FACT SHEET

NATIONAL CLEAN PLANT NETWORK

Grape Leafroll Disease

Introduction

Leafroll is one of the most important virus diseases of grapevines. It occurs in all the major grape-growing regions of the world. Grapevine leafroll disease can affect all native and Vitis vinifera cultivars, hybrids, and rootstocks, although symptoms are not expressed on all infected vines. The disease was described in Europe as early as the 19th century but its graft-transmissibility was not demonstrated until 1937. In 1979, a specific type of virus (closterovirus) was reported in a leafroll-affected vine, and, shortly thereafter, in 1983, the capacity of mealybugs to transmit one of the viruses associated with this disease was shown.

Symptoms and impact

Leafroll-affected vines are less vigorous than healthy vines. Older leaves are cupped with the principal veins remaining green in late summer and fall. Symptoms are usually most conspicuous in red-fruited cultivars of Vitis vinifera with leaves becoming distinctly red in addition to cupping (Figure 1A, B) although the main veins of such leaves remain green (Figure 1C). In white-fruited V. vinifera cultivars, symptoms are less pronounced, consisting of a slight chlorosis in addition to cupping (Figure 1D). Infected, native cultivars, hybrids, and rootstocks usually remain symptomless.

Leafroll causes significant yield losses (up to 30 to 50%) and delays fruit ripening (Figure 1E, F). Reduced soluble solids and increased titratable acidity are also often reported. Berries of red-fruited cultivars may show pale coloring due to reduced skin anthocyanin pigments. Lower vigor associated with virus infection increases vine susceptibility to adverse environmental factors, such as cold winter temperatures, resulting in a higher level of mortality in virus-infected vines. As a consequence, the cost of vineyard maintenance increases due to more frequent vine replacements.

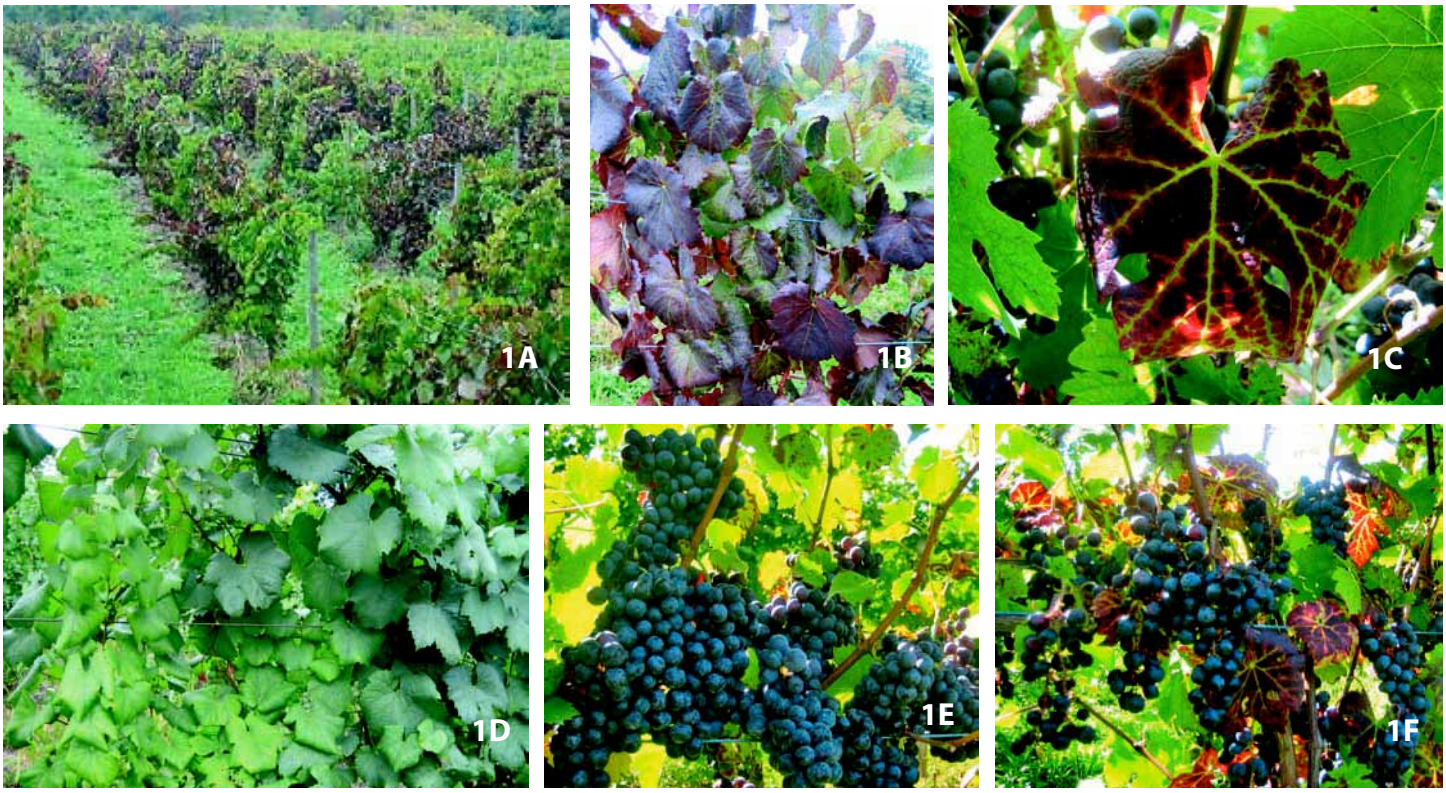

Figure 1. (A) High incidence of leafroll disease in a Vitis vinifera cv. Lemberger vineyard with conspicuous leaf reddening; (B) Close-ups of Lemberger and (C) Cabernet franc leaves with cupping and reddening while main veins remain green; (D) Leafroll symptoms (small, cupped, light green leaves) on a Chardonnay vine (left) compared to a healthy vine (right); and (E) Fruit yield and quality of a healthy and (F) leafroll-affected Vitis vinifera cv. Cabernet franc. Photos by Marc Fuchs.

Causal agents

To date, ten different filamentous viruses (Figure 2) identified as Grapevine leafroll-associated viruses (GLRaVs) have been isolated and characterized from leafroll-infected grapevines. These ten viruses are numbered from 1 to 10 (GLRaV-1 to GLRaV-10) based on the order of their discovery. They all belong to the family Closteroviridae. The GLRaVs are serologically unrelated and their particle length ranges between 1,400 to 2,200 nanometers (Figure 2). Other than Vitis species, no wild or cultivated plant species are known to serve as alternate hosts for leafroll-associated viruses.

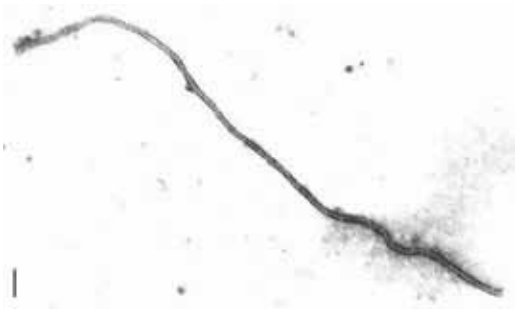

Figure 2. Electron micrograph of a GLRaV particle isolated from a leafroll-diseased vine. Note scale bar for particle size (1 nanometer - nm - equals 1/1,000,000 millimeter). Photo by Marc Fuchs.

Most of these viruses can be detected by wood or green grafting onto indicator vines of V. vinifera cv. Pinot noir, Cabernet franc or Gamay. Lab tests including serological assays, such as double antibody sandwich enzyme-linked immunosorbent assay (ELISA), and molecular assays, based on polymerase chain reaction (PCR), can also be used to detect GLRaVs in grapevine tissue.

Among the ten viruses associated with leafroll disease, GLRaV-1, GLRaV-2, and GLRaV-3 usually prevail in leafroll-affected grapevines. Additionally, GLRaV-2 also incites a severe graft-incompatibility syndrome and decline of scions grafted on certain rootstocks, including Kober 5BB, 3309C, 5C, 1103P, Harmony, and Freedom.

Conditions for infection

The most efficient means of transmitting leafroll-associated viruses is through vegetative propagation and grafting. GLRaVs can be moved across long distances in planting and propagation materials. In addition, insect vectors in two homopteran insect families (mealybugs – Pseudococcidae - and soft scales – Coccidae) (Figure 3) can also transmit four (GLRaV-1, -3, -5, and -9) of the ten GLRaVs. Mealybugs and soft scales feed on a wide range of host plants and can be serious pests of woody plants and shrubs, including Vitis. Most species overwinter as eggs and young instar nymphs beneath the bark of the trunk or underground on the roots. Females are wingless but can exhibit limited mobility, while adult males, which lack mouthparts, and hence, cannot feed and transmit the viruses, are winged. Because of their small size, crawlers and adults can be readily wind-blown.

Several such vectors are known from New York and other states in the eastern US: Parthenolecanium corni or brown apricot scale, P. persicae or grapevine scale, Pulvinaria vitis or woolly vine scale, Neopulvinaria innumerabilis or cottony maple scale, and Pseudococcus maritimus or grape mealybug. Another important pest of grapes and a known vector of GLRaV, Planococcus ficus or vine mealybug, has not been reported from the eastern US but is a potential invader. Although a detailed census of mealybugs and soft scale insects has not yet been conducted in New York vineyards, scattered observations suggest that populations tend to be low, except in a few isolated cases where outbreaks have occurred.

Management

To date, the only way to manage grapevine leafroll disease and secure a healthy and high quality crop is to ensure that the planting material originates from virus-tested, virus-free mother plants and that factors contributing to infestation via insect vectors are well controlled. GLRaVs can be eliminated from prospective propagation material by heat treatment and tissue culture, among other techniques. The importance of establishing new blocks with clean planting material cannot be over-emphasized because, once a vine is infected, there is no cure in the vineyard.

No sources of resistance against any of the GLRaVs have been identified in wild or cultivated grapes. Therefore, conventional breeding is not a viable option to develop GLRaV-resistant material. Research is on-going to develop resistant material through genetic engineering.

In nurseries and mother blocks, the use of virus-tested material followed by regular and routine monitoring for the disease, its causal agents, and insect vectors is paramount for providing planting material of high phytosanitary standards. Stocks in nurseries and mother blocks should be tested regularly for GLRaVs and such blocks isolated from commercial vineyards to avoid infection through vector transmission. Also, mealybugs and soft scales should be intensively surveyed and managed.

Figure 3. A soft scale female with white egg sac, potential vector of GLRaVs, collected in a vineyard near Seneca lake in the Finger Lakes Region in New York. Photo by Joe Ogrodnick.

Produced by the New York State Integrated Pest Management Program, which is funded through Cornell University, Cornell Cooperative Extension, the NYS Department of Agriculture and Markets, the NYS Department of Environmental Conservation, and USDA-CSREES. Design by Media Services, Cornell University. Layout by Karen English, New York State IPM Program. Cornell Cooperative Extension provides equal program and employment opportunities. Posted 2/07 at www.nysipm.cornell.edu/factsheets/grapes/diseases/grape_leafroll.pdf.