Studies needed of vectors spreading leafroll disease in California vineyards

by Deborah A. Golino *and* Rodrigo Almeida

Leafroll, a common disease of grapevines caused by a large group of related viruses, reduces the yield and quality of fruit from infected vines. Yield losses of 10% to 20% are fairly typical. Leafroll damages the phloem of infected vines, delaying sugar accumulation and reducing anthocyanin production. Fruit from infected vines is low in sugar, poorly colored and ripens late. In some varieties, fruit maturity is delayed so that fruit on the affected vines may be pale or even whitish at harvest, while fruit on healthy vines is ripe and well colored; late ripening may also expose the fruit to autumn rains that cause rot.

In the past, researchers observed little natural field spread of leafroll disease in California vineyards. Unfortunately, this situation seems to have changed. In the early 1990s, field spread was observed in the UC Davis Foundation vineyard (Rowhani and Golino 1995). More recently, the mapping of leafroll distribution in a 'Cabernet Sauvignon' vineyard in Napa County documented an increase in infection rate of approximately 10% per year over 5 years (see page 156).

Grapevine leafroll viruses. There are currently nine recognized, serologically distinct viruses associated with grapevine leafroll disease. These are unique, closely related viruses, not strains of the same virus. Taxonomically the nine "grapevine leafroll associated viruses" (abbreviated GLRaV-1, and so on) are classified in the virus family *Closteroviridae*, which is characterized by large, flexuous, rod-shaped particles ranging from 1,250 to 2,200 nanometers in length.

Many of these leafroll viruses are transmitted by mealybugs and soft scales. The obscure, longtailed, citrus, grape and vine mealybugs are commonly found in California vineyards and can transmit one or more forms of the virus (Golino et al. 2002; Martelli 2000). In Europe, soft scales such as the vine scale (*Pulvinaria vitis*) have been shown to transmit GLRaVs (Belli et al. 1994); this insect is also found in California vineyards, although the more common soft scale is the European fruit lecanium scale (*Parthenolecanium corni*), which has been implicated but not yet shown to vector GLRaV. Little is known about the biology of leafroll transmission by mealybugs or scales, a research gap we are currently working to fill.

Research goals. Control of insect-borne plant diseases such as leafroll depends upon a solid understanding of pathogen transmission biology. This knowledge could help explain the efficiency, or lack thereof, of certain insecticides in reducing disease spread. It might be the basis for the development of roguing strategies (i.e., the removal of infected vines to prevent virus from spreading), and it should result in improved and vector sampling practices. The newly invasive vine mealybug may result in increased rates of leafroll disease in California, a situation similar to the invasive glassy-winged sharpshooter and Pierce's disease. Our research groups are working to understand how mealybugs transmit leafroll to grapes, with the goal of providing growers with short- and long-term information that can be incorporated into disease management practices.

We have recently determined that first-instar vine mealybugs are more efficient in transmitting leafroll (GLRaV-3) than adult insects. First instars may be dispersed by wind, causing them to travel farther than adults. As a result, virus spread may match these patterns of mealybug movement, which in this case could be reasonably random. We are now working to identify specific periods of the year with high risk of disease spread. The rationale is that large numbers of first instars are not present in vineyards yearround and spread may be increased when crawler populations are high; disease control approaches could be developed to target these times. The incorporation of such knowledge, when available, into management practices may also reduce the undesirable environmental impacts of certain insect-control strategies.

Understanding leafroll transmission. We have focused our efforts on the transmission of leafroll by the vine mealybug, primarily due to its invasiveness and present threat to the grape industry. Other mealybugs, however, may be at least as efficient in transmitting leafroll, so they, too, must be assessed. In addition, the current leafroll epidemic in Napa Valley is probably driven by another factor and not the vine mealybug, as this insect has a limited spatial distribution in that area. Factors behind the epidemic may include a large-scale change of rootstocks over the last decade or the emergence of a virus strain that is transmitted more efficiently by vectors than previously established isolates.

Sue Sim

A leafroll-infected grapevine.

Grapevine leafroll viruses are of economic importance worldwide. Until recently this viral disease complex was assumed to be largely graft-transmitted under California conditions. The finding that mealybugs transmit leafroll was a breakthrough that explained observations of disease spread under field conditions. We are still at the early stages in understanding the most basic aspects of the biology and ecology of leafroll transmission by mealybugs.

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