Julius Kühn-Institut
Bundesforschungsinstitut für Kulturpflanzen
Federal Research Centre for Cultivated Plants

Needs for new disease resistance

Reinhard Töpfer and Rudolf Eibach

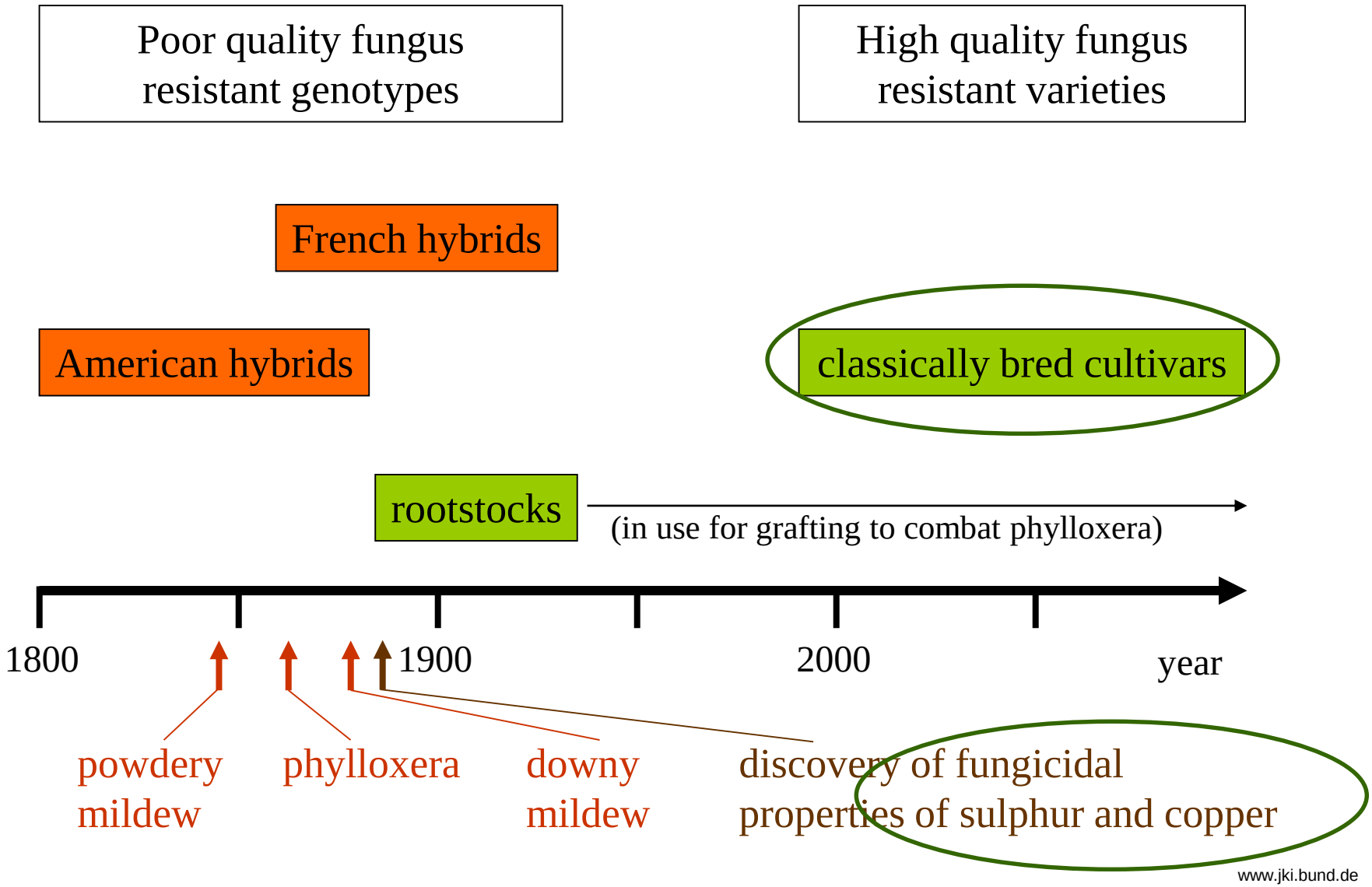
Institute for Grapevine Breeding Geilweilerhof

www.jki.bund.de

powdery mildew

downy mildew

Milestones in Grapevine Breeding



Occurrence of Fungicide Resistances

(according to HG Hewitt (1998) Fungicides in Crop Protection, modified by Deising et al.)

Class of Fungicides	First occurrence of resistance	Years prior to occurrence of resistance	Pathogen
Organic mercury	1964	40	*Pyrenophora avenae*
Benzimidazole	1970	2	*Venturia inaequalis, Botrytis cinerea*
Phenylamide	1980	2	*Phytophthora infestans, Plasmopara viticola*
Dicarboximide	1982	5	*Botrytis cinerea*
DMIs	1982	4	*Blumeria graminis*
Carboxanilide	1986	14	*Ustilago nuda*
Morpholine	1994	34	*Blumeria graminis*
Strobilurine	1998	2	*Blumeria graminis* f.sp. *tritici*

Grapevine Resistance Breeding

cultivated ***Vitis vinifera***

- **High quality**
- **No mildew resistance**

e.g. `Müller-Thurgau´

Vitis wild species

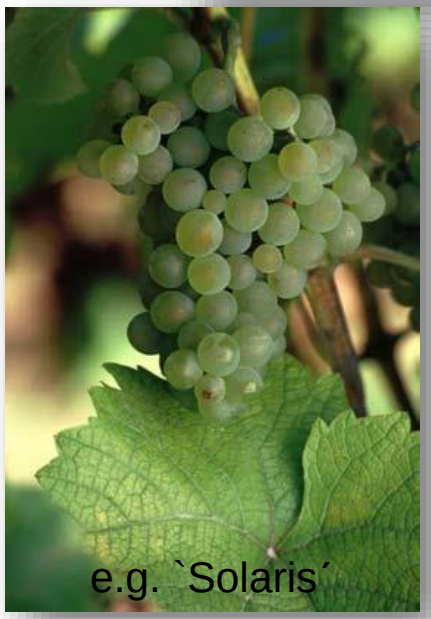
- **Poor quality**
- **High mildew resistance**

e. g. *Vitis amurensis*

Repetitive pseudo backcrosses using various *V. vinifera* cultivars

New cultivars

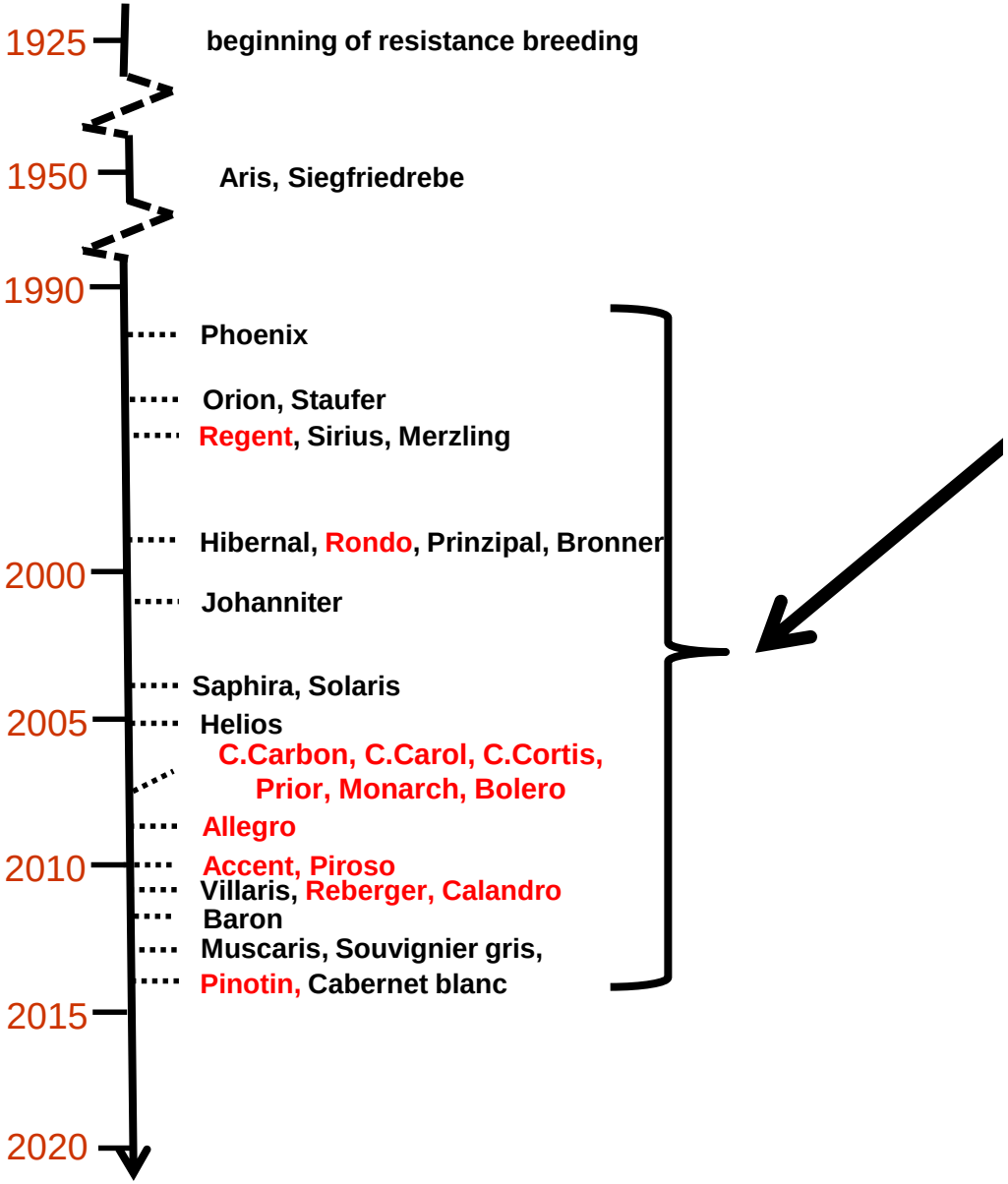
- **High quality**
- **High mildew resistance**



e.g. `Solaris´

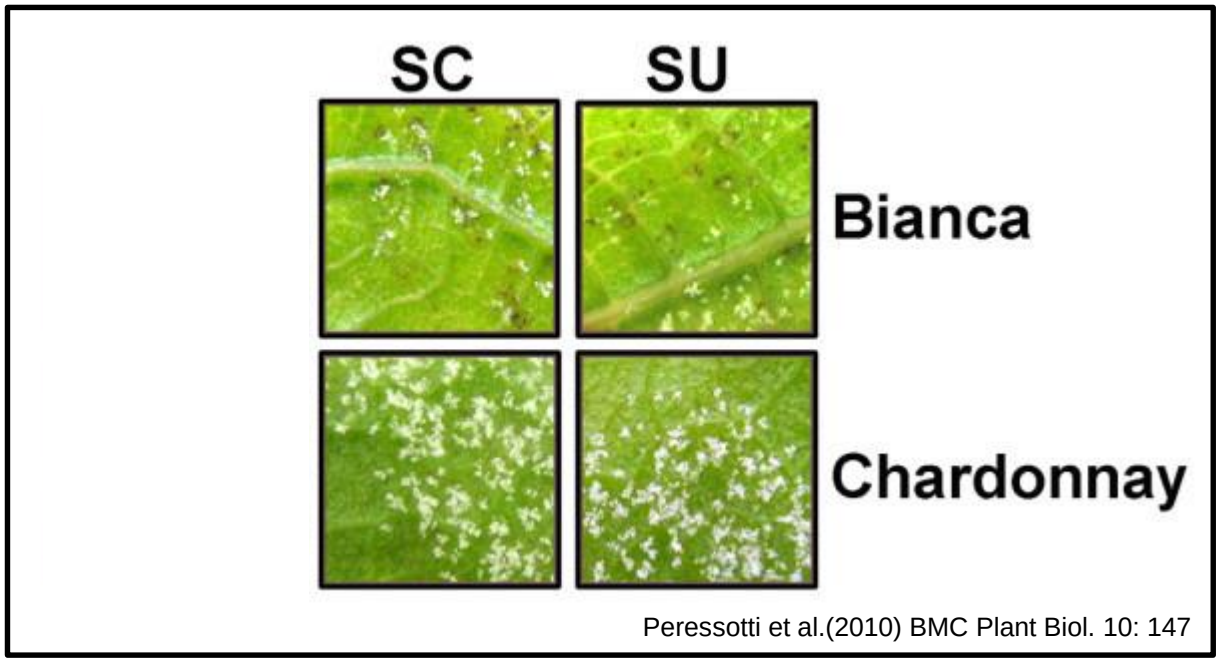
(Breeder WBI Freiburg)

Resistance Breeding in Germany

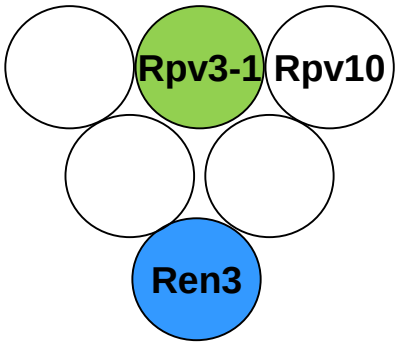


Durability of resistances

Plasmopara viticola (downy mildew) 6 dpi



Peressotti et al.(2010) BMC Plant Biol. 10: 147

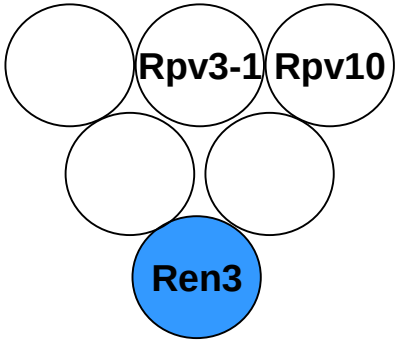


Bianca

Isolate SL

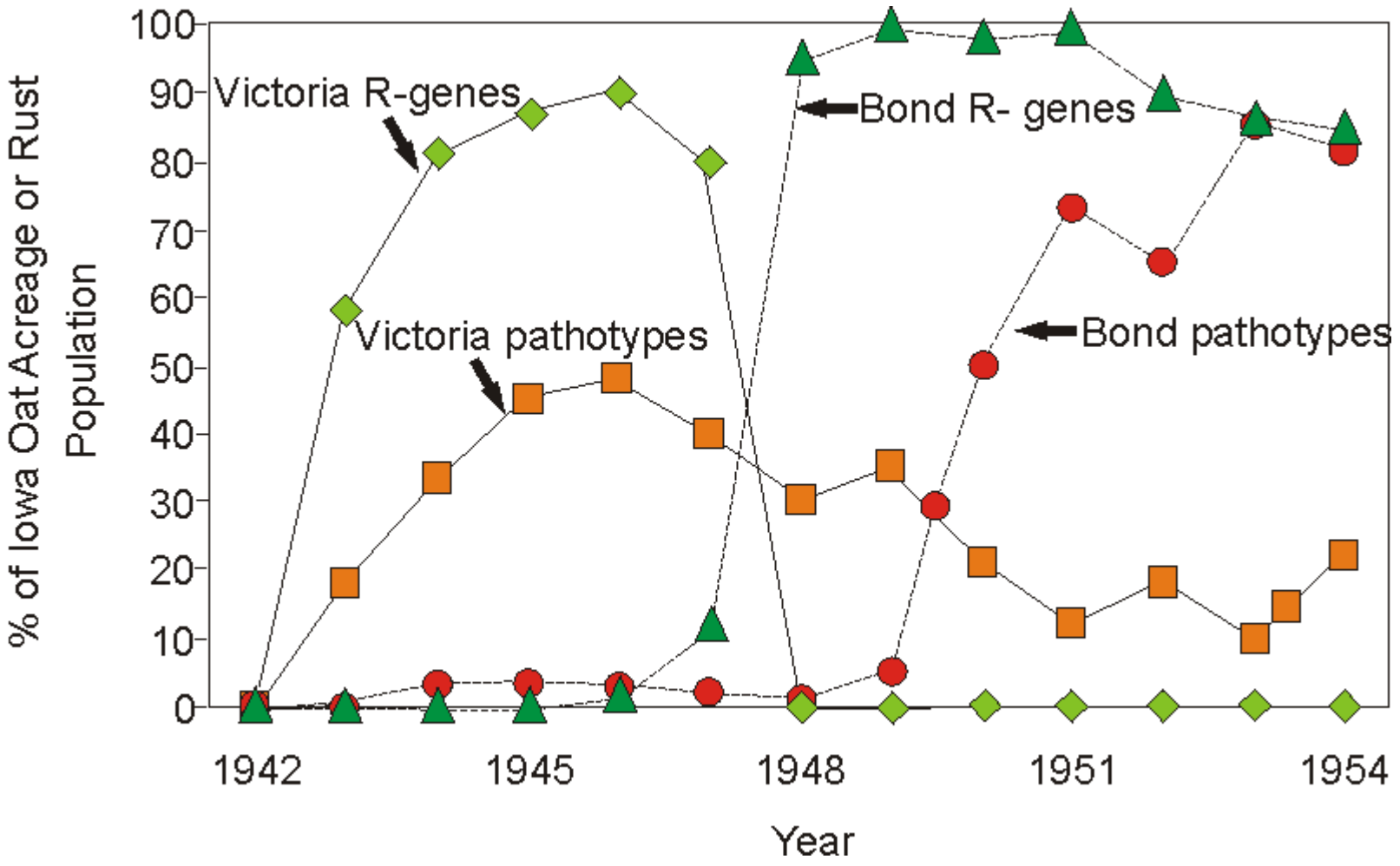
QTL Rpv3 disappears applying isolate SL

→ formation of *P. viticola* races



Bianca

Classical Boom-and-Bust Cycle



(Form: Mundt et al. 2014, modified; original data from Browning and Frey 1969)

Specific Considerations:

Durability of resistance

Riesling

Weisser Heunisch x (*Vitis vinifera* ssp. *sylvestris* x Traminer) ?

First mentioning:

1435 Rüdesheim: bill for plants

Dürbach: vines in a vineyard

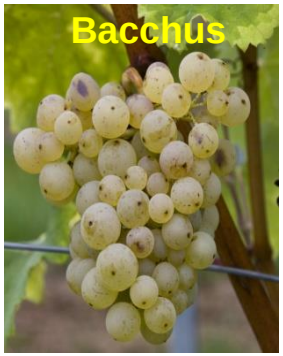
1464/1465 Trier: plants for cultivation

1490 First documented mentioning of a vineyard

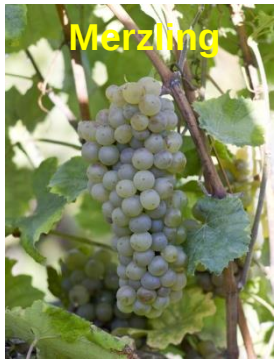
1491 (“Ruslingwingart”) near Worms.

Grapevine cultivars are used for centuries and some are used all over the world

Downy Mildew: Example I



X



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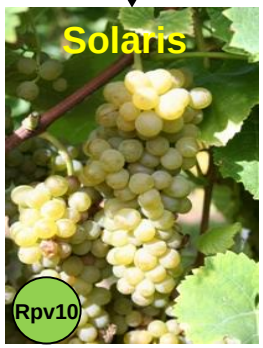
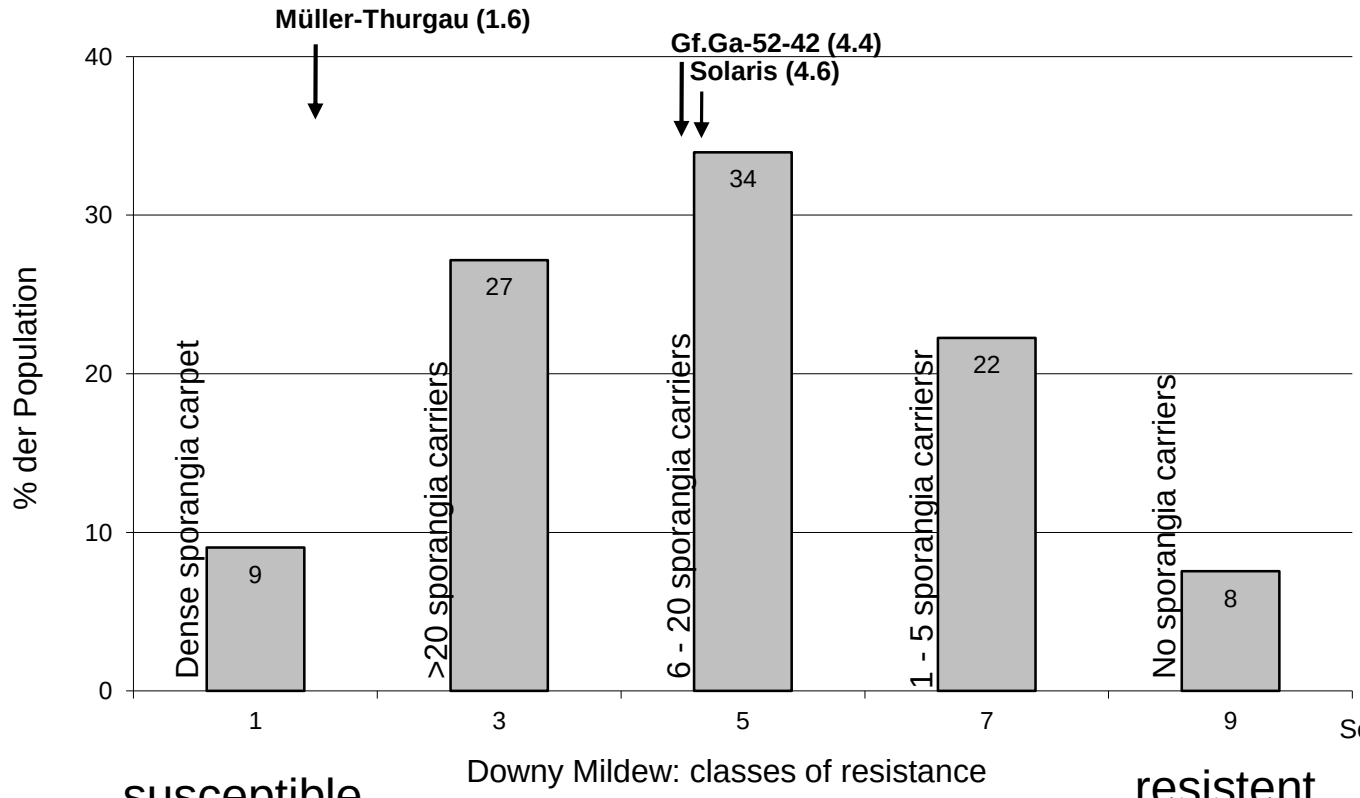


X

Gf.2008-059 (Rpv10, Rpv3)

- Rpv3 Rpv10
- Rpv3 Rpv10
- Rpv3 Rpv10
- Rpv3 Rpv10

Variability of *Downy Mildew* resistance within the whole progeny (Example I)

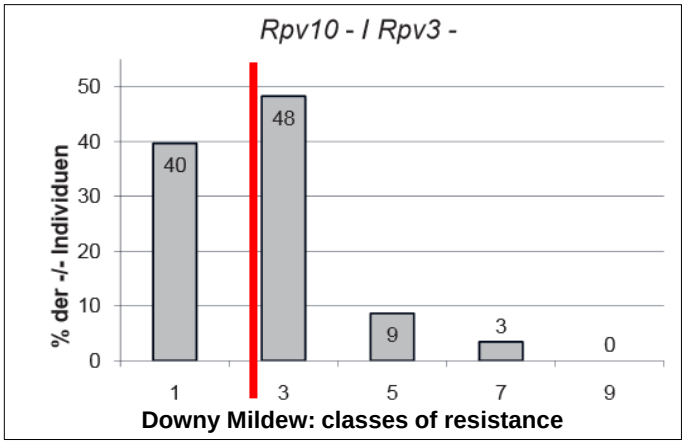


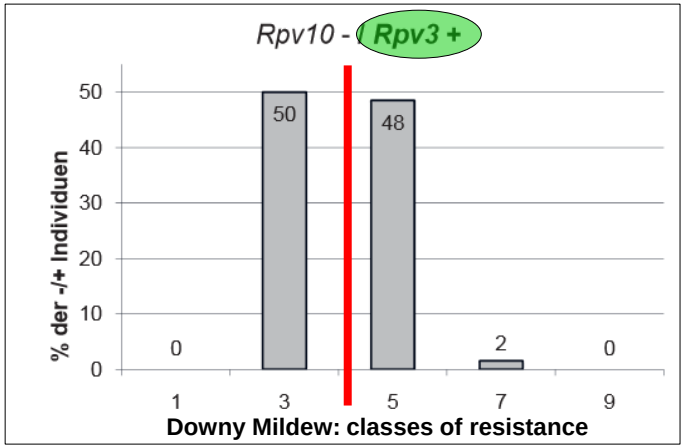
Schwander *et al.* 2011

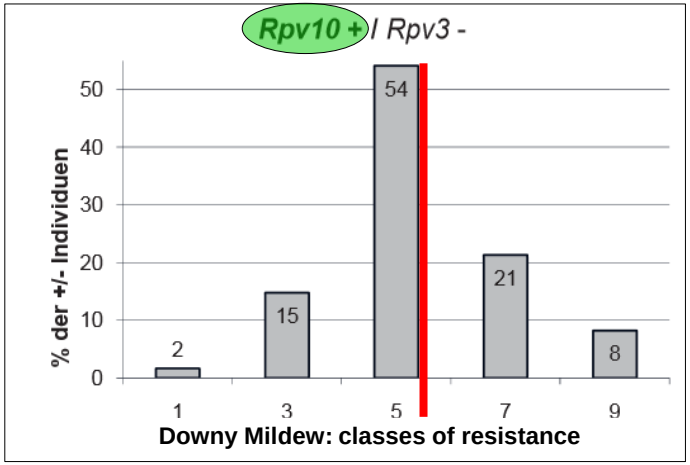
susceptible

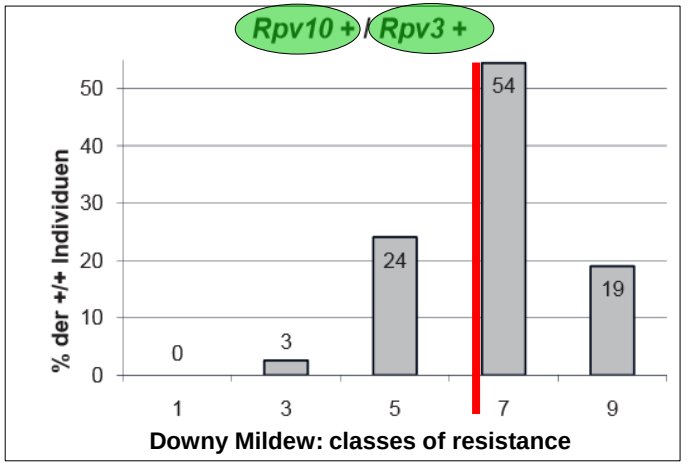
resistent

- individual resistance loci: degree of resistance ?
- effect of combination ?



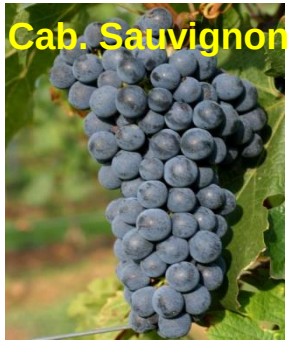






Schwander et al 2011

Downy Mildew: Example II



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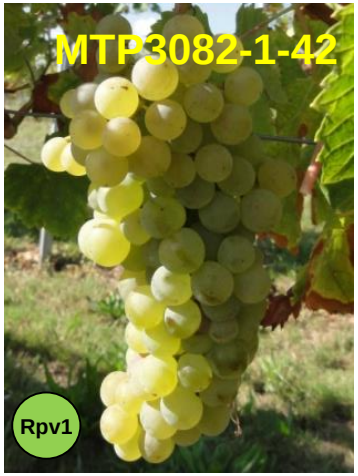


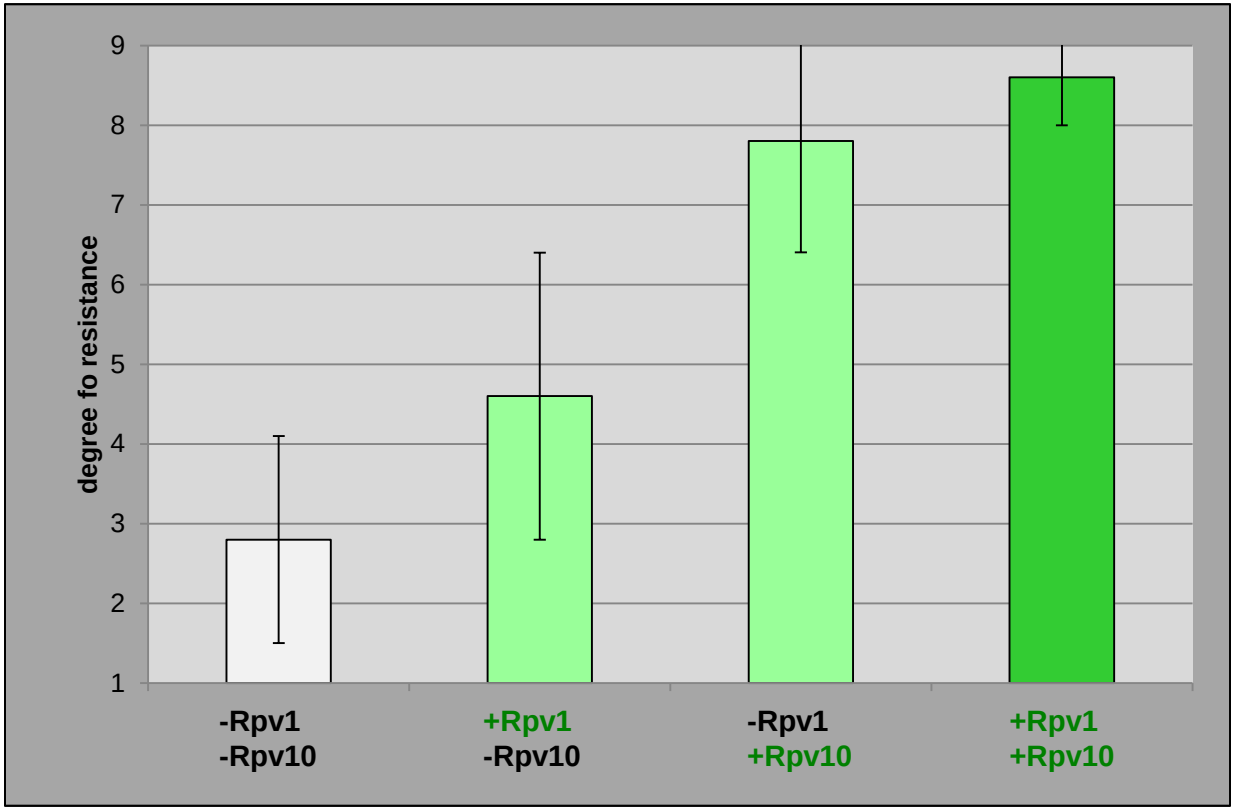
X

Gf.2015-127 (Rpv1, Rpv10)

Rpv1 Rpv10 | Rpv1 Rpv10 | Rpv1 Rpv10 | Rpv1 Rpv10

Downy Mildew: Example II

Influence of individual resistance loci and their different combinations on degree of resistance

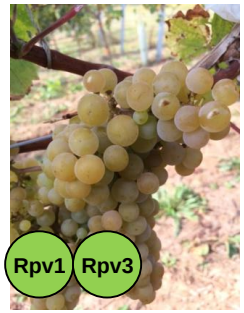


Downy Mildew:
Example III

MTP3082-1-42

X

Regent



Gf.2005-305-119

X

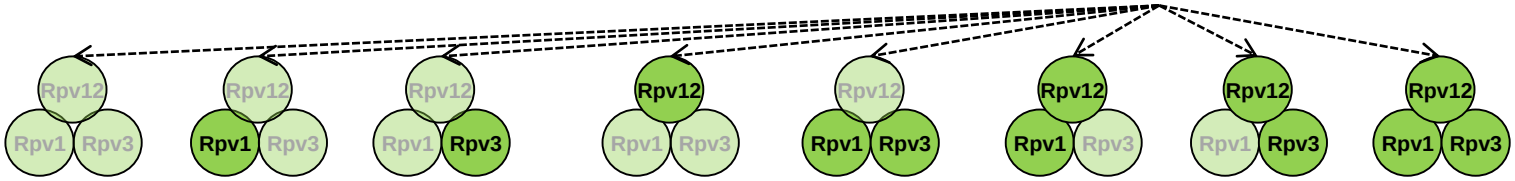
Petra

Gf.2011-7-128

X

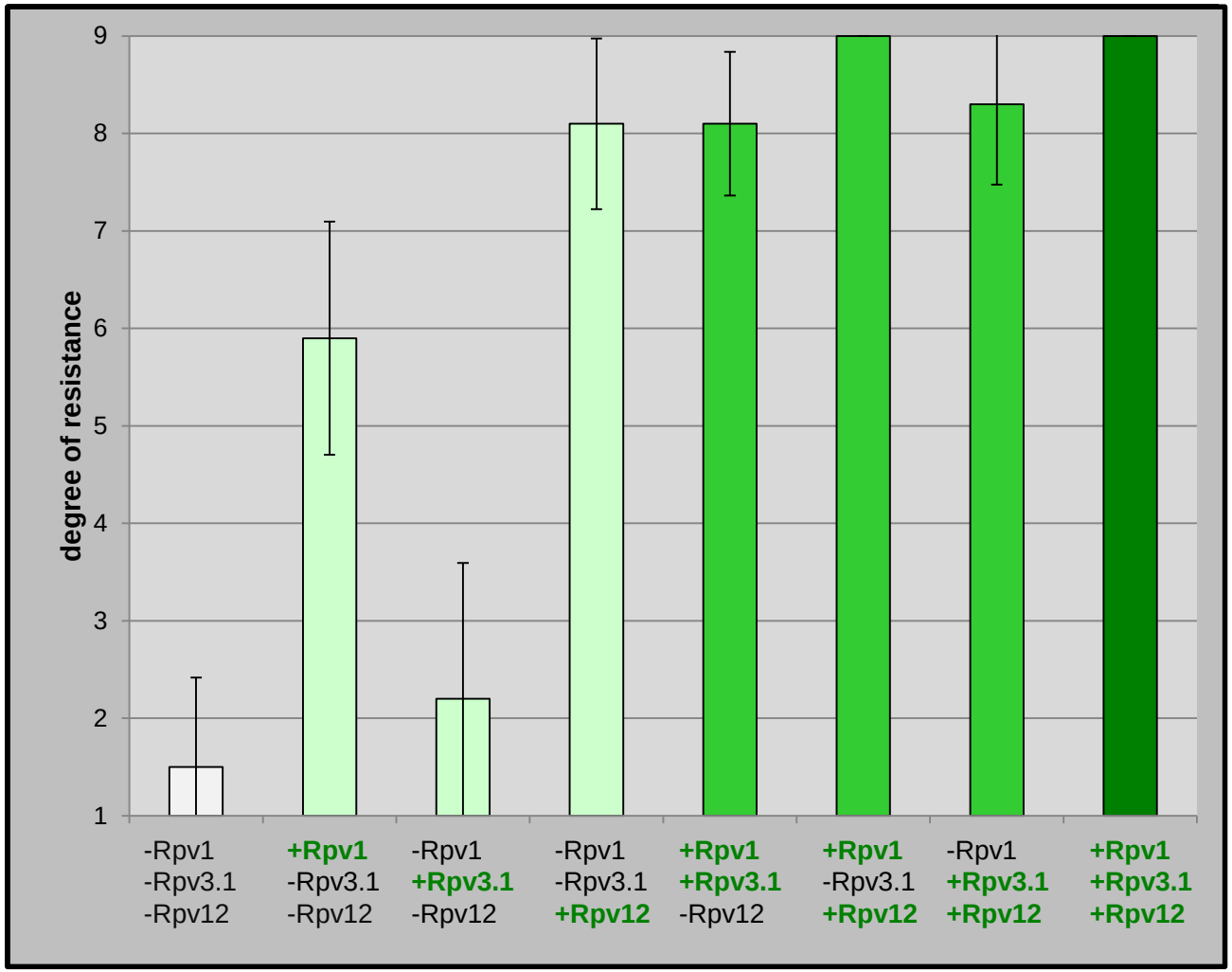
Kishmish vatkana

Gf.2015-72



Downy Mildew: Example III

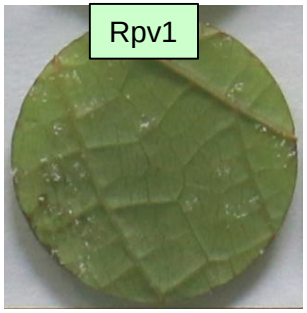
Influence of individual resistance loci and their different combinations on degree of resistance

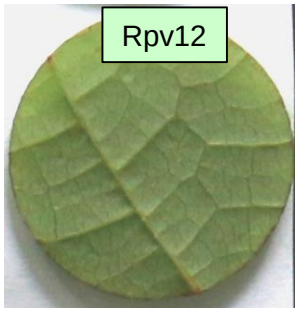


Downy Mildew

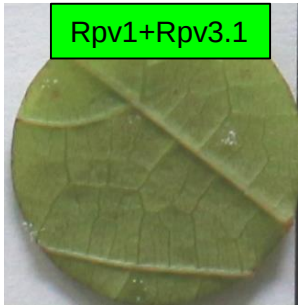
Leaf disc essays

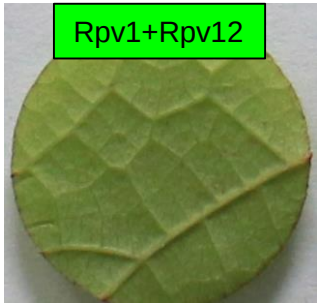
no resistance locus





1 resistance locus



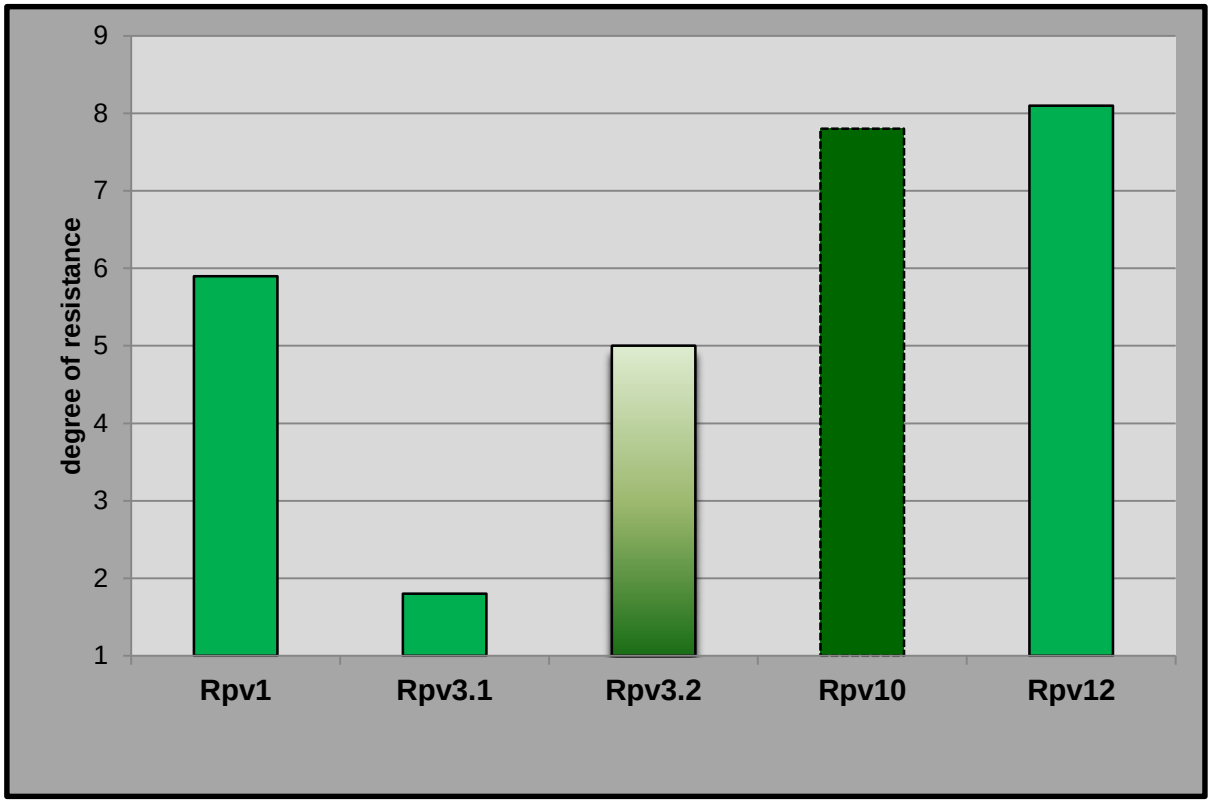


2 resistance loci

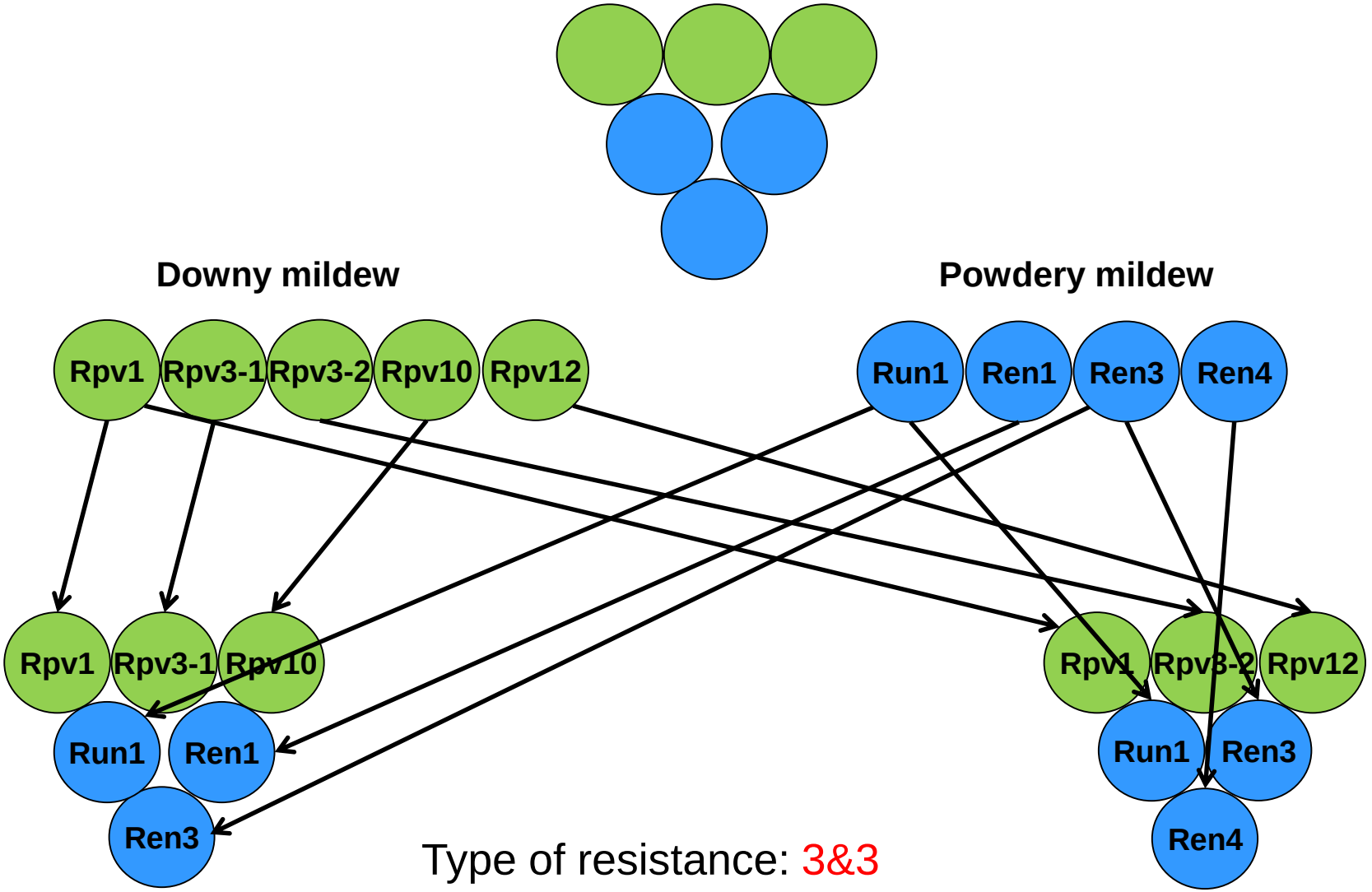
3 resistance loci

Comparison of different Downy Mildew resistance loci for their individual degree of resistance

- Results deduced from different experiments -



Aim: combining 3 resistance loci for powdery mildew (●) and 3 for downy mildew(●)



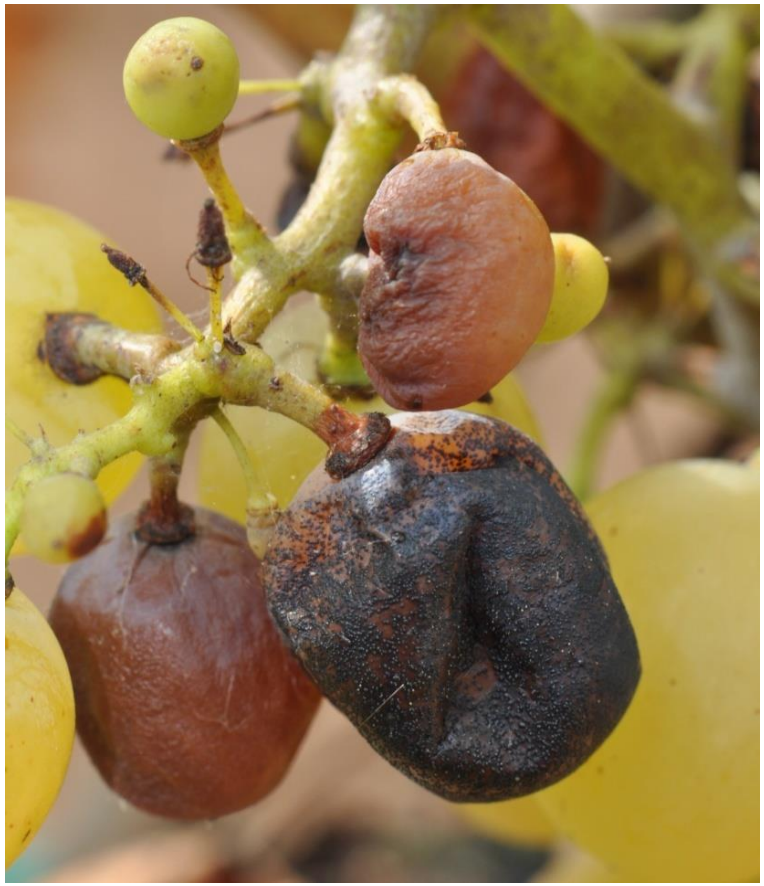
Type of resistance: 3&3

1 ……..……..further combinations……40

Specific Considerations:

Other Diseases showing up e.g. Black Rot

- caused by *Guignardia bidwellii* (Ellis) (ascomycete)
- nativ to North America, introduced in 1885



What could/should be done from a breeding point of view?

- Focus on major pathogens but look also for the next pathogen
- Identify new and strong sources of resistance
- Combine different resistance loci → ideally 3 loci (mechanisms)
- Do not „burn“ resistances → by using stepwise new single resistances
- Use a minimum of plant protection → „add a kind of a chemical resistance mechanism“
- Create varieties with different combinations of resistances
- Look for adaptation to climate change

→ Make a good compromise on the time scale!
→ We need international research and pre-breeding!