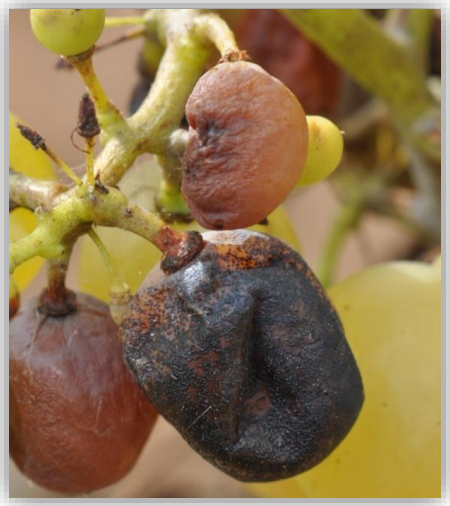
Ludger Hausmann
JKI Institute for Grapevine Breeding
Geilweilerhof

Developing tools and resources for breeding grapevines resistant to black rot or phylloxera



Objectives & Outline

- Identification of **novel sources of black rot resistance**
  - Production of *in vitro* inoculum
  - Establishment of a resistance test
  - Assessment of resistance level
  - Elaborate possibilities for a black rot resistance *in vitro* bioassay
  - Screening of a diverse set of plants

  In cooperation with Pál Kozma, PTE, Hungary
- Identification of **novel sources of phylloxera resistance**
  - Development of a resistance test
  - Screening of a diverse set of plants

  In cooperation with Nathalie Ollat, INRA, France

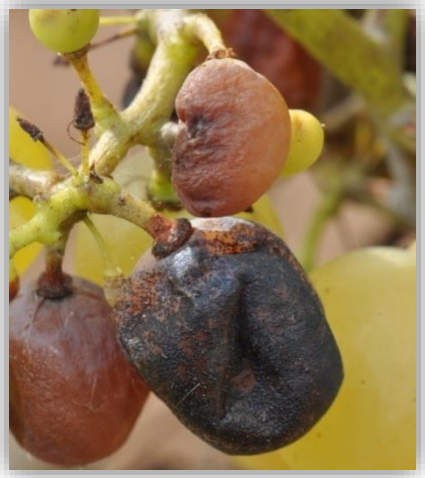
Black Rot

- *Guignardia bidwellii* (Ellis)
  [*Phyllosticta ampelicida*]
- Hemibiotrophic ascomycete
- Serious disease in humid and warm regions
- Can infect all young green parts of a vine
- First symptoms 11 to 14 dpi

black rot on leaves . . .

Black Rot

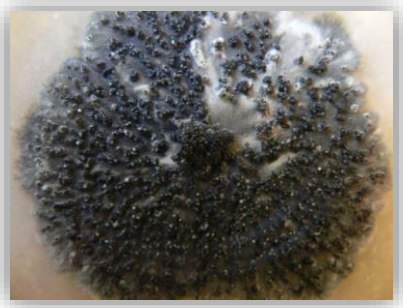
- Native to North America, introduced to Europe in 1885
- Meanwhile increasing problem in AT, FR, DE, HU, IT, LU, PT, RO, CH
- Since 2002 severe loss of yield in some regions of Germany (organic farming!)
- New mildew tolerant cultivars may suffer from reduced plant protection

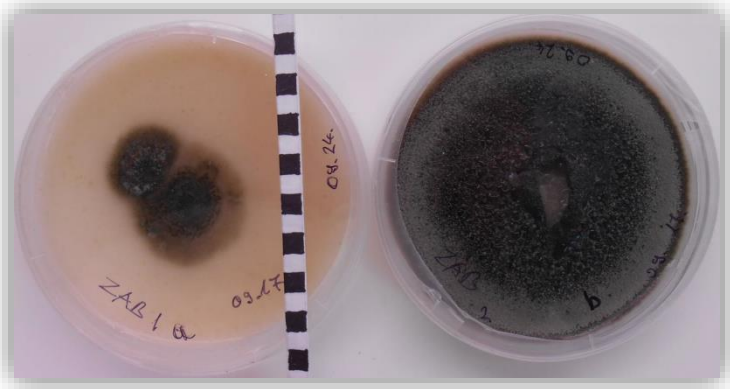


. . . on berries

Production of *in vitro* inoculum

Propagation on oatmeal agar





0% 10%

Grapevine must

Mass spore production for large screenings

Establishment of a resistance test

- Plastic bag experiments in the field . . .
- . . . or in the greenhouse on potted plants

Establishment of a resistance test

- Experiments in climate chambers

- independent of weather conditions
- best control of humidity and temperature

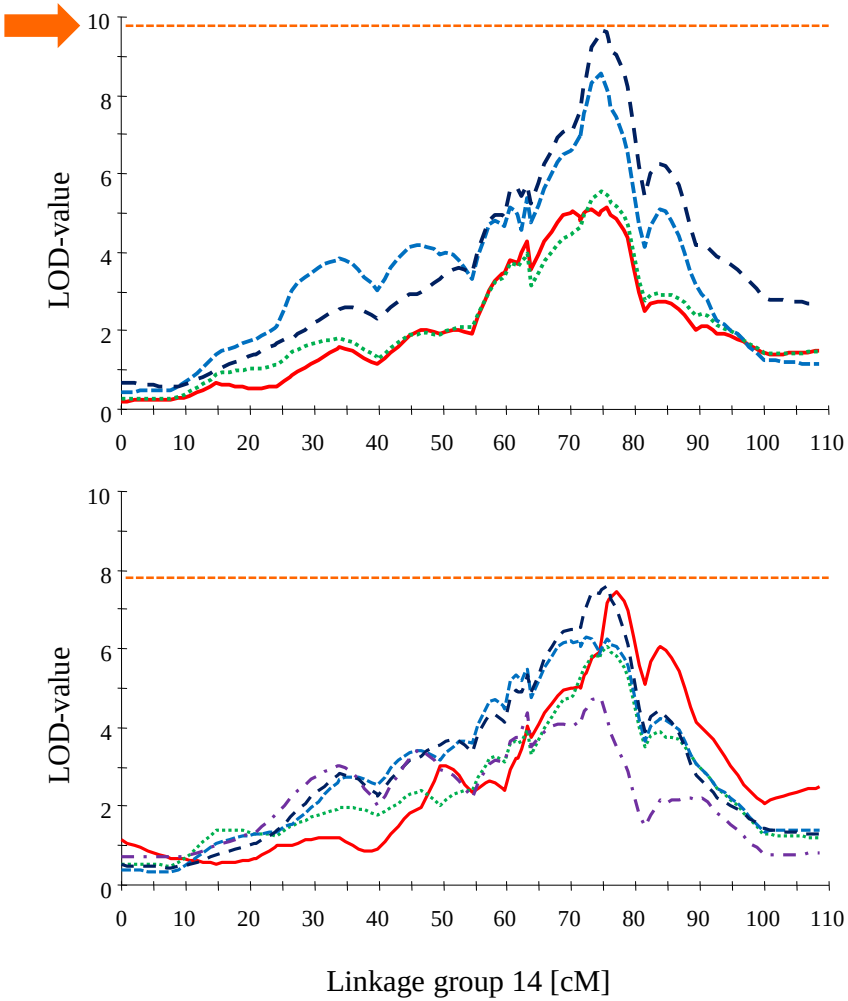
- potted plants needed
- space is limited
- spore production for inoculum

Assessment of a resistance level

Evaluation of 9 different rating systems

Infection in %	———
Maximal value	·····
Infected leaves	– – –
5 classes	– – –

Time course	———
Existence of pycnidia	·····
Quality of lesions	– – –
4 classes	– – –
2 classes	– · – ·



Assessment of a resistance level

Class of resistance		definition
1	very low	Many lesions or extensive lesions up to totally affected leaves with pycnidia on almost all leaves
3	low	Several lesions with pycnidia on two or more leaves
5	medium	Few lesions with several pycnidia (< 2 cm), one or two leaves show symptoms
7	high	One lesion with a diameter of less than 2 cm – no pycnidia
9	very high	No visible symptoms

1 **3** **5** **7** **9**

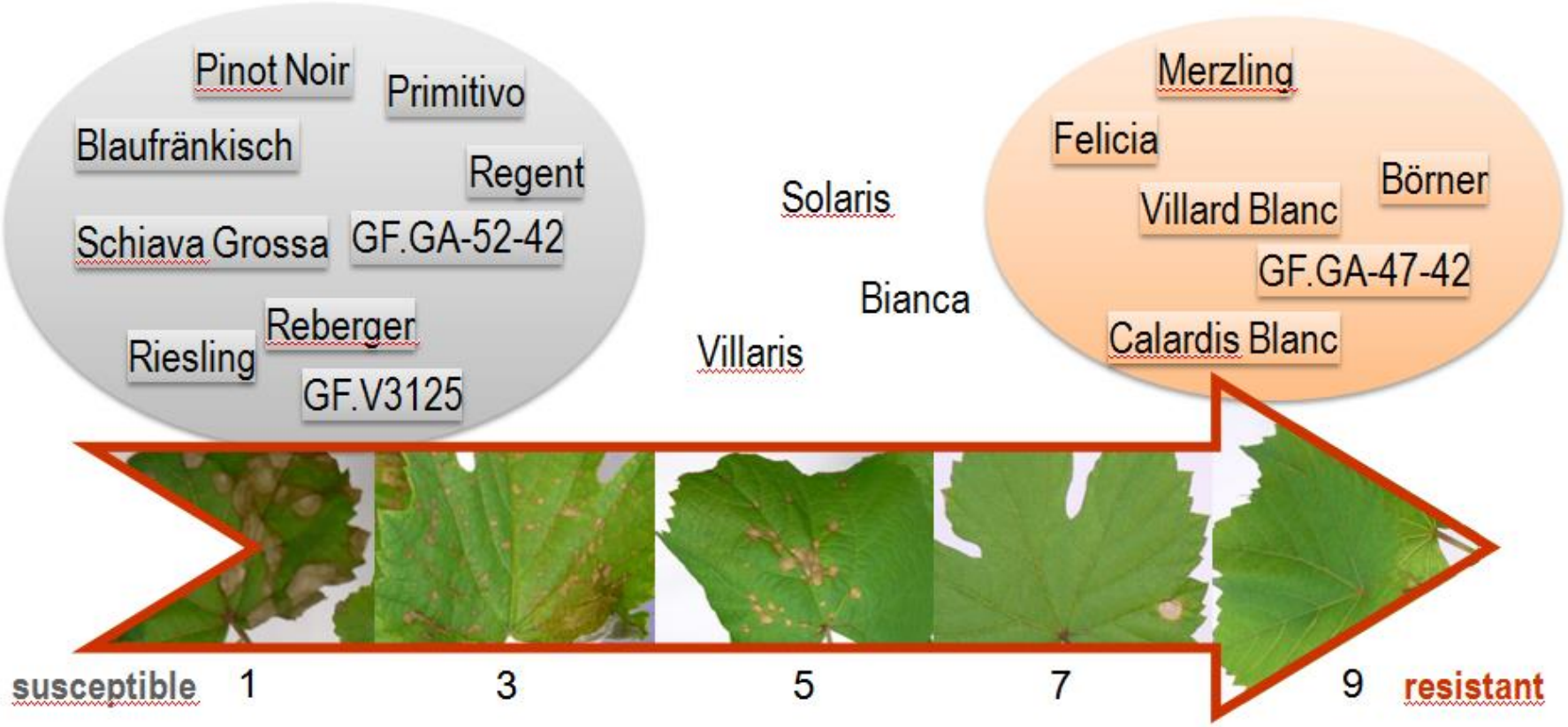
Alternative in vitro bioassays?

- Leaf discs or detached leaves
  - In/on water or agar
  - Eppendorf tubes, Petri dishes, test glasses, plastic grid above water basin,
  - Spores, mycelium, injuries, Ca^{++}, Kinitin

No black rot infection even after 3 weeks!

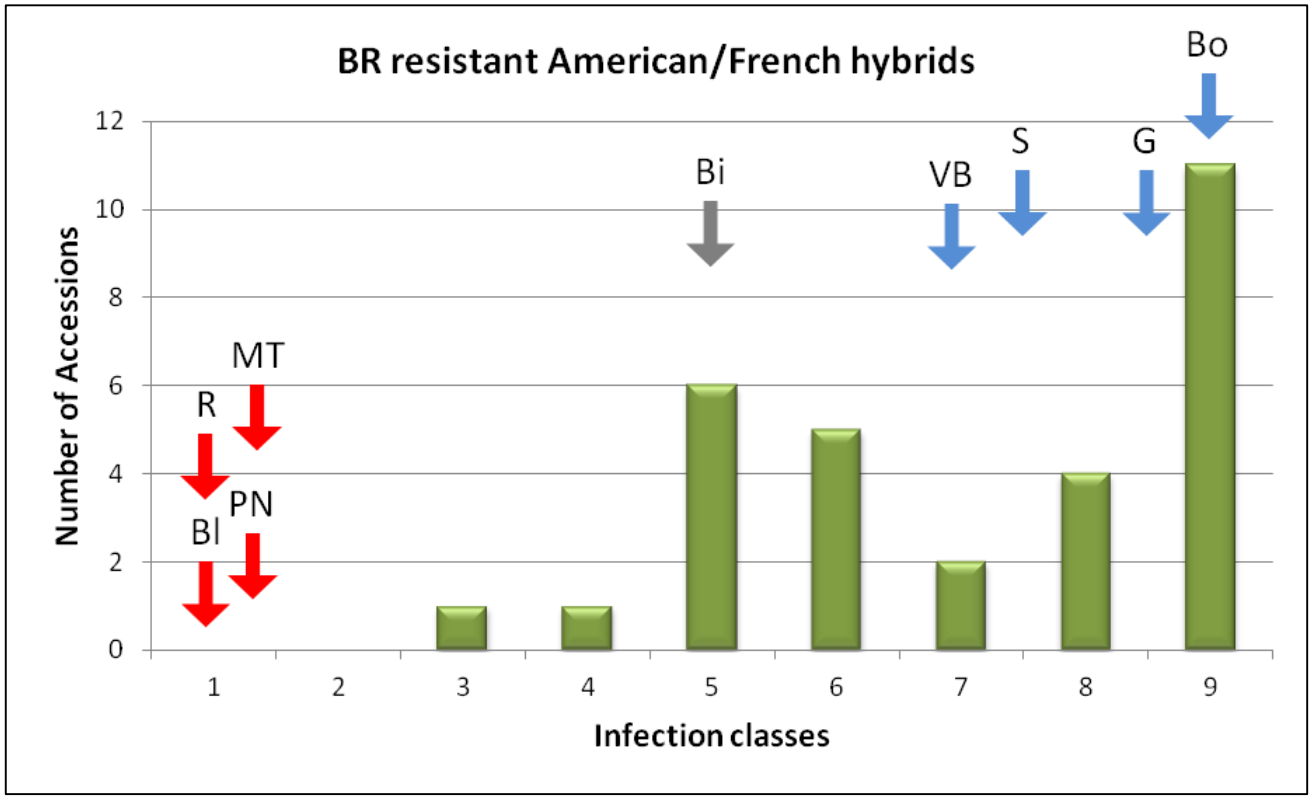
Results – Screening for BR resistant accessions

- Some traditional varieties, new cultivars and breeding lines



Results – Screening for BR resistant accessions

- Frequency of distribution of 30 tested American/French hybrids

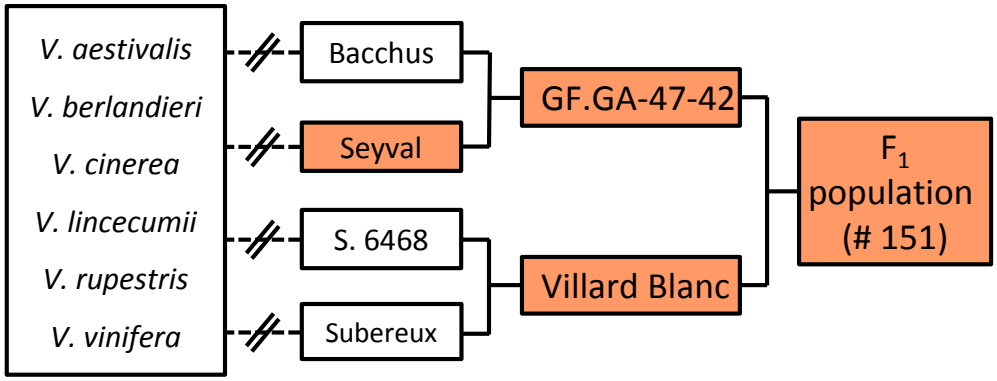


Variety (scores 8 - 9)
Etta
Beta
Rommel
Champanel
Cloeta
De Chaunac
Fredonia
Missouri Riesling
Xlnta
Carman
Chancellor
Clinton
Hanover
Ironclad
Suelter

Controls: Bl=Blaufraenkisch, MT=Mueller-Thurgau, PN=Pinot Noir, R=Riesling, Bi=Bianca, Bo=Boerner, G=GF.GA-47-42, S=Seyval, VB=Villard Blanc

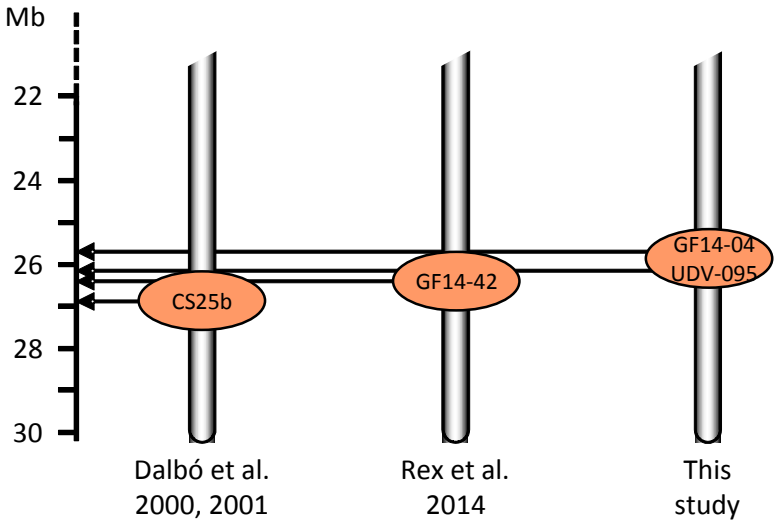
Results – Screening for BR resistant accessions

- Mapping of BR resistance in a biparental population



- Both parents show high BR tolerance
- Pyramided resistance expected in F1

- Several resistance loci detected scattered over the entire genome
- One major QTL found on chr. 14
- Two other BR QTLs already found in this genomic region



Results – Screening for BR resistant accessions

- 110 *V. vinifera* cultivars and interspecific hybrids

  9 accessions showed high 9 moderate leaf resistance

No	Accession Name	Type / Origin	Partner	# Tests	Level of Resistance	Comment
1	Börner	rootstock	PTE	6	9	
2	Csillám	Franko-American hybrids x Vvi_v	PTE	6	9	no symptoms
3	Seibel 7053	Franko-American hybrids	PTE	6	9	rotted berries
4	M. rotundifolia n.1	M. rotundifolia seedling	PTE	4	9	
5	Seyve-Villard 5276	Franko-American hybrids	PTE	6	7-9	superficial spots on berries
6	15-7-1	Vam x Vvi_v F2	PTE	2	9	mummies and rotted berries
7	5-10-6	Vam x Vvi_v F2	PTE	4	9	superficial spots on berries
8	5-11-6	Vam x Vvi_v F2	PTE	2	9	superficial spots on berries
9	5-16-3	Vam x Vvi_v F2	PTE	2	9	rotted berries
10	Teréz	Franko-American hybrids x Vvi_v	PTE	6	7	rotted berries
11	5-11-2	Vam x Vvi_v F2	PTE	6	7	few peeling spots on berries
12	Felicia	new variety	PTE	6	5-7	no symptoms
13	Malverina	Franko-American hybrids x Vvi_v	PTE	6	5-7	rotted berries
14	Merzling 13-12-9	new variety x Vvi_v	PTE	6	5-7	few peeling spots on berries
15	Villaris	new variety	PTE	6	5-7	
16	GM 318-57 239 F2	Franko-American hybrids x Vvi_v	PTE	6	5	rotted berries
17	Seyve-Villard 12375	Franko-American hybrids	PTE	6	5	mummies and rotted berries
18	Seyve-Villard 18315	Franko-American hybrids	PTE	4	5	mummies and rotted berries

Results – Screening for BR resistant accessions

- A collection of 58 *V. vinifera* cultivars of Georgian origin

  2 accessions showed moderate resistance

No	Accession Name	Type / Origin	Partner	# Tests	Level of Resistance	Comment
1	Muradouli	Georgian *V. vinifera* cv	PTE	4	4	
2	Ojaleshi	Georgian *V. vinifera* cv	PTE	4	4	

Results – Screening for BR resistant accessions

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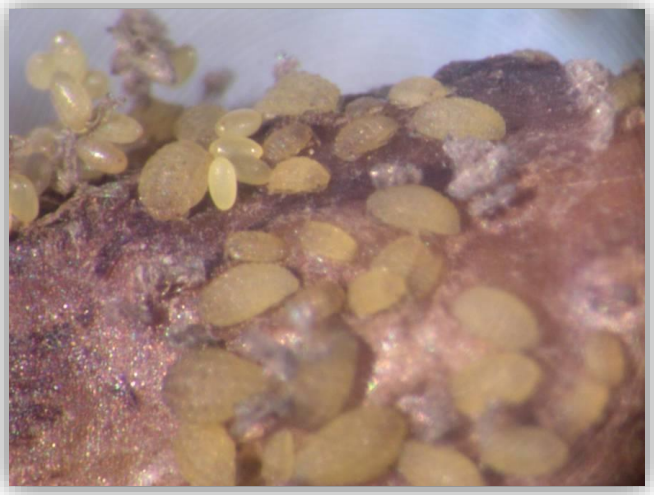
- A segregating population of (*V. cinerea* 6524-219 x Tannat) F2
  - Black rot resistance transmitted by *V. cinerea*
  - 308 seedlings of F2 two times tested
  - Segregation ratio was about 1:1
  - Expectation of at least 2 genes, both confer high level of resistance

Phylloxera

- *Daktulosphaira vitifoliae* (Fitch)
  Aphid-like insect
- Introduced to Europe around 1863
- Attacks roots
  - Nodosities on root tips
  - Tuberosities on older roots
- Secondary fungal infections
  → root rot → death
- Grafting scion on rootstocks
- Rootsocks are tolerant not resistant
- Small genetic basis



Development of a resistance test

- Potted plants (woody cuttings → triplicates, 4 years)
- Inoculation with eggs → soil, close to roots
  - Pcf7 strain, closed container (INRA)
  - From galls, open pots (JKI)
- Controls: Boerner (R), Pinot Noir (S)

INRA, D. Papura

Assessment of a resistance level

- Determing the number of nodosities for each plant

Results – Screening for DV resistant accessions

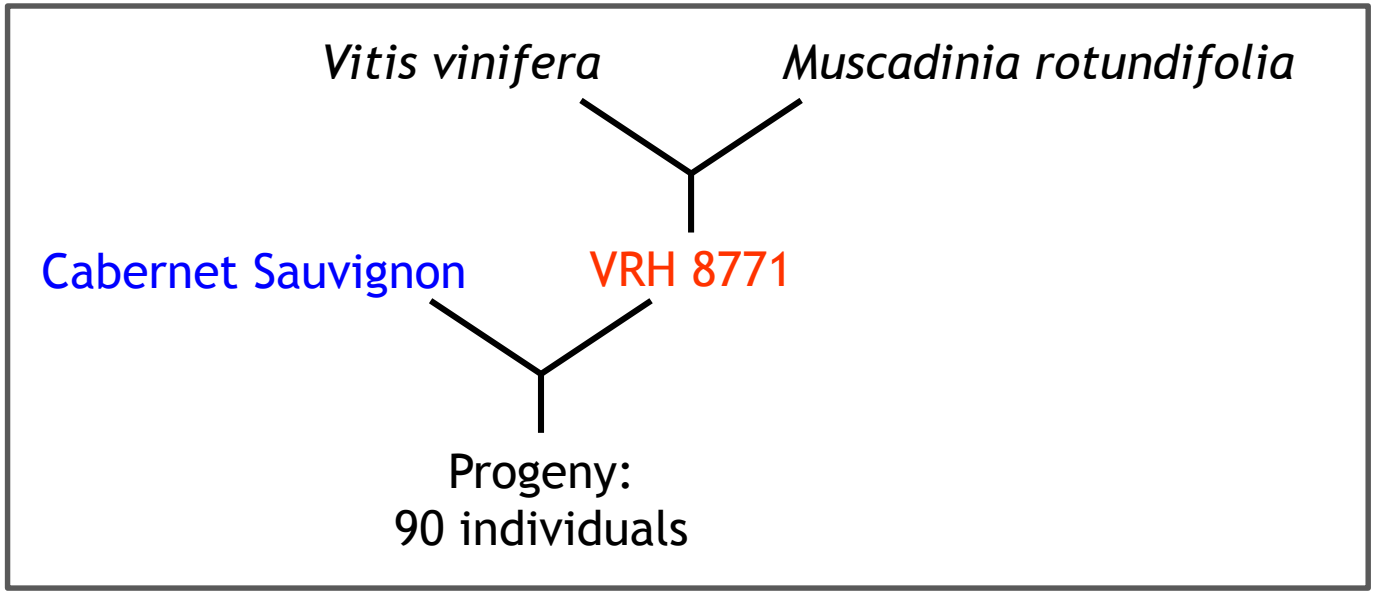
- 19 accessions of *V. aestivalis* (2015)

No	Accession name	Species	Partner	# Tests	Level of Resistance	Comment
1	AESTIVALIS GF 02	Vae	JKI	1	1,0	
2	AESTIVALIS GF 04	Vae	JKI	1	1,0	
3	AESTIVALIS GF 06	Vae	JKI	1	1,0	
4	AESTIVALIS GF 07	Vae	JKI	1	1,0	
5	AESTIVALIS GF 11	Vae	JKI	1	1,0	
6	AESTIVALIS GF 12	Vae	JKI	1	1,0	
7	AESTIVALIS GF 13	Vae	JKI	1	1,0	
8	AESTIVALIS GF 14	Vae	JKI	1	1,0	
9	AESTIVALIS GF 17	Vae	JKI	1	1,0	
10	AESTIVALIS GF 18	Vae	JKI	1	1,0	
11	AESTIVALIS GF 19	Vae	JKI	1	1,0	
12	AESTIVALIS GF 22	Vae	JKI	1	1,0	
13	BOERNER	Vci, Vri	JKI	1	1,0	reference
14	AESTIVALIS GF 03	Vae	JKI	1	1,3	
15	AESTIVALIS GF 15	Vae	JKI	1	1,3	
16	AESTIVALIS GF 23	Vae	JKI	1	1,3	
17	AESTIVALIS GF 01	Vae	JKI	1	1,7	
18	AESTIVALIS GF 20	Vae	JKI	1	2,0	
19	GF.V3125	Vvi_v	JKI	1	2,4	reference
20	PINOT NOIR	Vvi_v	JKI	1	2,5	reference
21	AESTIVALIS GF 05	Vae	JKI	1	3,0	
22	AESTIVALIS GF 10	Vae	JKI	1	3,0	

1 = no nodosities
2 = up to 10 nodosities
3 = 11-30 nodosities
4 = > 30 nodosities

Results – Screening for DV resistant accessions

- Mapping of phylloxera resistance in Muscadinia



  - Phenotyping of the entire progeny
  - Development of a genetic map

For details → poster Lalanne-Tisné, G. et al.

Thank you for your attention

- JKI Institute for Grapevine Breeding Geilweilerhof, Siebeldingen, Germany
  - Friederike Rex
  - Rudolf Eibach
  - Reinhard Töpfer
- PTE, University of Pécs, Research Institute of Viticulture and Enology, Pécs, Hungary
  - Pál Kozma
- INRA UMR EGFV, ISVV, Villenave d'Ornon, France
  - Nathalie Ollat
- EU for funding

Wine tasting – tomorrow afternoon

- Two new bred cultivars with high black rot tolerance

‘Felicia‘

Gf. 1993-22-06 (‘Calardis Blanc‘)