SCREENING GRAPEVINE RESISTANCE TO EUTYPA DIEBACK

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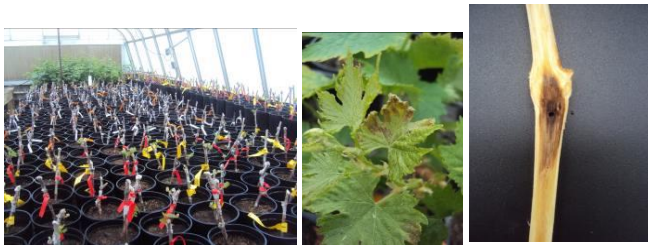
Eutypa dieback, caused by the fungus *Eutypa lata*, is a very damaging trunk disease of grapevine worldwide. This disease affects many vineyards in the US, mostly in producing areas with > 12 inches of rain during winters.

GOAL: Compare 3 protocols to provide a rapid and reliable methodology for grapevine resistance phenotyping for use by pathologists and breeders.

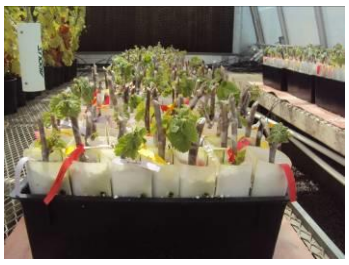
BENEFITS: Planting resistant cultivars remains the best method to grow a crop with limited pesticide applications and low production costs.

Hardwood cutting: Foliar and wood symptoms after 1 year



Green cutting assay: Wood symptoms only after 4 months

Detached cane assay: Foliar symptoms only after 5 weeks



Two types of symptoms are caused by *E. lata*. First, the fungus degrades the grapevine wood using a large array of enzymes, resulting in wood cankers and eventual death of the entire plant. Second, the fungus produces metabolites in the wood that are transported to the canopy, causing diagnostic foliar symptoms, such as shoot stunting and drying of flowers. The effects of the disease on yield can be dramatic.

Both published work and our preliminary observations suggest that grapevine cultivars vary in their resistance to Eutypa dieback. Planting vineyards with resistant cultivars would limit pesticide applications and production costs, while reducing crop losses over time. However, there is an urgent need for developing a fast method of identification of resistant cultivars. Indeed, it currently takes approximately a year to reproduce wood and foliar symptoms in controlled conditions. This lengthy procedure prevents initiating breeding programs, in which hundreds of progeny per cross need to be characterized for disease resistance each year. Accordingly, we compared three procedures to identify resistance to Eutypa dieback wood and foliar symptoms, with the aim of setting up a fast and reliable screening assay.

SUMMARY OF ACHIEVED WORK (2013-2014):

FIG.1: Severity of **wood lesions** in nine *V. vinifera* cultivars assessed either after 1 year incubation for hardwood cuttings.

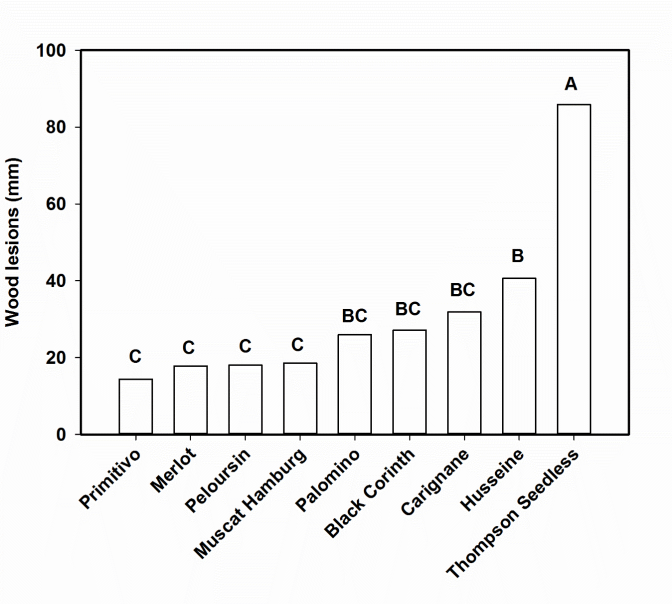
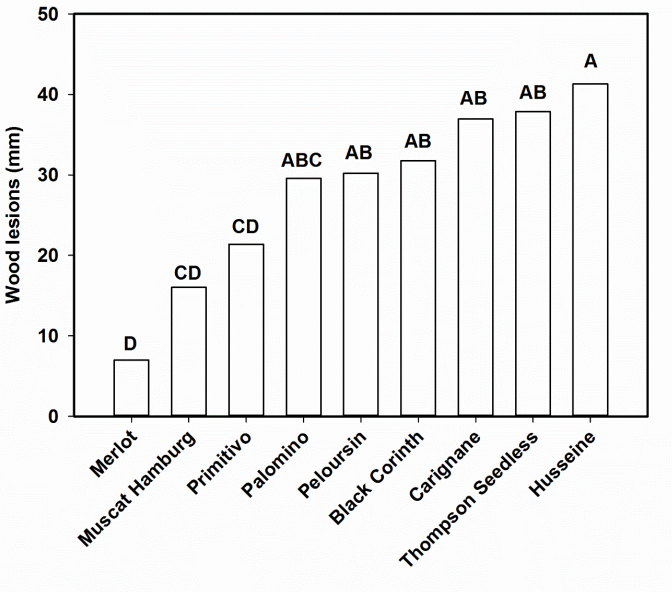


FIG.2: Severity of **wood lesions** in nine *V. vinifera* cultivars assessed either after 4 months incubation for mist-propagated, green cuttings.



1. The traditional, lengthy protocol (1 year) using hardwood cuttings allowed the development of wood lesions and foliar symptoms.

2. The green cuttings assay allowed wood lesions to develop in lignified stems, but no foliar symptoms appeared during the 4 month-long incubation.

3. We observed variation among cultivars for resistance to wood lesions (FIG. 1 and FIG. 2).

4. **Merlot** and **Primitivo** are among the **most resistant cultivars** tested for wood lesions.

5. The table-grape cultivars **Thompson seedless** and **Husseine** are among **the most susceptible**, for wood symptoms.

6. For wood symptoms, results were relatively consistent between hardwood cutting assay and green cutting assay.

SUMMARY OF ACHIEVED WORK (2013-2014, CONTINUED):

FIG.3: Incidence of **foliar symptoms** in nine *V. vinifera* cultivars assessed either after 1 year incubation for hardwood cuttings.

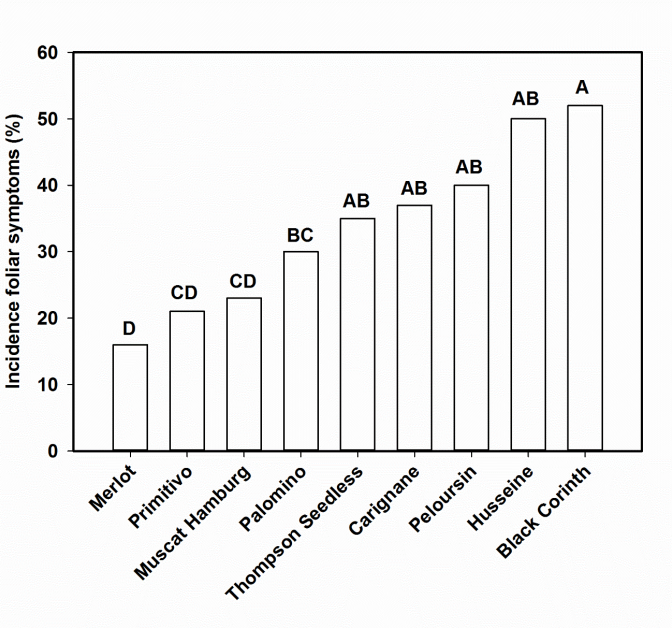
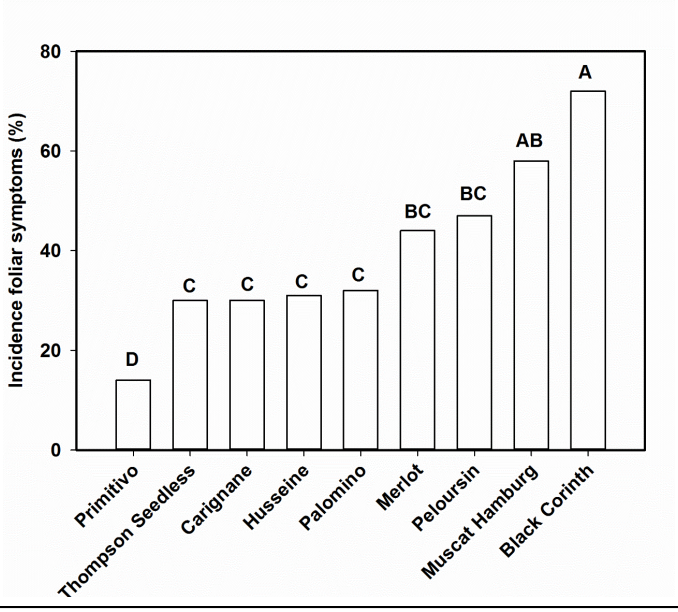


FIG.4: Incidence of **foliar symptoms** in nine *V. vinifera* cultivars assessed either after 5 weeks incubation for detached canes.



1. The **detached cane assay allowed foliar symptoms to appear within 5 weeks**. No wood symptoms developed during this period.

2. **Merlot** and **Primitivo** are among the **most resistant cultivars** tested for foliar symptoms in the twelve month, traditional assay (FIG. 3).

3. **Primitivo** is the **most resistant cultivar** tested for foliar symptoms in the 5 weeks assay (FIG. 4), while Merlot was not ranked among the most resistant cultivars.

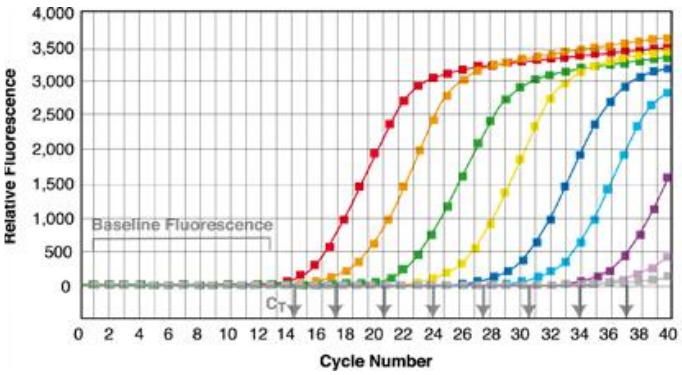
4. **Black Corinth** and **Peloursin** were consistently among **the most susceptible** cultivars for foliar symptoms in the two assays.

PROPOSED, CONTINUING WORK FOR NEXT FUNDING PERIOD:

Our objective is to compare the **expression profiles of genes potentially involved in resistance to Eutypa dieback** foliar symptoms **between these characterized, resistant and susceptible grapevine cultivars**. We propose the following objectives:

Collect grape leaves for RNA extraction.

Utilize qPCR to detect differential expression of target genes



- Determine if genes of interests are differentially regulated between susceptible and resistant cultivars.

- Examine if the foliar symptom expression correlates with gene regulation within a cultivar.

USDA-NIFA SCRI – Baumgartner *et al.* – New detection, research and extension tools for managing wood-canker diseases of fruit and nut crops

RESISTANCE TO PHOMOPSIS DIEBACK AND PHOMOPSIS CANE AND LEAF SPOT

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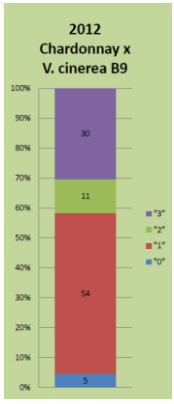
In eastern North American vineyards, Phomopsis cane and leaf spot caused by *Phomopsis viticola* is a destructive foliar disease, but in other Mediterranean grape-growing regions, *P. viticola* is primarily associated with a wood-canker disease, Phomopsis dieback.

GOAL: Determine if the genetic resistance to Phomopsis cane & leaf spot, expressed in green tissues, provides dual resistance to Phomopsis dieback in woody tissues.

BENEFITS: Breeders can incorporate cane and leaf spot resistance into their breeding programs and, in turn, growers will have resistant cultivars to both Phomopsis cane and leaf spot and dieback.

Disease ratings (0 to 3) of cane symptoms were conducted for 149 siblings from Chardonnay × *V. cinerea* cross in 2012.



Siblings from **Chardonnay × *V. cinerea* B9** crosses segregate for resistance to the cane symptoms in the field.

By inoculating woody tissues of these segregating siblings, we will assess the correlation between resistance to canopy symptoms and wood symptoms.

Symptoms of Phomopsis cane and leaf spot include leaves with numerous tiny, chlorotic spots with rounded or irregular margins. Infections of green shoots and the rachis result in dark brown and necrotic lesions. Heavily-spotted leaves and rachises often abscise prematurely or break. Fruit is susceptible at all stages of berry development, and the resulting fruit rot can diminish yields significantly. Infected shoots that are retained after dormant-season pruning as spurs or canes give rise to weak shoots the following growing season.

In California, *P. viticola* is better known as the causal agent of Phomopsis dieback. Symptoms of the disease include wood cankers as revealed by cutting a cross-section through an infected trunk, cordon or cane. Infected vines show spur and shoot dieback, weak canopy growth and overall poor yields.

Genetic markers linked with resistance to Phomopsis cane and leaf spot have been identified in breeding programs in Geneva, as part of the **SCRI VITISGENE PROJECT (collaboration with Bruce Reisch)**, NY. Siblings from Chardonnay × *V. cinerea* B9 crosses segregate for resistance to the cane symptoms in the field. We propose to determine if the genetic resistance to Phomopsis cane & leaf spot, expressed in green tissues, provides dual resistance to Phomopsis dieback in woody tissues.

Genetic resistance to cane and leaf spot symptoms could be integrated into breeding programs for resistance of grapevine woody tissues to canker formation.

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RESISTANCE TO BOTRYOSPHAERIA DIEBACK AMONG TABLE-GRAPE CULTIVARS

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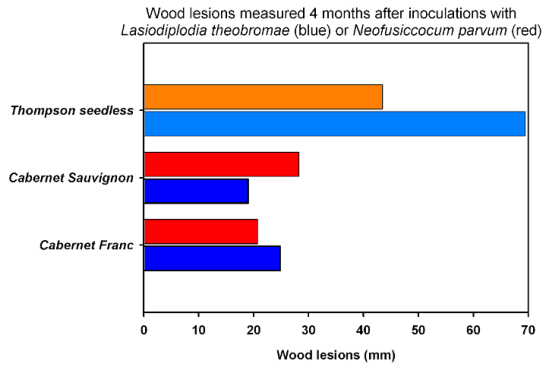
Based on our previous research experiences on the resistance of *Vitis vinifera* woody tissues to trunk disease pathogens, table-grape cultivars appear more susceptible to wood degradation than wine-grape cultivars.

GOAL: Evaluate the existing variation in resistance to Botryosphaeria dieback among 7 widely planted table- and raisin-grape cultivars.

BENEFITS: Knowledge on resistance will provide guidelines on cultivars to plant in high-risk areas.

Cultivar Thompson seedless is more susceptible to Botryosphaeria dieback than common wine-grape cultivars Cabernet franc and Cabernet Sauvignon.



We will screen 7 table-grape cultivars for resistance to Botryosphaeria dieback in greenhouse assays. Resistance will be based on the extent of wood degradation.

Cultivars
Flame Seedless
Thompson Seedless
Red Globe
Crimson Seedless
Autumn King
Scarlet Royal
Valley Pearl

Moreover, comparisons of anatomical features between Thompson seedless, the most widely planted cultivar for table- and raisin-production in CA, and wine-grape cultivars Merlot and Cabernet Sauvignon, suggest that xylem vessel sizes could correlate with disease susceptibility, with Thompson seedless having larger vessels.

Most table-grape and raisin-grape vineyards are located in the southern Central Valley of California, where the most prevalent disease is Botryosphaeria dieback. The most virulent fungal species responsible for this disease is *Neofusicoccum parvum*. Besides, this species is among the most destructive wood-canker pathogens of grapevine worldwide. Table-grape vineyards are thus at greater risk of succumbing to trunk diseases. Despite the genetic variation that exists among table-grape cultivars, most cultivars planted derive from the cultivar Thompson seedless, from which the seedless character was introgressed into new cultivars by grape breeders.

We propose to determine the existing variation in resistance to Botryosphaeria dieback among seven widely-planted table-grape cultivars. We will assess if disease resistance correlates with anatomical features (vessel diameters) and chemistry (percent dry weight in cell wall components lignin and glucan) of the wood. Knowledge on resistance will provide guidelines on cultivars to plant in high-risk areas.