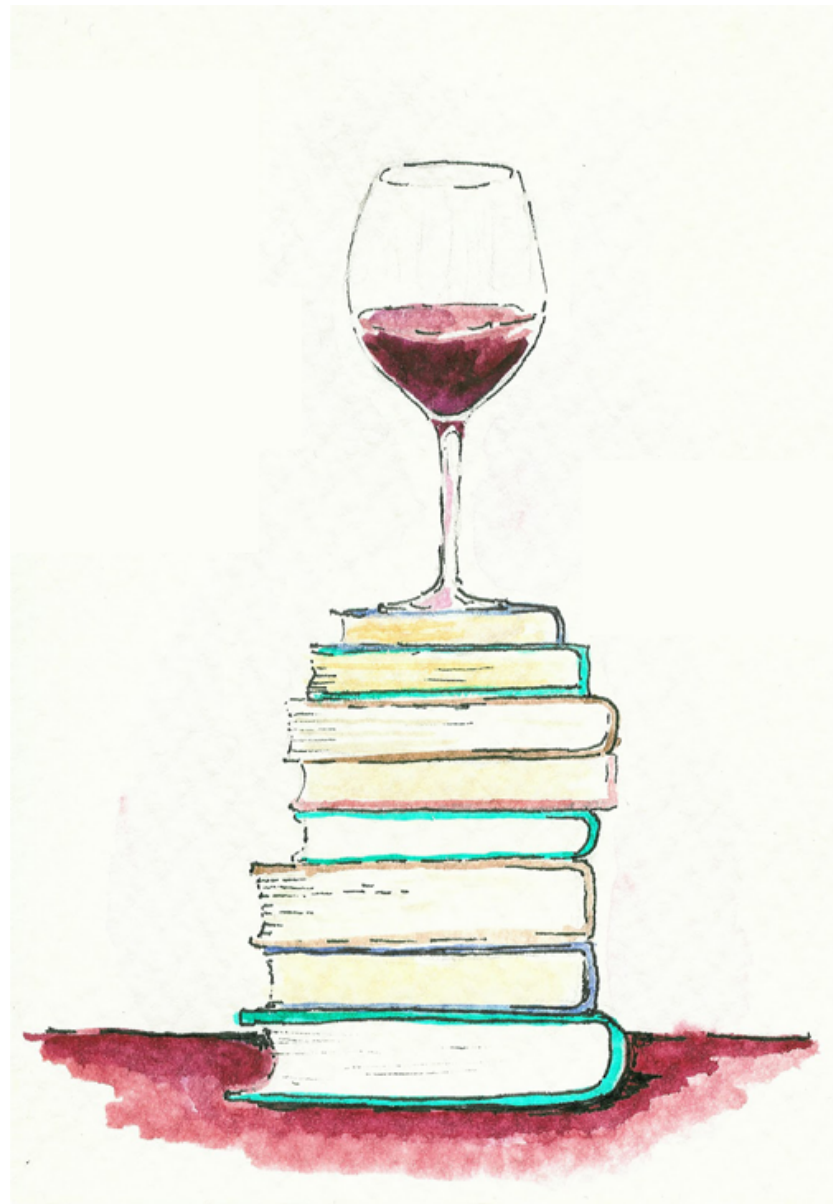


The best way to
learn about
wine is...



...to drink it



Genetic Evolution of Grapes

Andreas Goschin

Vitis vinifera



- **Taxonomy:** *Cormobionta* - *Angiospermae* - *Dicotyledonae* – *Rosidae* - *Rhamnales* - *Vitaceae* - *Vitis* - *Vitis vinifera*
- Genome: ~500 Mbp, $2n = 38$
- Perennial

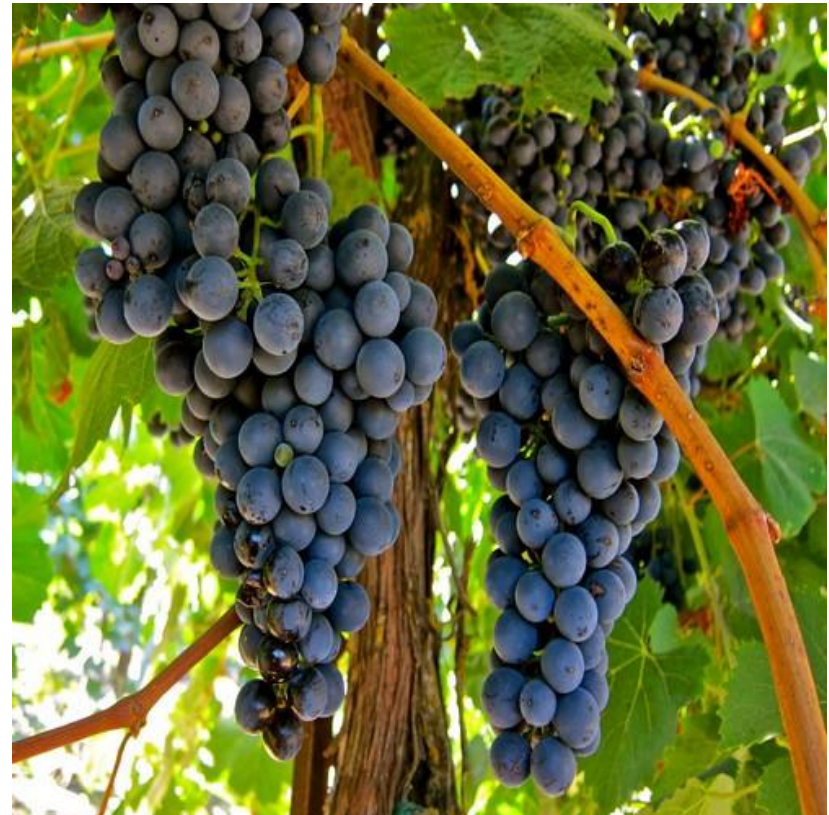
Vitis vinifera
subsp. sylvestris



?

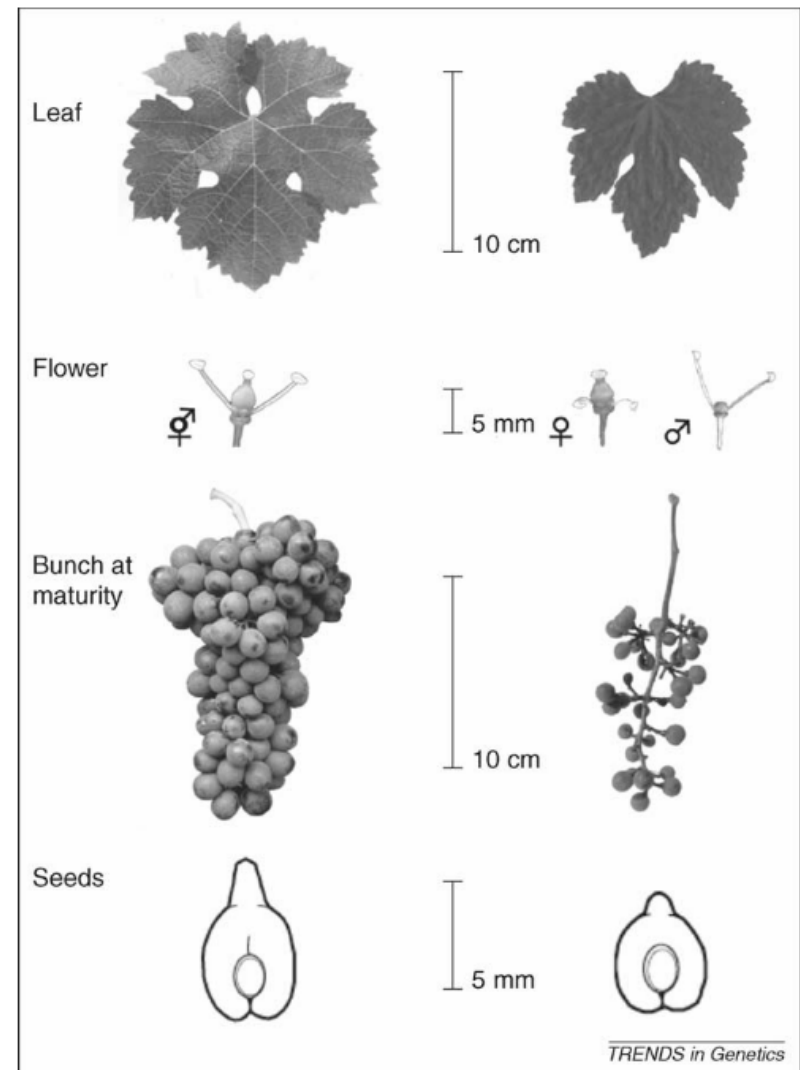


subsp. vinifera



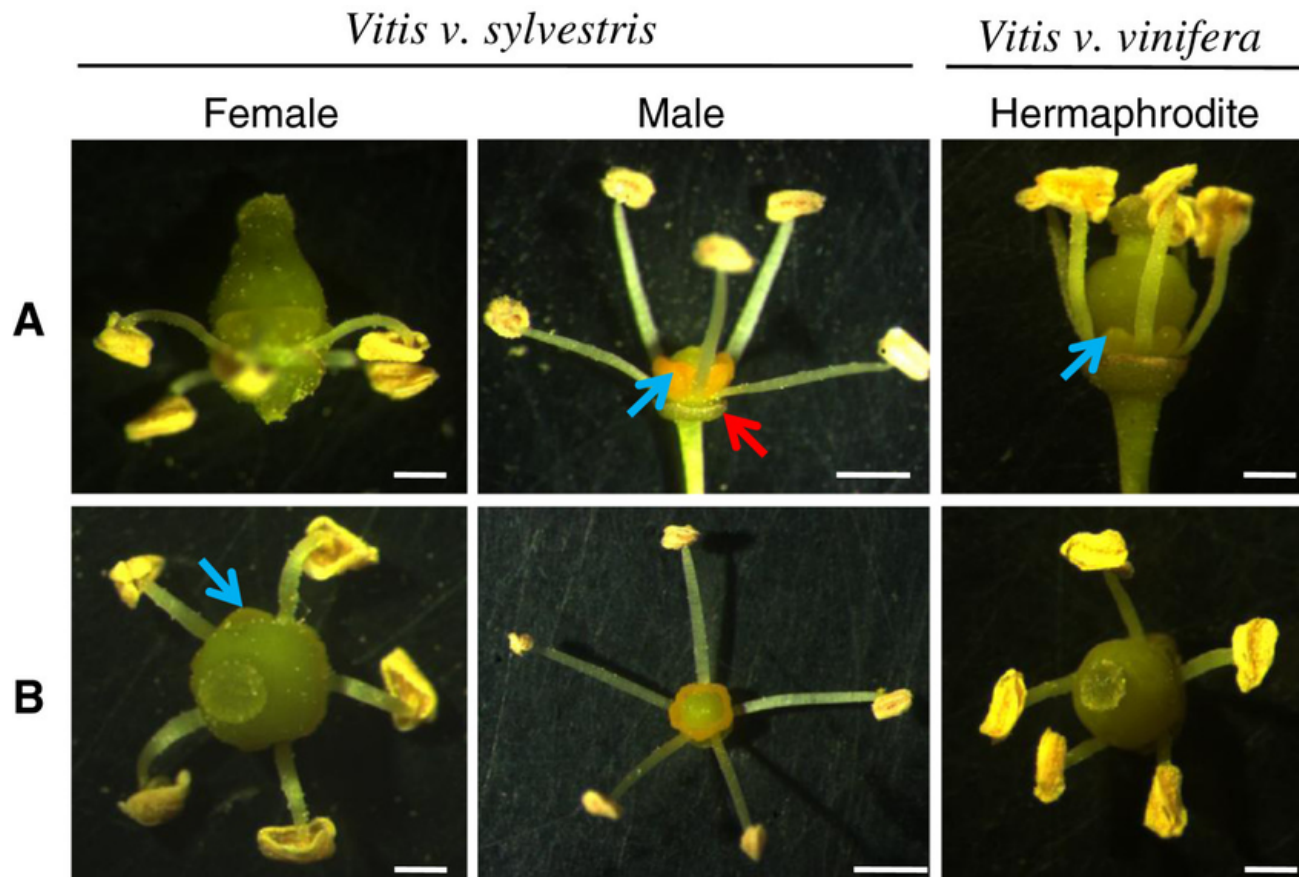
Genetic evolution

- Increased berry and bunch size
- Increased sugar content
- Improved flavour profile
- Dioecy to hermaphroditism



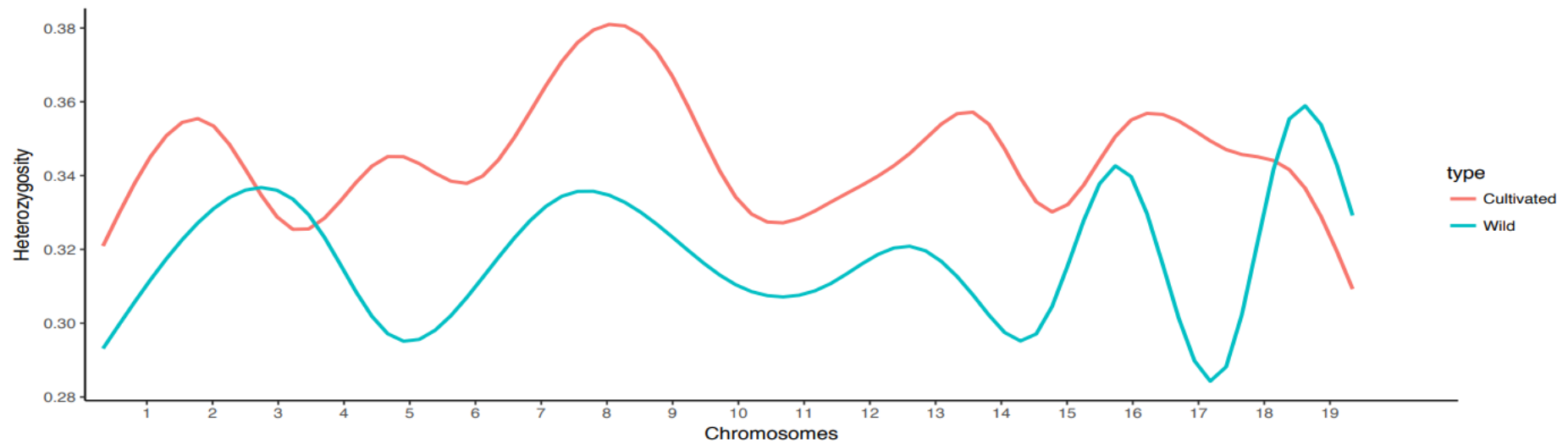
This et al. (2006)

Dioecy to hermaphroditism



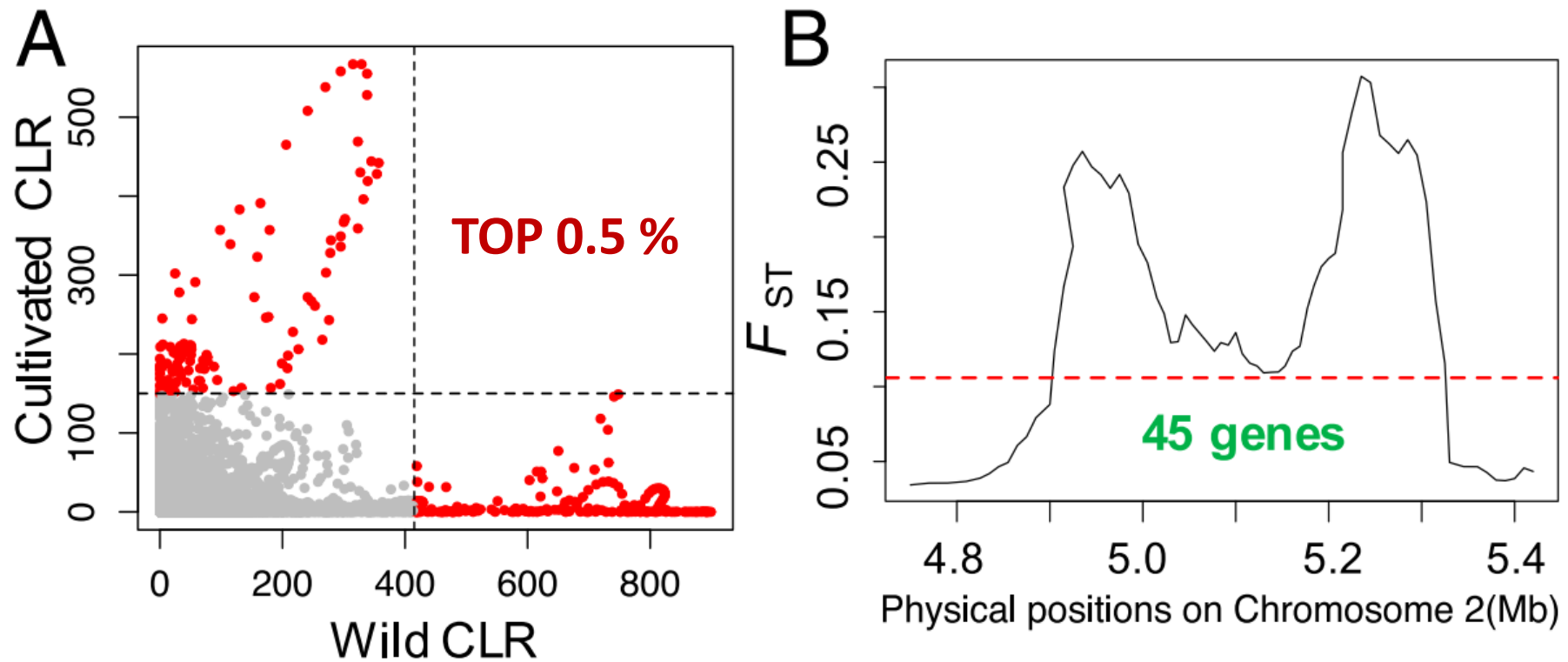
Ramos et al. (2014)

Scanning for selective sweeps



Zhou et al., 2017

Dioecy to hermaphroditism

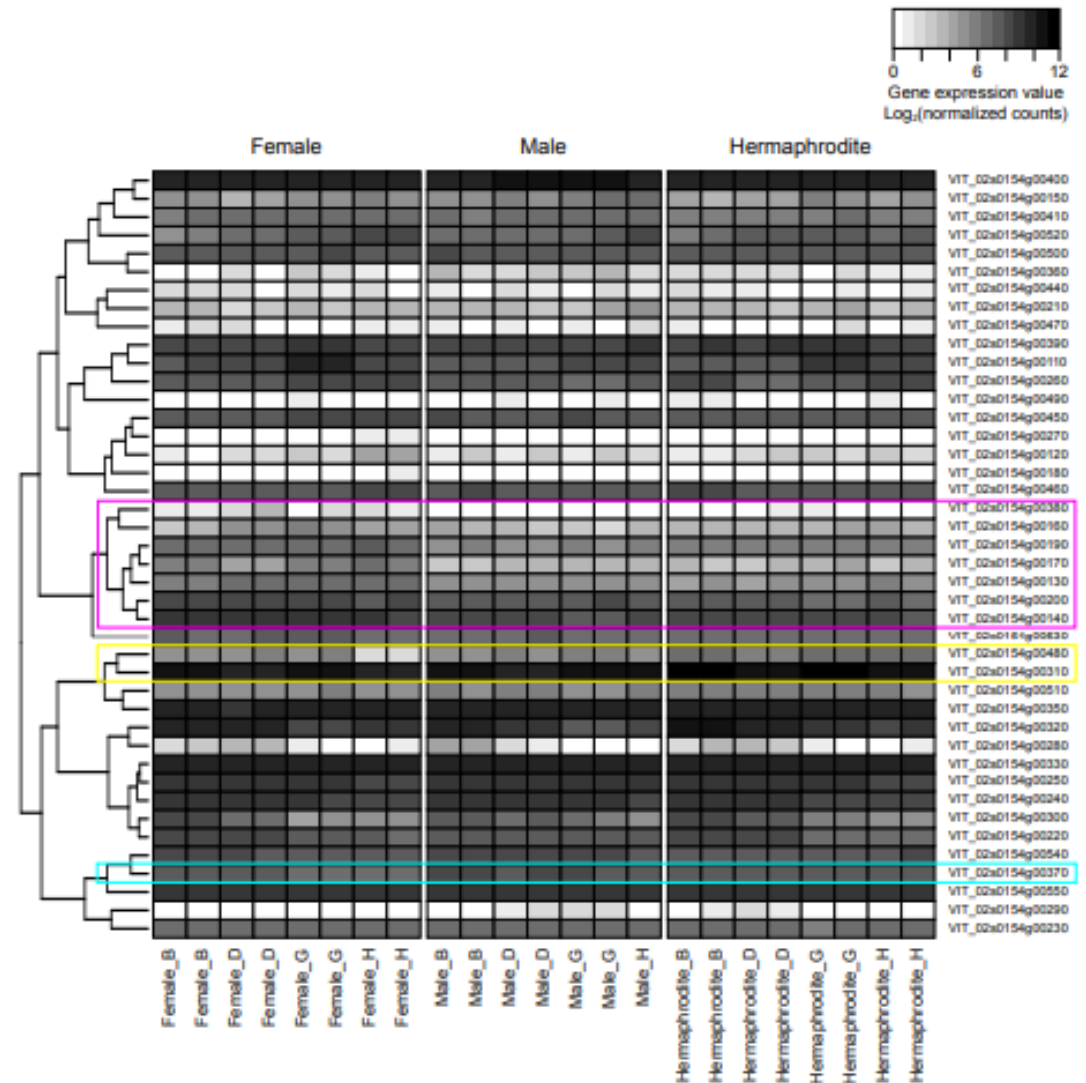


Validation

- Female
- Male
- Hermaphrodite

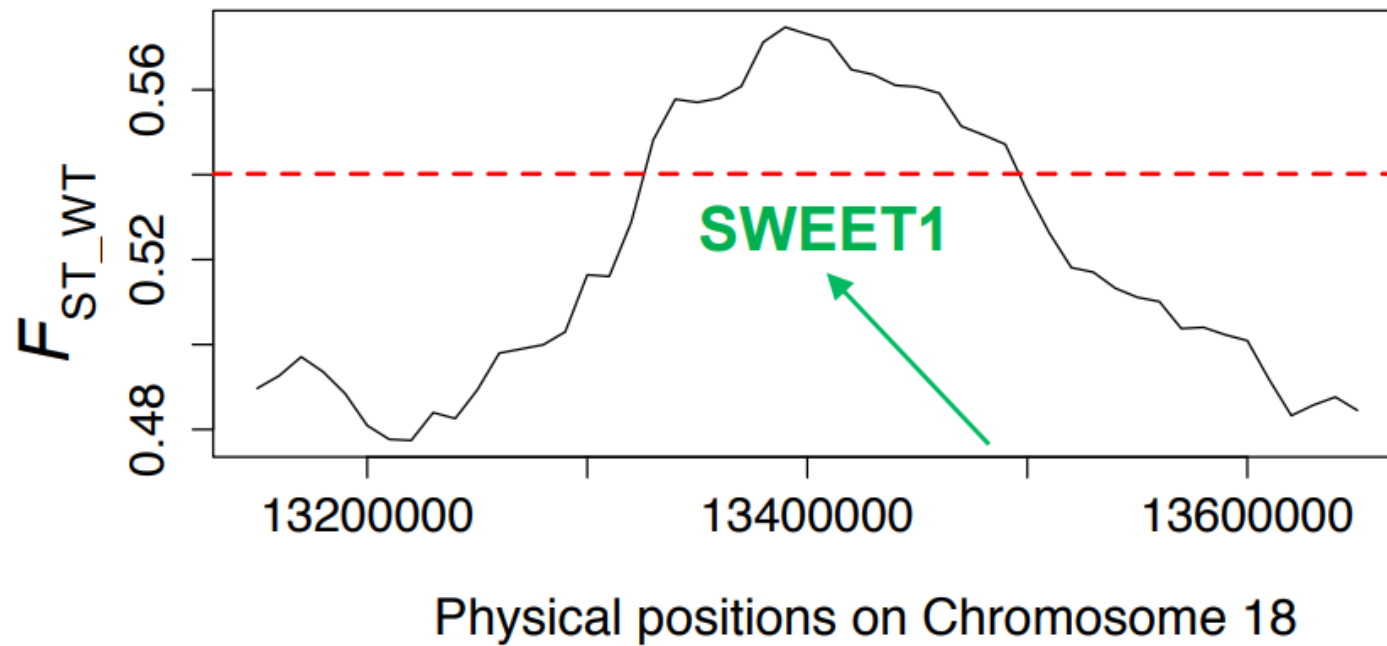
VviFSEX

Aborts stamen
development?

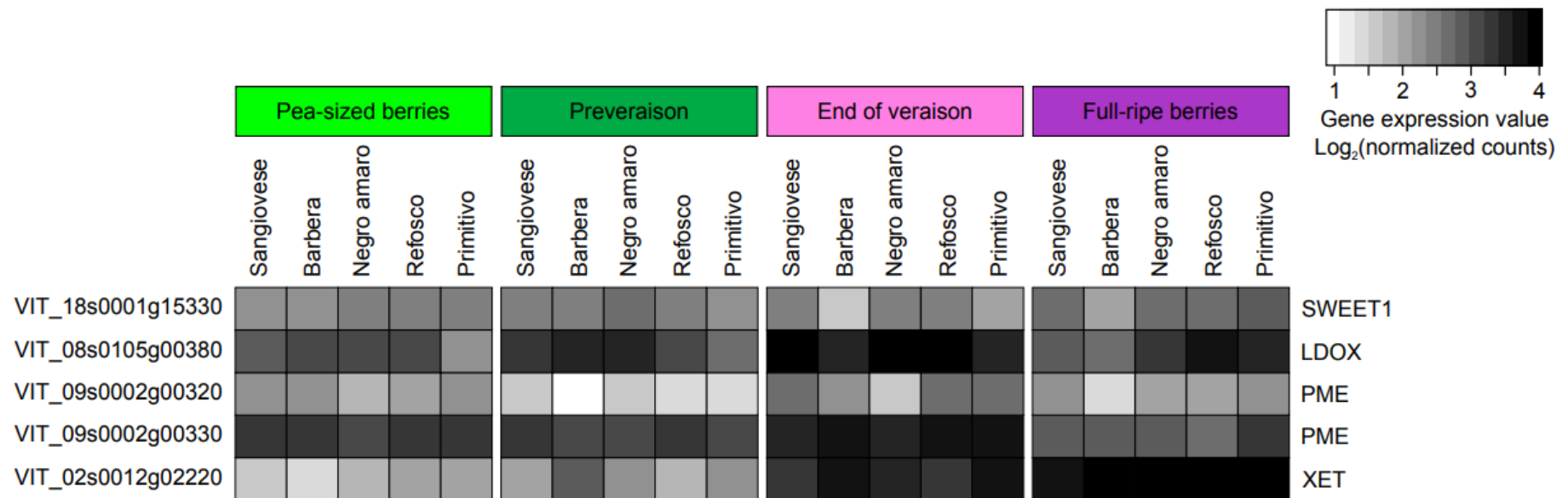


Zhou et al., 2017

SWEET1: Sugar transporter



Verifying candidate genes



Zhou et al., 2017

History of cultivation

- 6000-5000 BC: Origin in neolithic period

→ Egypt, Mediterranean

- Romans → Europe

- Catholic church and islam



History of cultivation

- Missionaries → America
- Early 19th century: South Africa, Australia, New Zealand
- Late 19th century: Introduction of pathogenes

Late 19th century: Introduction of pathogens



Mildew



Phylloxera

agric.wa.gov.au

Late 19th century: Introduction of pathogenes

Devastation of European vineyards

→ Reduction of cultivar diversity

→ Using indigenous *Vitis* species as **rootstocks** and for **breeding**
interspecific hybrids → pathogen resistance

Cultivation

Breeding of new crosses



Finger Lakes Grape Program



hort.cornell.edu

Cultivation

Propagation with cuttings

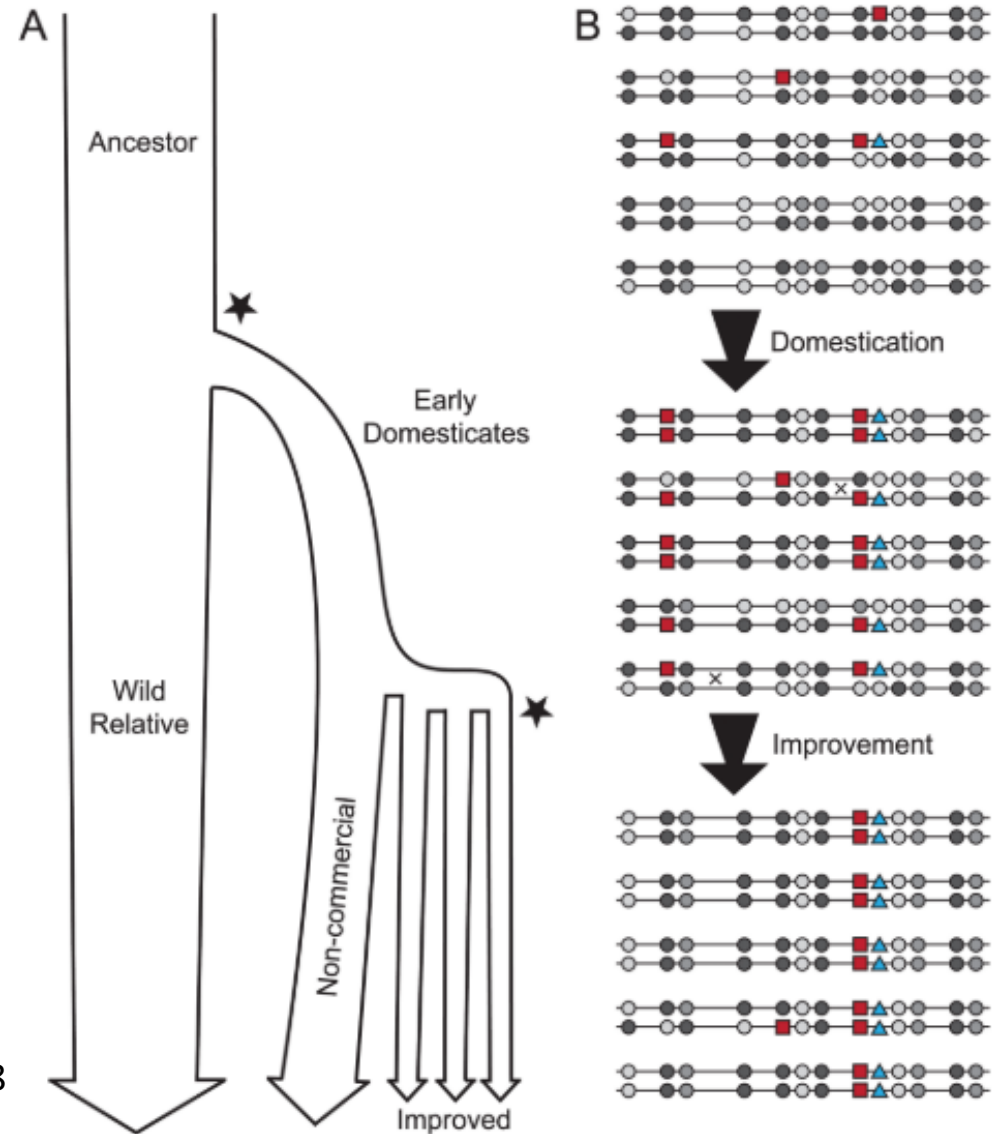
- immortalizes cultivar
- clones with unique traits
- allows grafting



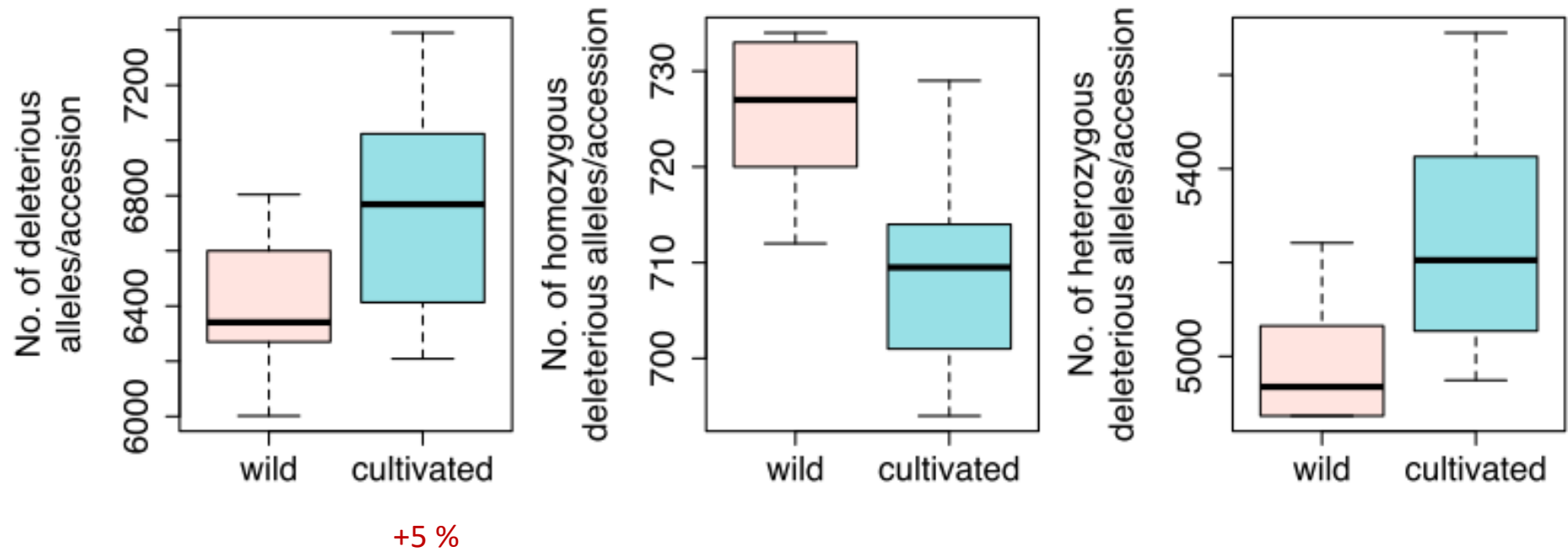
Cost of domestication

Deleterious variants ↑
Genetic variety ↓

Moyers et al., 2018

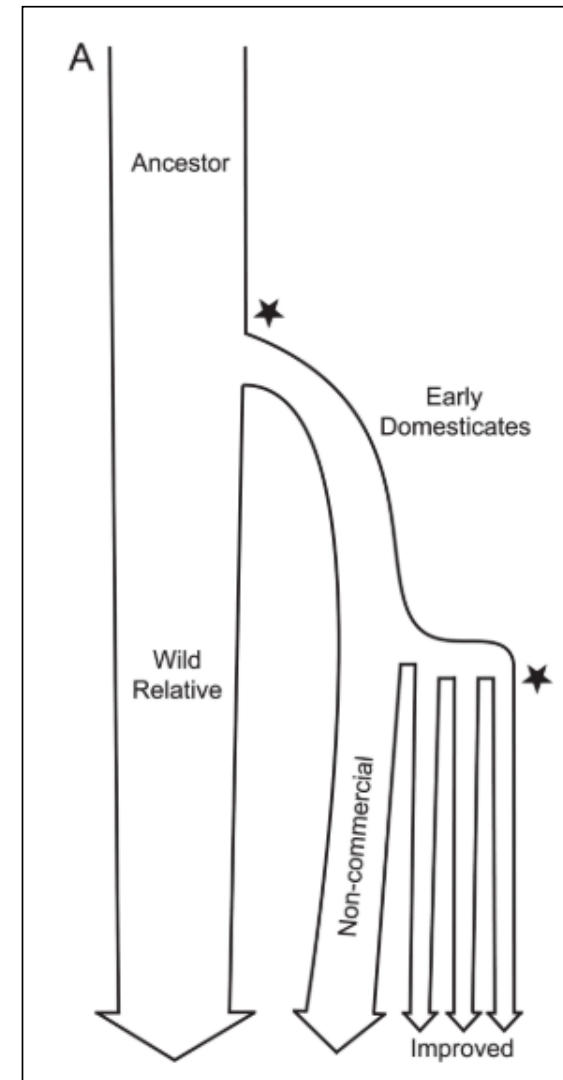
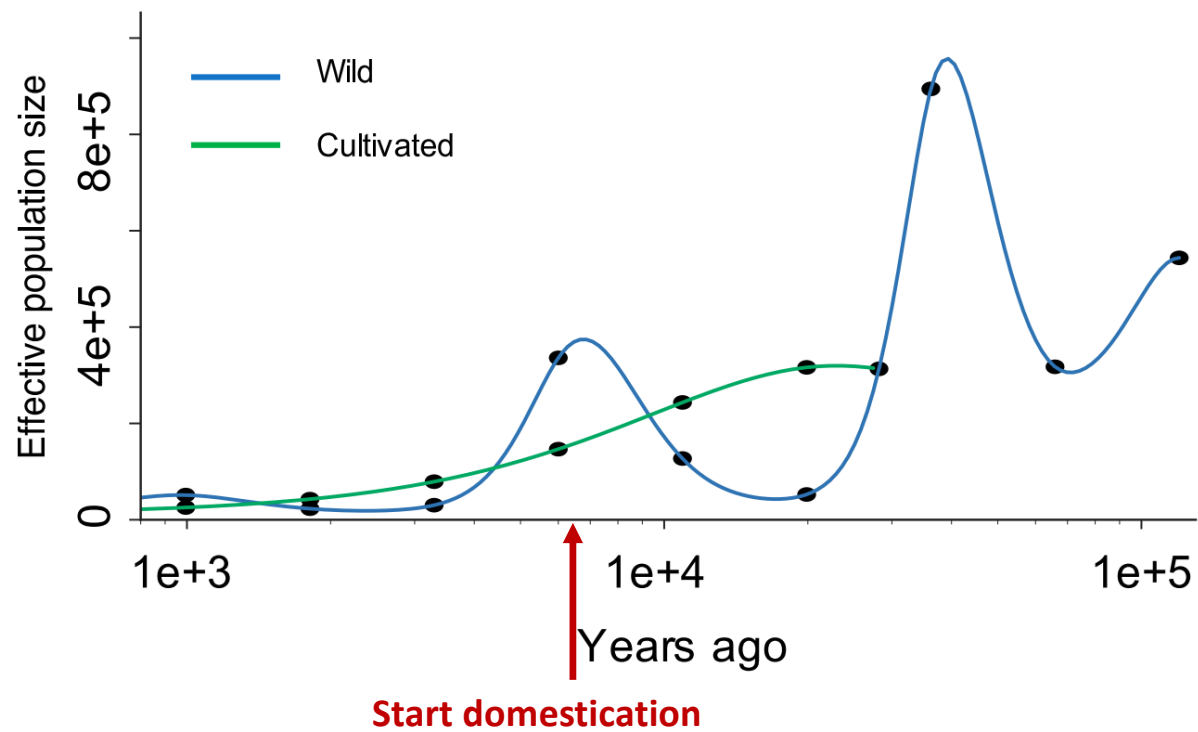


Deleterious variants



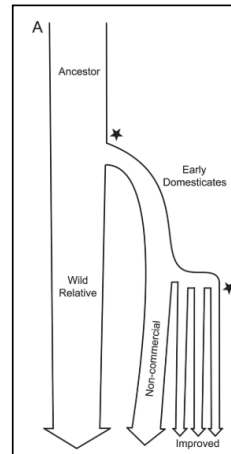
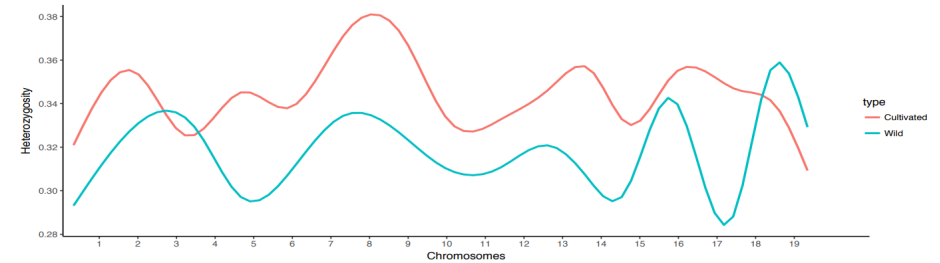
Effective population size

Zhou et al., 2017



Summary

- Grapes mainly propagated clonally
- Selective sweeps → gene detection
- Cost of domestication:
 - Genetic Variety ↓
 - Deleterious variants ↑



Discussion

- Why are there fewer homozygous deleterious variants in cultivated grapes?
- Interspecific *vitis* hybrids are not used anymore, what could be the reason?

	Grape	Maize	Rice	Tomato
Diversity: Cultivated/Wild	94%	83%	64%	54%
Progenitor population used for cultivation	33-50%	<10%	~2%	NA

Zhou et al., 2017

