Examining Biotrophic & Necrotrophic Pathogen Resistance in Grapes

Abigail Basen & Elsa Petit
Stockbridge School Of Agriculture
Email: abasen@umass.edu

Abstract

Understanding pathogen resistance is vital to further improve agricultural systems in their battle against disease. Disease resistance in emerging grape cultivars' needs to be documented. The goal of this study is to quantify whether there is a correlation between the biotrophic and necrotrophic resistances. In 2021, a first leaf disc assay was ran including three grape varieties and a few necrotophs. This initial study showed that a leaf disc assay could detect differences in level of resistance. This year's study focused on obtaining more statistical power for testing the correlation between between the biotrophic and necrotrophic resistances: we increased the number of grape varieties and we selected three of the most represented necrotrophic species from the 2021 collection. I ran a first leaf disc trial including a single necrotroph on nine grape varieties. Based on those preliminary results, I improved the protocol to screen more varieties in a more controlled environment.

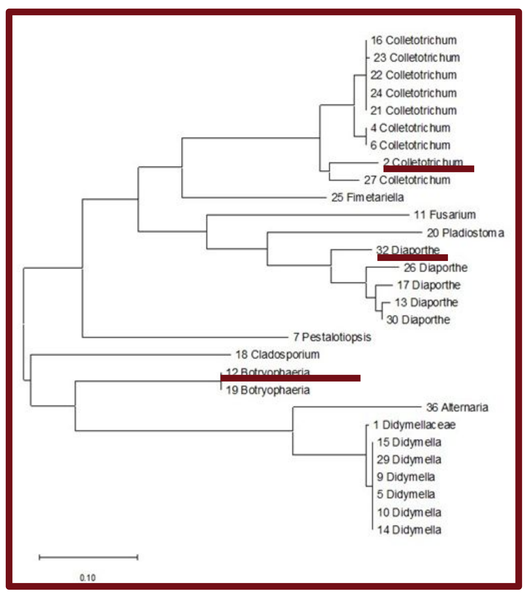

Fig. 1 Phylogenetic tree based on the ITS sequences of necrotrophic fungi collected in 2021. Underlined Culture 2, Culture 12, and Culture 32 were used in this experiment as they represent the most common pathogenic species.

Methods

- Four healthy leaves from each of the nine grape varieties were collected at Cold Spring Orchard, Belchertown
- Leaves were washed using 1% bleach solution followed by a rinse in sterile DI water
- Fungal plugs were created using a sterile corer for three different necrotrophs (Fig. 1)
- Cleaned leaves were poked with a sterile needle to create injury. (Fig. 2)
- Fungal plugs were placed on the injured leaf and removed on day 7. Pictures of lesions were taken over a 10 day period. (Fig. 3)

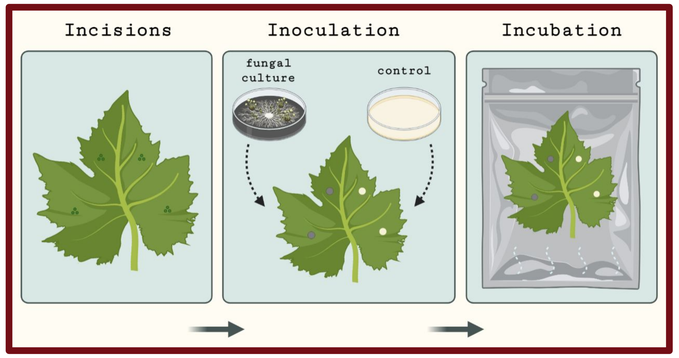

Fig. 2 Diagram of leaf plugs assay

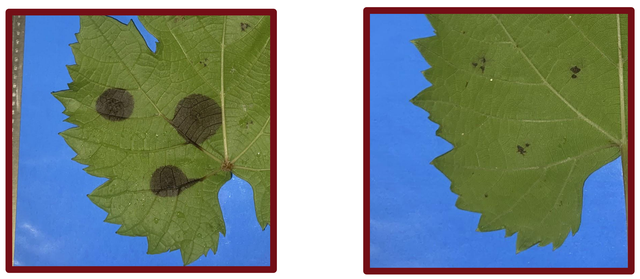

Fig. 3 Underside of the leaf of the grape varieties La Crescent (left) and Marquette (right) on day 10 of being infected with Colletotricum (Fig.1)

Acknowledgements: CAFÉ summer Scholar 2022, MAS00516
Thank you to Elsie Murphy and Julietta Mascitelli.

Results

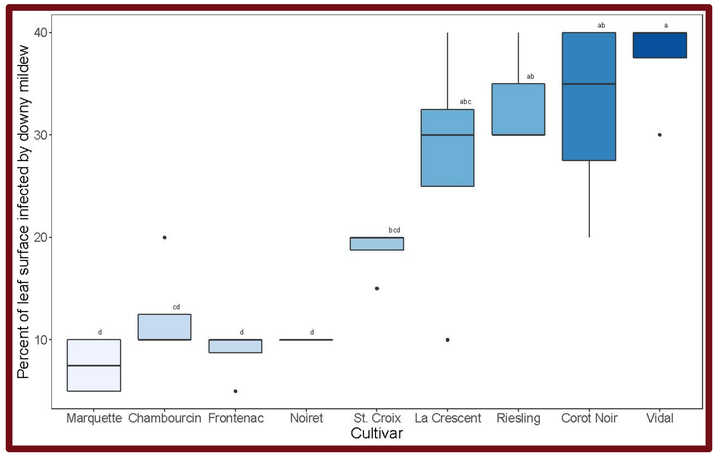

Fig.4 Percentage of leaf surface infected by downy mildew on the nine different grape varieties.

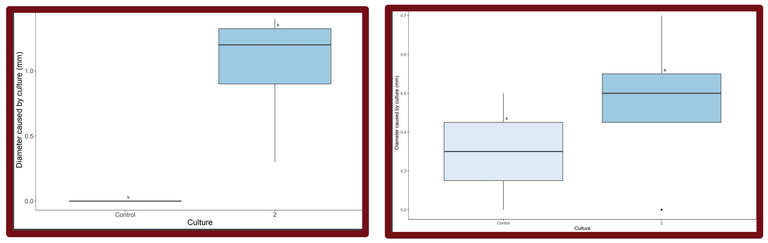

Fig. 5 Boxplots taken from first experimental run with Colletotrichum comparing lesions from the control plugs versus the Colletotrichum plugs. St. Croix (left) and Corot Noir (right)

1. Fig. 4 : statistically significant differences between the nine grape varieties in the level of resistance to the biotrophic downy mildew detected.
2. Fig. 5 : the leaf disc assay allowed us to detect statistically significant differences between lesions sizes. In some instances, there was too much variability in the lesions sizes due to environmental factors and/or the control became contaminated.
3. Improved leaf disc assay with a more controlled environment (humidity, contamination), which limited contamination and variability when scaling up.
4. Scaling up of the leaf disc assay:
   a. Increased number of replicates for each grape variety
   b. Increased number of grape varieties
   c. Increased number of necrotrophs
5. Future explorations:
   a. Assess software-assisted image measurements of lesions size.
   b. Use of a hyperspectral camera to detect potential differences in symptoms caused by various necrotrophs.