“Persistent, persuasive and unrealistic”: Myths and truths about the leaf roll epidemic

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The great enemy of the truth is very often not the lie, deliberate, contrived and dishonest, but the myth, persistent, persuasive and unrealistic.

There are risks and costs to action. But they are far less than the long range risks of comfortable inaction.

Things do not happen. Things are made to happen.
Presentation sequence

- Update on within block epidemiology
- Feedback on the Napa Q-study of subjectivity about leafroll disease
- Neighborhood groups
  - The issues
  - Ex ante analysis based on ecological principles
  - The way forward?
Within-block epidemiology

2007 Oakville study

Leafroll Incidence

2002 23.3%
2003 41.2%
2004 45.8%
2005 49.8%
2006 66.1%

How do these results compare with others?

Are there generic lessons to learn?
What did we find?

GLRaV-3 variant level breakdown (n=468)

Data from Dr Rodrigo Almeida, UC Berkeley
What did we find?

Data from Dr Rodrigo Almeida, UC Berkeley
### Temporal progress

**Within block logistic rates**

<table>
<thead>
<tr>
<th></th>
<th>Yount</th>
<th>Napa</th>
<th>All</th>
</tr>
</thead>
<tbody>
<tr>
<td>mean r</td>
<td>0.19</td>
<td>0.21</td>
<td>0.32</td>
</tr>
<tr>
<td>var. r</td>
<td>0.016</td>
<td>0.019</td>
<td>0.081</td>
</tr>
<tr>
<td>s.d. r</td>
<td>0.127</td>
<td>0.139</td>
<td>0.285</td>
</tr>
</tbody>
</table>

Rate range: 4% p.a. to 20% p.a.
Mean = 10.8%
Spatial patterns of a GLRaV epidemics

Overlay vineyard block maps with sampling grid

Count vine disease status in each quadrat.

Examine the statistical properties of the incidence at two scales
Combined data sets

Disease progress seems to follow common dynamics in every study.

Probably related to vector behavior.
Disease pattern consistent with simple mealybug movement model

\[
V := \begin{pmatrix}
R_I & p_{il} & p_{ih} & p_{ihd} \\
p_{li} & R_L & p_{lh} & p_{lhdi} \\
p_{hi} & p_{hl} & R_H & p_{hhdi} \\
p_{hdi} & p_{hdi} & p_{hdh} & R_{Hd}
\end{pmatrix}
\]

\[
P^{(0)} := \begin{pmatrix}
100 \\
0 \\
0
\end{pmatrix}
\]

\[
P^{(t)} := V \cdot P^{(t-1)}
\]

Leafroll Incidence

- 2002: 23.3%
- 2003: 41.2%
- 2004: 45.8%
- 2005: 49.8%
- 2006: 66.1%

\[
SSD_V = \begin{pmatrix}
0.065 \\
0.2 \\
0.378 \\
0.357
\end{pmatrix}
\]

- GLRV-symptoms
- Latent GLRV
- Adjacent
- Distant
Combining space and time: simulation for replacement planning

Decline in utility with disease
“...To a hungry man, the satisfaction derived from a square meal is unaffected by the meals other people eat or, if he is hungry enough, by anything else they do. His meal...is a pure private good. At the other extreme, the quality of air that the modern citizen breathes in the centre of a city depends almost entirely on what his fellow citizens contribute toward countering pollution...Clean air in a metropolis... is close to a pure public good.”

Q-method study

• Q-method: Study of subjectivity
• Workshops to generate discourse (3)
• Extraction of a set of characteristic statements (47 from discourse)
• Ranking of statements by participants in Q-sort (37)
• Statistical analysis
Opinions about leafroll management
Consistent agreement

• **46;** Virus tested nursery stocks are very important, I think we always have reservations and doubts in the back of our mind when we are sourcing material from any situation.

• **14;** Leafroll matters because it affects grape quantity and quality; therefore, vine quality and cost.

• **21;** Leafroll matters because of its possible transmission to a previously healthy vineyard, putting other blocks, growers/producers at risk.

• **44;** Virus tested nursery stocks play a critical role in obtaining clean plant material. The continual retesting of mother blocks is also paramount to moving toward less leafroll in the field.

• **42;** Planting clean stock would be a good start for an effective leafroll disease management program, and then removing any host plants in the surrounding area.

• **45;** Virus tested nursery stocks are extraordinarily important. I feel it should almost be mandatory and expected.
Inter-block meta-population model

\[
\frac{dI}{dt} = rH + \eta R - cI - (1 - \zeta) \rho I \\
\frac{dH}{dt} = \beta R + (1 - \zeta) \rho I - rH - \nu H \\
\frac{dR}{dt} = cI + \nu H - \beta R - \eta R
\]
What drives the leafroll epidemic regionally?

Infected

Healthy

Long time scale for return on investment

Block management
Prospects

• Explore possibility to change supply structure
• Neighborhood groups starting to form
  – Facilitate process
  – Assess and alleviate difficulties
  – Introduce disease mapping using Smartphone app and secure web GIS
• Add financial values to within-block simulation to provide management plans
• Work with USDA-ARS Corvallis and USU to examine wind-mediated dispersal
• Extend Q-study to nurseries, another production area (Lodi started) and/or grape different commodity
  – Facilitate industry-wide dialogue
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