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Grapevine Leafroll Disease

Leafroll is the most widespread and economically damaging viral disease of grapevines in the world. All native and *Vitis vinifera* cultivars (hybrids and rootstocks) are susceptible to leafroll, but not all cultivars express leafroll symptoms when infected. Symptoms resembling leafroll disease were observed in European vineyards as early as mid-nineteenth century, but the association of the disease with viruses was demonstrated much later – in the 1930s.

Causal Agents and Vectors. Grapevine leafroll disease is caused by several serologically and genetically distinct +ssRNA viruses called grapevine leafroll-associated viruses (GLRaVs) including, GLRaV-1, GLRaV-2, GLRaV-3, GLRaV-4, GLRaV-5, GLRaV-6, GLRaV-7, and GLRaV-9. All GLRaVs are graft-transmitted and GLRaV-1, GLRaV-3, and GLRaV-4 are vectored by mealybugs (*Pseudococcidae*) and soft-scale (*Coccidae*) insects. Those insects are found in Connecticut. Vector transmission is the major form of moving GLRaVs from plant to plant in a vineyard. Over long distances, grafting and infected propagate planting materials are the most efficient means of spreading those viruses.

Symptoms and Economic Impact. Leafroll disease symptom expression differs by grape type (red-berried vs white-berried) of *V. vinifera* and foliar symptoms are more prominent by the end of summer to fall. Inred cultivars, leafroll displays as red or reddish-purple discolorations in inter-veinal areas, but a narrow strip of leaf tissue on either side of the main veins remains green, giving the appearance of "green veins" (Figure 1-A and C). In contrast, white-berried cultivars show mild yellowing or chlorotic mottling of inter-veinal areas of leaves and in some cases, it is difficult to visually know if they are infected, since some cultivars remain asymptomatic. Furthermore, GLRaV-2 cause severe graft-incompatibility syndrome and decline of scions grafted on certain rootstocks, including Kober 5BB, 3309C, 5C, 1103P, Harmony, and Freedom.

Grapevine leafroll disease causes yield losses, quality reduction of the berries, delays in fruit ripening, and vine death (Figure 2). The disease also induces the reduction of the soluble solids in grape juice, modifications of individual and total anthocyanins, phenolics, and tannins, which in turn drastically interfere with wine quality. Reduced cluster size, loose clumps, and small berries are also observed in leafroll affected vineyards.

In the absence of any control measure, grapevine leafroll disease can cause losses of up to $40,000 per hectare per growing season. Current economic recommendations for most wine producing states is to replace the entire vineyard if the disease prevalence is greater than 25%.

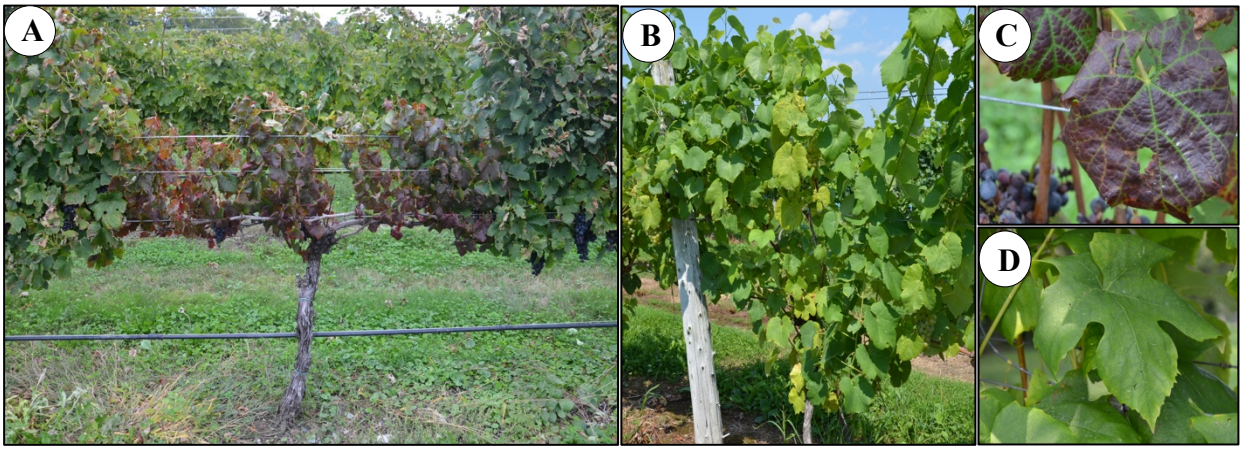

Figure 1. Typical leafroll degeneration/decline disease symptoms in grapevine leaves. (A) and (C) in red grape cultivars. (B) and (D) in white grape cultivars.

Management. There is no cure for vines infected with GLRaVs and commercially resistant grapevine cultivars are nonexistent. Therefore, the adoption of good sanitary methods with plant materials and implemention of management strategies - based on the elimination of infected plants and control of vectors in the local farms and its surrounding regions - are the best available grapevine leafroll disease control methods.

Beginning with clean propagated planting materials is essential when establishing a new vineyard or when replacing plants in old vineyards. Do not rely only on visual symptoms for diagnoses as some grape cultivars do not show symptoms and those that do, can take up to five years to develop typical leafroll disease symptoms. The best approach for proper diagnoses is to have the plants tested in qualified labs.

In summary, it is extremely important that all plant rootstocks and scion wood bought from nurseries is healthy and tested free of GLRaVs. **Growers should only acquire planting material from virus-tested, clean vine stocks!** Since most of these viruses have vectors that are present in Connecticut and can spread to the entire vineyard, control of mealybugs and scale insects together with regular scouting and roguing out diseased vines are recommended measures to reduce the disease spread within a vineyard.

Figure 2. Irregular and delayed fruit ripening, reduced cluster size, loose clumps, and small berries in grapevines with leafroll degeneration/decline disease.