



Using CWR and pre-breeding potato

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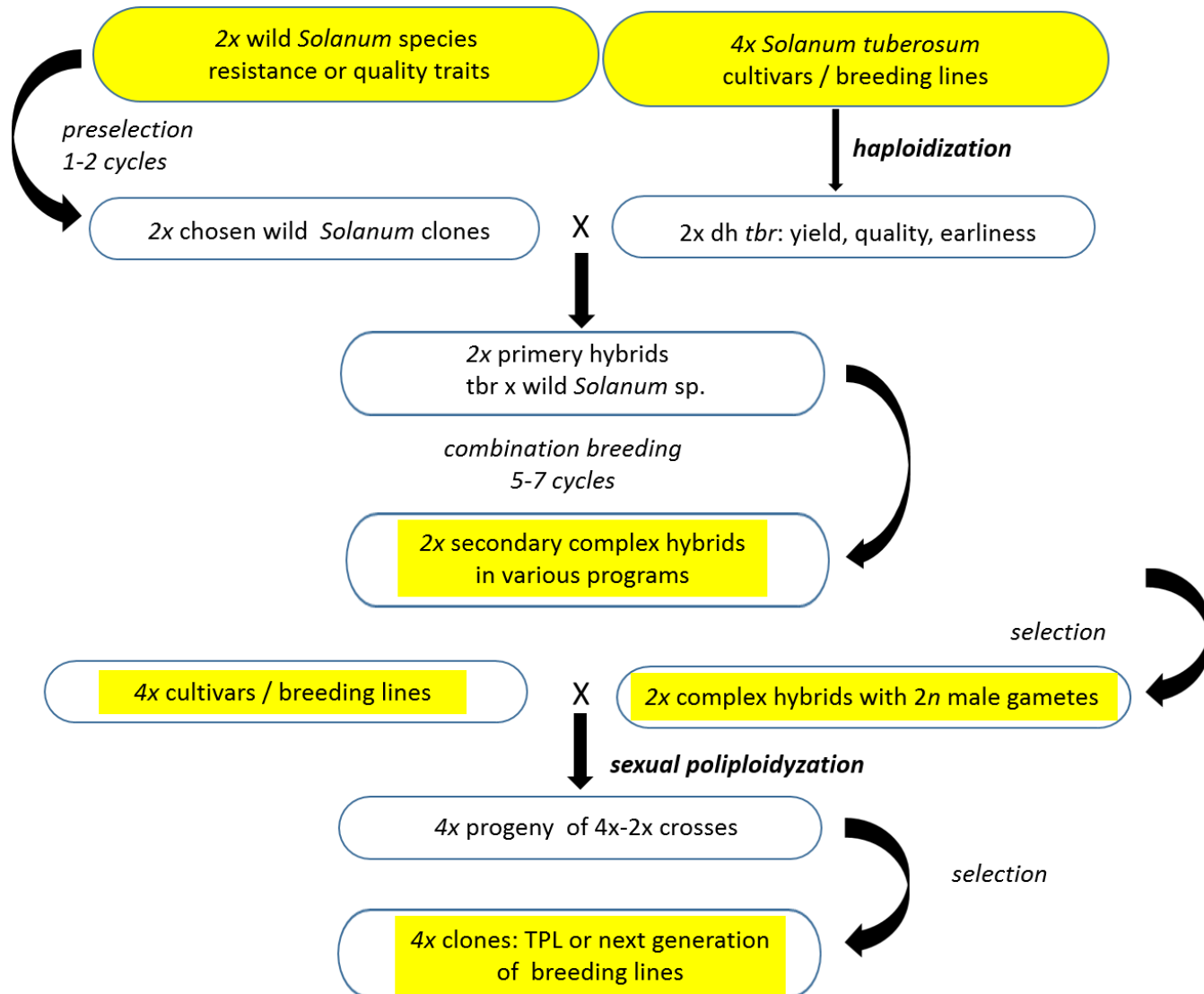
Potato parental line breeding in Poland

- **Diploid** level
- **Tetraploid** level –
parents of 72 Polish
varieties

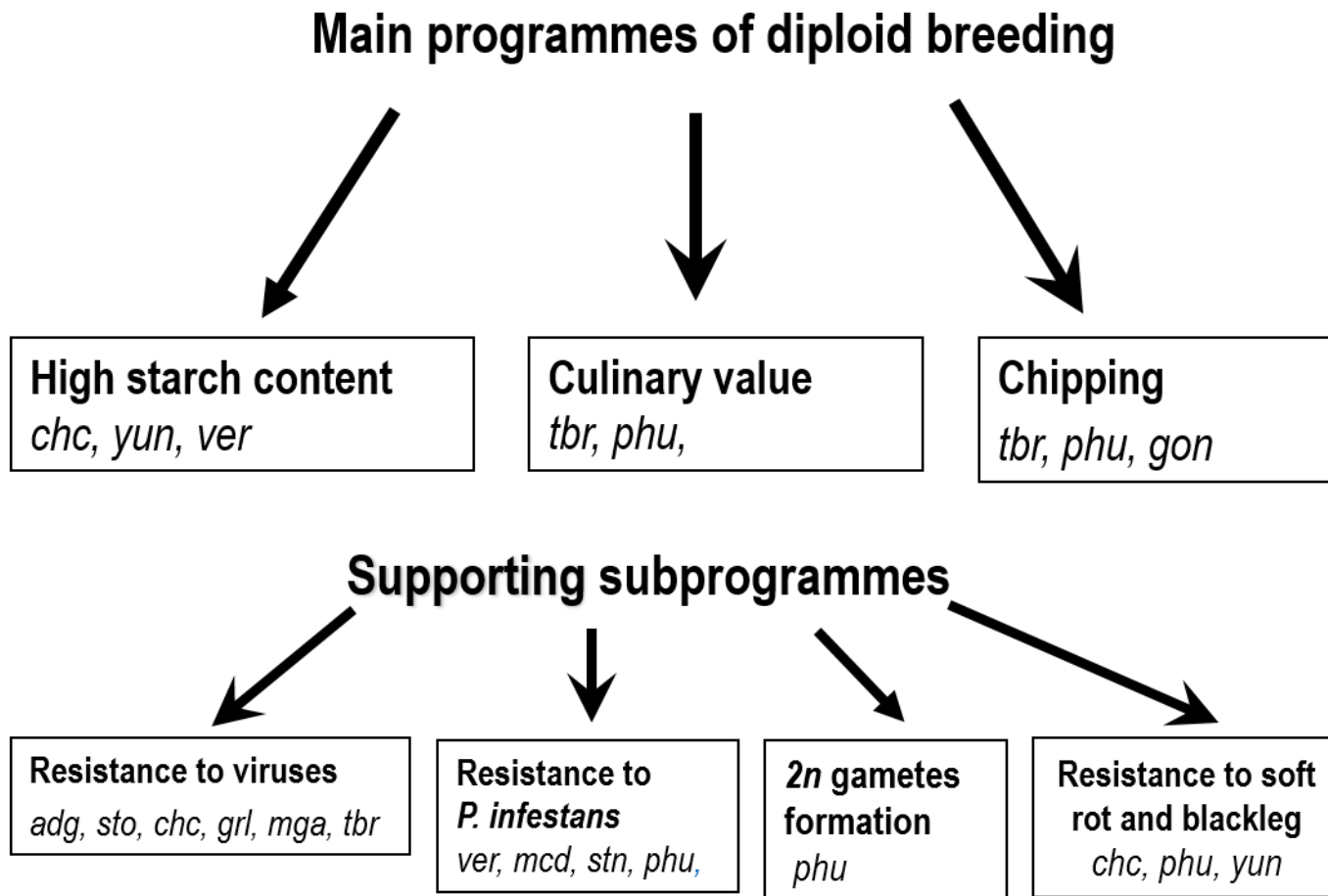


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The scheme of diploid potato breeding at IHAR-PIB



Main and supporting programmes of diploid breeding at IHAR-PIB



Potato resistance genes and QTL mapped at IHAR-PIB

Trait	Chromosome, location of the <i>R</i> gene or QTL											
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Resistance to viruses								<i>Ns</i>	<i>Ny-Smira</i> <i>Ny-1</i> <i>Gm</i>		<i>PLRV1</i> <i>Ny-2</i> <i>Rm</i> <i>PLRV4</i>	<i>Ryf-sto</i>
Resistance to <i>S. endobioticum</i>											<i>Sen2</i>	
Resistance to pectinolytic bacteria 2000 (QTL)												
Resistance to pectinolytic bacteria 2021 (QTL)												
Resistance to <i>P. infestans</i> (QTL)												
Resistance to <i>P. infestans</i>				<i>R2-like</i>			<i>Rpi-mch1</i>		<i>Rpi-phu1</i>	<i>Rpi-rzc1</i>	<i>Rpi-Smira1</i>	

Marczewski et al. 2001, 2002, 2004, 2006; Flis et al. 2005; Szajko et al. 2019; Plich et al. 2018; Zimnoch-Guzowska et al. 2000; Lebecka et al. 2021; Śliwka et al. 2007, 2006, 2012a, 2012b

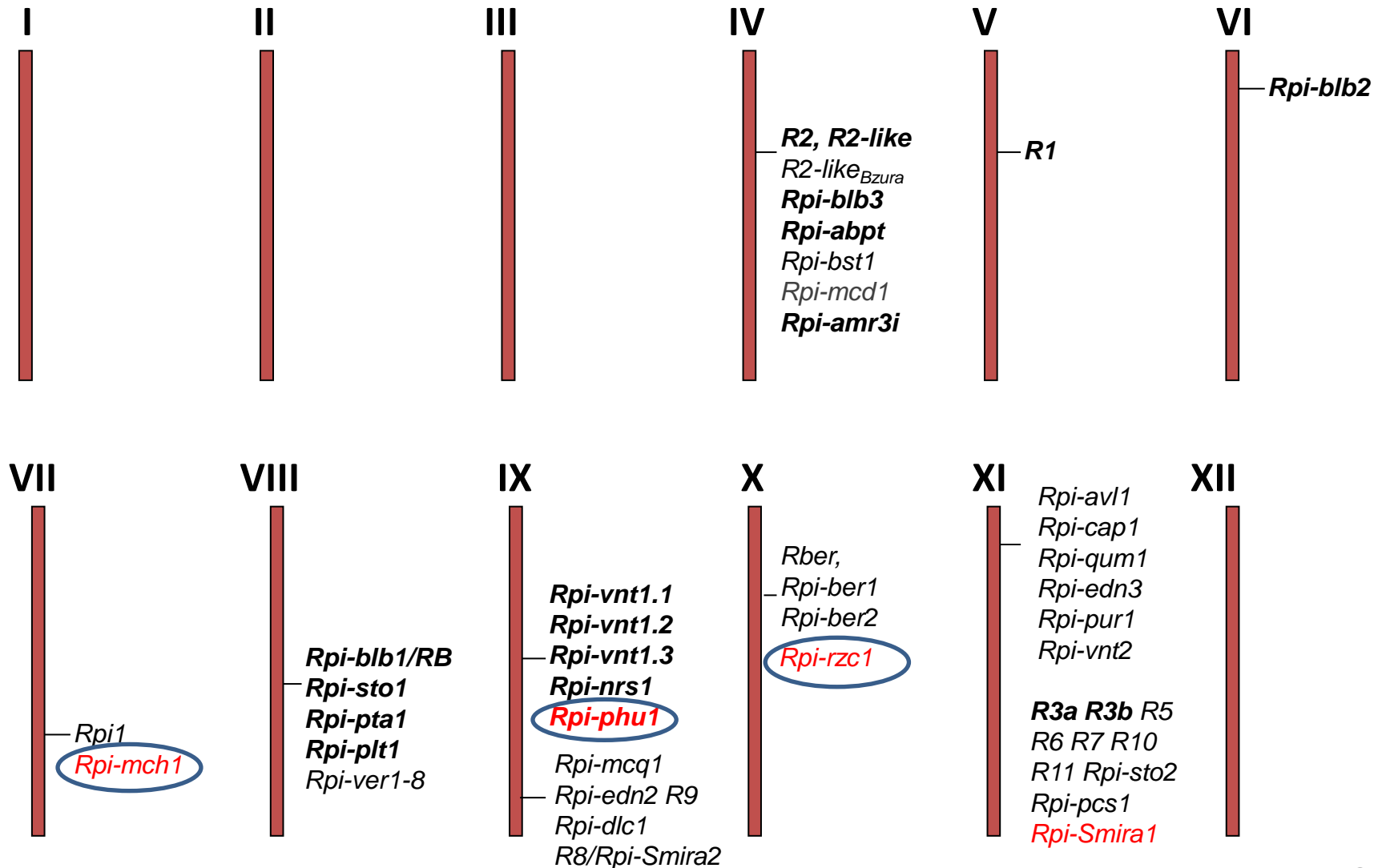
QTL for other traits mapped at IHAR-PIB

Trait	Chromosome, location of the major genes or QTL											
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Flower colour												
Maturity												
Tuber morphology and dormancy												
Tuber morphology												
Tuber blackspot bruise and enzymatic discoloration												
Crisp colour												
Starch-corrected crisp colour												
Leaf sucrose content												
Tuber starch content												
Tuber greening												

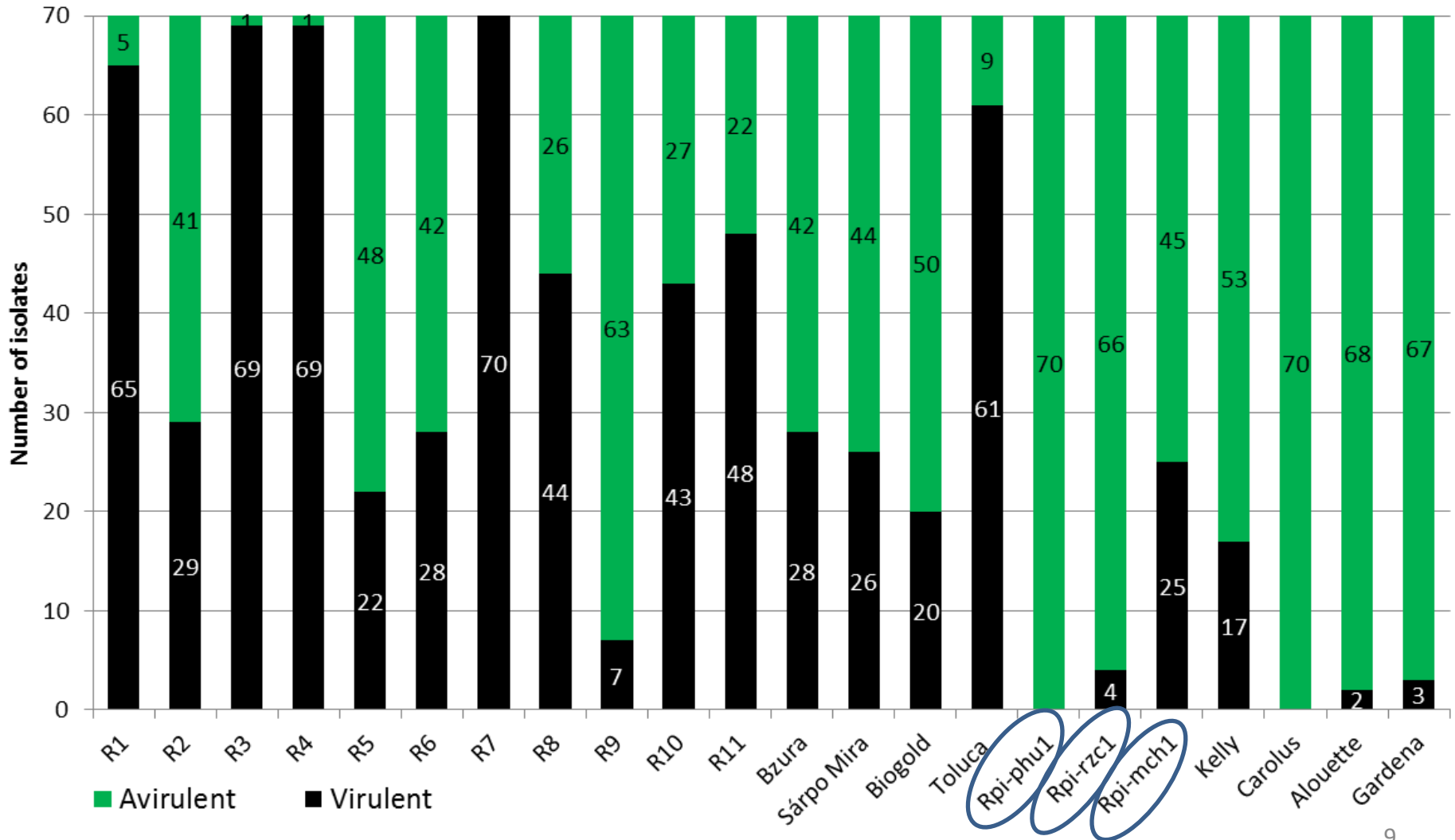
Śliwka et al. 2008, 2012, 2016; Sołtys-Kalina et al. 2020; Hara-Skrzypiec et al. 2018; Plich et al. 2020

Resistance to *P. infestans*

Genes for late blight resistance on potato genetic map



Virulence of *P. infestans* isolates from Poland (2017)



Rpi-phu1

- **1970** *S. stenotomum* x *S. phureja* comes from CIP, Lima, Peru crosses with *S. tuberosum* 2x
- 1992 first resistant tetraploid (unreduced gametes)
- **2006** mapping the gene (Śliwka et al. 2006, TAG)
- 2009 sequencing, virulent isolate *P. infestans* EC1; MP1162; = ***Rpi-vnt1.1*** (Foster et al. 2009, MPMI)
- 2010 MAS (Śliwka et al. 2010, JAG)
- 2012 pyramiding with Sárpo Mira
- 2014 GMO field tests in The Sainsbury Laboratory [Jones et al.]
- **2018** Cultivar Gardena by Zamarte Potato Breeding Ltd Group IHAR



Solanum phureja



Solanum stenotomum

Solanum ruiz-ceballosii Cárđ. 2x (2EBN) **VIR8664 (VIR7370)**

274

VII. Series Tuberosa



Figure 127. – *Solanum sparsipilum* (Ochoa 662). 1. Flowering plant. 2. Corolla. 3. Petal. 4. Stamens, dorsal view. 5. Pistil. 6. Calyx. 7. Pedicel and pistil. 8. Fruit. All $\times \frac{1}{2}$.

- Originates from:
Bolivia, Peru

- Syn. *S. sparsipilum*, re-identified as
 - ***S. brevicaulle***

- Selected clones:
 - resistant to *P. infestans*
 - low tendency to enzymatic blackening and after-cooking darkening



rzc flower colour

dH Balbina

x

99-10/36 *rzc*

a



b



c



d



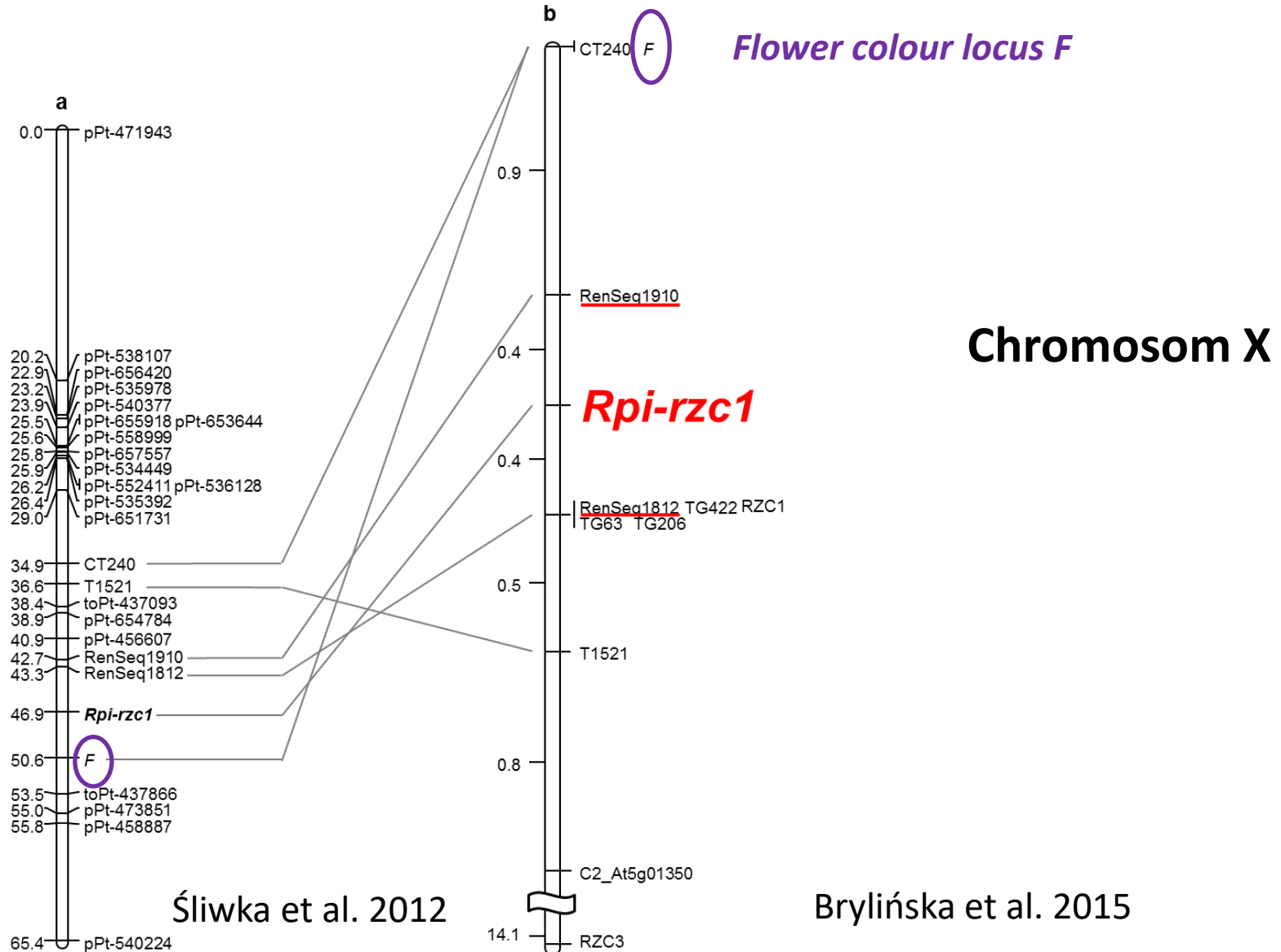
e



f



Two linkage maps:



Solanum × *michoacanum* (Bitter.) Rydb. 2x (1EBN) **VIR5763**

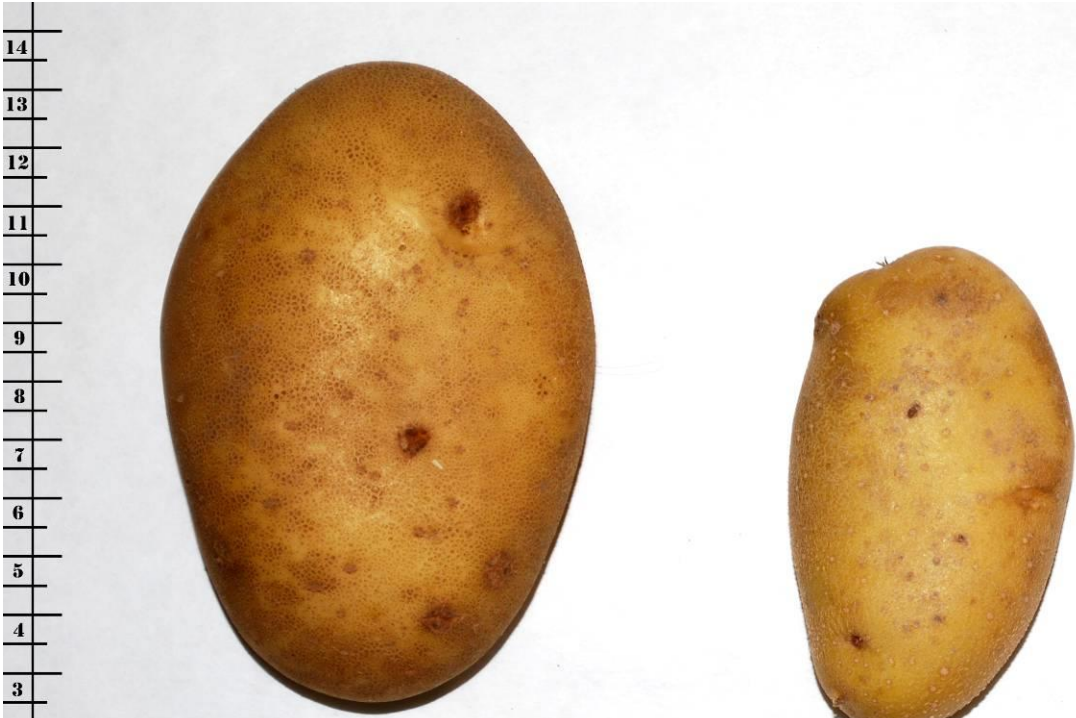


Resistant genotypes with mean scores ≥ 6

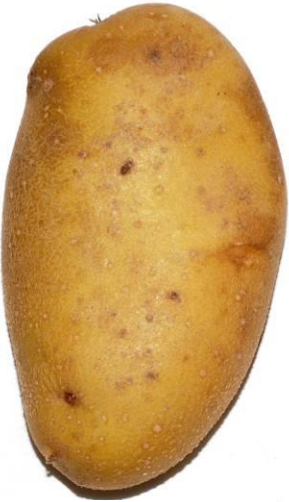
- Originates from:
Mexico, state: Michoacán,
- Natural hybrid:
S. bulbocastanum × *S. pinnatisectum*
(Hawkes 1990)
- Selected clones:
 - resistant to *P. infestans* (whole leaf test)
 - suitable for cold chipping



Tuber sizes



Tetraploid



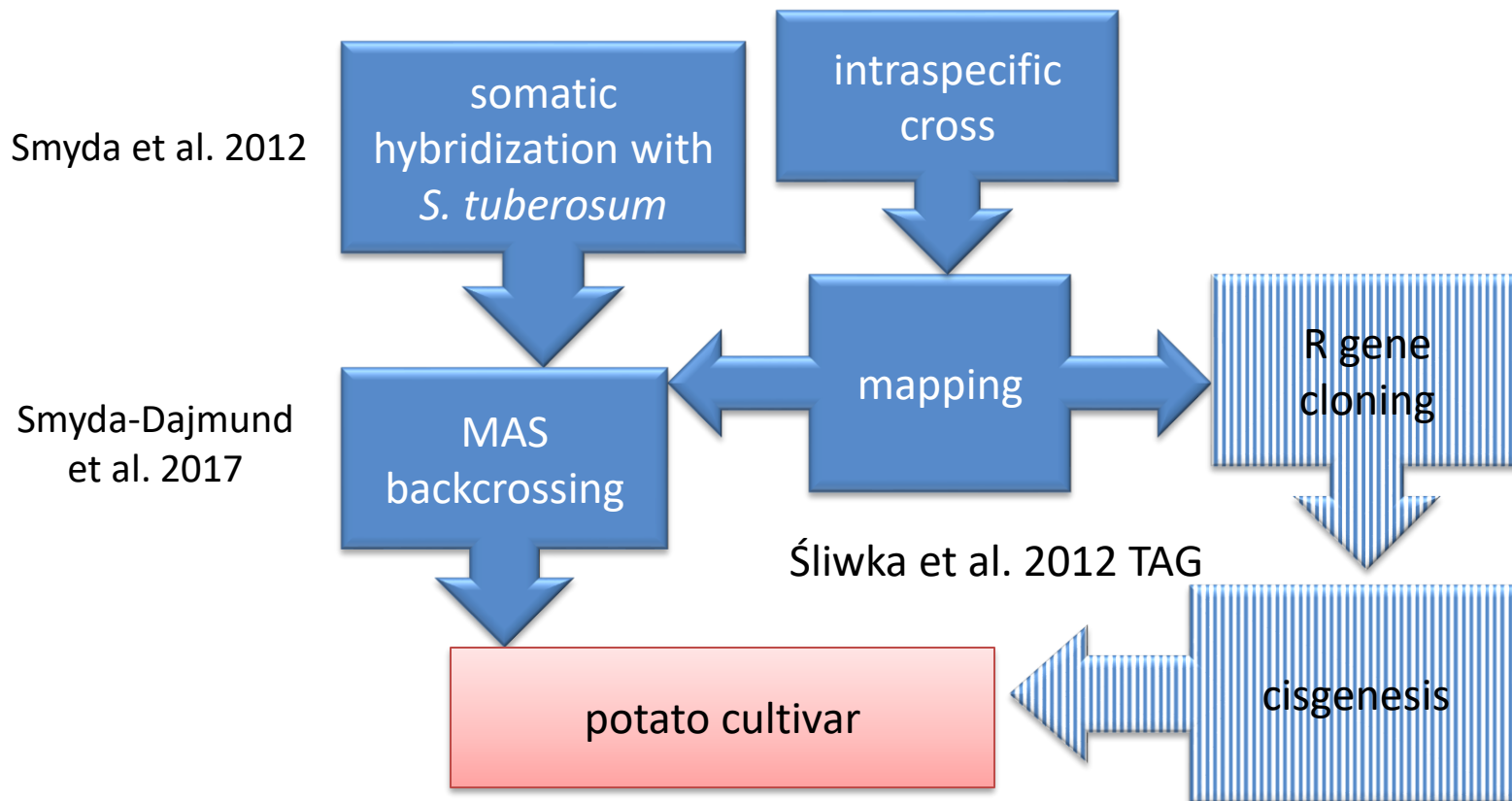
Diploid



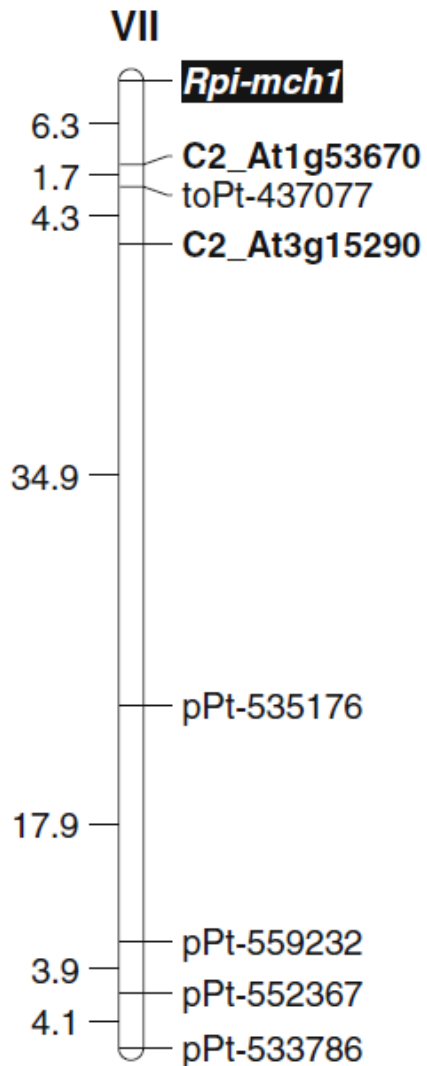
S. x michoacanum

Transfer of resistance to cultivated potato

S. × michoacanum



Rpi-mch1 gene was mapped to the chromosome VII of the potato genome



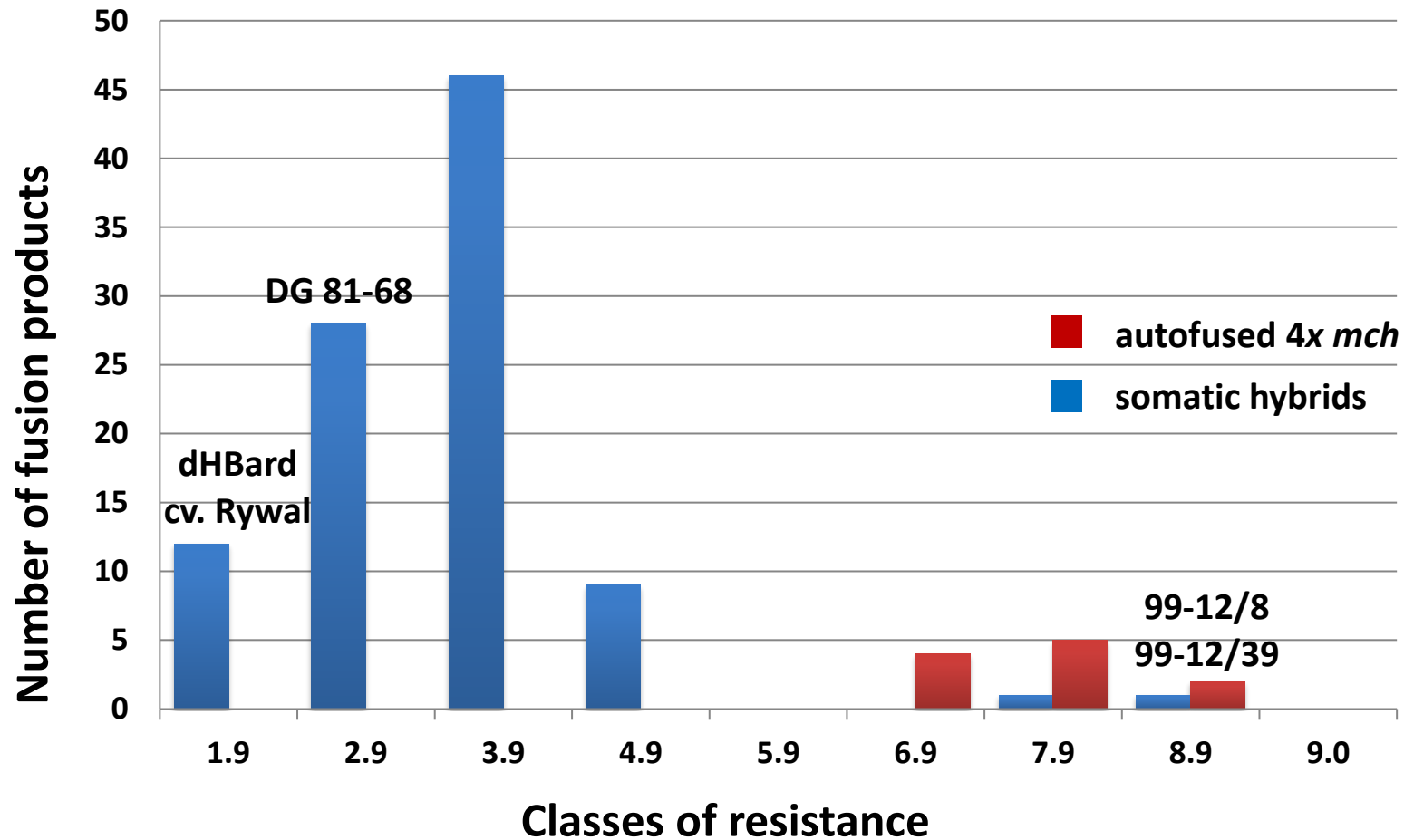
Theor Appl Genet (2012) 124:397–406
DOI 10.1007/s00122-011-1715-4

ORIGINAL PAPER

A resistance gene against potato late blight originating from *Solanum × michoacanum* maps to potato chromosome VII

Jadwiga Śliwka · Henryka Jakuczun · Marcin Chmielarz ·
Agnieszka Hara-Skrzypiec · Iga Tomczyńska ·
Andrzej Kilian · Ewa Zimnoch-Guzowska

Out of 97 *S. × michoacanum* (+) *S. tuberosum* somatic hybrids 2 were resistant to *P. infestans*

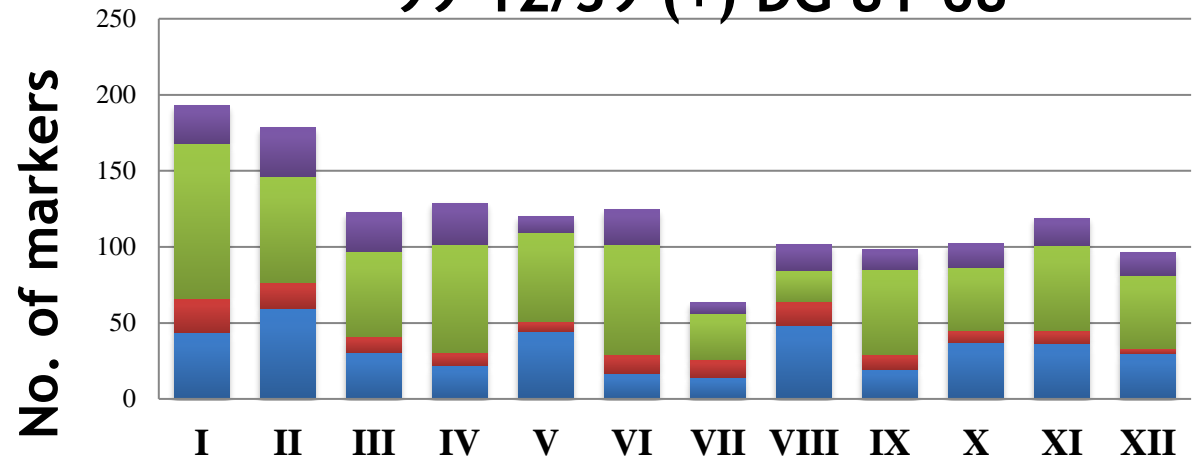


(Smyda-Dajmund et al. 2016)

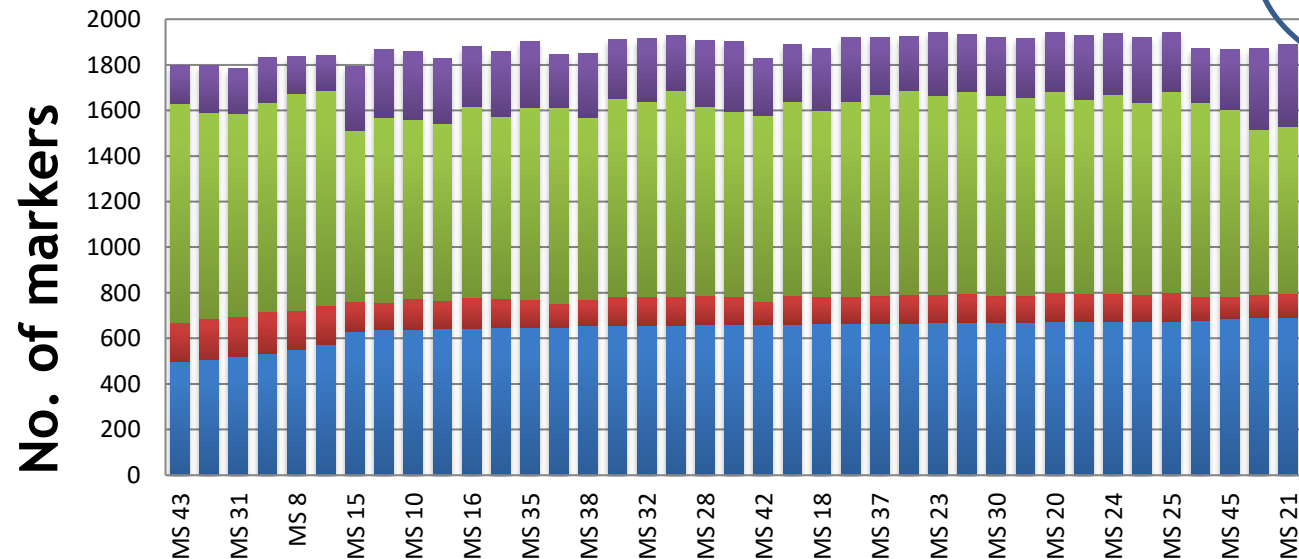
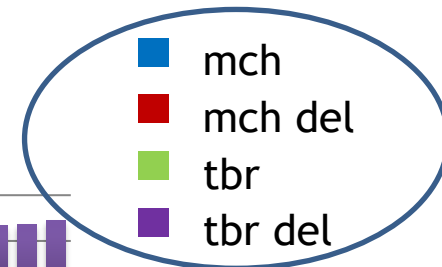
Resistant genotypes with mean scores ≥ 6

Nuclear composition of *S. × michoacanum* (+) *S. tuberosum* somatic hybrids based on DArT markers

99-12/39 (+) DG 81-68



Composition of 12 chromosomes of somatic hybrids



Nuclear genome composition of somatic hybrids

Epigenetic analysis

- MSAP and HPLC methods indicated an increase in DNA methylation in the somatic hybrids in comparison to their parents
- The somatic hybridization changed the level of cytosine methylation in the studied potato somatic hybrids



Article

Analysis of Cytosine Methylation in Genomic DNA of *Solanum* × *microacanum* (+) *S. tuberosum* Somatic Hybrids

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BC₁ progeny from *S. × michoacatum* (+) *S. tuberosum* somatic hybrids and cv. Flaming



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Thank you for your attention