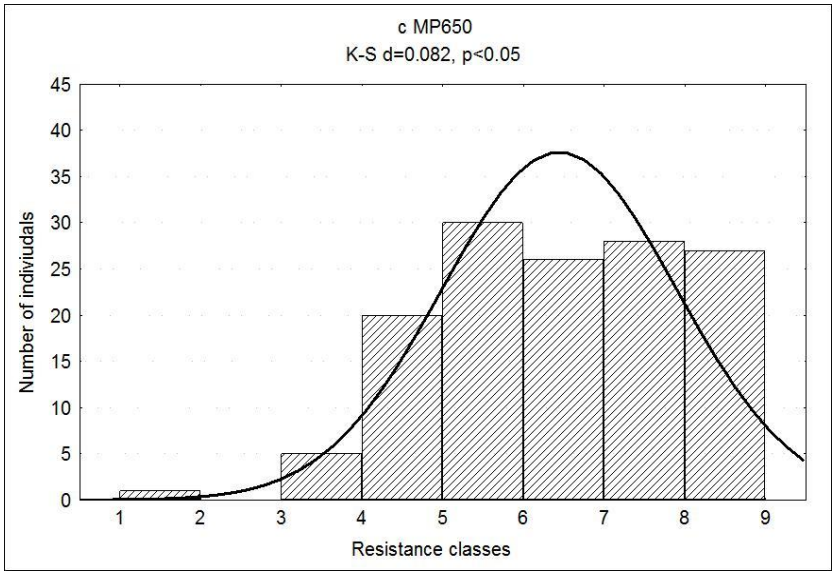
MP 650

$p < 0.05$

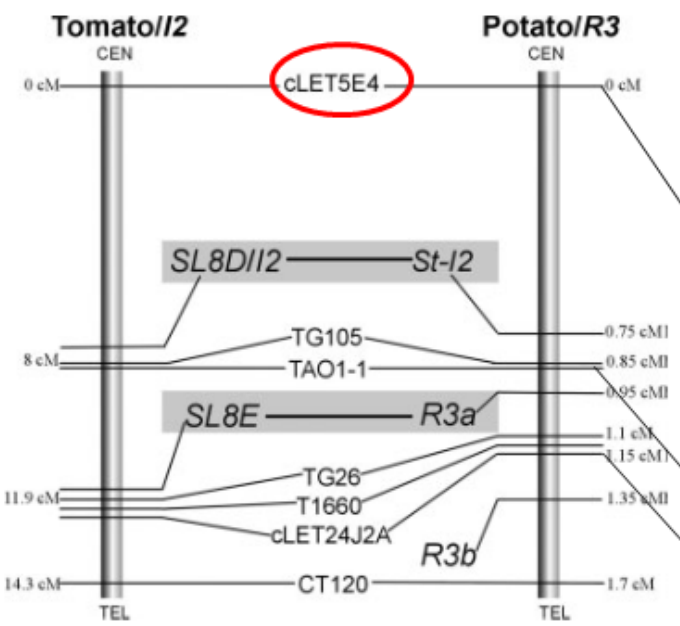
Frequency distribution of mean resistance to *P. infestans*



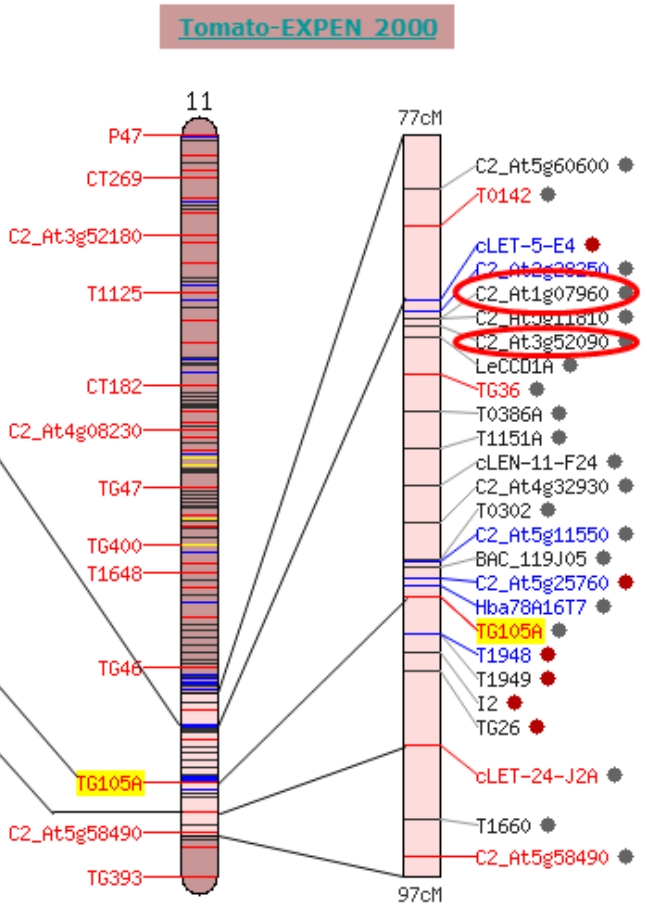




PCR marker identification



The Plant Journal (2005) 42, 251–261



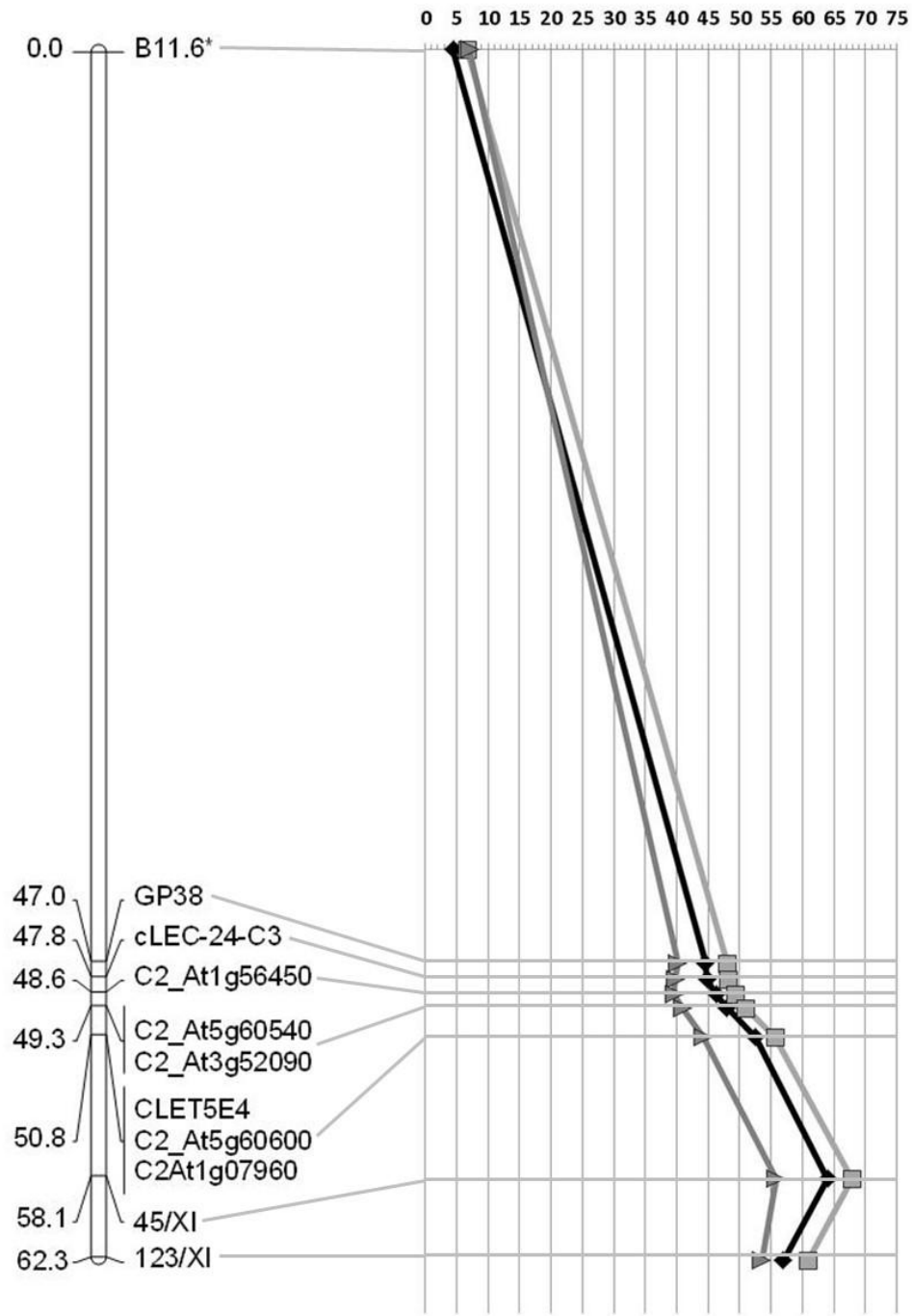
http://www.sgn.cornell.edu/

Solanaceae Genomics Resource Genome Browser

Potato (Solanum tuberosum group Phureja DM1-3) PGSC v2.1.11 Pseudomolecules

Markers and primers used in this study, their sequences, annealing temperatures and restriction enzymes used to detect polymorphism

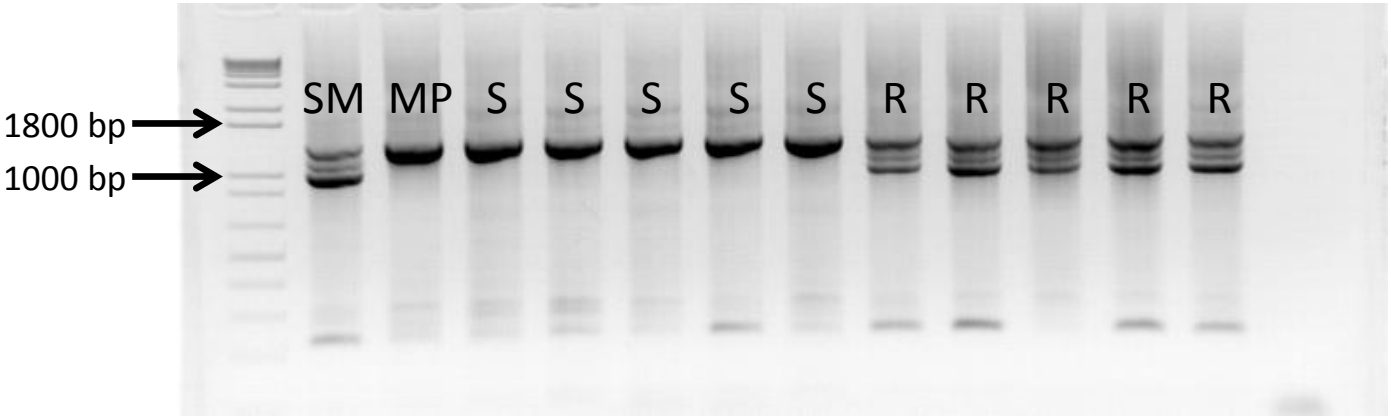
Name of the marker	Primer sequences	Ta (°C)	Product size (bp)	Restriction enzyme	Source
B11.6		60	1800	EcoRI	Polish patent no: P-399117
GP38	TGGAACTTACTTCACTGACAAACT TGCAGTAACTGAAAGCAACAGAT	55	800	RsaI	Marczewski et al. 2006
cLEC-24-C3	AGATCGGCAAATGATCCAAG ACTTGTGGCGAAAAATGAGG	55	1200	TaqI	SGN [c]
C2_At1g56450	ACTTGTTCTTGGTGGAGTAAAAAATGG ACTCCCTCTTCTGTGATTTTTGCAATCTG	55	1000	EcoRI	SGN [c]
C2_At5g60540	TGCTGTTTTCATCCGTGCTCC AGTTAATTCGGGATGAAAAGCAG	55	900	MspI	SGN [c]
C2_At3g52090	AGGGATACGAAGATCATGAATGCAGC ACTCTTCAGATGATCAAGTTCCTTGTC	55	1500-1400	a.s. [a]	SGN [c]
C2_At1g07960	ATGGTTTGTCAAATTTTGTGTTCC AAGAGTTTGAATGTAGGGTATGAATG	55	800	HinfI	SGN [c]
C2_At5g60600	TTGCTTCAAGGTTGCAGAATGCG ACCAGGCAAGTGTGACGTCTTCTCTC	55	900	HhaI	SGN [c]
cLET5E4	CCAGGCATGCTCAATTTGGAGT TTCCCTGTTTGGACTACTTGTGGA	55	300	HhaI	Huang et al. 2005
45/XI	AGAGAGGTTGTTTCCGATAGACC TCGTTGTAGTTGTCATTCCACAC	55	900-1500	a.s. [a]	PGSC [d] chr11:39956309..39958308
123/XI	TCCCATAACGATCTCCCAAA TTTGCTCCTTACCCATCACC	60	1500	TaqI	PGSC [d] chr11:41151558..41153557



Distribution of percentages of variance (R^2) in resistance tests with three *P. infestans* isolates (MP324, MP618, MP650) explained by markers along Sárpo Mira chromosome XI. All markers are significantly linked to late blight resistance at $p < 0.0000$. The only exception is marked as *. In this case linkage is significant with $p < 0.01$ to $p < 0.002$ depending on *P. infestans* isolate used in tests. On the left, genetic distances in cM are given

The band pattern of PCR marker, 45/XI, suggested the presence of resistance locus

SM– Sárpo Mira, resistant parent
MP – Maris Piper, susceptible parent
R, S (resistant, susceptible) – phenotype of progeny inoculated with three *P. infestans* isolates.

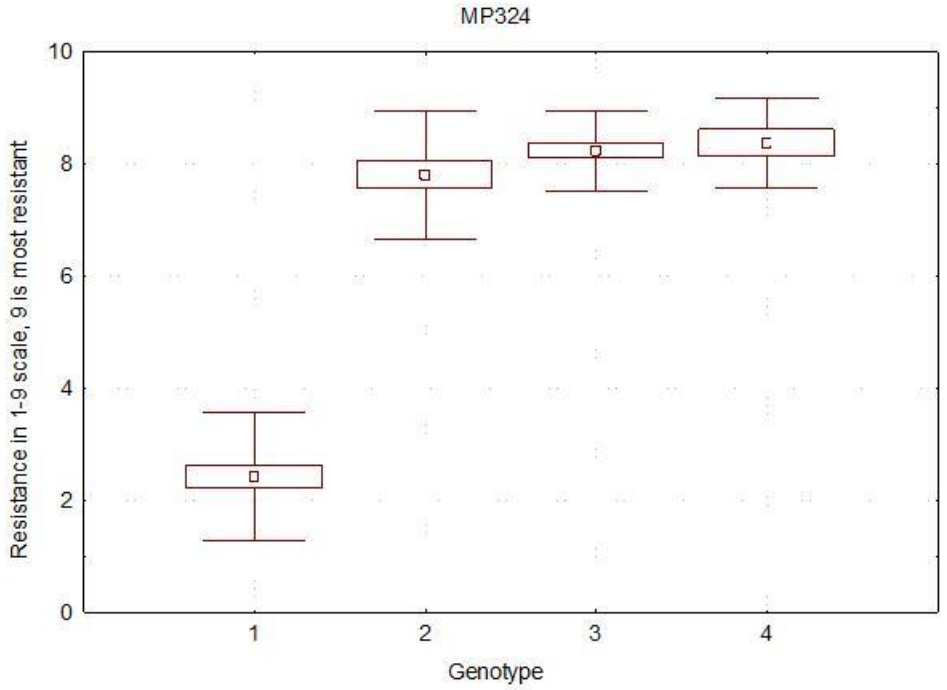


Piramiding

The 83 potato lines obtained from crosses between Sárpo Mira and *Rpi-phu1* donors

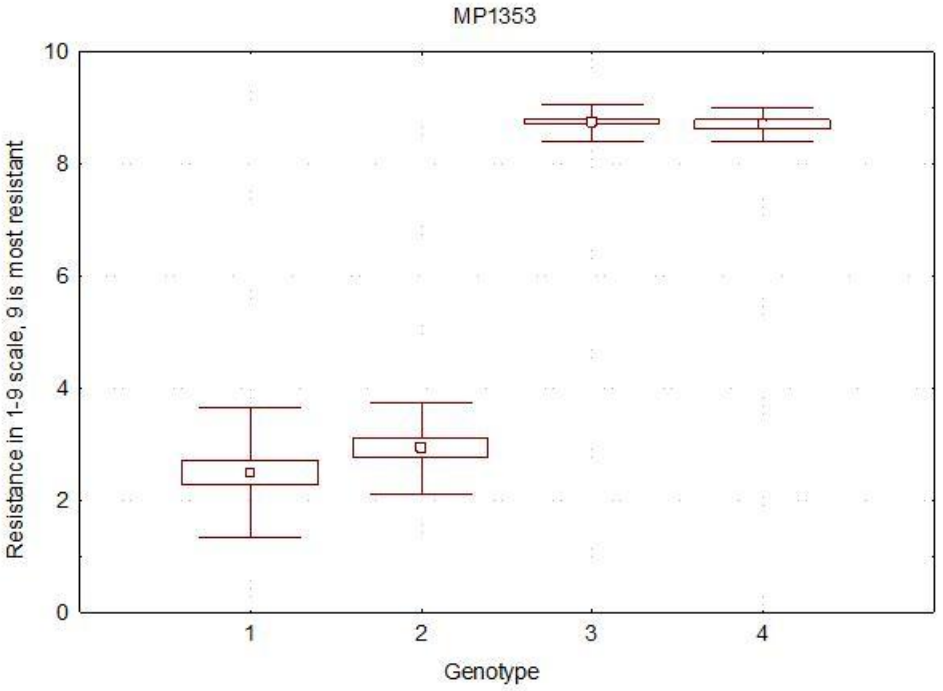
MAS
Marker phu6 for *Rpi-phu1*
Marker 45/XI for *Rpi-Smira1*

Isolate	Year, place of origin	Mating type	Race	Resistance	
				cv. Sárpo Mira	cv Maris Piper
MP324	**1997, Koszalin**	**A1**	**1.2.3.4.5.6.7.8.10.11**	**8.6 ± 0.6**	**3.0 ± 1.9**
MP1353	**2011, Białuty**	**A2**	**1.2.3.4.5.6.7.8.10.11**	**5.8 ± 0.4**	**n.t.**



Box plots illustrating resistance profiles of four different groups of progeny's Sárpo Mira x clones Z-03.3817 and Z-03.3827.

The square indicates the mean value, box around it- standard error and the whiskers- standard deviation



Marker-assisted selection:

1. without any resistance genes
2. with the *Rpi-Smira1* locus
3. with the *Rpi-phu1* gene
4. with the *Rpi-Smira1* locus and the *Rpi-phu1* gene: 10 plants

Ten plants with pyramid of both genes

- 2 recombinants between marker 45/XI and *Rpi-Smira1* (Group 2)
- 11 individuals: contradictory results of resistance tests and phu6 marker (Group 3 and 4)

Field trials

Thank you
for
your attention