Profiling Viruses Associated with Grapevine Leafroll Disease in the Vineyards of the Pacific Northwest

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PROJECT OBJECTIVES:
Characterize and document the occurrence and distribution of different grapevine leafroll associated viruses in the Pacific Northwest region.

MAJOR ACCOMPLISHMENTS (2007–2010):
Grapevine viruses in the Pacific Northwest vineyards:
We have documented the presence of grapevine viruses to gain a comprehensive assessment of the sanitary status of vineyards in the Pacific Northwest region. Samples were collected from red-fruited grapevine cultivars showing symptoms of grapevine leafroll disease (GLRD). Due to the absence of visible symptoms in white-fruited cultivars, samples from these cultivars were collected randomly. Leaf samples were collected from Washington, Oregon, and Idaho vineyards, with majority of samples obtained from the Columbia Valley of Washington State. The samples were tested individually for different grapevine viruses using a combination of serological and molecular diagnostic assays and further confirmed by molecular analysis of portions of viral genomes. The results have shown the presence of seven different viruses associated with GLRD (*Grapevine leafroll-associated virus* [GLRaV]-1, -2, -3, -4, -5, -7, and -9), three viruses associated with Rugose wood disease complex (*Grapevine rupestris stem pitting-associated virus* [GRSPaV], *Grapevine Virus A* [GVA] and *Grapevine Virus B* [GVB]) and two viruses associated with grapevine degeneration (*Grapvine fanleaf virus* [GFLV] and *Tomato ring spot virus*) in several wine grape cultivars. During our survey in 2009 season, Grapevine fleck virus (GFkV) was detected in cv. Chardonnay and *Grapevine Syrah virus-1* (GSyV-1) was detected in cvs. Syrah/Shiraz and Chardonnay in geographically separate vineyard blocks planted by different growers. We have also detected the Red Globe strain of GLRaV-2 in two wine grape cultivars (Pinot Noir and Chardonnay) grown in geographically separate vineyard blocks. Mixed infections of GLRaVs in different combinations were detected in individual grapevines. Among the seven GLRaVs documented, GLRaV-3 was found to be the most prevalent. Our results also revealed the presence of GRSPaV, GVA, GVB, and GFLV as mixed infections with GLRaVs in grapevines showing GLRD symptoms. These results highlight the importance of continued monitoring for viruses to ensure preventing their spread to new vineyards via planting materials. The information generated from this project underscores the need for testing for different viruses in 'clean' plant programs and grapevine certification programs for sustainable growth of wine grape industry in the Pacific Northwest. The outputs of this project have been deployed in the virus indexing program at the NorthWest Grape Foundation Service at WSU-IAREC, Prosser, Washington for the supply of 'clean' planting materials to promote sustainability of the wine grape

industry in the region. The project has disseminated information to wine grape industry stakeholders and regulatory agencies for increased awareness of grapevine viruses and their negative impacts.

TECHNOLOGY TRANSFER/OUTREACH:

- Grapevine fanleaf disease detected in Washington vineyards. Voice of the Vine. May 20, 2010 http://wine.wsu.edu/vinevoice/2010-05-20.html.
- Naidu, R.A. 2010. Virus Diseases. In: Pest Management Guide for Grapes in Washington. Washington State University, Extension Bulletin EB0762, pp.24-27.
- Naidu, R.A. 2010. Fanleaf threat: a concerted effort is needed to prevent its spread. Good Fruit Grower February 15, 2010, Volume 61, No.4, pages 26-27.
- Naidu, R.A. 2010. Podcasts on grapevine virus diseases, http://wine.wsu.edu/virology/.
- Seeking Answers for Grape Diseases. Voice of the Vine. March 5, 2009, http://lyris.cahnrs.wsu.edu/read/archive? id=172181.
- Naidu, R.A., O'Neil, S. and Walsh, D. 2008. Grapevine leafroll disease. Washington State University, Extension Bulletin EB2027E. 20pp.
- Naidu, R.A. 2008. Virus Diseases. In: Pest Management Guide for Grapes in Washington. Washington State University, Extension Bulletin EB0762, pp.24-27.
- Naidu, R.A. 2007. Virus Diseases. In: Pest Management Guide for Grapes in Washington. Washington State University, Extension Bulletin EB0762, pp.23-26.
- Oral and poster presentations at:
    - The American Phytopathological Society Annual Meetings 2007, 2008, 2009, and 2010.
    - Annual National Viticulture Research Conference, University of California, Davis, 2007, and 2008.
    - The 7th International Symposium on Cool Climate Viticulture and Enology, June 20-22, 2010, Seattle, WA.
    - 2010 Cool Climate Viticulture & Enology Conference. Wine Islands Growers Association. Saanichton, Vancouver Island, BC., Canada
    - 16th Meeting of the International Council for the study of virus and virus-like diseases of the grapevine. 31 August - September 4, 2009, Dijon, France.
    - The Washington Association of Wine Grape Growers Annual Meeting & Trade Show, Kennewick, WA, 2007, 2008, 2009, and 2010.
    - The Washington State Grape Society annual meeting. Grandview, WA, 2008 and 2009.
    - The 6th International IPM Symposium-Transcending Boundaries, March 24-26, 2009, Portland, OR.
- Workshops and tailgate meetings were conducted for regulatory agencies, certified nurseries, and growers in Washington, Oregon, and Idaho states to disseminate information on grapevine viruses.

EXTERNAL SUPPORT:

- Viticulture Consortium-West
- The Washington Wine Commission's Wine Advisory Committee

COLLABORATOR:
Dr. Robert R. Martin, Research Plant Virologist, ARS Corvallis, OR.

RECENT PUBLICATIONS:

- Jarugula, S., Alabi, O.J., Martin, R.R. and Naidu, R.A. 2010. Genetic variability of natural populations of *Grapevine leafroll-associated virus 2* in Pacific Northwest vineyards. Phytopathology 100:698-707.
- Alabi, O.J., Martin, R.R. and Naidu, R.A. 2010. Sequence diversity, population genetics and potential recombination events in *Grapevine rupestris stem pitting-associated virus* in Pacific Northwest Vineyards. Journal of General Virology 91: 265-276.
- Naidu, R.A. and Mekuria, T.A. 2010. First report of *Grapevine fleck virus* from Washington vineyards. Plant Disease 94: 784.
- Mekuria, T.A. and Naidu, R.A. 2010. First report of grapevine virus sequences highly similar to *Grapevine Syrah virus-1* from Washington vineyards. Plant Disease 94: 787.
- Mekuria, T.A., Karasev, A.V., Martin, R.R. and Naidu, R.A. 2009. First report of *Grapevine leafroll-associated virus-3* in six wine grape cultivars in Idaho. Plant Disease 93:1218.
- Mekuria, T.A., Gutha, L.R., Martin, R.R. and Naidu, R.A. 2009. Genome diversity and intra- and interspecies recombination events in *Grapevine fanleaf virus*. Phytopathology 99:1394-1402.
- Mekuria, T., Martin, R.R. and Naidu, R. A. 2008. First report of the occurrence of *Grapevine fanleaf virus* in Washington State vineyards. Plant Disease 92: 1250.
- Jarugula, S., Soule, M.J., Rowhani, A. and Naidu, R.A. 2008. First report of *Grapevine leafroll-associated virus 9* in Washington State vineyards. Plant Disease 92: 485.