Pyramiding late-blight resistance genes from *S. bulbocastanum* and *S. stoloniferum* to create novel potato pre-breeding lines

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Solanum bulbocastanum, Dun. (2n=2x=24; genome BB, 1EBN) of series *Bulbocastana* was identified as a valuable genetic resource due to its high resistance to all known races of *Phytophthora infestans* causing late-blight. *S. stoloniferum*, Schlechtd. et Bché (2n=4x=48; genome AABB, 2EBN) belonging to series *Longipedicellata* bearing resistance to PVY (Ry_{sto}) linked with male sterility. In addition, resistance to foliage blight in specific accessions was recorded. R genes *Rpi-blb1*, *Rpi-blb2*, *Rpi-blb3*, *Rpi-sto1* (functionally identical to *Rpi-blb*1) from both wild species that conferring resistance to *P. infestans* has been identified and molecular markers are available (Vleeshouwers et al. 2011). The suitability of these species as genetic resources in potato pre-breeding programs using biotechnological approaches was studied. Somatic hybrids were produced between gene bank accessions of *S. bulbocastanum*, GLKS 31741 (*blb*41), USDA PI 498223 (*blb*8, 9, 12, 21) or *S. stoloniferum*, GLKS 30602 (*sto*602/1) and *S. tuberosum*, cv. Quarta, Delikat, diploid breeding line 9183, and somatic hybrids *blb*41 (+) cv. Delikat *via* protoplast fusion. BC progenies from sexual crosses using *S. tuberosum*, cvs. Quarta, Sarpo Mira were developed. PCR-based marker assays were applied for detecting *Rpi-blb* and *Rpi-sto* genes in progenies (Colton et al. 2006; Wang et al. 2008; Lokossou et al. 2009; Zhu et al. 2012). Assessment of late-blight was made *via* detached-leaf assay, field trial using artificial infection by *Phytophthora infestans*, and agroinfiltration (Du et al. 2014). Yield, amount of tubers and tuber shape were assessed in a field trial.

Results

- ✓ Identification of *Rpi-blb1* and *-blb3* genes in *S. bulbocastanum*, accession *blb*41 and of gene *Rpi-blb2* in individuals of accession *blb*8-21 confirmed by agroinfiltration
- ✓ Detection of resistance gene *Rpi-sto1 = Rpi-blb1* in *S. stoloniferum* accessions
- ✓ Confirmation of *Rpi-blb1* and *-blb3* genes in hybrids *blb*41 (+) cv. Delikat and BC progenies and detection of Rpi-*blb*2 gene in *blb*8 (+) 9183 hybrids
- ✓ Pyramiding of the three *Rpi-blb* genes in hybrids between *blb*8; 12; 21 (+) somatic hybrids *blb*41 (+) cv. Delikat by means of cell fusion
- ✓ Backcrossing of octoploid *sto*602/1 (+) cv. Delikat hybrids with somatic hybrid 9183 (+) *blb*8 753/5 carrying *Rpi-blb*2 gene, and other cultivars
- ✓ Improvement of resistance to foliage blight in selected *blb*-BC lines by scoring values < 3 (1 = no attack, 9 = fully invested in a leaf assay) and low rAUDPC (% attack) values in replicated field tests. Maturity was estimated medium to late
- ✓ Acceptable yield, tuber characters, starch contents and suitable for processing quality of few selected breeding lines

Conclusion

Late-blight resistance genes *Rpi-blb1*, *Rpi-blb2*, *Rpi-blb3* and *Rpi-sto1* from *S. bulbocastanum* and *S. stoloniferum* were transferred into somatic hybrids and BC offspring. Majority of breeding lines showed late and very late maturity. Few selected lines were medium-late and had some acceptable agronomic traits. The somatic hybrids and BC progenies with improved resistance to late-blight are available as crossing partners.

References

Colton et al. 2006, Crop Science 46:589–594; Du et al. 2014, J Vis Exp 83 e50971; Lokossou et al. 2009, MPMI 22:630–641; Vleeshouwers et al. 2011, Annu Rev Phytopathol 49:507–531; Wang et al. 2008, Theor Appl Genet 116:933–943; Zhu et al. 2012, Transgenic Res 21:89–99