Infection Risk Potential of South American Spongospora subterranea f. sp. *subterranea* inoculum

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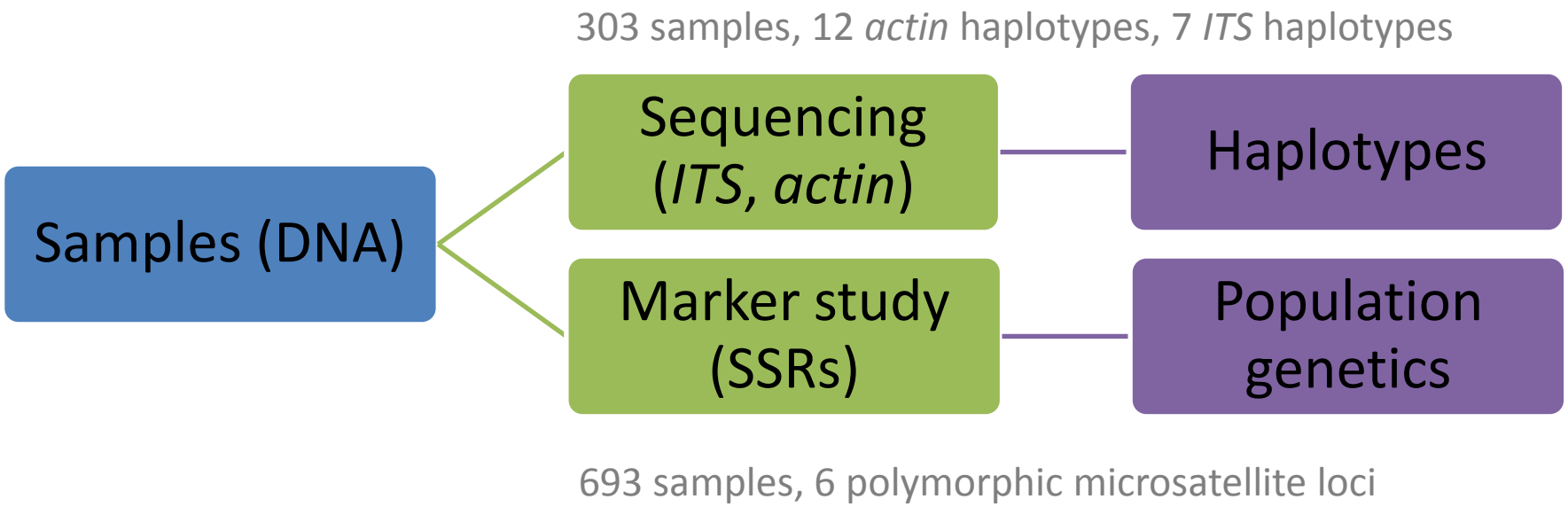
PhD project: worldwide sample collection

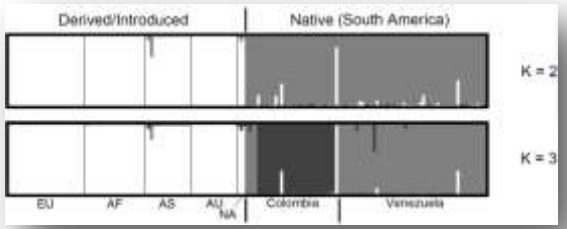
19 countries, 22 locations, all continents, mostly field populations

PhD project: combination of microsatellite and sequence data derived from sample DNA's

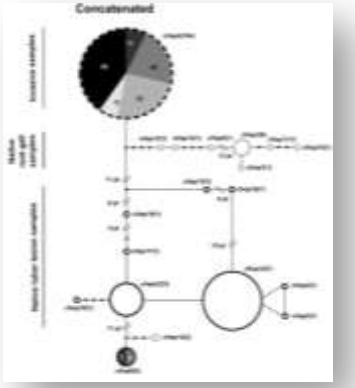


PhD project: combination of microsatellite and sequence data derived from sample DNA's

693 samples, 6 polymorphic microsatellite loci

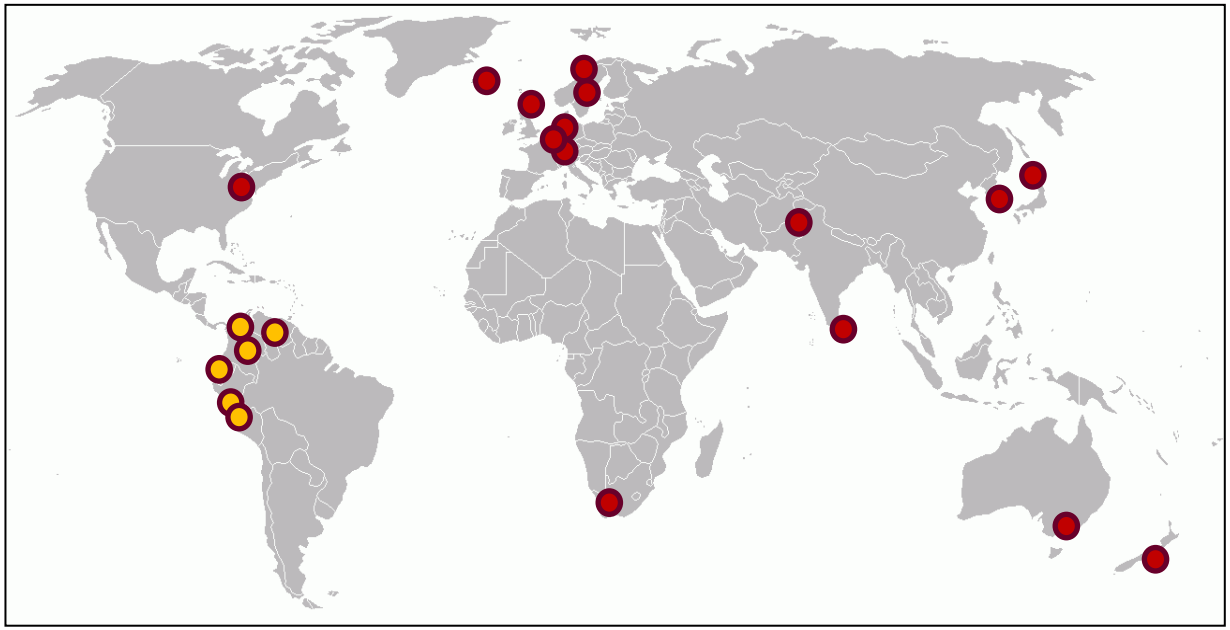


303 samples, 12 *actin* haplotypes, 7 *ITS* haplotypes



1. Hypothesis

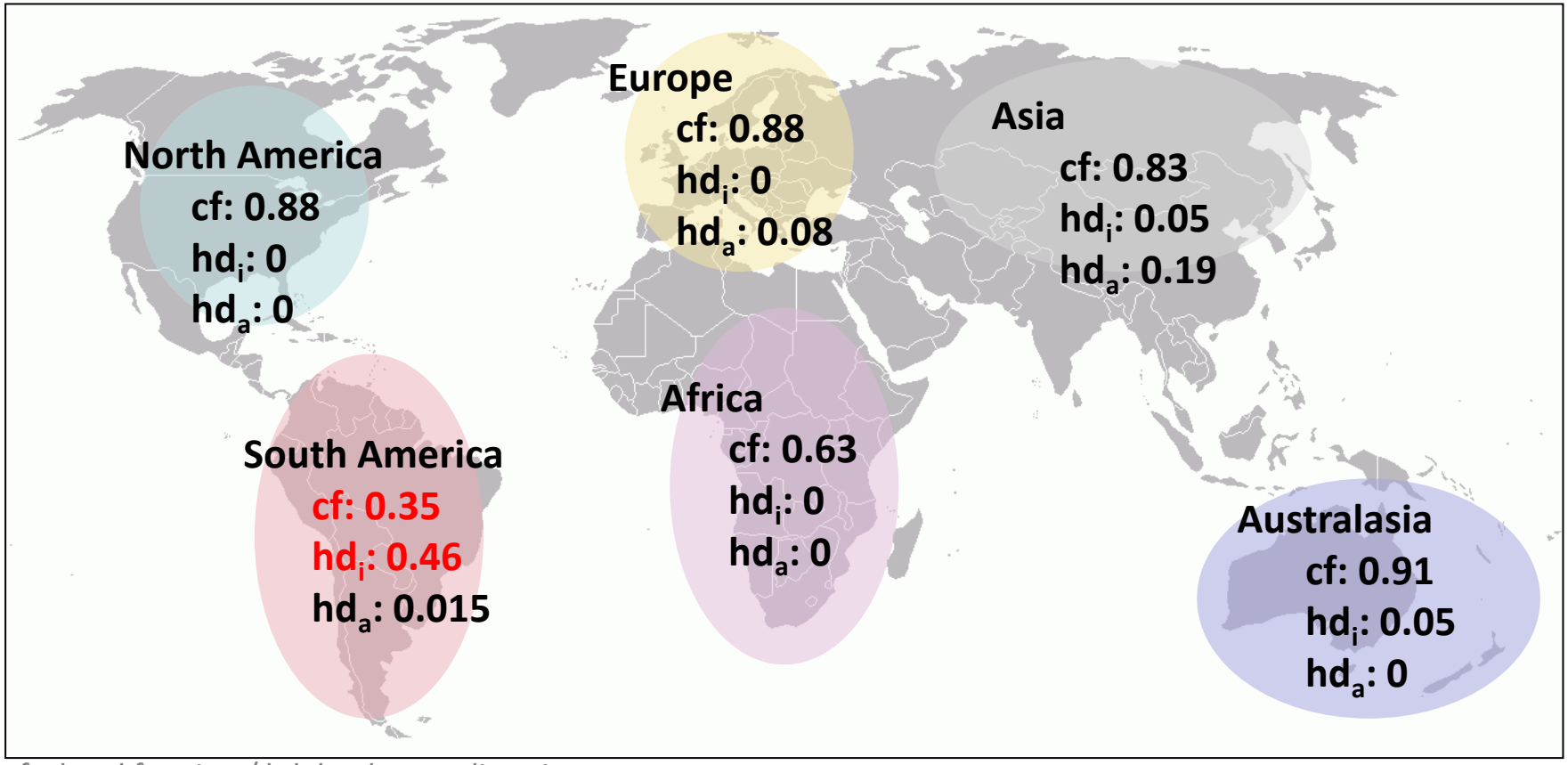
South America is the native region of *Spongospora*, were potato was domisticated



Results:

South American populations were consistently more divers compared to all other regions

South America: 127 (566) samples: 82 (49) MLGs / 17 out of 19 haplotypes

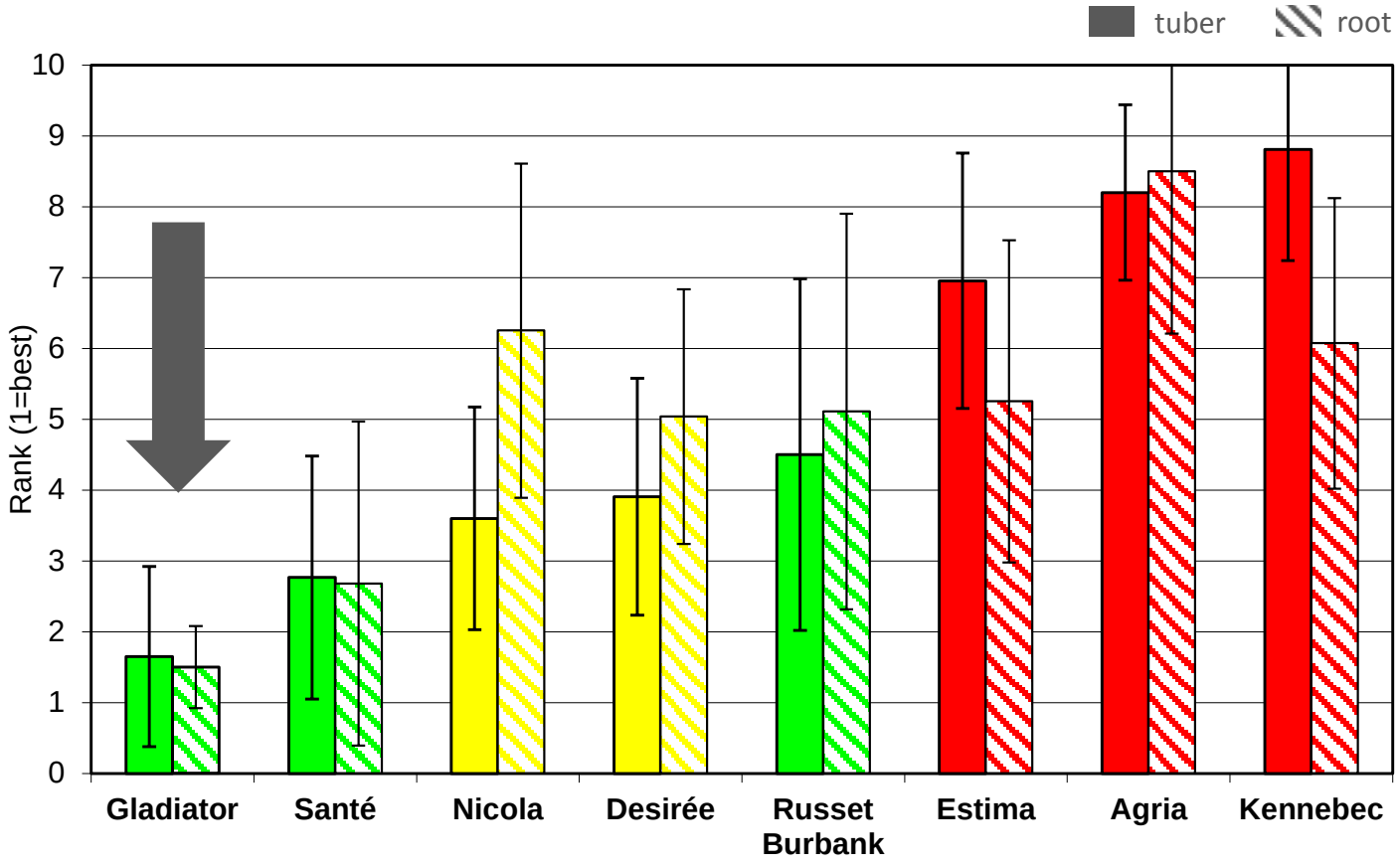


cf: clonal fraction / hd: haplotype diversity

The low global genetic diversity of *Spongospora subterranea* fsp *subterranea* allows potato breeders to select for resistance which is likely to be durable anywere.

Exception: South America

Cultivar ring-test: four years and six locations



Merz U., A. K. Lees, L. Sullivan, R. Schwärzel, T. Hebeisen, H. G. Kirk, K. Bouchek-Mechiche and H. R. Hofferbert (2012). Powdery scab resistance in Solanum tuberosum: an assessment of cultivar x environment effect. Plant Pathology 61(1), 29-36.

Cultivar behaviour different in SA daylength!

TABLE 2.—*Continued.*

CIP Accession	Cultivar or clone	Season					
		1987	1988	1989	1991	1992	1993
720127	Puebla	-	R	-	-	MR	-
720147	Americana INTA	-	-	-	MR	MR	-
800048	Desiré	-	-	-	MR	MR	-
800098	Kennebec	-	-	R	MR	-	-
800923	Spunta	-	-	R	-	-	MR
800934	MS-35.9	MR	-	-	-	MR	-

Torres *et al*., 1995

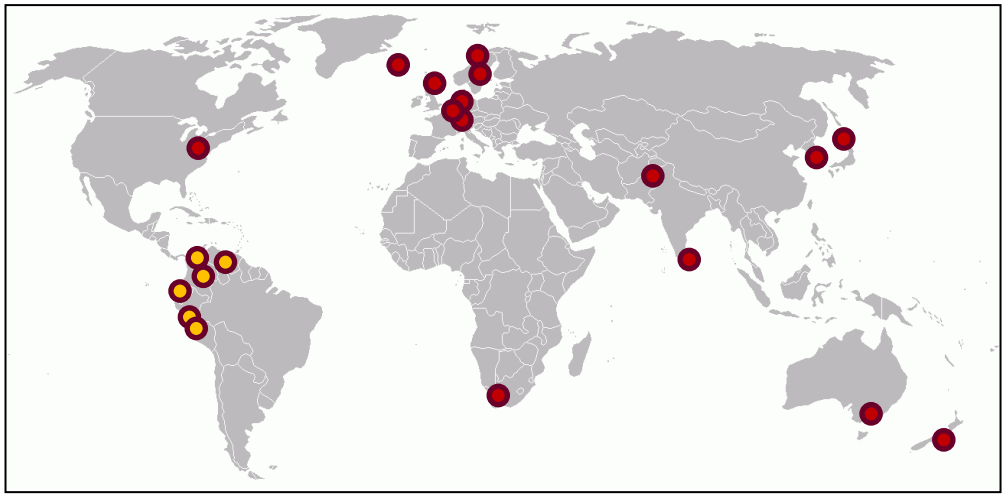
Mean powdery scab severity scores (9 = no tuber lesions; 0 = very heavily infected) for 133 potato cultivars and 18 germplasm lines (*) grown in disease assessment field trials from 1991/92 to 2010/11. Each line was tested over at least two growing seasons.

Very resistant		Moderately resistant		Moderately susceptible		Very susceptible	
Cultivar	Score	Cultivar	Score	Cultivar	Score	Cultivar	Score
Swift	9.0	Russet Burbank	7.9	2581.3*	6.9	Kennebec	5.9
Vtn62-33-3*	8.8	Highlander	7.9	Frisia	6.9	Concorde	5.9
Gladiator †	8.8	Ranger Russet	7.9	Bildtstar	6.9	Crebella	5.9

R. Falloon, P&F, NZ

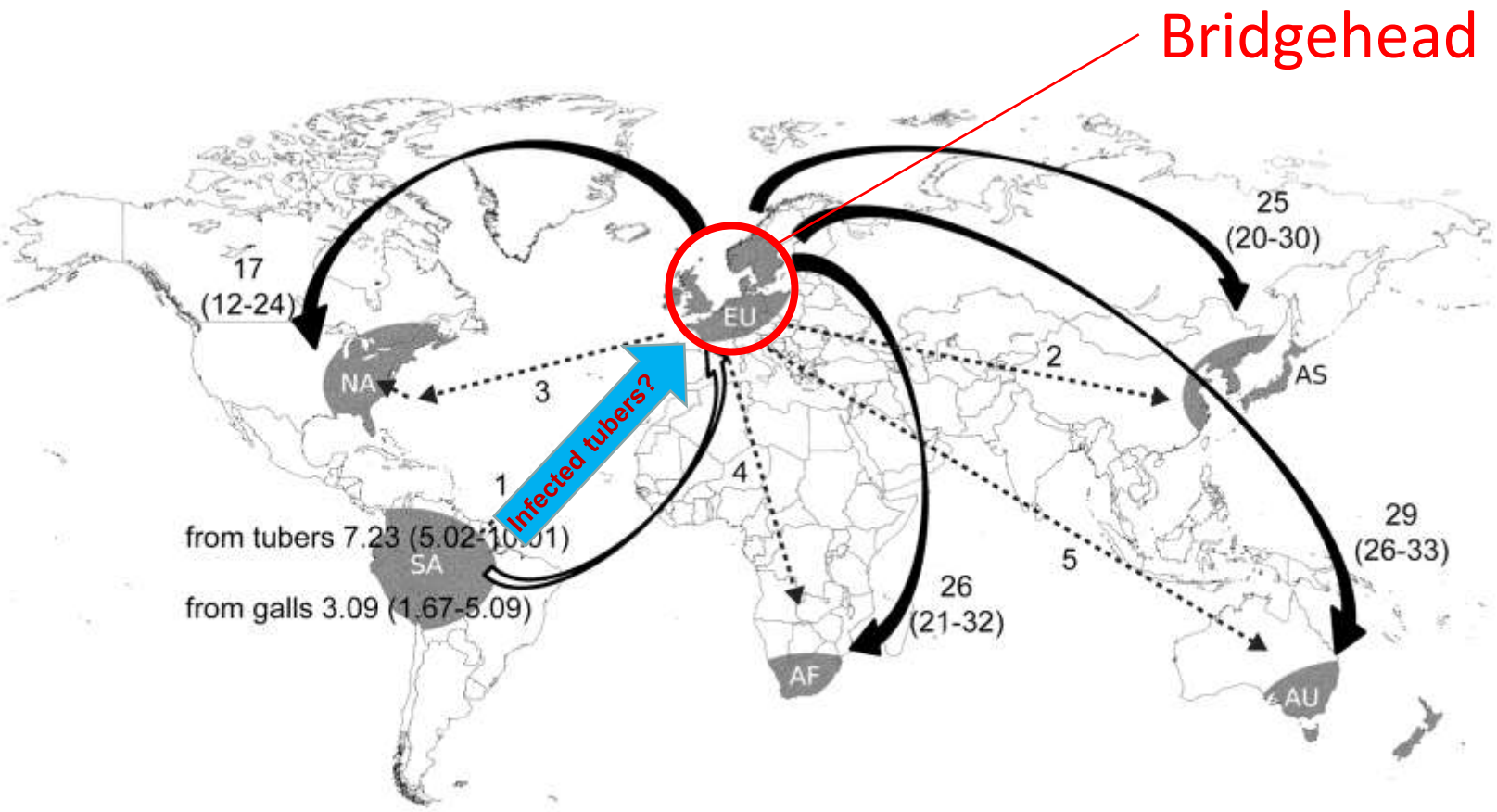
2. Hypothesis

Spongospora **was introduced to Europe through colonial trade (historical geneflow) and from there distributed to all other regions (recent geneflow)**



Migration history

Gene flow analysis

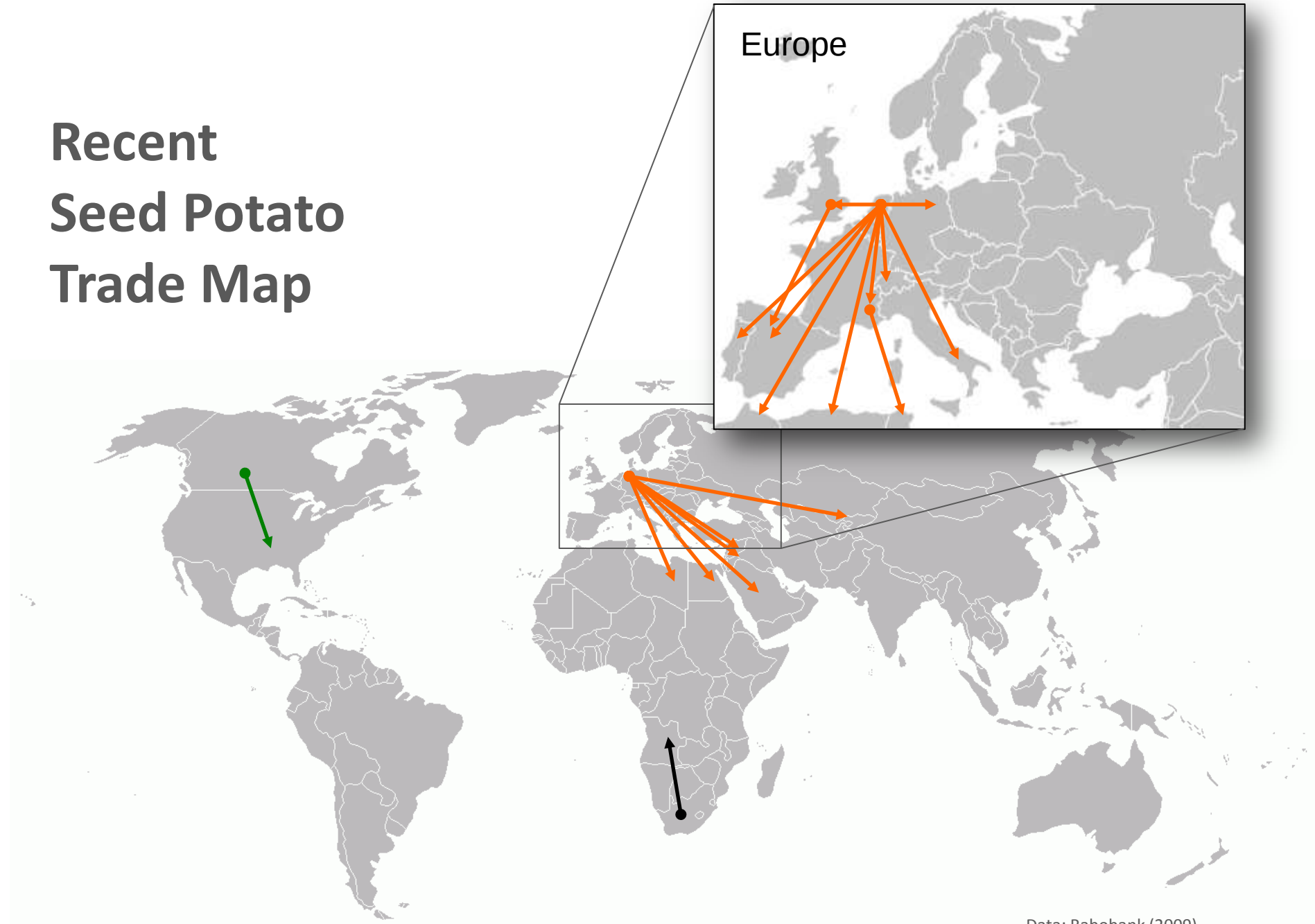


Historic gene flow
(conquistadores)

Founder population cut off from native region after one or few introduction events, limited genetic diversity

Recent gene flow
(colonialism, seed trade)

Recent Seed Potato Trade Map

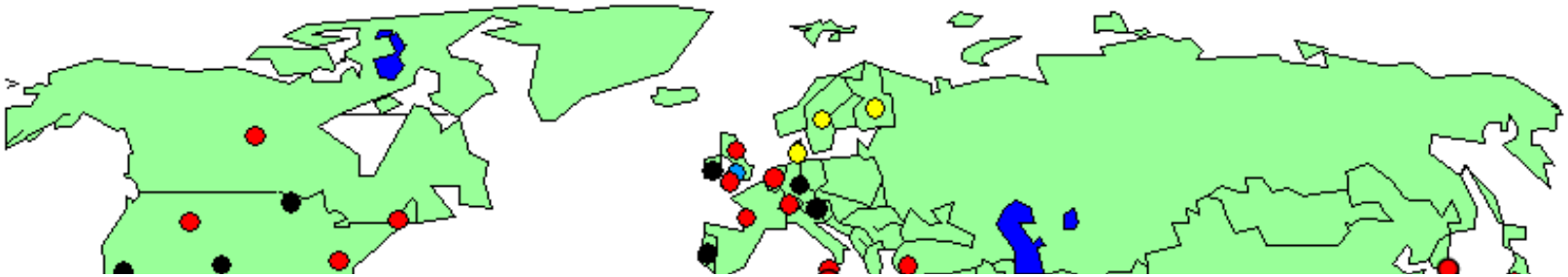


Arrows: Seed potato trade > 10,000t

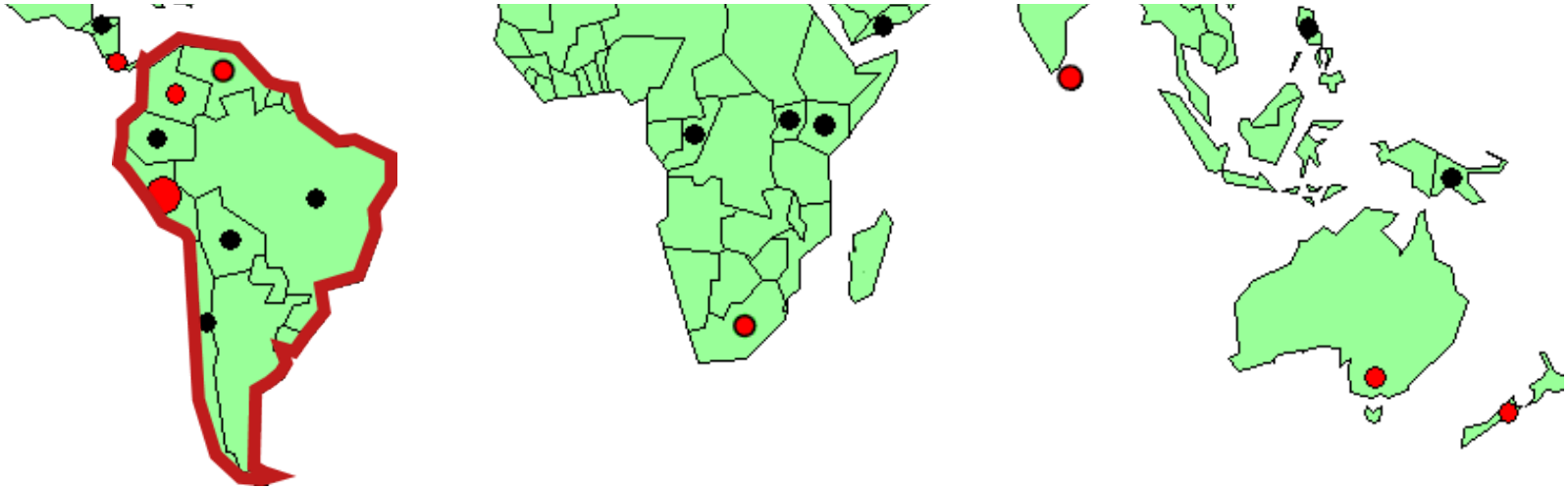
Data: Rabobank (2009)

Powdery scab occurs worldwide

New introductions from South America have to be avoided



Strict quarantine measures are needed



Research history Report history

Gau RD, Merz U, Falloon RE, Brunner PC (2013) Global Genetics and Invasion History of the Potato Powdery Scab Pathogen, *Spongospora subterranea* f.sp. *subterranea*. PLoS ONE 8(6): e67944. doi:10.1371/journal.pone.0067944

Inoculation experiment cv Agria

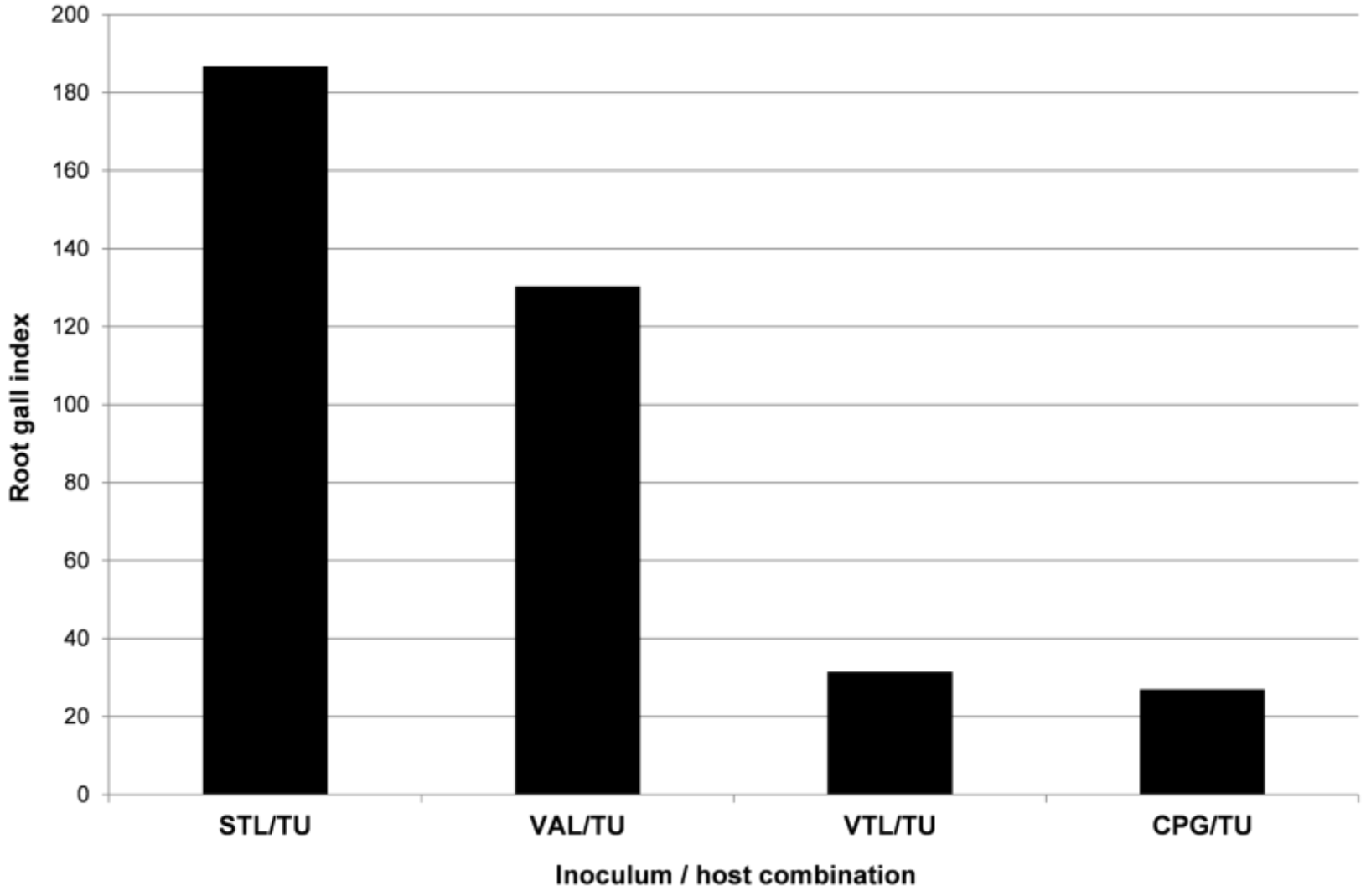
Inoculation experiment

inoculum – host combinations

Inoculum source	Inoculum ID	Host	Cultivar
Colombia *S. phureja* galls	CPG	*S. tuberosum* ssp. *tuberosum* *S. phureja*	'Agria' 'Shaucha Amarilla'
Switzerland *S. tuberosum* ssp. *tuberosum* galls	STG	*S. phureja*	'Shaucha Amarilla'
Switzerland *S. tuberosum* ssp. *tuberosum* tuber lesions	STL	*S. tuberosum* ssp. *tuberosum* *S. tuberosum* ssp. *andigena*	'Agria' 'Pardo pastusa'
Venezuela *S. tuberosum* ssp. *tuberosum* tuber lesions	VTL	*S. tuberosum* ssp. *tuberosum* *S. tuberosum* ssp. *andigena*	'Agria' 'Pardo pastusa'
Venezuela *S. tuberosum* ssp. *andigena* tuber lesions	VAL	*S. tuberosum* ssp. *tuberosum* *S. tuberosum* ssp. *andigena*	'Agria' 'Pardo pastusa'

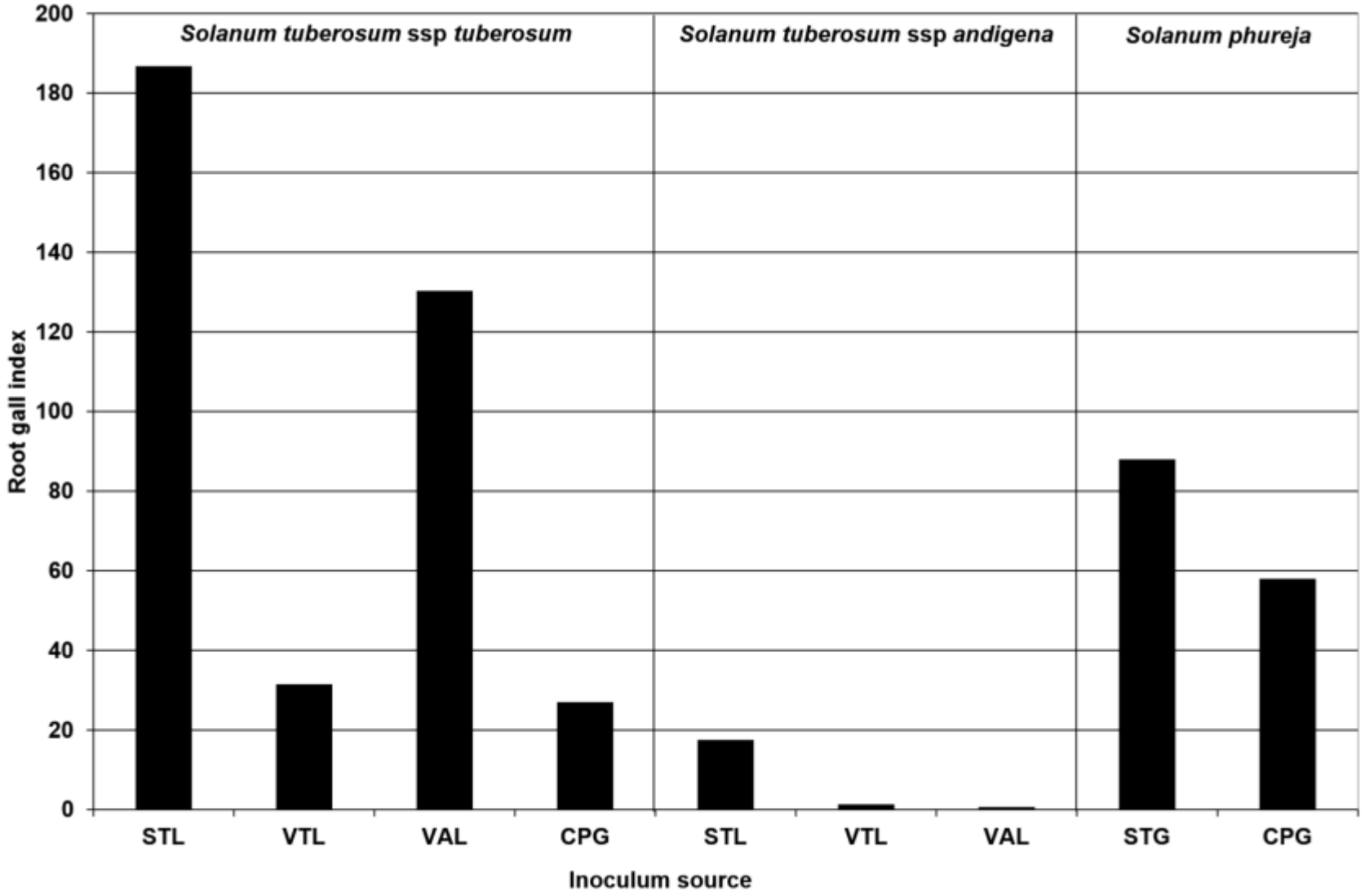
Inoculation experiment

results: root galling on cv Agria



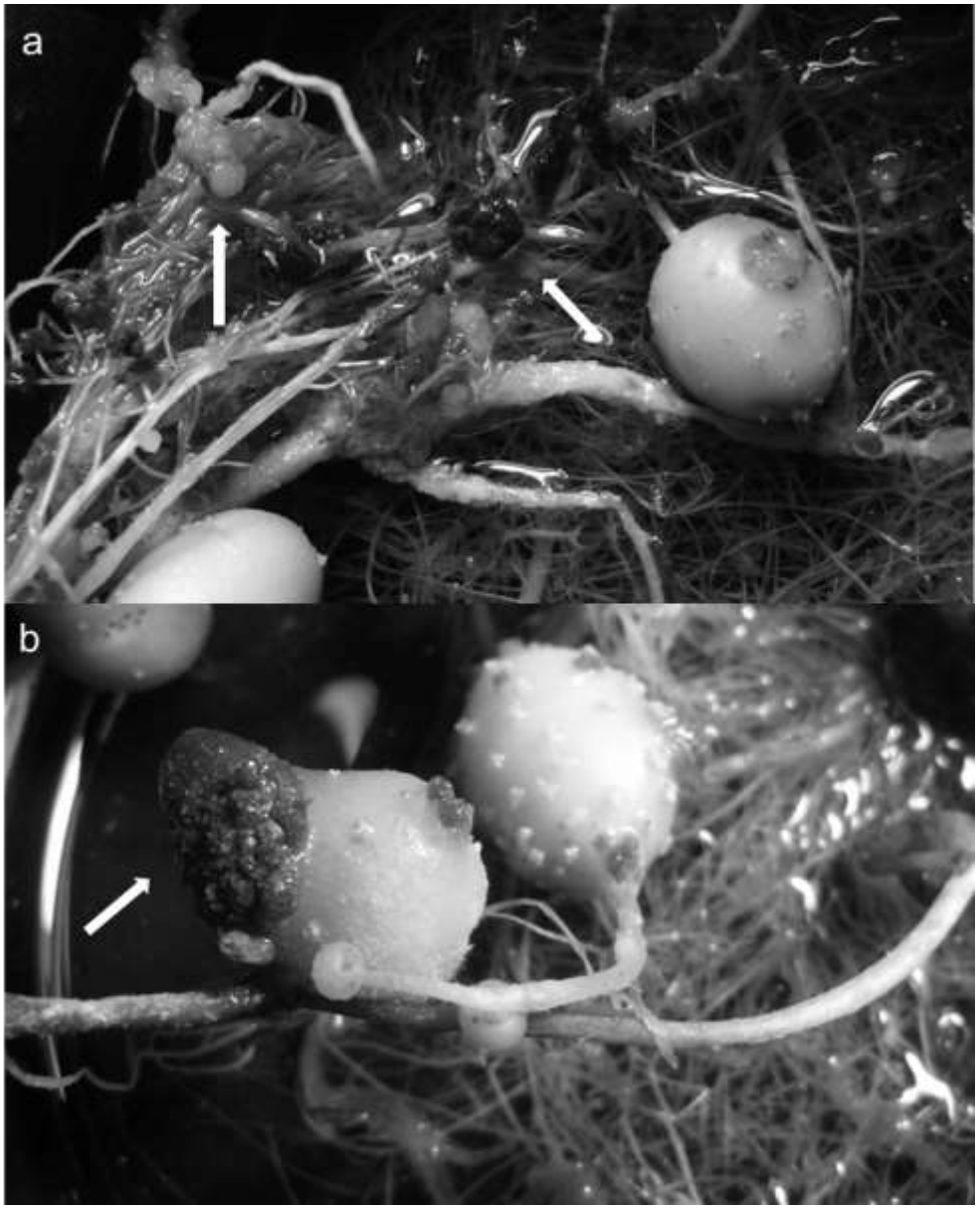
Inoculation experiment

results: root galling - all



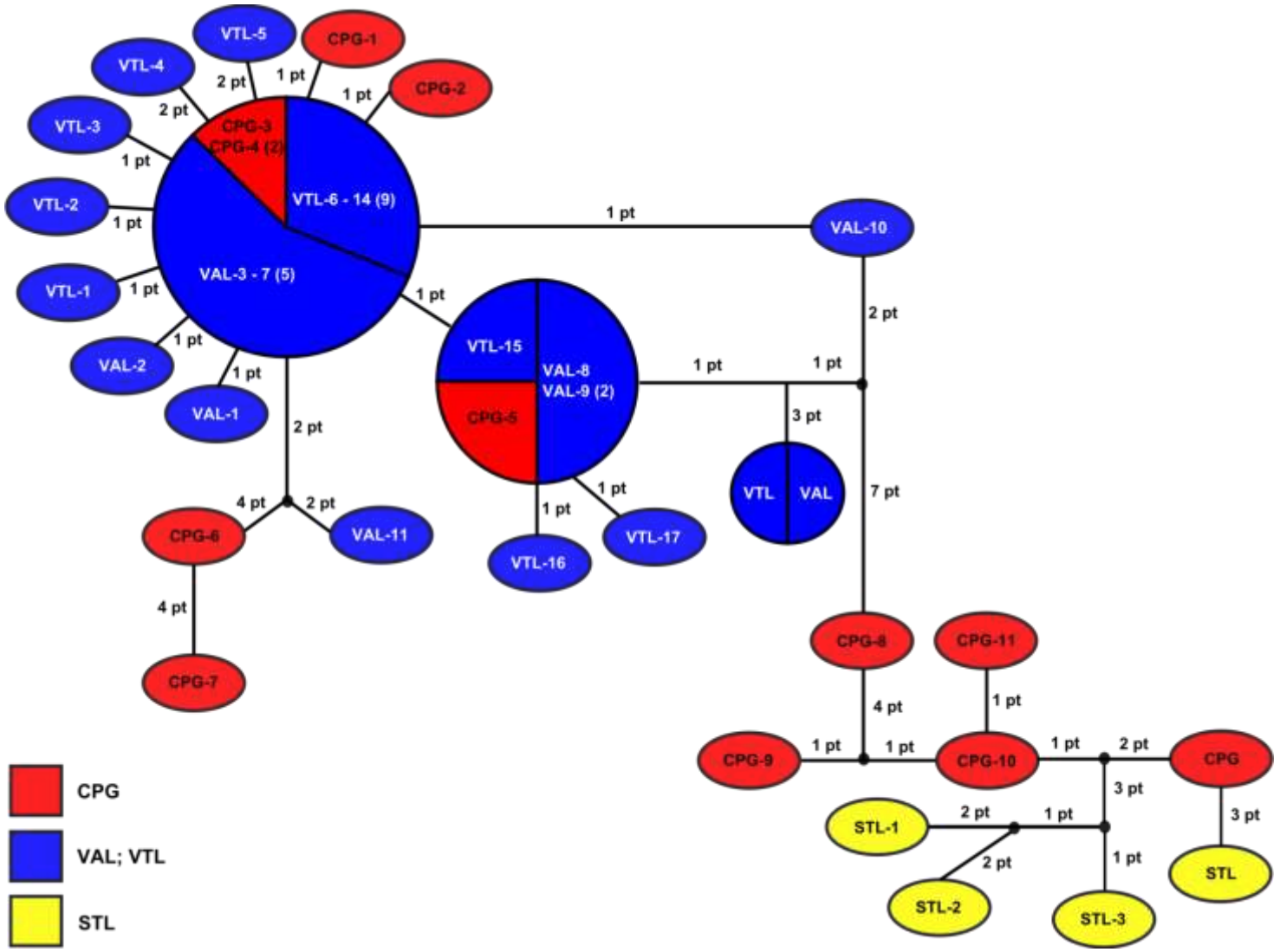
Inoculation experiment

results: root galling – tuber lesions



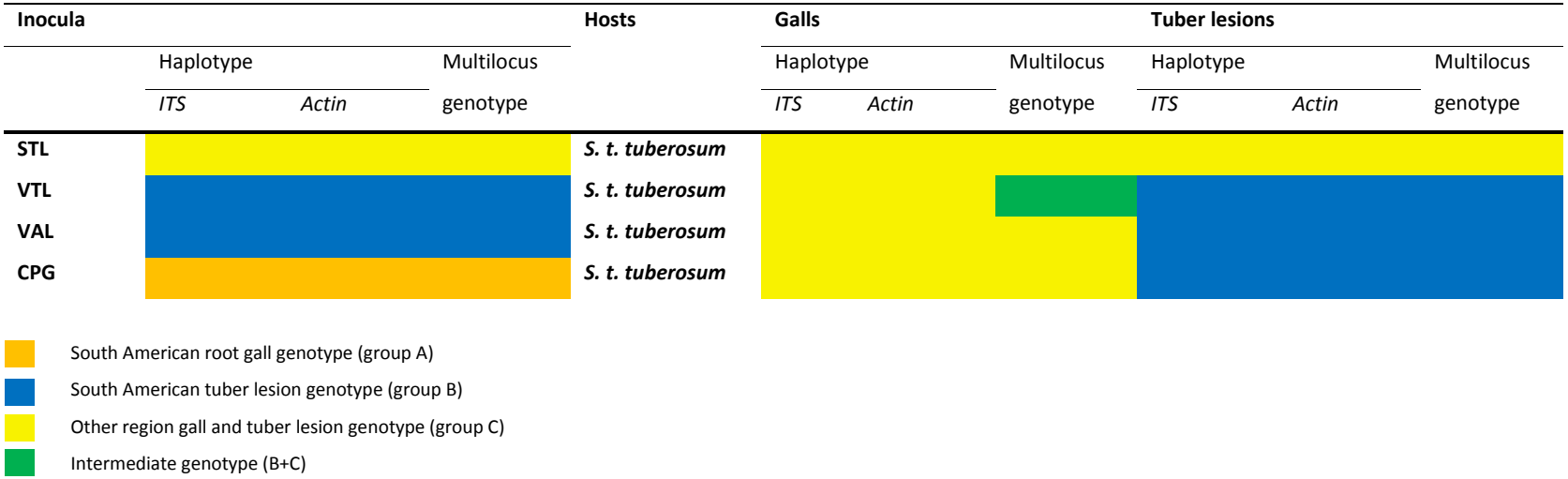
Inoculation experiment

results: haplotype network of ITS fragments of inocula



Inoculation experiment

results: genotype pattern of inocula, galls and lesions



Inoculation experiment

final conclusions

- The bioassay allows assessment of:
  - zoosporangial root infection (7d)
  - root gall infection (65d), and
  - tuber production and infection (95d)

- Group C strains are best adapted to worldwide long-day *Tuberosum*
- Group C inoculum again shows the least genotypic diversity
- Risk of invasion of group A and B inoculum exists – impact?
- Genotype shifts – organ specific genotype selection?

Inoculation experiment

final conclusions