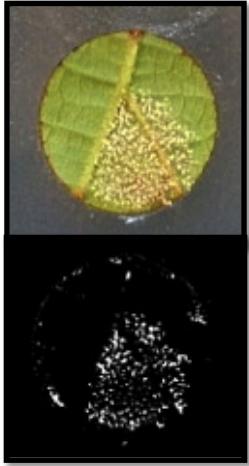


Genetic resources and breeding: current status and shifting paradigms

Bruce Reisch

bruce.reisch@cornell.edu



Germplasm -

- How many breeders here use Germplasm????
- To me, it's my candy store, fills my cravings.
- How many here are curators of collections?
- <http://www.vivc.de> – Incorporates information on germplasm collections from 130 institutions in 45 countries
- Germplasm is “accessible” – but do we have enough?
 - Yet there are phyto-issues with accessibility
 - Loss of wild germplasm continues.
 - Provides a response to the “frozen genetics” of wine grapes, access to variability for traits of all kinds, stresses, climate change



nature International weekly journal of science

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Archive > Volume 506 > Issue 7486 > News > Article

NATURE | NEWS

عربي

Grapevine gene bank under threat

Scientists raise concerns about relocation of premier French research vineyard dubbed the 'Louvre of vines'.

Declan Butler

05 February 2014

PDF Rights & Permissions



Christophe Simon/AFP/Getty

The Domaine de Vassal vine collection near Montpellier holds 2,300 different grape varieties.

Major collections are important, but in each case we must ask whether their long-term survival is assured. Losses of any type would be a major blow.

- Wolkovich et al. 2018: “Tremendous diversity among 1,100 planted varieties . . . Yet little of this diversity is exploited. Instead, many countries plant 70-90% of total hectares with the same 12 varieties – representing 1% of total diversity.”

nature
climate change

PERSPECTIVE

<https://doi.org/10.1038/s41558-017-0016-6>

From Pinot to Xinomavro in the world's future wine-growing regions

E. M. Wolkovich^{1,2*}, I. García de Cortázar-Atauri³, I. Morales-Castilla^{1,2}, K. A. Nicholas⁴
and T. Lacombe⁵

NATURE CLIMATE CHANGE | VOL 8 | JANUARY 2018 | 29–37

- Klein et al. 2018: Correcting identification and confirming accession identity; clarifying taxonomic relationships; leading to identification of new, unsampled populations for the germplasm system. Provides further foundation for germplasm enhancement.
- “Further work is needed to expand living collections of contemporary and emerging crops and their wild relatives, and to use genomic and phenomic approaches to characterize diversity in these taxa”

American Journal of
Botany



RESEARCH ARTICLE

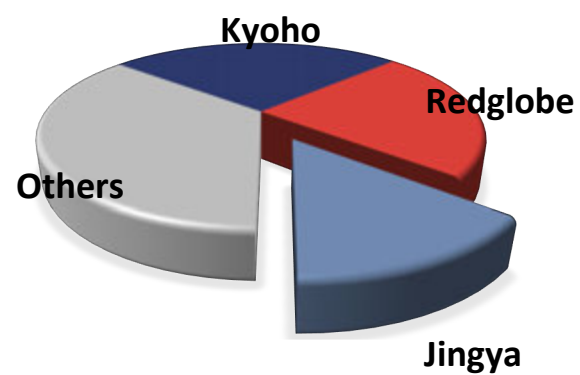
High-throughput sequencing data clarify evolutionary relationships among North American *Vitis* species and improve identification in USDA *Vitis* germplasm collections

Laura L. Klein¹, Allison J. Miller^{1,6}, Claudia Ciotir¹, Katie Hyma^{2,5}, Simon Uribe-Convers³, and Jason Londo^{4,6}

American Journal of Botany 105(2): 1–12. doi:10.1002/ajb2.1033

- “Grapevine breeding is tedious and time-consuming. Grapevines have a long juvenile phase, require much field space, expensive trellising systems, etc.”
- We often see statements like these in research articles, but . . .
- . . . Despite challenges, there are many success stories in the last 50 years. So let’s spend some time to celebrate these successes together.*
- *Disclaimer – not every success story is included; these are just a selection of highlights. Apologies to numerous success stories not included.

China



China – 2012 Table Grape Area Planted



'Jingya' – 4X, >7,000 ha
Institute of Botany, CAS



'Summer Black' – 3X, ca 30,000 ha
Origin: Japan

Thank you to Shaohua Li, Jiang Lu, Jianmin Tao and Yanshuai Xu for sharing information.

China



‘Beihong’



‘Beimei’

‘Muscat Hamburg’ X *V. amurensis*
widely planted wine grapes, Institute of Botany, CAS

Thank you to Shaohua Li, Jiang Lu, Jianmin Tao and Yanshuai Xu for sharing information.

Japan -

'Shine Muscat': Registered 2006; In 2015 - 992 ha (7%);
sells for 1593 yen/kg
('Kyoho' sells for 859 yen/kg)

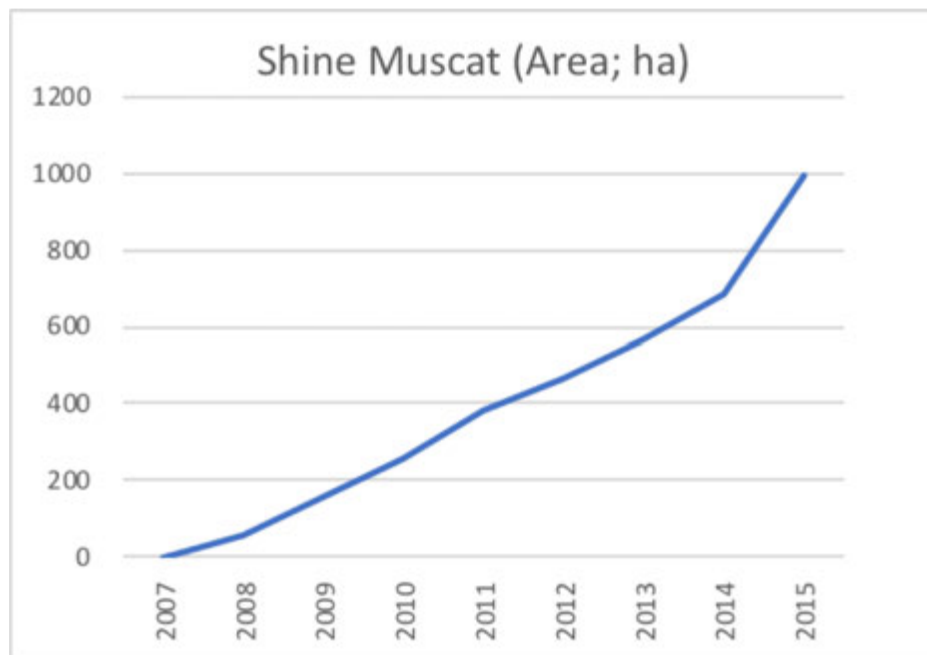
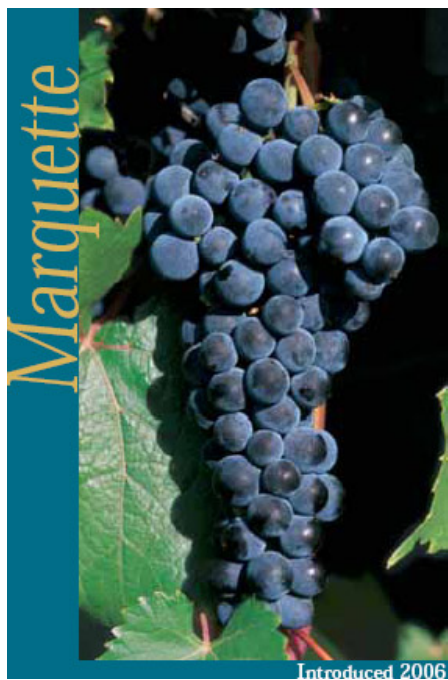


Photo credit: NARO, Japan

Thank you to Atsushi Kono for sharing information.

Cold hardy wine grapes, Minnesota, USA



'Marquette' - 2006

Photo credit: Univ. of Minnesota



'Frontenac' - 1996



'Traminette'

- Released 1996
- JS 23-416 x 'Gewürztraminer'
- Gaining widespread acceptance
- Moderately disease resistant
- Late bud break
- Exc. balance of sugar, acid, pH
- Wine can be very similar to 'Gewürztraminer'
- Estimated 200 ha (USA)
- Price per ton: \$600-1000
- Garnering many awards



California

- 'Fiesta' – 1973, early ripening raisin grape, 4,965 ha 2017 –USDA ARS
- 'DOVine' – 1999, first embryo rescue cultivar, dried-on-vine cane cutting – major innovation, 225 ha 2017 – USDA ARS
- 'Flame Seedless' – 1973, 6,226 ha 2017 USDA ARS
- 'Redglobe' – 1980 release 4,105 ha 2017; >50,586 ha in China – UC Davis
- 'Sugraone' – 1972 release, 2,083 ha 2017; Sun World, California (more around the world)
- 'Symphony' 1981 release (604 ha) and Rubired, 1958 release (4,690 ha) – UC Davis



Redglobe

Thank you to Peter Cousins for suggestions.

Australia – CSIRO introductions

- ‘Tarrango’ – 1975, good acidity, a red wine for warm climates
- ‘Taminga’ – 1982, Traminer-style dessert wine
- ‘Marroo Seedless’ – 1988, reached 1 million boxes annually in USA in 1990s
- ‘Carina’ – 1975, mainstay of dried currant production >30 years



Taminga



Tarrango

Thank you to Peter Clingeffer for sharing information.

Italy:

'Rebo' ('Merlot' X 'Teroldego')
Fondazione E. Mach, all'Adige

brings Merlot qualities to wines in areas
less suited to Merlot



Thank you to Silvia Vezzulli and Marco Stefanini for sharing information.

Italy:

‘SAUVIGNON KRETOS B.’ (‘Sauvignon’ X ‘Bianca’)



‘Merlot Khorus’ (‘Merlot’ X
Kozma 20-3)



Recent introductions, University of Udine and Institute of Applied Genetics

Thank you to Silvia Vezzulli and Marco Stefanini for sharing information.

Romania (192,000 ha, long history of grape cultivation)

‘BĂBEASCĂ GRI’



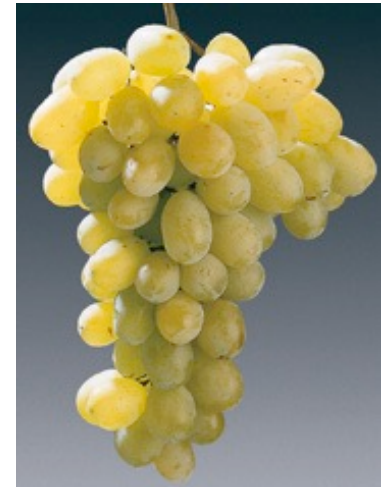
Research and Development Station for Viticulture and Enology
Odobești

‘ȘARBA’



BG: 1975, now 307 ha
Sarba: 1972, now 270 ha
Victoria: 1978, now 255 ha

‘VICTORIA’



Research and Development Station
For Viticulture and Enology
Drăgășani

Thank you to Radu Sestras, Carmen Popescu and Liviu Dejeu for sharing information.

Hungary – ‘Bianca’

- KRF Research Station for Viticulture and Enology, Kölyuktető (Eger)
- Released 1982
- >1,000 ha Hungary; >2,000 ha Russia
- Interspecific crossing (‘Villard blanc’ descendant)
- some progeny named in Serbia



Photo credit – Jakob Federer, CC BY-SA 3.0

Rootstocks – USA and Brazil

- VR 039-16 – muscadine hybrid, 1991, released by the Univ. of California, Davis; fanleaf virus resistance
- Brazil: IAC572 and IAC766, for tropical areas, hybrids with *V. caribaea*, released in the 1960s, resists insects and diseases of the tropics. From “Instituto Agronômico de Campinas”.

Thank you to Marco Dalbó and Peter Cousins for sharing information.

ARO-Volcani Centre, Israel



Thank you to Avi Perl for sharing information.



'BIG PEARL'



**ARO-Volcani Centre,
Israel**

‘Red Loosh 1’

Thank you to Avi Perl for sharing information.

'Starlight'

'Prime seedless'

Prime Seedless
ca. 2,300 ha
45,000 tons/yr
South Africa
Mexico
Egypt



**ARO-Volcani Centre,
Israel**

Thank you to Avi Perl for sharing information.

France

- 'Caladoc' INRA ca. 1990? 3,000 ha
- 'Marselan' INRA 1990 3,500 ha

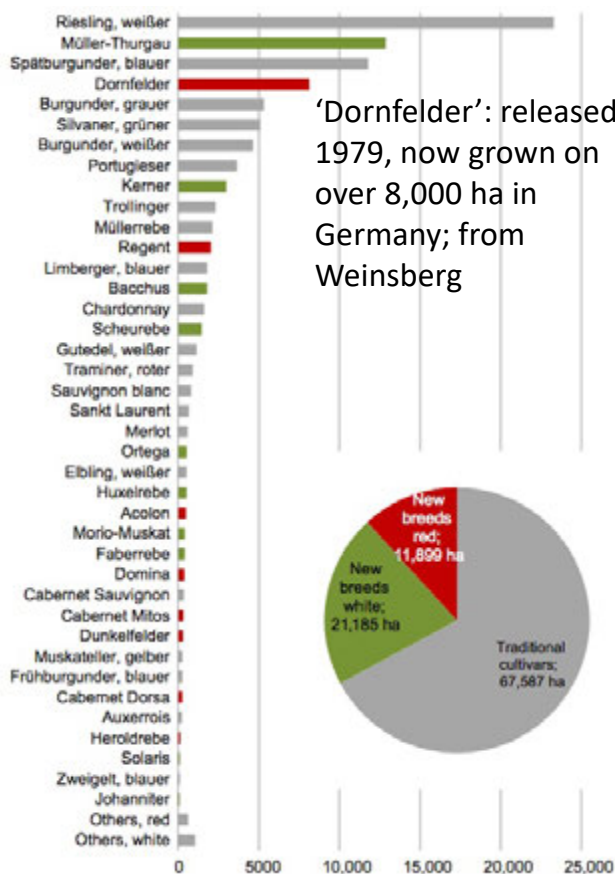


'Caladoc'

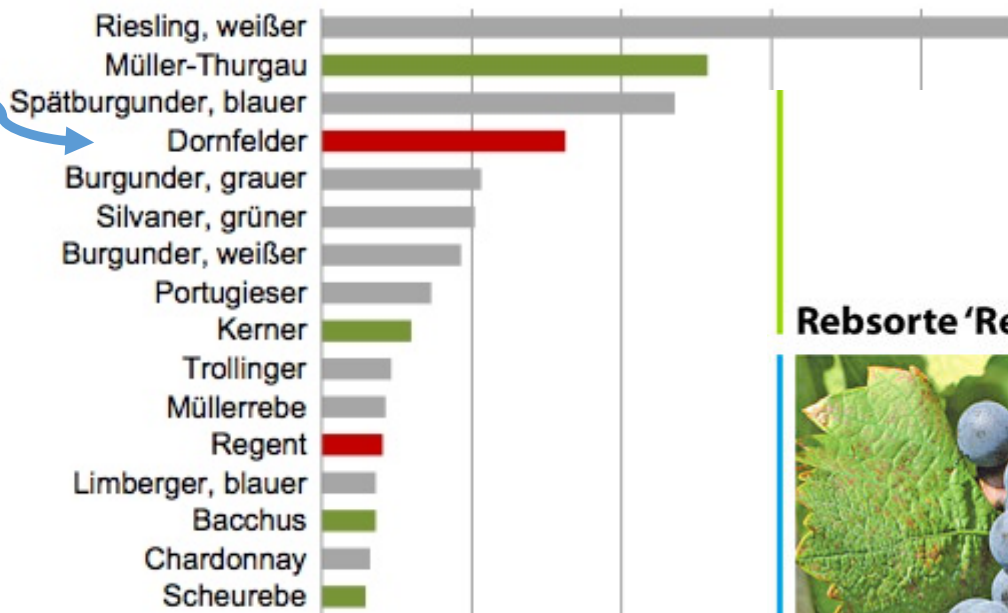


'Marselan'

Thank you to Laurent Audeguin for sharing information.



'Dornfelder': released 1979, now grown on over 8,000 ha in Germany; from Weinsberg



1967: Cross made
1994: Plant Variety Protection granted
1996: Approval for Qualitätswein
1996-2001: Classified in all German growing regions

Deep dark and full-bodied red wine with southern character



Rebsorte 'Regent'



Tiefdunkler und körperreicher Rotwein mit südlichem Charakter

The Changing World of Grape Breeding: The way it used to be. . .

New
Cultivars

Breeder / Geneticist

Pathologist

Enologist

Entomologist

Viticulturist

The Changing World of Grape Breeding: The new look, 2018 . . .

New Cultivars

Breeder / Geneticist

Pathologist

Enologist

Entomologist

Viticulturist

Embryo Rescue Specialist

Genomicist (Plant and Pest and Pathogen)

Computational Biologist

Economist

Wine and Flavor Chemist

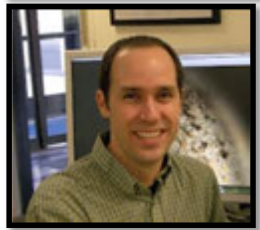
Physiologist

Physicist (light engineering and freeze damage)

Meteorologist (Climate Change)

- COST action FA1003 "East-West Collaboration for Grapevine Diversity Exploration and Mobilization of Adaptive Traits for Breeding" (2010-2014).
<http://www.diprove.unimi.it/GRAPENET/index.php>
- **GrapeGen06** – Management & Conservation of Grapevine Genetic Resources” 1.5 million Euro, 24 participants, 17 countries (2007-2010)
<http://www1.montpellier.inra.fr/grapegen06/accueil.php>
- COST OC-2017-1-22194 “Data integration to maximise the power of omics for grapevine improvement” Project “**Integrape**” 2018-2021
- **Innovine**, “Combining innovation in vineyard management and genetics for a sustainable European viticulture”, funded by the EU’s Seventh Framework Programme. <http://www.innovine.eu> , 27 partners, 7 countries, 8.5 M Euro, 2013-2016
- “**VitisGen2**: Application of next generation technologies to accelerate grapevine cultivar development ”, USDA-NIFA Specialty Crop Research Initiative, \$US 6.5 M, 2017-2021 (9 institutions, 23 researchers)
<http://www.vitisgen2.org>



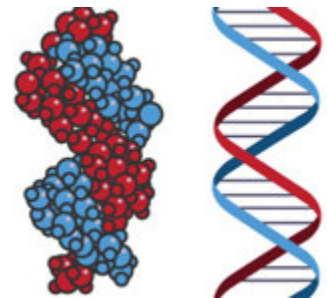
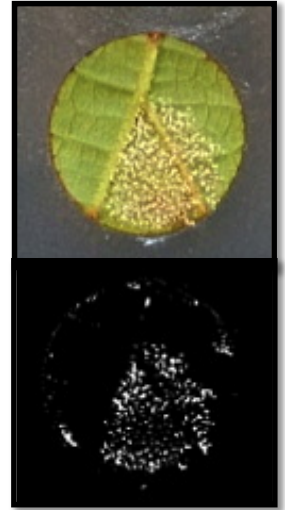


Co-lead
Lance Cadle-Davidson



"VitisGen2: Application of next generation technologies to accelerate grapevine cultivar development"

Bruce Reisch and Lance Cadle-Davidson
<www.vitisgen2.org>



Cornell University



VitisGen2 – in a nutshell

We focus on applying technological innovations in phenotyping and genotyping to deliver breeding lines with durable powdery mildew resistance and high fruit quality, and to better manage existing vineyards.

- Develop a set of *transferable* markers for all mapping families.
- Process DNA and support Marker-Assisted Selection for up to 8500 samples per year
- Develop genome sequence data for every wild North American grapevine species of breeding interest.
- Testing PM resistance allele combinations
- High throughput phenotyping of (for example) PM, juice chemistry, and cluster architecture
- Extension
- Trait economics



- **Paradigm shift alert:** incorporating other areas of science – physics, economics, meteorology/climate change, engineering
- Plant breeders are now inundated with information. Microbiome. Phenotype. Sequence/Markers. Weather. Real time soil conditions. Future grape breeders must be ready to make decisions with deluge of information.
- **International cooperation** – to take advantage of big data, interchange of ideas
- Remembering Barbara McClintock
<https://epistemologies.files.wordpress.com/2007/10/a-feeling-for-the-organism-comp.pdf>
- ‘Study organisms carefully, look for rules AND exceptions, make sure to get to know the organism, no two plants are alike.’

The Future . . .



You are here: Decanter - News - Wine News

Bordeaux's Vignobles Ducourt plants 'disease resistant' vineyard

Tuesday 12 August 2014 | by Jane Anson

[Like](#) 49 [Tweet](#) 43 [Google+](#) 7 [Share](#) 103

Vignobles Ducourt, which owns 440 ha in the Bordeaux region, has planted its first 'no spray vineyard' consisting of grapes crossed with disease resistant varieties.



Welcome to PIWI International

HERE IT'S ALL ABOUT FUNGUS-RESISTANT GRAPE VARIETIES (PIWI)!

In order to enable the further dissemination of fungus resistant grape varieties, we encourage the collection and exchange of information between research institutes, grape breeders and refiners of grapes, wine growers and manufacturers of fungus-resistant varieties.



Executive Committee:

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Lance Cadle-Davidson

Jason Londo

Gavin Sacks

Tim Martinson

Julian Alston

Project Manager:

Fred Gouker

Genetics Team:

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Rachel Naegele, TG Lead

Acknowledgments



Funding:

USDA-NIFA Specialty Crops Research Initiative
Project Number 2017-51181-26829



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