Les stratégies d'amélioration génétique de la vigne en Italie

Gabriele Di Gaspero

Institut de génomique appliquée

Udine, Italie

Assembleée générale Lien de la Vigne,
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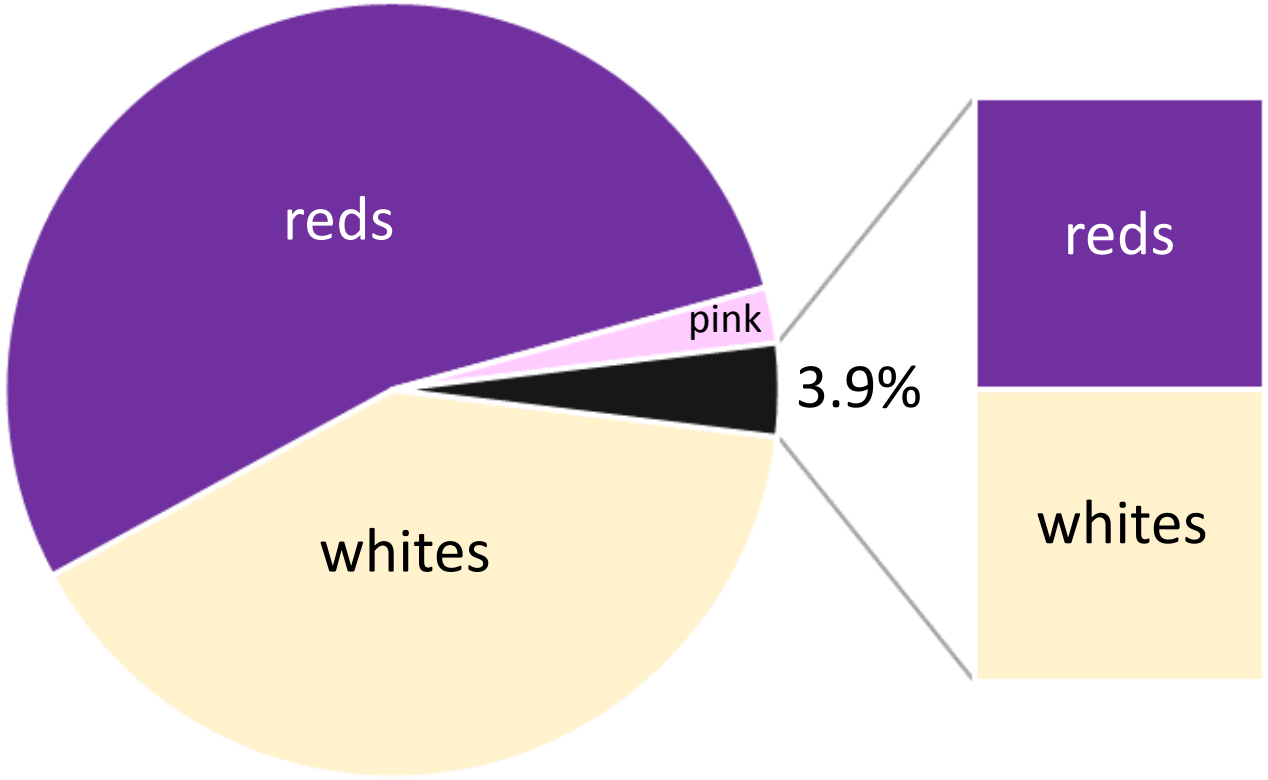
Current situation

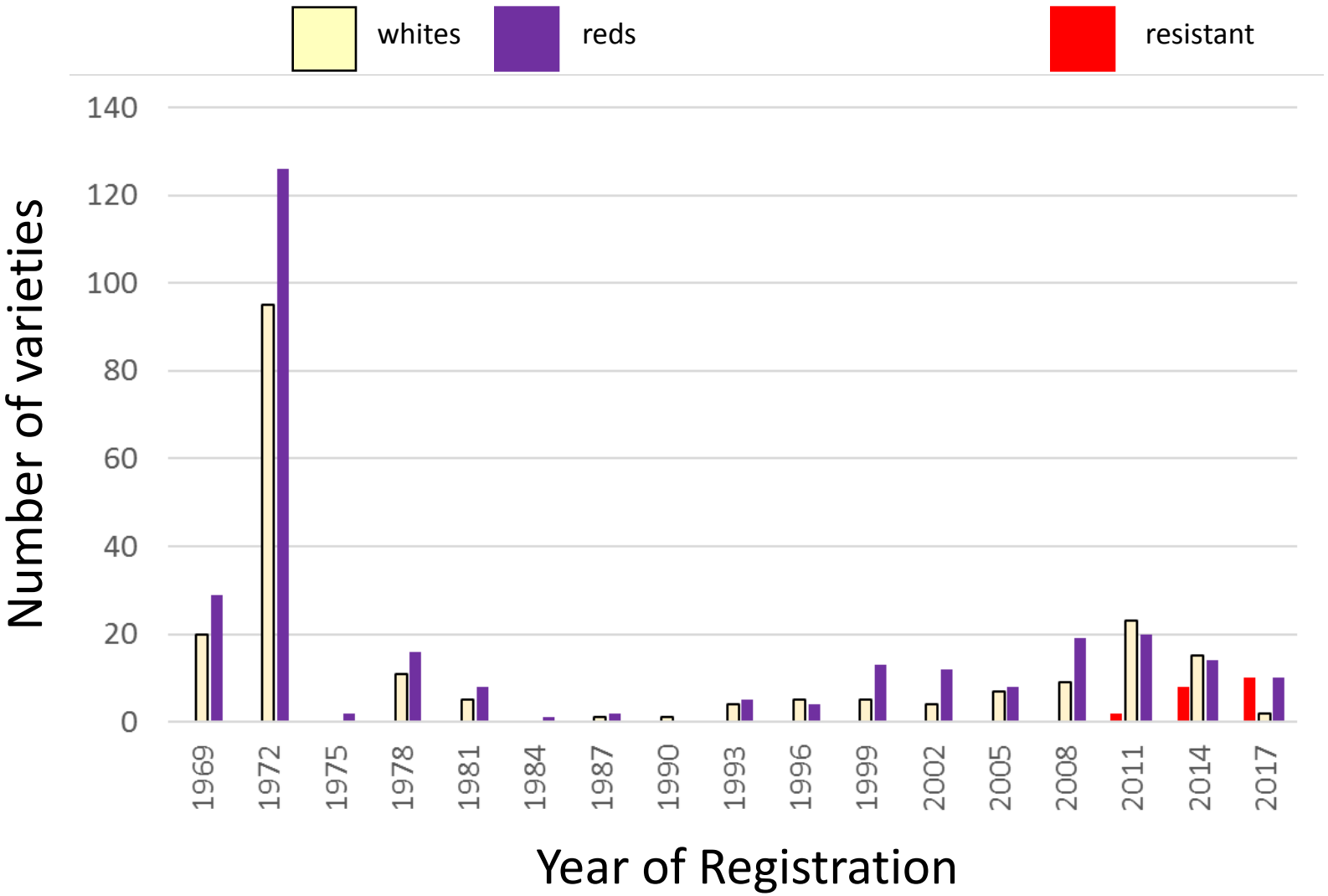
Registered varieties: 516

Resistant varieties



source Ministry of Agriculture, http://catalogoviti.politicheagricole.it

Historical trend



Resistant winegrapes registered in the Italian National Catalogue

Bronner
Helios
Johanniter
Solaris
Muscaris
Souvignier gris
Fleurtai
Soreli
Sauvignon Kretos
Sauvignon Rytos
Sauvignon Nepis

Cabernet Carbon
Cabernet Cortis
Prior
Regent
Merlot Kanthus
Merlot Khorus
Cabernet Eidos
Cabernet Volos
Julius

Country of selection

*Germany, WBI-Friburg, JKI**

Bronner
Helios
Johanniter
Solaris
Muscaris
Souvignier gris

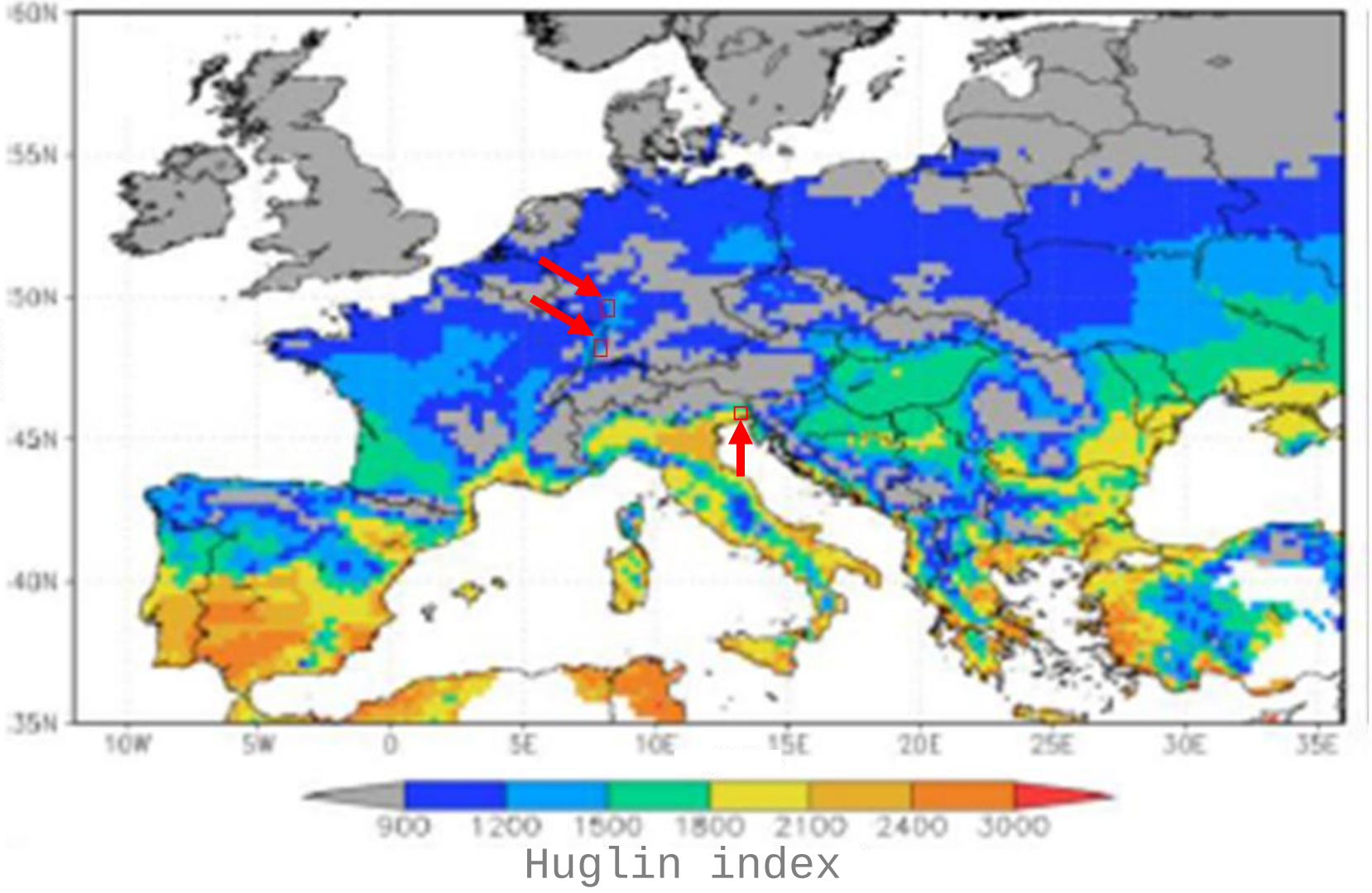
Cabernet Carbon
Cabernet Cortis
Prior
Regent*

Italy, Northest

Fleurtai
Soreli
Sauvignon Kretos
Sauvignon Rytos
Sauvignon Nepis

Merlot Kanthus
Merlot Khorus
Cabernet Eidos
Cabernet Volos
Julius

The need of resistant winegrapes for warmer climates



source Int J Biometeorol, Fraga et al. 2012

Year of crossing

1967-1987

Bronner 1975
Helios 1973
Johanniter 1968
Solaris 1975
Muscaris 1987
Souvignier gris 1983

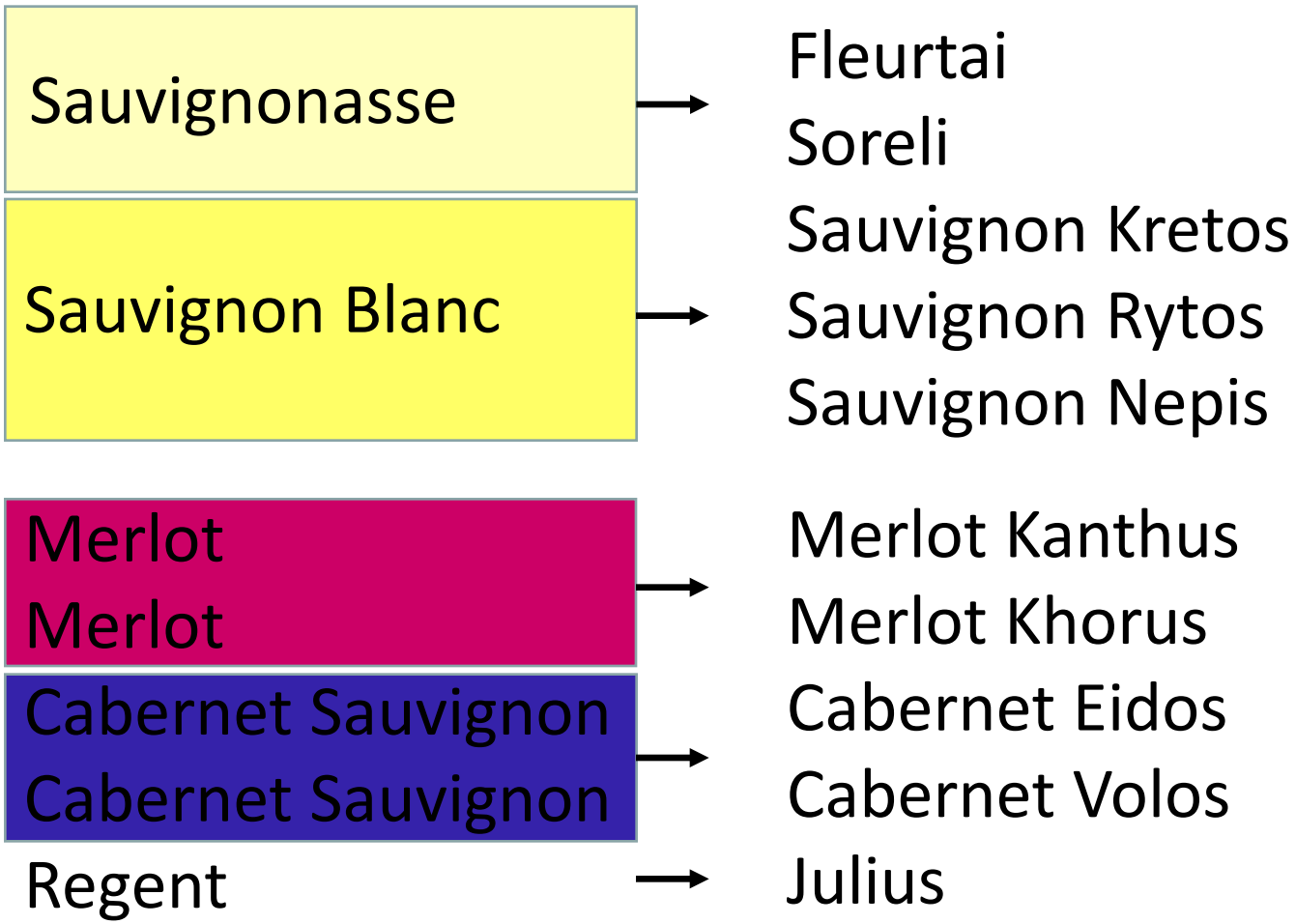
Cabernet Carbon 1983
Cabernet Cortis 1982
Prior 1987
Regent 1967

2000's

Fleurtai 2002
Soreli 2002
Sauvignon Kretos 2003
Sauvignon Rytos 2002
Sauvignon Nepis 2002

Merlot Kanthus 2002
Merlot Khorus 2002
Cabernet Eidos 2002
Cabernet Volos 2002
Julius 2002

Noble parent of the pair



Countrywide VCU field trials

Current situation

1. Conventional grape breeding
2. New Plant Breeding Technologies (NPBTs)

National initiatives

- Absence of a coordinated and funded national program
- Parallel or complementary initiatives, private and public
- Voluntary coordination between institutions, companies and breeders

Public

CREA (Council for Agricultural Research, Ministry of Agriculture):

Conegliano (wine grapes), Bari (table grapes)

Public/Private

Foundation Edmund Mach – San Michele all'Adige

Udine (University of Udine – Institute of Applied Genomics)

Private

Vivai Cooperativi Rauscedo

InnoVitis srl (Bozen)

Public

University of Milan (rootstocks)

Conventional grape breeding

Demands from vine growers:

- Use local varieties as noble parents in crossing, even if they are made aware that the resulting variety will be different
- Reduced spraying requirements

Coordination in responding to local demands, focusing on different local varieties as noble parents:

CREA-Conegliano -> local varieties in Veneto region: Glera (Prosecco), Raboso Piave, funded by local wine industry

FEM-San Michele all'Adige -> local varieties in Trentino /Emilia Romagna regions

VCR -> varieties with commercial interest abroad

Udine (University of Udine – Institute of Applied Genomics) -> reproducing major wine styles

Conventional grape breeding

Strategic objectives for national viticulture :

obtaining a broader range of resistant varieties

- suitable for warmer climates (Central and Southern Italy)
- High acidity for sparkling wines (Northern Italy)
- Higher yields
- differentiation for reproducing all most common wine styles
- Secondary diseases (antracnose, black rot)

Conventional grape breeding

Now in the market

Downy mildew resistance (Rpv3, Rpv10, Rpv12)

Only downy mildew resistance or weak powdery mildew resistance (Ren3)

In the marker within the next 5 years

Improved powdery mildew resistance

In 10 years

Significant improvement for secondary disease without compromising on quality

resistance genes/QTLs for grape diseases

Vitis International Variety Catalogue (http://www.vivc.de/)
"Table of Loci for Traits in Grapevine Relevant for Breeding" – Update October 1st, 2018

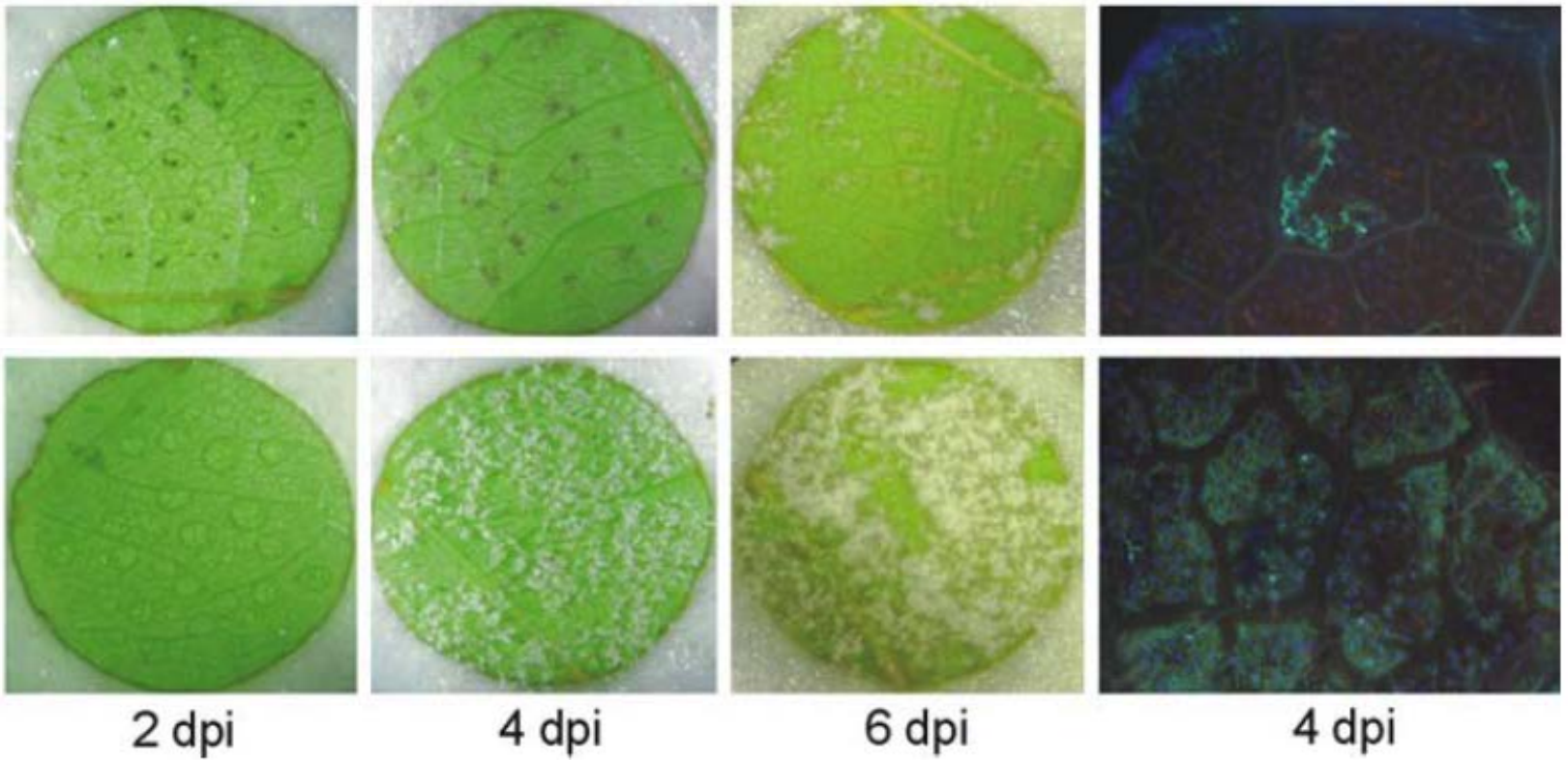
Downy mildew (Rpv1 -> … -> Rpv27)

Powdery Mildew (Ren1 -> … -> Ren10; Run1 -> Run2.1, Run2.2)

Black rot (Rgb1 -> Rgb2)
Diaporthe ampelina (Phomopsis viticola) (Rda1 -> Rda2)

Phylloxera (Rdv1)
Agrobacterium sp. (Rcg1)
Pierce's disease (Rdr1)
Xiphinema index (XiR1)

R genes activate the immune system



Conventional grape breeding

- Resistance durability issues
  - Monogenic resistances
- Pyramidisation strategies
  - Combination of monogenic resistances (stacked R genes)

ETI genes for downy mildew resistance

Zarja severa
(Rpv12)
↓
Fleurtai

Villard blanc
(Rpv3)
↓
Bianca, Regent

Severnyi
(Rpv10)
↓
Bronner, Solaris

Pyramidisation of resistance genes

Zarja severa
(Rpv12)

Villard blanc
(Rpv3-1)

Severnyi
(Rpv10)

↓

Bronner, Solaris

(Rpv3-1+Rpv12)

↓

SK 86 2-293

↓

Panonia

Petar Cindrić

in 1986

Pyramidisation of resistance genes

Zarja severa
(Rpv12)

Merzling
(Rpv3-3)

Severnyi
(Rpv10)

(Rpv3-3+Rpv10)

↓

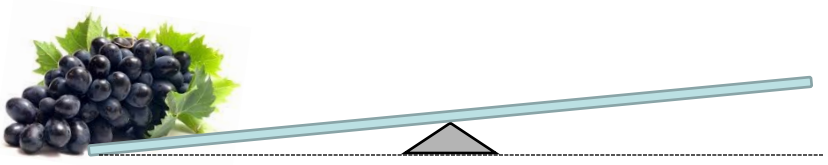
Norbert Becker Bronner in 1975

Conventional grape breeding

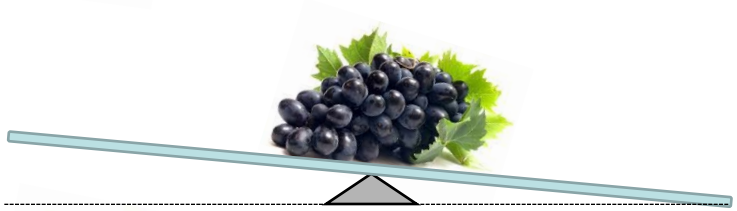
- Quality issues
- Classification issues

Current classification in Italy

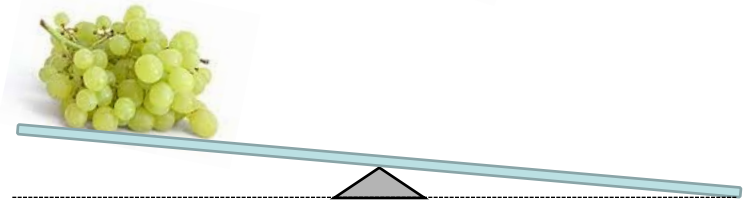
Merlot



VINIFERA



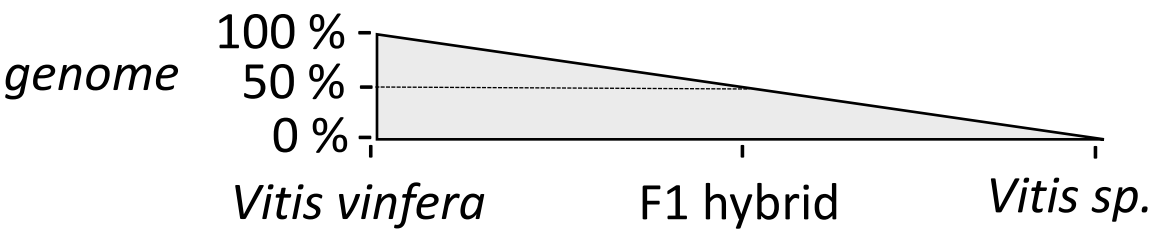
Isabella



Soreli

“HYBRIDS”

only for generic wines
or protected geographical indication (PGI) wines
not for appellation d'origine contrôlée (PDO) wines



New Plant Breeding Technologies (NPBTs)

- National initiative “New Plant Breeding Technologies” (Sustainable Biotechnologies) for improving 11 Mediterranean crops, initially launched in 2016

- grapevine, olive, tomato, peach, apricot, Citrus, wheat, eggplant, apple, cherry, poplar

- Precision agriculture (AGRIDIGIT) and biotechnology (BIOTECH)

- Funded by the Ministry of Agriculture, operated by CREA (Council of Agricultural Research)

- BIOTECH -> EUR 5.9 M € of which 2.49 M € equipment
- of which VITECH (grape biotechnogy) -> € 789.994

New Plant Breeding Technologies (NPBTs)

VITECH operated by CREA-VE (Dr. Luigi Cattivelli & Dr. Riccardo Velasco)
«Biotechnologies for grapevine improvement to increase sustainability and competitiveness of the wine sector»

-> equipment & platforms for NPBTs
-> crop specific programs and objectives
-> collaboration between CREA and other research institutes for the implementation of specific objectives

-> objective: obtaining a genome-edited grape prototype (three years)