## CGCN Webinar Series: Rootstocks and research updates

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Cool Climate Oenology & Viticulture Institute

Brock University





- Brief background on rootstocks and their benefits
- Rootstock selection in Canada
- Ongoing rootstock trials in Ontario
  - Clone x rootstock evaluations
  - Cold Hardiness
- Climate change and rootstock considerations
- CCGN and need for domestic rootstock production

# Matching grapevine material to the environment

- The selection of plant material is an important resource for climate adaptation
- Species or crossings of different species
- Cultivar
- Clone
- Rootstock
- Quality of material



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# What is a rootstock?



- Specialized stock material to which the grapevine cultivar (*scion*) with desirable fruit characteristics are grafted
- The shoot portion is called the *scion*
- The root portion (*rootstock*) provides the root system to the fused combination of genotypes
- Rootstocks almost always have high proportion of North American species in their genetic background



V. Rupestris



V. Berlandieri



#### The grafted grapevine









Photo credit: B. Cafroll

Photo Credit: Wikipedia

Rootstocks

- Strongly interact with scion genotypes ar modify:
  - Whole plant development
  - Biomass accumulation and partitioning
  - Phenology



 Rootstock breeding programs aim to improve pest resistance and adaptation to abiotic stresses



## Why do we use rootstocks in Canada?

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- Phylloxera resistance
- Nematode resistance
- Adaptability to:
  - High pH soils (lime)
  - Saline soils
  - "Wet Feet"
  - Drought
- 80% of world's vineyards use rootstocks



Photo Credit: L. Eads

# **Rootstock benefits**

- Resistance ullet
  - Phylloxera, nematodes
- Tolerance •
  - Lime, Salinity, Water stress
- Growth  $\bullet$ 
  - Control, shorten vegetative cycle
- Uptake •
  - Nutrients •







C. Sauv grafted to Riparia (center) and C3309 (L and R)

Photo courtesy: A. Reynolds

# What rootstocks do we use in Canada?

- Our rootstock choices are largely mediated by:
  - Harsh winter climate and;
  - Relatively short growing season

Rootstocks must be resistant to phylloxera and nematodes, and adaptive to a wide range of soil conditions

• Soil water availability





# Rootstock selection in Canada



- Many factors to consider when choosing a rootstock
  - Our grape growing regions have quite dramatic differences in soil types and climate.
  - Large variation in vintages
    - Wet growing seasons
    - Persistent drought
    - <sup>-</sup> Short periods of drought
    - <sup>-</sup> Dry summer and wet fall
  - Rootstocks have different degrees of resistance to drought, wet-feet, cold temperatures
  - Production goals larger vines + higher yields, smaller vines and yield/vine
- Canada's wine regions are diverse so there is not just one rootstock that is the "best"

# Characteristics of common rootstocks in Canada (Modified from Cousins 2005, Shafer 2004).



Rootstock	Parentage	Ease of propagation	Phylloxera protection	Root-knot nematode resistance	Dagger nematode resistance	Calcareous soil adaptation	Soil Recommendation	Scion vigour
Riparia Gloire	V. riparia	High	High	Low	Medium	Low	Deep, moist, fertile soils	Low
3309C	V. riparia x V. rupestris	High	High	Low	Low	Low	Deep, well- drained, moist soils	Low to medium
101-14	V. riparia x V. rupestris	High	High	Medium	Medium	Low	Deep, moist, soils	Medium
SO4	V. riparia x V. berlandieri	High	High	Medium	Medium	Medium	Light, well- drained, low fertile soils	Medium
5C	V. riparia x V. berlandieri	High	High	Medium	Medium	Medium	Moist, heavy soils	Medium

# Climate change and grape growing in Canada

- Climate changes are a reality
- Studies indicate a:
  - Rise of the average temperature
  - More heat waves and days with >30°C
  - Higher drought incidence
  - Reduced snow cover and increased rainfall in winter
  - More extreme weather events
  - We farm extremes and weather has a significant impact on production



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## Evaluation trials and future development

- Cool Cimate Oenology & Viticulture Institute Brock University
- Specific scion/rootstock combinations may work well in some regions and very poorly in others; hence the need for regional rootstock trials.
- Rootstocks may help improve sustainability of wine regions through adaptation to climate change (i.e., drought, heat, new pests)
  - New plantings may use new scion material but possibly grafted to a more resilient rootstock (i.e., a more drought tolerant in BC)
  - We likely need a domestic and an international effort for more rootstocks as abiotic AND biotic threats continue to increase in our regions

#### Cultivar x clone x rootstock evaluations

- Cool Cimate Oenology & Viticulture Institute Brock University
- Funded through OGWRI/NSERC-CRD (Inglis, Willwerth, Kemp) and now CGCN/AAFC (Agri-Science Grape cluster)
- Industry partnerships for vineyard blocks
- Different soils, clones x rootstocks of core varieties





# **Regional Rootstock trials in Ontario**

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- Trials began in 2016
- Examined variety x clone on different rootstocks in existing mature vineyards
- Newly planted variety x clone x rootstock trial vineyards in 2018
- 5 different varieties x different clones x SO4, C3309, Riparia Gloire, 101-14 and selected others (C1616, 1103P, 420A, 110R).
- Different soil types heavy clay loam and sandy loam
- Examining vine performance, yield components, fruit composition and oenological potential

# **Rootstock selection and hardiness?**



- Many factors to consider when choosing a rootstock
- Rootstocks might affect cold hardiness indirectly
  - Many studies indicate rootstocks can greatly affect vigor and vine balance
  - Vines over-cropped tend to be less cold tolerant, especially on year with poor weather
  - Crop load (yield per vine (kg)/vine size (g)) can help evaluate if the vine is over or under-cropped
- Winter hardiness of young vines grafted to different rootstocks was researched in the 80s (Miller et al. 1988)
  - Concluded that of the 3 rootstock tested (5BB, SO4, 3309), 3309 was the most suited to cold temperature own-rooted had the worst performance of all.



# What if the vines we planted were more tolerant?

- Can we find, within specific cultivars, <u>clones</u> that are more cold tolerant?
  - Could better clone selection reduce cold damage to cold tender cultivars?

- Does the **rootstock** influence the cold tolerance?
  - Could we use rootstock to improve cold tolerance?

How can clone x rootstock impact cold tolerance? Hébert-Haché et al. (2021) Am J. Enol. Vitic.

- Study using existing vineyard plantings
- 4 different Sauvignon blanc clones on one common rootstock (SO4) and 2 different Riesling clones on 3 different rootstock (3309, SO4, Riparia Gloire)





# Other rootstock trials in Ontario

- Cabernet franc
  - 327 x 3309, 101-14, Riparia Gloire; 214 x 101-14
- Riesling
  - 21B, 239,49 x 3309 and 21B, 9 x SO4

#### H. Fisher and A. Rahemi

South Coast vineyard studies (sandy, vigorous soils) Different V. vinifera grafted to different rootstocks Pinot noir grafted to different V. Riparia accessions as rootstocks





# Rootstock selection

- Yearly differences, but overall appears less important for cold hardiness than cultivar and/or clone
- All vines had similar crop load and were considered "in balance"



# Clone x rootstock interactions

- The clone x rootstock interaction was significant almost every sampling date on the first year of the study
- Clone 49 performed better on SO4 rootstock, but clone 239 performed better on Riparia Gloire.
- Important yearly variation



\* indicates a significant clone x rootstock interaction (p < 0.05)

# Cold hardiness considerations



- Cultivar, clones and even rootstocks can impact hardiness but it is dynamic and growing season influences should be taken into consideration.
- Vine material matched to site conditions will be most resilient to effects of climate change and just weather in general
- Clone x rootstock should be taken into consideration in future studies and reporting of cultivar hardiness
- Poor rootstock choice has an immediate impact on winter survival

# **Quality of material**

- Cool Cimate Oenology & Viticulture Institute Brock University
- Important for quality, general performance and resistance to stress
- Quality of material
  - Good source of material
  - True to type
  - Clean from major viruses or diseases







# **Domestic Rootstock production**

- Canada's vineyards depend on grafted grapevines
- Viruses are graft transmissible in nature
  - Spread through vine propagation
- Dirty scion material AND rootstock material can lead to vine health issues and continued spread of viruses through nurseries
- It is essential to have clean rootstock material as part of the Domestic clean plant program
- Therefore, we need a continued focus on a **domestic** clean plant program and clean rootstocks right here in Canada vs. importation
  - A national effort through CGCN, institutions, industry including nurseries
  - What would happen if the borders were shut down for imported material?





Conclusion



- Rootstocks are essential for Canadian vineyard production
- Many benefits:
  - Resistance to biotic pests (phylloxera, nematodes)
  - Tolerance to different soils and abiotic stress (i.e. drought, wet feet, cold)
  - Growth, vigour
  - Uptake of nutrients
- Regional studies of cultivars, clones and rootstocks are increasingly important
- Rootstocks will be an important adaptation strategy to climate change
- Domestic rootstock production is a critical component for CGCN's program

# And thanks to our funding and industry partners



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**Canadian Grapevine Certification Network** 

**CGCN-RCCV** 

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Grape Growers