Economic impact of grapevine leafroll disease on *Vitis vinifera* cv. Cabernet franc in Finger Lakes Vineyards of New York.

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Background. Grapevine leafroll disease is one of the most widespread viral diseases in vineyards, affecting nearly all grape and wine regions in the world. Infection causes yield losses, ripening delays, and alters fruit chemistry, including lowering soluble solids and increasing titratable acidity. The viruses associated with leafroll disease are transmitted through propagation of infected material, grafting, and several insect vectors. Little is known about the economic impact of grapevine leafroll disease over the lifespan of a vineyard and the cost-effectiveness of interventions of such as replacement of individual vines or vineyard replanting. Current methods to control the spread of grapevine leafroll disease in New York State are limited to planting material derived from certified, virus-tested stock and identification and removal of infected vines. We compared the economics of several leafroll management strategies and recommend loss-minimizing strategies for vineyards in the Finger Lakes of New York.

Experimental design. Ten winery-vineyard operations in the Finger Lakes of New York with a history of grapevine leafroll disease were surveyed in 2009 and 2010 to determine the prevalence of the disease, resulting yield reductions, control measures used, and any financial penalties for poor fruit quality. To model disease management scenarios, initial disease levels of 0-60% together with existing models were used to predict levels of infection over time in the presence of vectors. Control options included roguing (removal and replacement of individual infected vines), replacement of entire vineyards, or no action. The model also included virus-induced yield reductions of 30% or 50%, and possibility of a 10% price penalty for lower quality fruit. We computed the per-acre net present value[1] per acre for a Cabernet franc vineyard over a typical 25-year life span for the following six scenarios:

1) Baseline: A vineyard free of grapevine leafroll disease
2) Early infection without intervention: Disease introduction in year 1 with no roguing or replacement
3) Clean planting: A vineyard initially planted to material derived from certified, virus-tested stock at a 25% higher planting material cost
4) Vigilant management: Disease introduced during planting, but symptomatic vines are replaced
5) Early vineyard replacement: Replacement of the entire infected vineyard in year 4 with certified virus-tested stock
6) Later introduction with and without removal: A vineyard with disease introduced between years 12 and 20, with and without roguing

[1] *Net Value* is the difference between revenues and costs. The term *Present* indicates that the *Net Value* over 25 years is expressed in today's dollars to take into account the time value of money.

Results. The net present value (NPV, see footnote above) was used to compare the economic impact of grapevine leafroll disease on the six scenarios. Without any disease control, the economic impact ranged from $10,000 to 17,000/acre over the lifetime of a Cabernet franc vineyard, depending on the degree of yield reduction and the size of the penalty for poor fruit quality.

Planting with clean plant material, which added a 25% price premium to the overall cost, reduced grapevine leafroll disease-related losses to $750/acre, whereas roguing and replacement with clean plant material resulted in losses ranging from $1,300 for a vineyard with initial low infection rate (1%) to $9,500 for a vineyard with a moderate initial infection rate (25%). For vineyards with an initial infection level of at least 25%, the economically optimal solution was to replace the vineyard. A decision matrix is presented in Table 1 (below).

Table 1. Decision matrix for roguing versus vineyard replacement.

Degree of disease-induced yield reduction	Recommended action if there is a 10% penalty for lower fruit quality	Recommended action if there is no penalty for lower fruit quality
<30% yield reduction		
≤ 25% infection	rogue	rogue
> 25% infection	replace vineyard	do not control[2]
30% yield reduction		
≤ 25% infection	rogue	rogue
> 25% infection	replace vineyard	indifferent
50% yield reduction		
≤ 25% infection	rogue	rogue
> 25% infection	replace vineyard	replace vineyard

Conclusions

- The economic impact of uncontrolled grapevine leafroll disease on Cabernet franc vineyard in the Finger Lakes ranges from $10,000 to $17,000 per acre over 25 years.
- Replanting with certified, virus-tested vines significantly reduce losses.
- Disease control decisions should be based on the level of infection, yield penalty, price penalty for lower quality fruit, and the age of the vineyard.

The bottom line: Paying a premium of 25% for certified virus-tested planting material is financially rewarding, although it may not initially appear to be an attractive alternative.

[2] This decision applied only if there is no evidence of inter-vineyard disease transmission. Otherwise, decision would need to account for potential risk of spreading the disease to neighboring vineyards if disease were to be left uncontrolled.

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