Potato breeding for agroecology: hope from wilderness

Jadwiga Śliwka*, Marta Janiszewska, Paulina Smyda-Dajmund, Paulina Paluchowska, Sylwester Sobkowiak, Zhimin Yin

Plant Breeding and Acclimatization Institute – National Research Institute, Młochów Division, Platanowa 19, 05-831 Młochów, Poland
*Presenting author, j.sliwka@ihar.edu.pl

Potato, *Solanum tuberosum* L., is the fourth most important crop species in the world grown for human consumption and starch used in industry. With many pests and diseases that attack potatoes, their cultivation requires large amounts of pesticides to secure yields. Potato originates from the Andes (Fig. 1) and over 200 related tuber-bearing *Solanum* spp. can be found in America. These potato relatives are either wild or cultivated by local communities. They can vary in ploidy (2, 3, 4, 5, 6x) but many of them can be crossed with diploid or tetraploid *S. tuberosum*. In contrast to modern European potato cultivars, potato relatives co-evolved in America with pests and pathogens and can be the source of resistance to many of them.

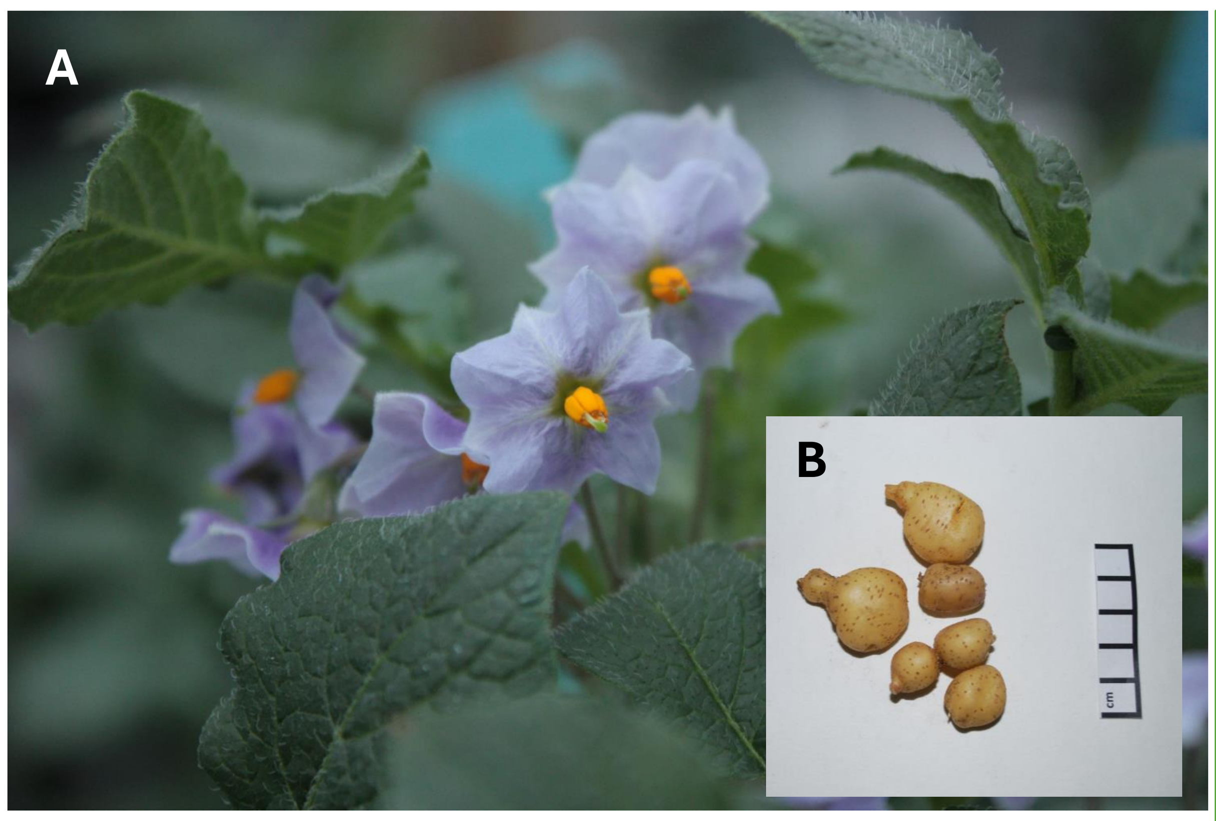

Figure 2 *Solanum guerreroense*: A. flowers, B. tubers.

Solanum guerreroense (Fig. 2) is a hexaploid species with Endosperm Balance Number = 4, which makes it crossable with cultivated potato. It is a source of resistance to *Phytophthora infestans* causing potato late blight (Fig. 3). This species was discovered in Guerrero, in Mexico, in coniferous and oak forests (Fig. 1). It is very rare and perhaps even extinct in its natural habitats. Within tested accession of *S. guerreroense,* we found also a desired low level of enzymatic discoloration of the tuber flesh and resistance to *Potato virus Y* (PVY, preliminary results).

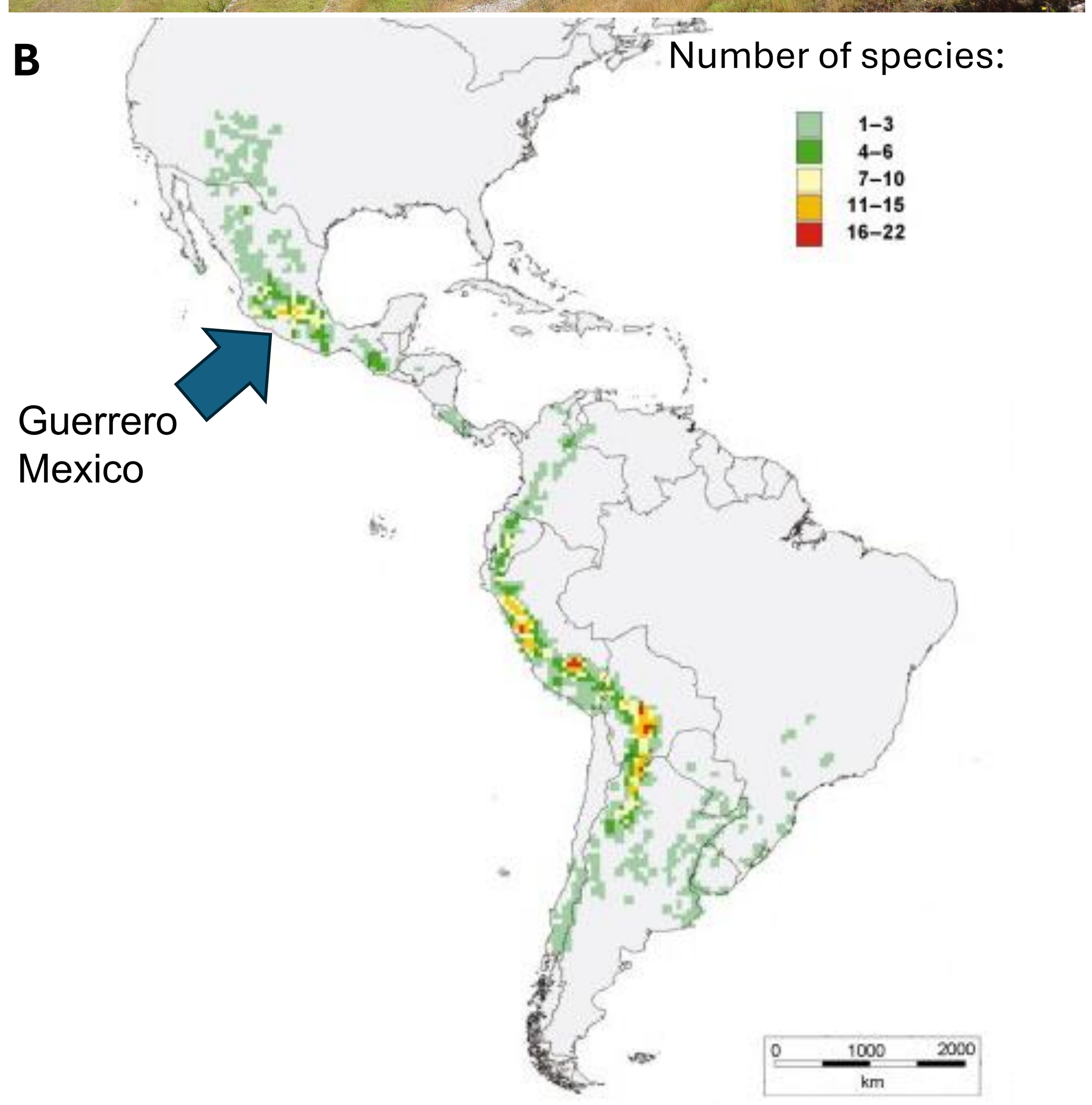

Figure 1 Origins of potato wild relatives: the Andes; A. Peruvian landscape, B. distribution of wild potato relatives (Jansky, In: Singh, Kaur (ed.), Advances in Potato Chemistry and Technology, Academic Press, 2009, pp 27-62, modified).

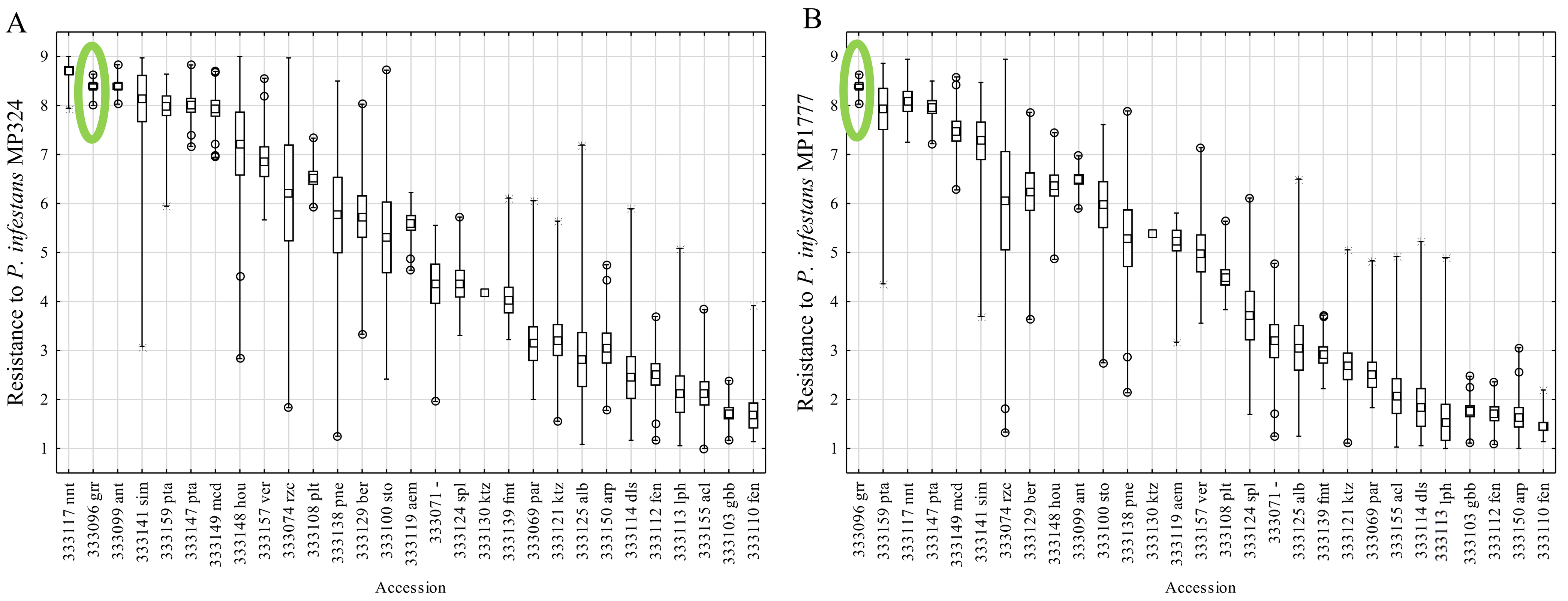

Figure 3 Late blight resistance of 29 accessions of *Solanum* species originating from the VIR collection and preserved at IHAR-PIB, A: mean results of detached leaflet tests (Fig. 4) with *P. infestans* isolate MP324 (2018–2020); B: *P. infestans* isolate MP1777 (2017–2019). The mean values of the resistance against *P. infestans* are shown as squares, the box represents standard error, the whiskers indicate minimum and maximum values, circles are outliers and extreme values are marked with an asterisk (Janiszewska et al. Potato Res. 66, 1–21 (2023)). Resistance in 1-9 scale, where 9 means the most resistant. Green ellipses mark *S. guerreroense*.

Figure 4 Detached leaflet test for late blight resistance.

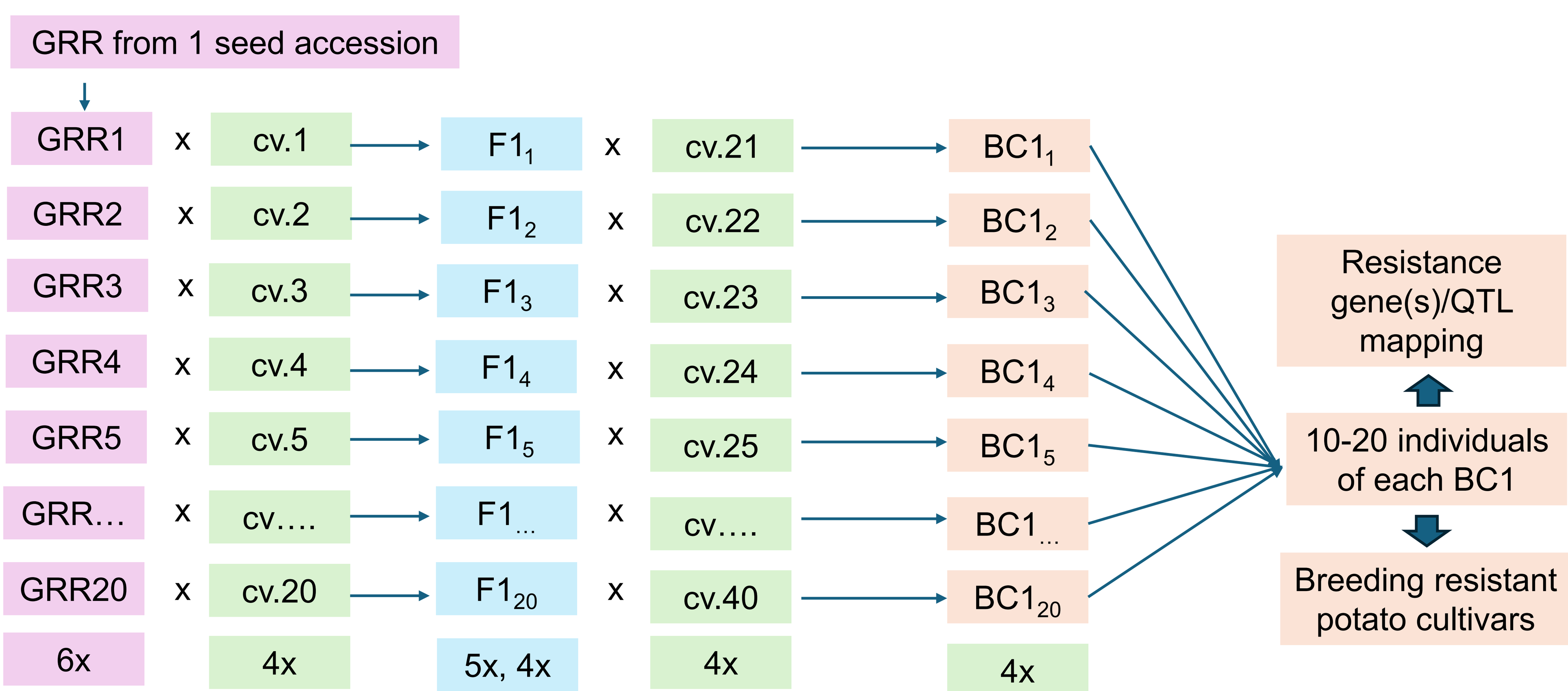

Figure 5 Crossing scheme for introgression of *S. guerreroense* (GRR) into cultivated potato gene pool. Cv. 1 – cv. 40: different potato cultivars.

Selected clones of *S. guerreroense* were tested for the presences of the late blight resistance genes described in literature using techniques based on next-generation sequencing: Amplicon Sequencing (AmpSeq) and Resistance gene enrichment sequencing (RenSeq).The results indicate that the resistance in our material is new and can widen the spectrum of resistance genes available so far against *P. infestans*. We plan to cross selected *S. guerreroense* clones (GRR1-GRR20) to various potato cultivars (cv. 1 - cv. 20) in order to introgress the late blight resistance and other potentially beneficial traits, such as PVY resistance and non-darkening tuber flesh, into cultivated potato gene pool (Fig. 5). Within F1, a mixture of penta- and tetraploids is expected. Selected, late blight resistant tetraploid will be further crossed with potato cultivars, and the obtained population will be used both for genome-wide association study and for further breeding of potato cultivars resistant to late blight.