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Grapevine Red Blotch Disease

Background

There are more than 70 virus and virus-like agents that infect grapevine worldwide. Relatively few of these are known to occur in Oregon. The major viruses on grapevine that cause disease in Oregon are Grapevine red blotch associated virus (GRBaV), Grapevine leafroll associated viruses (GLRaVs) and Tomato ringspot virus (ToRSV). Grapevine rupestris stem pitting virus is common but has little to no detectable impact on yield and quality of the fruit. GRBaV symptoms were first described in 2008 in 'Cabernet sauvignon' in California's Napa Valley. During a multi-state research project on GLRaVs conducted from 2008-2011 many vineyards with 'leafroll-like' symptoms tested negative for all known leafroll viruses. In 2012, a new virus was identified in 'Cabernet franc' in the New York's Finger Lakes region and also in 'Cabernet sauvingon' plants in the Napa Valley. These plants exhibited leafroll-like symptoms but tested negative for leafroll viruses. In late 2012, Dr. Sudarshana with the USDA-ARS in Davis, CA provided a molecular diagnostic method that could detect this new virus in the field.

During the winter of 2012-2013, nucleic acids (DNA and RNA) from the archived samples were tested with the molecular diagnostic method for GRBaV. Samples from the Rogue, Umpqua and Willamette Valleys in Oregon, tested positive for GRBaV. The majority of the GRBaV positive samples were from the Rogue Valley. The virus was detected in red-fruited cultivars (Barbera, Cabernet sauvignon, Cabernet franc, Grenache, Malbec, Merlot, Pinot noir, Syrah and Tempranillo) and in white-fruited cultivars (Chardonnay, Pinot gris, Roussanne, Semillon and Viognier). This information indicates that the virus is widespread in Oregon vineyards.

Symptoms

The symptoms are easily confused with those caused by GLRaVs. Symptoms in red-fruited cultivars start in late July and August as irregular interveinal red blotches on the lower leaves and the veins may turn red or remain green. The leaves generally do not show the downward rolling often seen with leafroll disease. As the season progresses, the reddening increases and symptoms develop higher in the canopy, similar to the symptom development pattern seen with GLRaVs. Of the >70 viruses and viroids known to infect grapevine worldwide, only GRBaV and GLRaVs are known to cause such symptoms, and more importantly to cause reductions in soluble solids in the fruit in some vineyards. In white-fruited cultivars, it is difficult to recognize GRBaV symptoms as infected vines develop irregular chlorotic areas that may become necrotic late in the season in some cultivars. It is impossible to distinguish between GLRaVs and GRBaV based on symptoms alone. Only testing can identify which virus is present.

GRBaV is not a new virus, but a newly recognized virus. Because the symptoms caused by GRBaV are similar to those caused by GLRaVs, red blotch was not recognized as a new disease until recently. The virus has been identified in herbarium samples from California that were collected in 1940, demonstrating that the virus has been around for at least 65 years in California vineyards. It has also been detected in 'Pinot noir' plants that were planted in the 1970's in the Willamette Valley. This block is surrounded by other clones of 'Pinot noir' and 'Chardonnay' that were planted at the same time but are not infected. This suggests that the diseased plants were infected at planting. These plants have since been removed.

GRBaV is widespread in the United States having been detected in California, Idaho, Maryland, New Jersey, New York, Oregon, Pennsylvania, Virginia, and Washington. Internationally, it has been reported in vineyards in Canada and in a research block in Switzerland.

Disease Impact

At this time, the major impact of GRBaV is on fruit quality rather than yield, though reduced yield was reported in Washington in vines infected with GRBaV and other viruses. The virus can cause reduced soluble solids in red- and white-fruited cultivars and higher titratable acidity. Work from Washington State University and California showed the impact of GRBaV on fruit quality is at least as serious as the impact of GLRaV-3, the most severe of the leafroll viruses. In infected 'Pinot noir' in Oregon, the impact GRBaV on soluble solids has been inconsistent. For instance, in 2013 one Willamette Valley vineyard showed no difference in Brix° between fruit from GRBaV-infected and healthy vines. In a 'Pinot noir' vineyard located in the Rogue Valley, there was a 0.9 Brix° reduction for infected vines compared to fruit from healthy vines. Therefore, large differences in virus symptoms across multiple sites can make GRBaV's impact difficult to determine.

In 'Pinot gris' no difference in Brix° was observed between infected and healthy vines in a vineyard in southern Oregon, although a significant reduction in fruit yield and plant growth was observed; however, this vineyard had issues with several other viruses in addition to GRBaV. Further work is needed to clarify the impact of GRBaV on fruit quality in 'Pinot gris'. Work in Sonoma and Napa Valleys suggests that impact on soluble solids is dependent on cultivar and growing site. 'Cabernet franc' and 'Pinot noir' infected with GRBaV have shown delayed and uneven ripening in some Oregon vineyards.

Detection

As mentioned above, the virus was first characterized in 2012 in New York and California, and a molecular diagnostic method using PCR was developed from that work. This method has been published and is in use by private and public laboratories for GRBaV diagnosis in grapevines. PCR detection is relatively expensive and in nurseries a subset of plants are tested. Using the PCR detection method, Foundation Plant Services (FPS) has tested all vines in the new Russell Ranch Foundation block; all were free of GRBaV. However, this block was initially set up in 2011 and there are limited cuttings available to nurseries for propagation. GRBaV has been detected in a few vines in the FPS Classic Foundation Block (~15 out of >5000). The Clean Plant Center Northwest (CPCNW) in Prosser, Washington also has a Foundation Block that has tested free of GRBaV, additionally, this block has been tested and found free of Agrobacterium that causes crown gall in grapevine and Grapevine rupestris stem pitting virus. Grapevines grown by nurseries in California's, Oregon's and Washington's grapevine certification program are being tested for GRBaV, but be aware that some nurseries are selling uncertified grapevines that have not been tested.

Transmission

So far, no insect vector of GRBaV has been identified. Movement of GRBaV in vineyards after planting has been documented, which clearly indicates the presence of some kind of a vector. An increase in the incidence of GRBaV over time in young, healthy vineyards that are adjacent to infected vineyards also suggests the existence of a vector.

Virus transmission by grafting has been demonstrated. Based on the large number of infected cultivars and wide geographic distribution of GRBaV, it is likely that spread has occurred primarily through movement of infected propagation material. Symptoms of GRBaV on grapevine rootstocks is unknown. Therefore, it is critical that rootstocks as well as scion material are tested prior to propagation and grafting to minimize the risk of graft transmission of GRBaV and other viruses. An initial report from Washington that the Virginia creeper leafhopper vectored GRBaV has not been repeatable. This leafhopper is not known to occur in Oregon. Vector transmission trials in Oregon with the western grape leafhopper and the blue green sharpshooter have been unsuccessful. It is possible to detect GRBaV in western grape leafhoppers that have fed on infected plants, however, when transferred to healthy vines, these insects did not transmit the virus. Probably any sucking insect or nematode that feeds on infected vines can pick up the virus, but to date, none has been proven to transmit the virus to healthy plants. Based on the pattern of spread observed in vineyards, it is very unlikely that nematodes vector GRBaV. Therefore, it is still unclear how the virus is spreading and under what conditions, especially given that it seems to spread in some vineyards but not in others. Further research is underway to determine how the virus is transmitted in the field.

There is a very good correlation between the presence of GRBaV and red blotch symptoms. Cornell University researchers have shown that GRBaV causes the red leaf symptoms reported in the field. Work on determining the exact impact on fruit quality and quantity is still underway.

What to do

People are the most efficient vector of grapevine viruses as they can move the viruses over great distances in a very short period of time. Therefore, care must be taken to obtain high quality, clean material when purchasing vines. Ask the nursery for its testing records. This information should include the year the testing was done, how many vines were tested in each block, which laboratory did the testing, and which viruses were tested for. Be careful you don't focus so intently on GRBaV that you forget those other viruses. If you suspect you have GRBaV, get it tested; **TEST – DON'T GUESS**.

GRBaV is on Oregon's list of quarantined pests for grape; do not accept any vines from an out-of-state nursery unless that shipment is accompanied by an official phytosanitary certificate verifying the vines are free of quarantine pests including GRBaV. Also, receipt of interstate shipments must be reported to the Oregon Department of Agriculture (notification@oda.state.or.us). Reporting these shipments helps the ODA verify other states are complying with our quarantine rules and helps protect you from receiving infected vines.

When starting a new vineyard, **START CLEAN!** Establishing a vineyard is a long-term investment. Don't necessarily go for the least expensive vines, they may be cheap for a reason. Starting clean is the most important component of a virus management program. Once a vine is infected with a virus, it cannot be cured in the field. That infected vine also serves as a source of inoculum for further spread of the virus within your vineyard or to neighboring vineyards. Remember, there are over 70 virus and virus-like agents that infect grapevines and relatively few of those are present in Oregon. Let's work together to minimize the risks of introducing new viruses into the state that could threaten our vineyards by starting new vineyards with high quality plants.

Sources of Additional Information on Grapevine Red Blotch Associate Virus:

- National Clean Plant Network – Grapes http://ncpngrapes.org
  This has fact sheets on Red Blotch, Leafroll, and Vein Clearing Viruses and Crown Gall
- Grapevine red blotch-associated virus, an emerging threat to the grapevine industry. Sudarshana, M.R., Perry, K.L. and Fuchs, M.F. 2015. Phytopathology 105:1026-1032.
  Great set of images of Red blotch and look-alikes.

- Grapevine red blotch-associated virus is widespread in the United States. Krenz, B., Thompson, J.R., McLane, H.L., Fuchs, M.F. and Perry. K.L. 2014. Phytopathology 104:1232-1240.

- Association of a DNA virus with grapevines affected by red blotch disease in California. Al Rwahnih, M., Dave, A., Anderson, M., Rowhani, A., Uyemoto, J.K. and Sudarshana, M. 2013. Phytopathology 103:1069-1076.

- Safeguarding fruit crops in the age of agricultural globalization.Gergerich, R.C., Welliver, R., Gettys, S., Osterbauer, N.K., Kamenidou, S., Martin, R.R., Golino, D., Eastwell, K., Fuchs, M., Vidalakis, G. and Tzanetakis, I.E. 2015. Plant Disease 99:176-187.

An advisory committee has been formed to develop and distribute information on Grapevine red blotch associated virus in Oregon, this committee includes: David Beck, Ted Casteel, Geoff Hall, Joel Myers, Nancy Osterbauer, Dipak Poudyal, John Pratt, Patty Skinkis, Vaughn Walton, John Pratt and Bob Martin. Several members of this committee have reviewed this article.


Pinot noir, red veins and blotches of leaf blade (RB)


Delayed fruit ripening in Cabernet franc (RB)


Pinot noir, green veins with red blotches of leaf blade (RB)

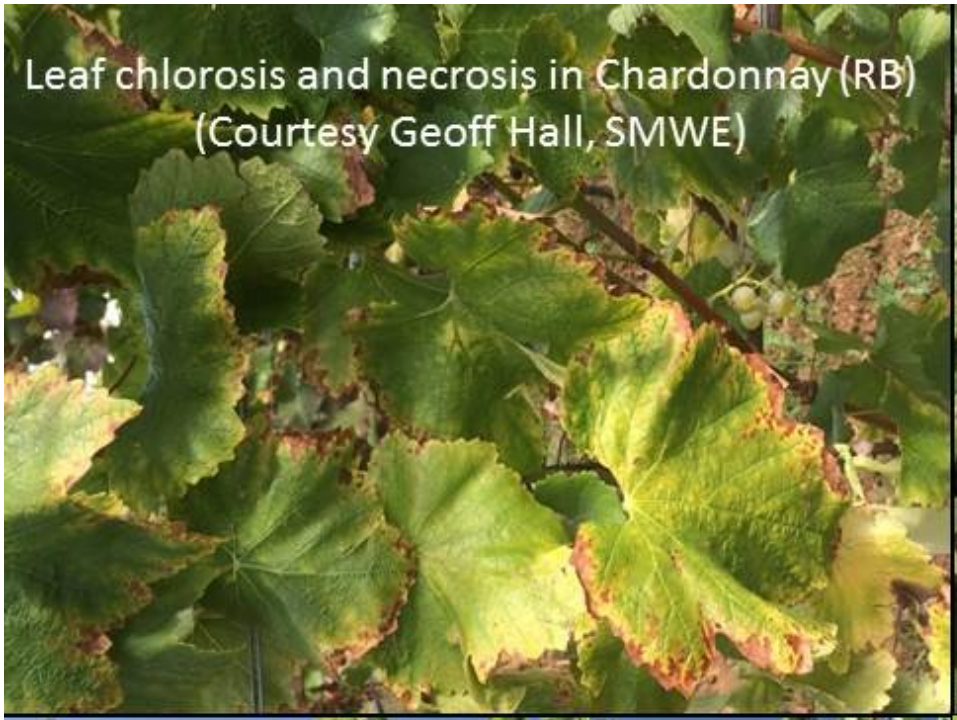

Red leaf blade, green veins in Cabernet franc (RB)

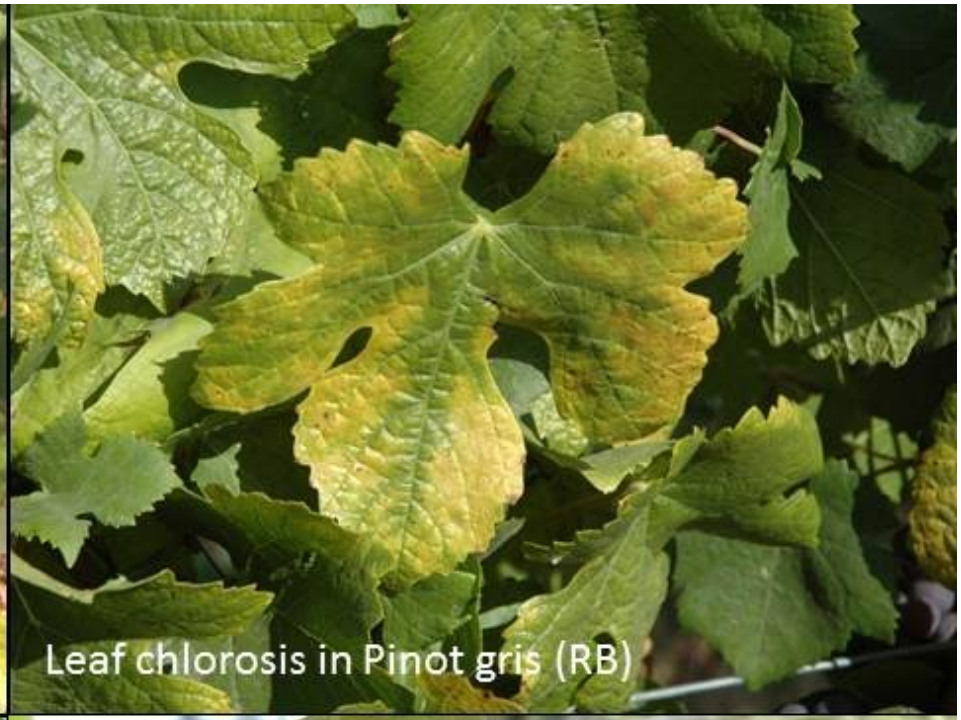

Chardonnay -1,(RB)
Courtesy R. Smith, UCCE


Chardonnay -2,(RB)
Courtesy R. Smith, UCCE

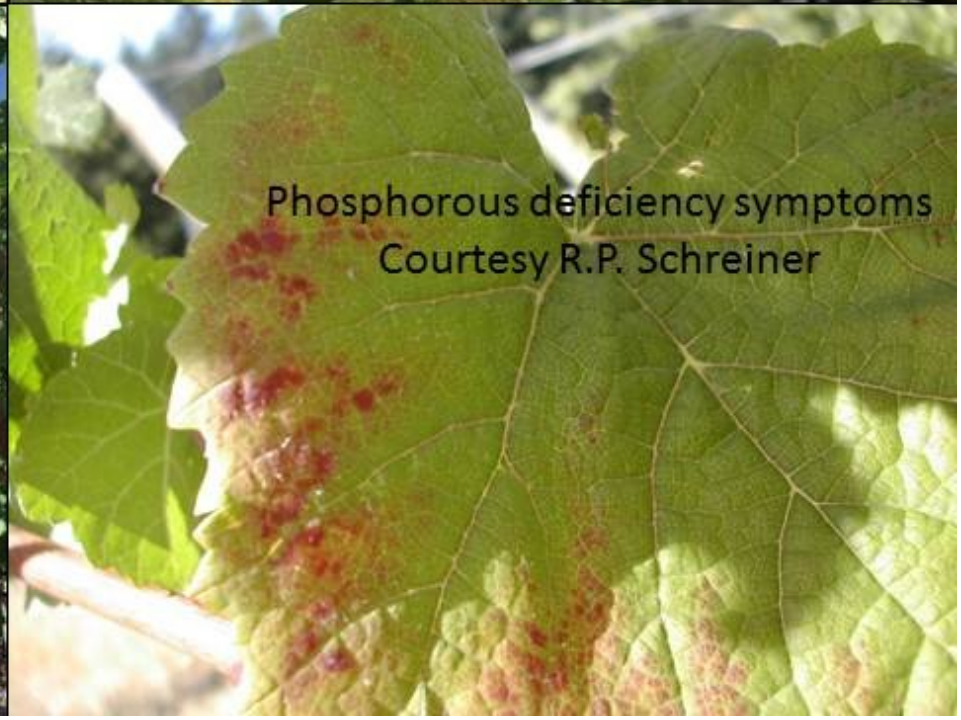

Chardonnay -3,(RB)
Courtesy R. Smith, UCCE


Sauvignon blanc (RB)
Courtesy R. Smith UCCE


Leaf chlorosis and necrosis in Chardonnay (RB)
(Courtesy Geoff Hall, SMWE)


Leaf chlorosis in Pinot gris (RB)


Red lower canopy in Cabernet franc (RB)


Phosphorous deficiency symptoms
Courtesy R.P. Schreiner


GLRaV 1, 2, & 3 in Chardonnay
GLRaV-3 in Merlot
Mg deficiency symptoms
Courtesy R.P. Schreiner
Symptoms of drought in Pinot noir
(courtesy R.P. Schreiner