

Canadian Grapevine Certification Network Webinar Series

May 26, 2021



Current Status of Grapevine Trunk Diseases in Canada

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Canadian Grapevine Certification Network
CGCN · RCCV
Réseau canadien de certification de la vigne



Agriculture and Agri-Food Canada
Agriculture et Agroalimentaire Canada

Canada

• Grapevine trunk diseases in Canada

- Botryosphaeriaceae sp. (*Diplodia mutila*) causing cankers described in 1964 in Ontario

Chamberlain et al. 1964. *Canadian Journal of Botany* 42:351-355

- In mid-2000 British Columbia starts experiencing:

Significant plant mortality primarily in newly established vineyards (industry expansion)

Yield losses in mature vineyards planted between 1995 and 2000



Photo credit: J. R. Úrbez-Torres (AAFC - SuRDC)

Photo credit: S. Poojari (CCOVI-Brock U.)

Primarily attributed to abiotic factors or to diseases favored by cold climatic conditions

- **Grapevine trunk diseases in Canada**

- BC industry interested in researching other potential biotic causes

- BCWGC included GTD as a research priority in 2009:

- 2010-2013. Developing Innovative Agri-Products (DIAP) - BCWGC-AAFC

Activity 3: *'Diagnostic Technologies and Management Strategies for GTD in British Columbia'*

- 2013-2018. Growing Forward I - AgriInnovation Program (AIP) - BCWGC-AAFC

Activity 3: *'Epidemiological and diagnostic studies of GTD to develop effective controls'*

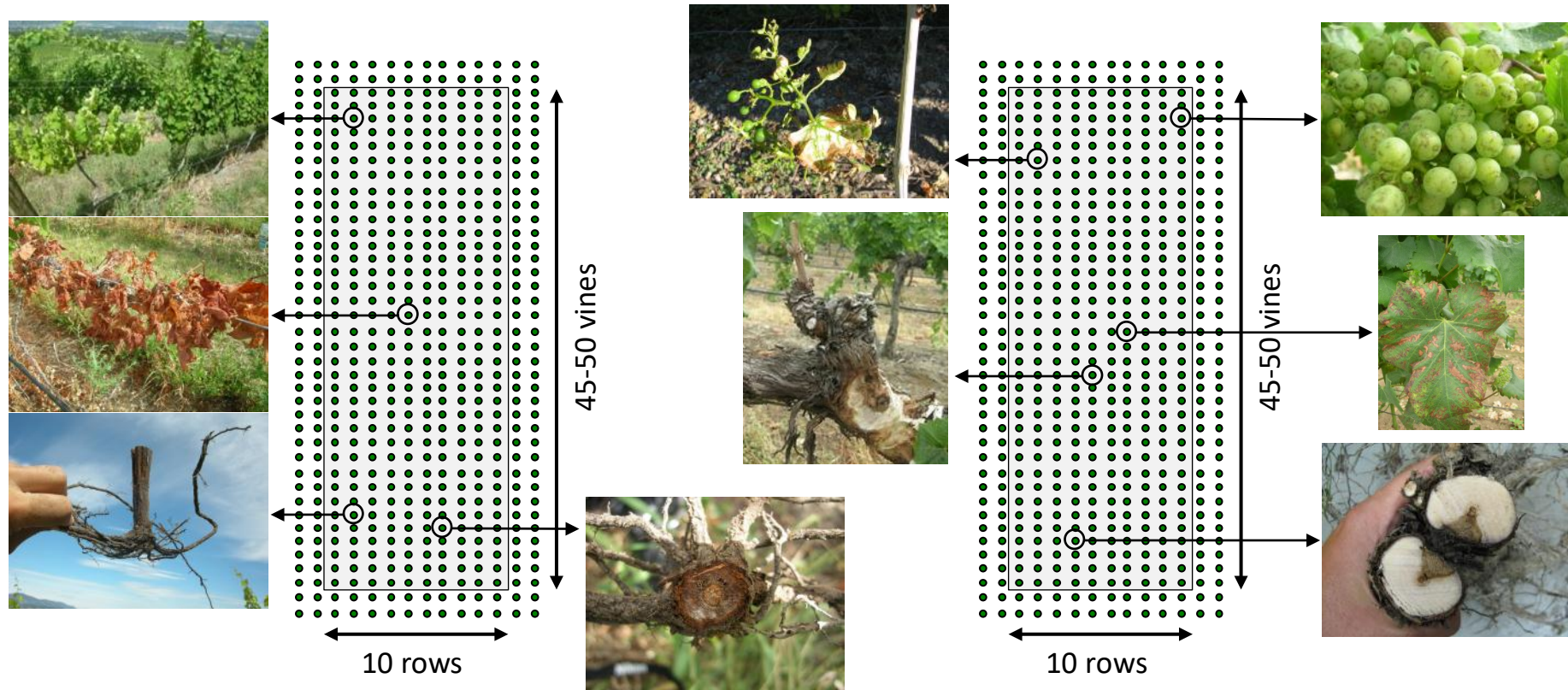
- 2018-2023. Growing Forward II – Canadian Agriculture Partnership (CAP) - CGCN-AAFC

Activity 21: *'From nursery to vineyard: Implementation of effective management strategies against GTD in Canada'*

• Grapevine trunk diseases in BC

1) Incidence/importance

- 2011-2013. Field surveys (**50** young and **70** mature vineyards)
- Monitored blocks of ~500 vines per vineyard (> 60,000 vines visually inspected)



Vineyards were monitored twice: June-July and August-September

• Grapevine trunk diseases in BC

1) Incidence/importance

- GTD symptomatic vines in **95%** of vineyards surveyed
- Results showed an overall of **10%** GTD infected vines in BC
- Up to **40%** incidence in a single young vineyard
- **50%** of young vines showing symptoms in June-July were dead when inspected again in August-September
- Up to **80%** incidence in a single mature vineyard
- **8%** of young vines used as re-plants in mature vineyards showed young vine decline symptoms
- **Significant young vine decline incidence**

Úrbez-Torres *et al.* 2014. *Plant Disease* 98:456-468 & 98:469-482

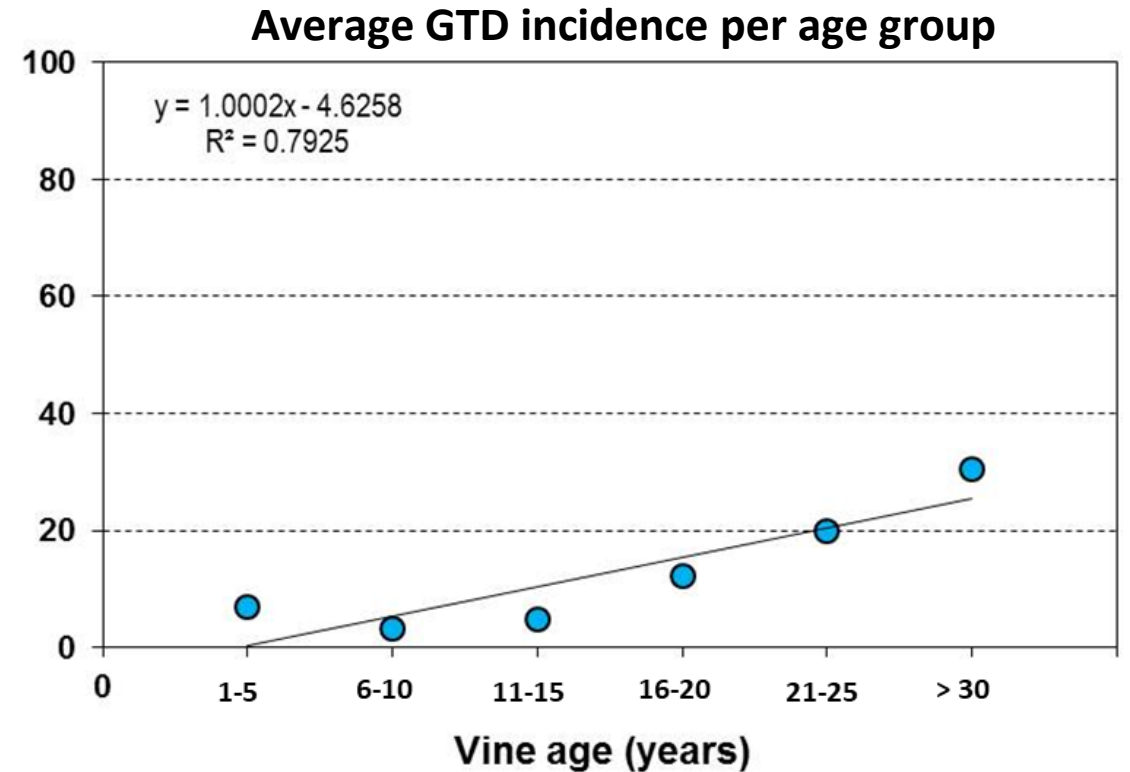
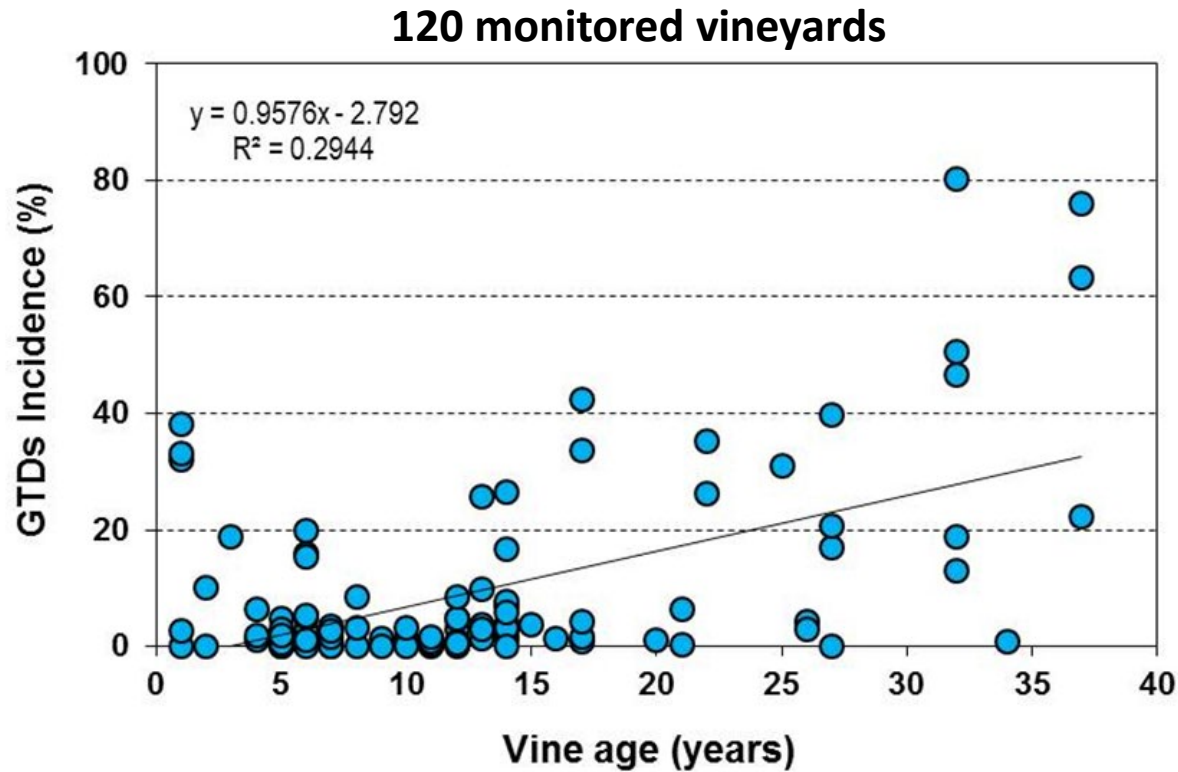


Photo credit: J. R. Úrbez-Torres (AAFC - SuRDC)

• Grapevine trunk diseases in BC

1) Incidence/importance

- Relationship between vineyard age and GTD incidence in BC



• Grapevine trunk diseases in BC

1) Incidence/importance

- Collection of more than **500 samples** to determine most prevalent GTD fungi in BC



Traditional plating
morphological characterization



Molecular identification
DNA/PCR/Sequencing



• Grapevine trunk diseases in BC

1) Incidence/importance

- GTD fungal pathogens identified in BC vineyards

Black foot

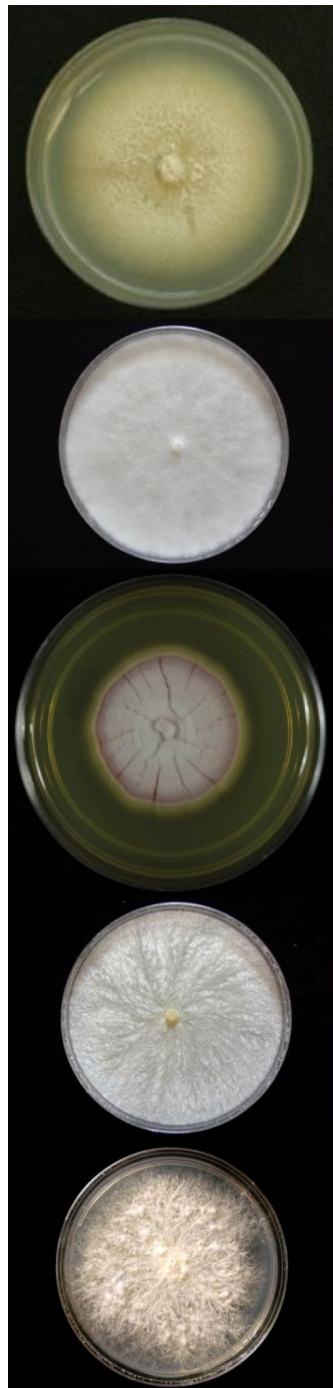
1. *Cylindrocarpon pauciseptatum*
2. *Ilyonectria liriodendra*
3. *Ilyonectria macrodidyma*
4. *Ilyonectria robusta*
5. *Ilyonectria torresensis*

Petri disease / esca

1. *Phaeomoniella chlamydospora*
2. *Cadophora luteo-olivacea*
3. *Phaeoacremonium canadense*
4. *Phaeoacremonium iranimum*
5. *Phaeoacremonium minimum*
6. *Phaeoacremonium roseum*

Cankers and dieback

- | | |
|-----------------------------------|--------------------------------------|
| 1. <i>Botryosphaeria dothidea</i> | 15. <i>Phomopsis amygdali</i> |
| 2. <i>Diplodia mutila</i> | 16. <i>Phomopsis</i> sp. |
| 3. <i>Diplodia seriata</i> | 17. <i>Diaporthe eres</i> |
| 4. <i>Diplodia</i> sp. | 18. <i>Diaporthe australafricana</i> |
| 5. <i>Dothiorella</i> sp. | 19. <i>Cytospora</i> sp. |
| 6. <i>Neofusicocum parvum</i> | 20. <i>Neofabraea</i> sp. |
| 7. <i>Neofusicocum ribis</i> | |
| 8. <i>Cryptovalsa ampelina</i> | |
| 9. <i>Diatrype pullmanensis</i> | |
| 10. <i>Diatrype whitemanensis</i> | |
| 11. <i>Eutypa flavovirens</i> | |
| 12. <i>Eutypa laevata</i> | |
| 13. <i>Eutypa lata</i> | |
| 14. <i>Phomopsis viticola</i> | |



• Grapevine trunk diseases in BC, SUMMARY

- GTD identified in BC and present in all grape growing regions
- GTD symptomatic vines recorded in 95% of vineyards surveyed
- 10% of total vines in BC estimated to be infected and symptomatic with GTD
- GTD incidence varied among surveyed vineyards (up to 40% in young and 80% in mature)
- High incidence of young vine decline and mortality of young vines
- 30 different GTD fungal species identified by morphological and molecular studies
- Young vines: *Phaeomoniella chlamydospora*, *Cadophora luteo-olivacea* and *Ilyonectria* spp.
- Mature vines: *Neofusicoccum parvum*, *Diplodia seriata* and Diatrypaceae spp.

• Grapevine trunk diseases in Canada

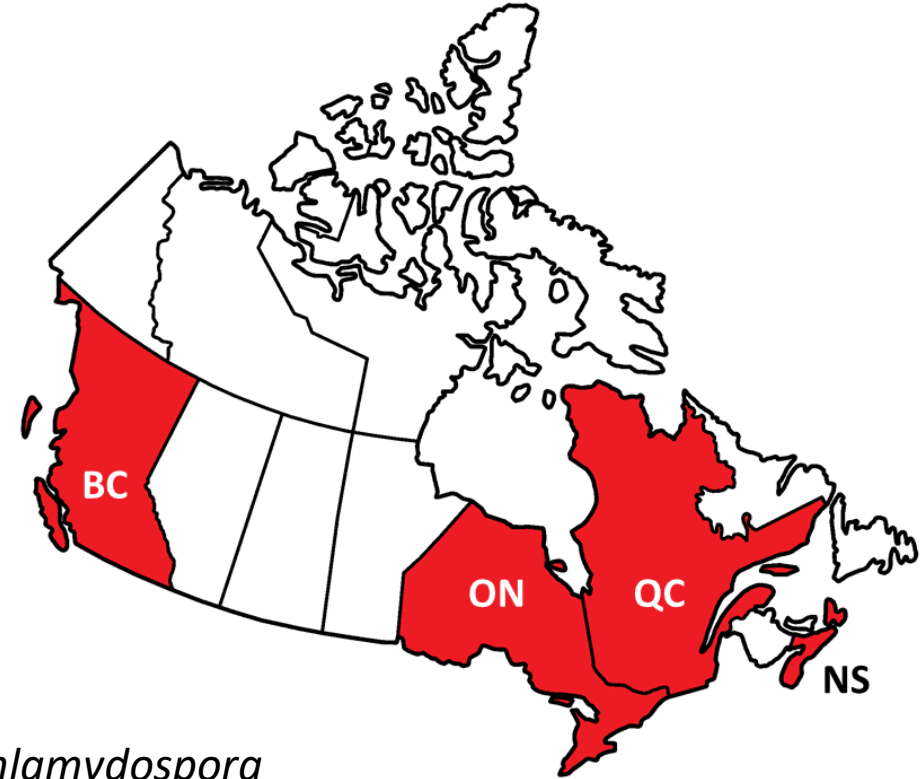
- No comprehensive work conducted on GTDs in other Provinces

Petit et al. 2011. *Cylindrocarpon* species associated with black-foot of grapevines in northeastern United States and southeastern Canada. *Am. J. Enol. Vit.* 62:177:183.

Travadon et al. 2015. *Cadophora* species associated with wood-decay of grapevine in North America. *Fungal Biology* 119:53-66.

Lawrence et al. 2016. Characterization of *Cytospora* isolates from wood cankers of declining grapevine in North America, with the descriptions of two new *Cytospora* species. *Plant Pathology* 66:713-725.

Samples submitted to SuRDC by **Dr. Wendy McFadden-Smith** (OMAFRA)



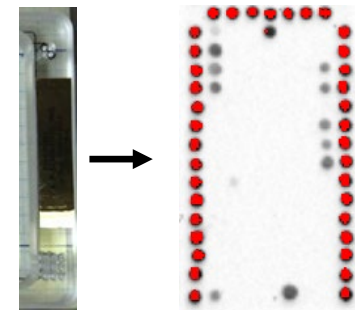
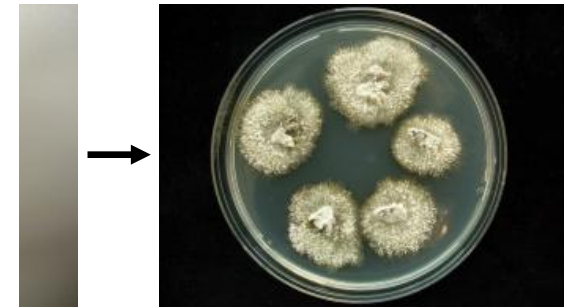
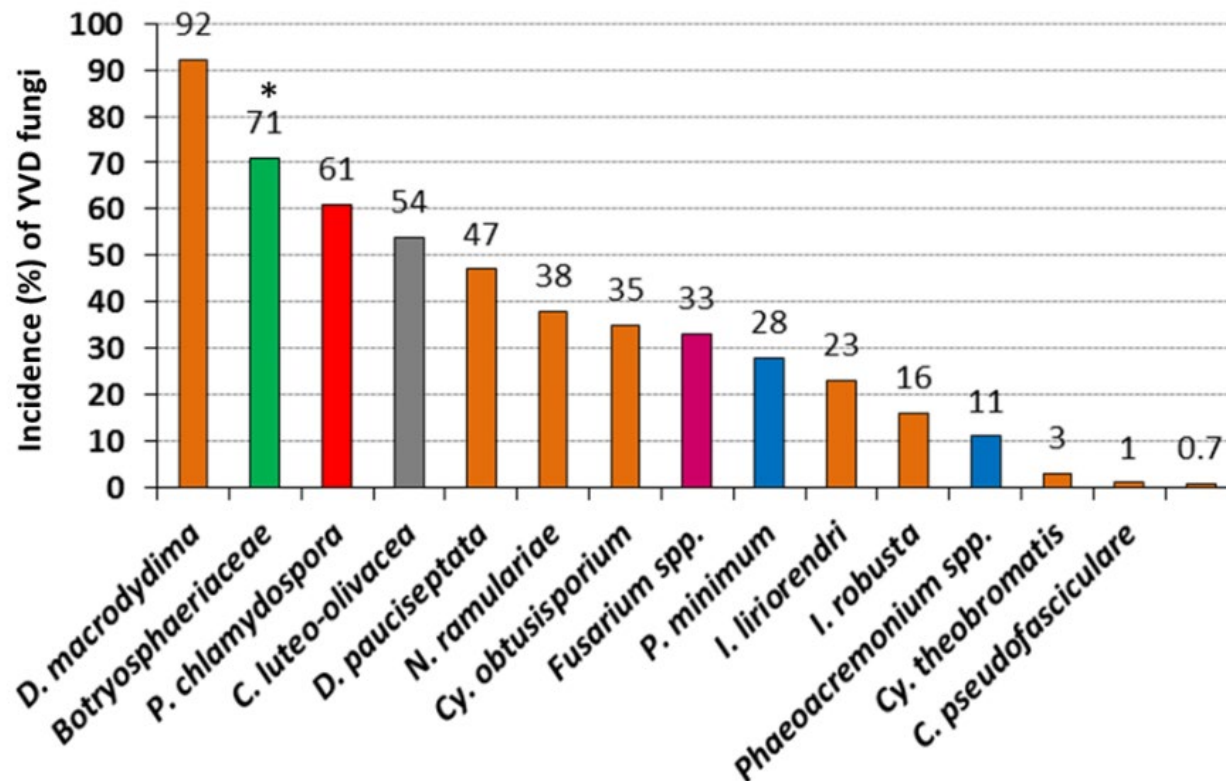
Phaeomoniella chlamydospora
Phaeoacremonium minimum
Eutypa lata
Phomopsis viticola
Diplodia seriata
Diplodia mutila
Neofusicoccum parvum

• Health status of grapevine nursery material planted in Canada

- Significant incidence of young vine decline in young vineyards in BC
- Studies to investigate the health status of nursery material in regards of GTD started in 2014
- 50 vines per nursery from two different nurseries (350 samples tested)

Traditional plating
morphological characteriza

DNA-microarray
multiplex molecular identific



* Detection based on PCR using primers BOT472R/ BOT100F. (Ridgway et al. 2011)

• Health status of grapevine nursery material planted in Canada

- Some GTD fungi are thought to be latent pathogens (stay dormant until become virulent)
- GTD fungi detected and identified from asymptomatic material



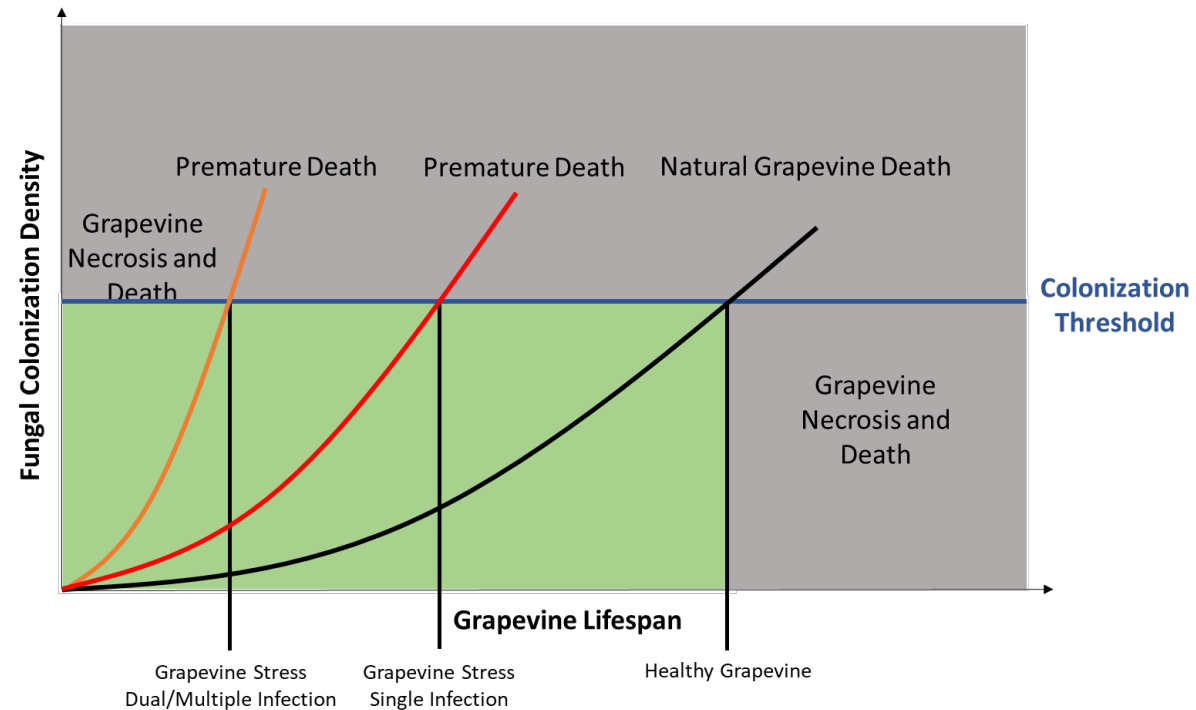
NA-A1-3B

Phaeomoniella chlamydospora
Dactylonectria macrodidyma
Phaeoacremonium minimum
Cadophora luteo-olivacea



NA-O1-5B

Phaeomoniella chlamydospora
Dactylonectria macrodidyma
Dactylonectria pauciseptata
Cylindrocarpon obtusisporium

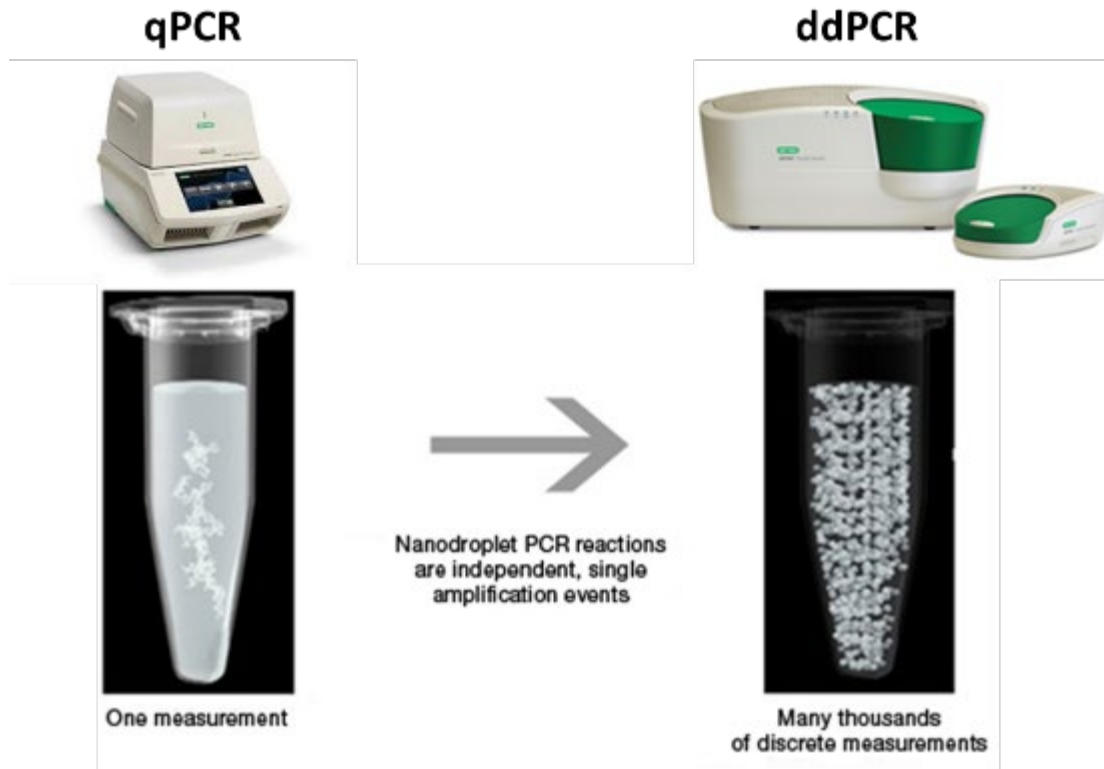


Úrbez-Torres et al. 2017. *Phytopathologia Mediterranea* 56:528

Hrycan et al. 2020. *Phytopathologia Mediterranea* 59:395-424

• Health status of grapevine nursery material planted in Canada

- Development and implementation of molecular tools for absolute pathogen quantification
- droplet digital™ PCR (ddPCR)



Primers/probes

Botryosphaeriaceae spp.

Phaeoacremonium minimum

Phaeomoniella chlamydospora

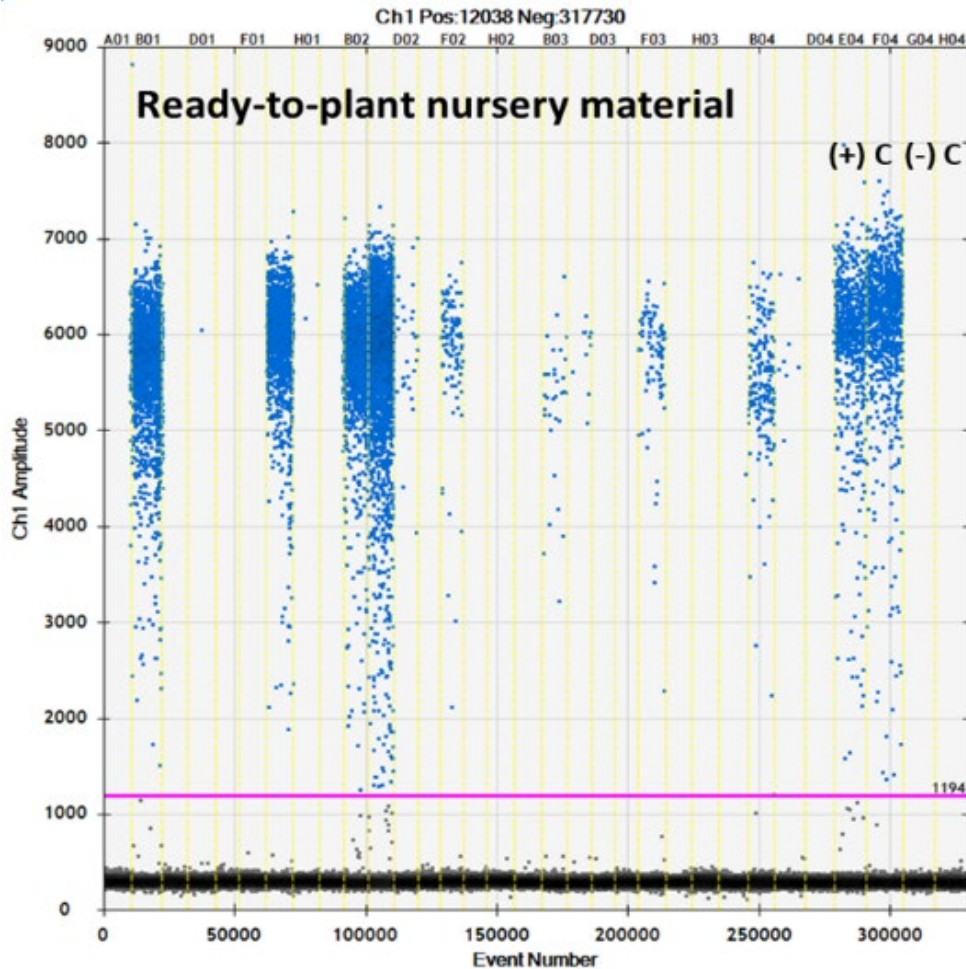
Cadophora luteo-olivacea

Ilyonectria spp.

- **Health status of grapevine nursery material planted in Canada**

- Development and implementation ddPCR for absolute pathogen quantification

Phaeomoniella chlamydospora



% of infected plants based on ddPCR

	Chardonnay	Merlot	Pinot Noir
<i>P. chlamydospora</i>	100%	87%	47%
<i>P. minimum</i>	40%	20%	14%
Botryosphaeriaceae spp.	7%	7%	7%
<i>Ilyonectria</i> spp.	60%	60%	100%
<i>C. luteo-olivacea</i>	100%	100%	53%

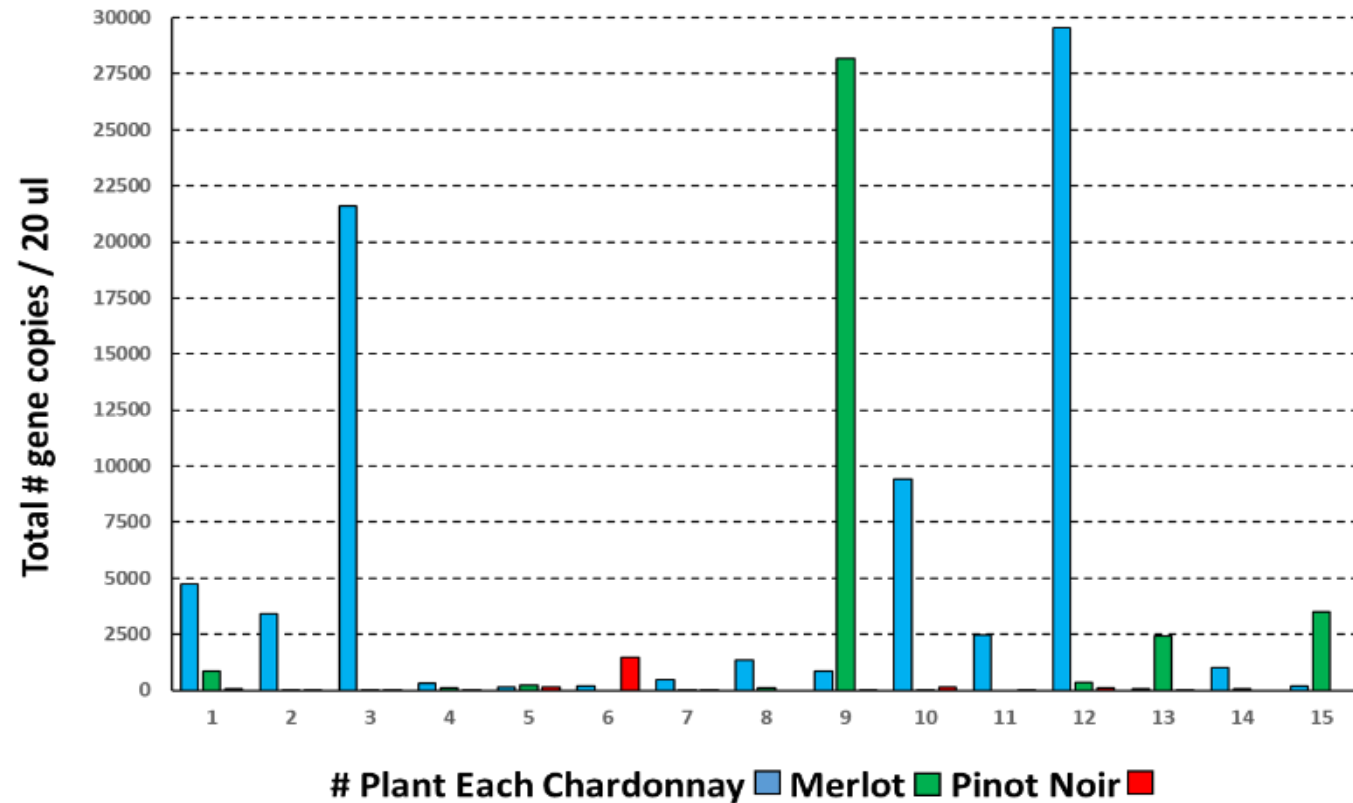
15 plants per cultivar

Presence of the pathogen may not result on disease development and eventual plant death

- **Health status of grapevine nursery material planted in Canada**

- Development and implementation ddPCR for absolute pathogen quantification

***Phaeomoniella chlamydospora* inoculum concentration per plant**

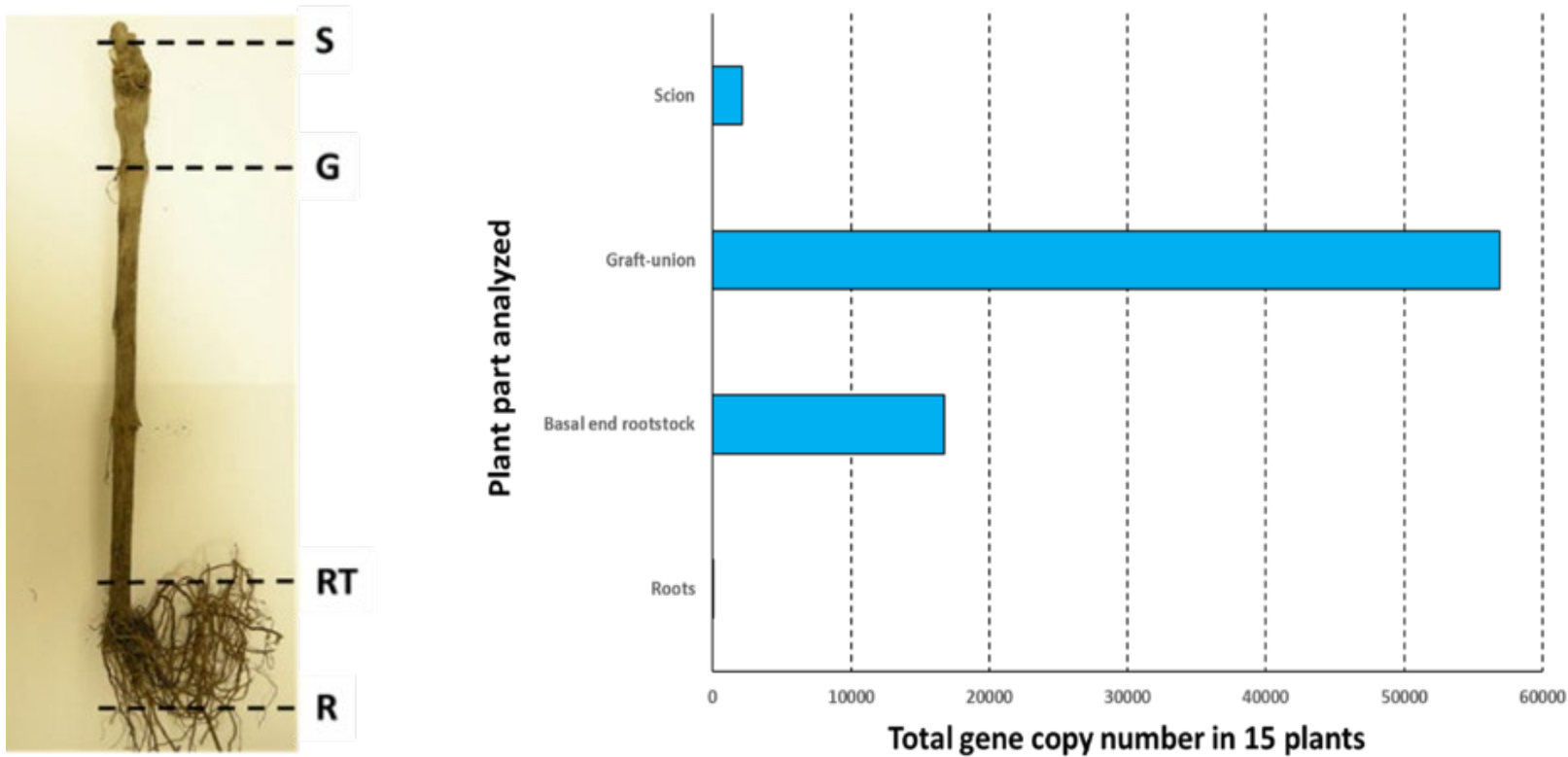


Significant pathogen concentration differences between cultivars

- **Health status of grapevine nursery material planted in Canada**

- Development and implementation ddPCR for absolute pathogen quantification

Phaeomoniella chlamydospora inoculum concentration per plant region in Chardonnay



Significant pathogen concentration differences between plant parts

• Health status of grapevine nursery material planted in Canada

- Determine factors that may favor transition from the latent to the virulent phase in GTD



Abiotic stress factors

Water stress

Nutrient deficiency

Over-cropping

Poor planting (J-rooting)

Cold temperatures

Biotic stress factors

Other pests and diseases

Nematodes

Inoculum thresholds

AMF (mycorrhizal fungi)

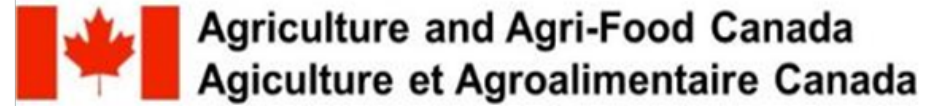
PhD Student Jared Hrycan



• **Health status of nursery material planted in Canada, SUMMARY**

- Development and implementation of two accurate and sensitive molecular tools
 - DNA-microarray: Detection (presence/absence), multiplex (70 pathogens / run)
 - ddPCR: Detection and absolute quantification (single or up to 2 pathogens / run)
- High presence of GTD fungi in nursery material planted in Canada
- *Ilyonectria* spp., *Phaeomoniella chlamydospora*, *Cadophora luteo-olivacea*
- Pathogen presence and/or abundance vary significantly between cultivars and plant's parts
- GTD fungi detected in both asymptomatic and symptomatic nursery material
- Possible latent phase of some GTD fungi
- Important to determine which abiotic and biotic stress factors may favor disease
- **Critical to develop and implement control of GTD fungi at the nursery level**

ACKNOWLEDGEMENTS



AAFC – SuRDC Plant Pathology Lab

Julie Boule Research Technician

Melanie Walker Research Technician

Jane Theilmann Research Technician

Mia Alexander Term Research Technician

Jared Hrycan PhD Student

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BC grape growers

Grapevine nurseries

THANK YOU!

