

**Supplemental Data for:**

Ricketts, K.D., M.I. Gomez, S.S. Atallah, M.F. Fuchs, T.E. Martinson, M.C. Battany, L.J. Bettiga, M.L. Cooper, P.S. Verdegaal, and R.J. Smith. 2015. Reducing the economic impact of grapevine leafroll disease in California: Identifying optimal disease management strategies. *Am. J. Enol. Vitic.* 66:138-147. doi: 10.5344/ajev.2014.14106.

**Appendix 1: 2013 Survey Instrument**

|                                   |            |
|-----------------------------------|------------|
| <b>For administrator use only</b> |            |
| State _____                       | Date _____ |
| Region: _____                     |            |

|  |
|--|
| <p><b>Who should answer this questionnaire?</b></p> <p>-Vineyard managers who have vineyards with grapevine leafroll disease and are actively engaged in disease management and monitoring.</p> <p>- If multiple vineyard managers exist in a single company, this survey should be directed to a single manager who is responsible for one or more vineyards which contain red varieties with grapevine leafroll disease.</p> <p>- If a vineyard management company has multiple clients, this survey should address the one or more vineyards which contain red varieties with grapevine leafroll disease.</p> <p>-Important: we are only looking at the impacts across red varieties.</p> |
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**Questionnaire**

Name of Respondent \_\_\_\_\_

Vineyard/Company \_\_\_\_\_ Contact Number/email \_\_\_\_\_

Years in operation: \_\_\_\_\_

Total size of vineyard operation: \_\_\_\_\_

**1. General**

1. Do you manage a block, ranch or entire vineyard? (specify one) \_\_\_\_\_

2. Size of area managed (acres): \_\_\_\_\_

3. Years this area has been in operation: \_\_\_\_\_

4. Planting density:

|             |       |
|-------------|-------|
| _____       | _____ |
| Row spacing | Ft    |

|              |       |
|--------------|-------|
| _____        | _____ |
| Vine spacing | Ft    |

|                |       |
|----------------|-------|
| _____          | _____ |
| Vines per acre | vines |

5. Did you plant with certified, virus-screened materials?

Y/N (indicate one) \_\_\_\_\_

6. Have you tested vines for GLRV? Y/N \_\_\_\_\_

7. Do you know what type of leafroll virus your vines have? If so, which one(s)? (If you do not know which type of leafroll virus your vines have, please indicate "NA." \_\_\_\_\_)

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**2. Average Disease Impact of the Area You Control: (Block, Ranch, Vineyard Level)**

*Directional notes: Of the areas you control, we want to know the impacts of leafroll virus (of tested OR suspected leafroll).*

Please tell us about 1-3 red varieties you think (or know) have grapevine leafroll disease. All future questions should be answered ONLY with the cultivars identified here.

| Level (ranch, block, vineyard) | Cultivar             | Acres | Percent symptomatic? (circle/check one)                                     | Average age | Mealybugs or scale insects? (Circle one)                           |
|--------------------------------|----------------------|-------|---|-------------|--|
| Level:<br>_____                | 1.<br>_____<br>_____ |       | a. 0<br>b. 0-10<br>c. 10-25<br>d. 25-50<br>e. 50 or more<br>f. I don't know |             | Mealybugs /<br>Scale insects<br>a)<br>b)<br>c)<br>d)<br>e) Unknown |
| Level:<br>_____                | 2.<br>_____<br>_____ |       | a. 0<br>b. 0-10<br>c. 10-25<br>d. 25-50<br>e. 50 or more<br>f. I don't know |             | Mealybugs /<br>Scale insects<br>a)<br>b)<br>c)<br>d)<br>e) Unknown |
| Level:<br>_____                | 3.<br>_____<br>_____ |       | a. 0<br>b. 0-10<br>c. 10-25<br>d. 25-50<br>e. 50 or more<br>f. I don't know |             | Mealybugs /<br>Scale insects<br>a)<br>b)<br>c)<br>d)<br>e) Unknown |

**3. Disease History:**

*Keep in mind the varieties within the ranches/blocks/vineyard discussed*

- A. Did the spread of the disease seem specific or random? \_\_\_\_\_.
- B. If it was specific, is there an infected vineyard in that direction? Y/N \_\_\_\_\_.
- C. If it was specific, was it between rows, between blocks, or between adjacent vines? (please indicate those that apply) \_\_\_\_\_.
- D. Was the spread for all infected cultivars the same? Y/N \_\_\_\_\_.
- E. If no, please explain: \_\_\_\_\_

We'd like to know how you felt the disease progressed over time.

- A. What was the prevalence<sup>1</sup> of disease after first symptoms sighted? If possible, please give us a percent: \_\_\_\_\_
- B. After 1 year? Please give a percent: \_\_\_\_\_
- C. After 5 years? Please give a percent: \_\_\_\_\_
- D. After 10 years? Please give a percent: \_\_\_\_\_

<sup>1</sup> e.g., a prevalence of 5% is when out of 100 grapevines, 5 are infected

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E. Age effect: Did you observe the disease spreading faster in plots of a particular age?

- Young (<5)
- Mature (5-20)
- Old (>20)
- No difference

**4. Economic Impact**

1. Cultivar \_\_\_\_\_

| Sugar reduction (Brix)   | Acidity increases (g/L)   | Color changes in fruit  |
|--|---|---|
| a. 0 (no decrease)<br>b. 0-1<br>c. 1-2<br>d. 2-3<br>e. 3-4<br>f. I don't know          | a. 0 (no decrease)<br>b. 0-0.5<br>c. 0.5-1<br>d. 1-2<br>e. 2 or more<br>f. I don't know | a. Significant<br>b. Moderate<br>c. Slight<br>d. No detectable change |
| Yield reduction  | Cluster size reduction (Y/N)  |   |
| a. 0 (no decrease)<br>b. 0-10%<br>c. 10-25%<br>d. 25-50<br>e. 50-75<br>f. I don't know | a. Yes, cluster size is reduced.<br>b. No reduced cluster sizes.                        |   |

2. Cultivar \_\_\_\_\_

| Sugar reduction (Brix)   | Acidity increases (g/L)   | Color changes   |
|--|---|---|
| a. 0 (no decrease)<br>b. 0-1<br>c. 1-2<br>d. 2-3<br>e. 3-4<br>f. I don't know          | a. 0 (no decrease)<br>b. 0-0.5<br>c. 0.5-1<br>d. 1-2<br>e. 2 or more<br>f. I don't know | a. Significant<br>b. Moderate<br>c. Slight<br>d. No detectable change |
| Yield reduction  | Cluster size reduction (Y/N)  |   |
| a. 0 (no decrease)<br>b. 0-10%<br>c. 10-25%<br>d. 25-50<br>e. 50-75<br>f. I don't know | a. Yes, there are reduced cluster sizes.<br>b. No reduced cluster sizes.                |   |

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3. Cultivar \_\_\_\_\_

| Sugar reduction (Brix)   | Acidity increases (g/L)   | Color changes   |
|--|---|---|
| a. 0 (no decrease)<br>b. 0-1<br>c. 1-2<br>d. 2-3<br>e. 3-4<br>f. I don't know          | a. 0 (no decrease)<br>b. 0-0.5<br>c. 0.5-1<br>d. 1-2<br>e. 2 or more<br>f. I don't know | a. Significant<br>b. Moderate<br>c. Slight<br>d. No detectable change |
| Yield reduction  | Cluster size reduction (Y/N)  |   |
| a. 0 (no decrease)<br>b. 0-10%<br>c. 10-25%<br>d. 25-50<br>e. 50-75<br>f. I don't know | a. Yes, there are reduced cluster sizes.<br>b. No reduced cluster sizes.                |   |

**5. Timing Impact**

|                      | Did blocks suffering from GLRD suffer delays in fruit ripening? Y/N | How long was the delay? (specify months/weeks/days) |
|----------------------|---|---|
| Cultivar 1.<br>_____ |   |   |
| Cultivar 2.<br>_____ |   |   |
| Cultivar 3.<br>_____ |   |   |

**6. Disease Control and Management Practices**

Directional Note: We want to know more about how you go about managing and controlling the disease and your strategies for disease testing.

- A. Do you remove symptomatic vines? Y/N \_\_\_\_\_.
  - a. If yes, what criteria do you use? For example, age, level of infection, etc.  
\_\_\_\_\_
- B. If you replanted, did you (indicate one):
  - a. Replant using budwood (cuttings) from your own vineyard
  - b. Buy certified, GLRV virus-tested vines
- C. Are you concerned about the re-infection through unclean cuttings/budwood? Y/N
- D. Do you test symptomless vines for the presence of leafroll virus? (circle) Y/N.
- E. If you have been testing symptomless vines, what was your testing strategy (circle one):
  - a. Random;
  - b. Around plot/block borders;
  - c. Symptomless vines neighboring symptomatic vines.

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F. Have you used any of the following practices in response to leafroll infection (check appropriate cell).

| Practice  | For which cultivars? | If yes, how many units?                      | Effectiveness? (circle one)   | Did you notice any differences in effectiveness among vines/ within plots? If yes, explain |
|---|----------------------|--|---|--|
| Vine roguing (i.e., removal and replacement (units=vines rogued)) |                      |  | <ul style="list-style-type: none"> <li>• Very effective</li> <li>• Moderately effective</li> <li>• Little to no reductions</li> </ul> | Y/ N _____<br>_____<br>_____   |
| Pesticide   | Pesticide name:      | Dosage:                                      | <ul style="list-style-type: none"> <li>• Very effective</li> <li>• Moderately effective</li> <li>• Little to no reductions</li> </ul> | Y/ N _____<br>_____<br>_____   |
| Sanitation management and fieldworker movement                    |                      | IF yes, how do you manage this? <sup>2</sup> | <ul style="list-style-type: none"> <li>• Very effective</li> <li>• Moderately effective</li> <li>• Little to no reductions</li> </ul> | Y/ N _____<br>_____<br>_____   |

**7. Grape Contracts**

1. Do you buy /sell grapes from vineyards other than your own? Y/N
  - A. If yes, do you have written contracts with those vineyards? Y/N
  - B. If yes, does the contract refer to quality standards related to one or more of the following (check those that apply)
    - a. \_\_\_\_\_ sugar (Brix). If yes, what is the standard? \_\_\_\_\_.
    - b. \_\_\_\_\_ color quality. If yes, what is the standard? \_\_\_\_\_.
    - c. \_\_\_\_\_ acidity. If yes, what is the standard? \_\_\_\_\_.
  - C. Penalty for lower standards (check one)
    - a. \_\_\_\_\_ Batch is refused.
    - b. \_\_\_\_\_ Penalty of (describe all that apply):
      - i. (Example) 25% price reduction for low Brix.
      - ii. \_\_\_\_\_ for \_\_\_\_\_.
      - iii. \_\_\_\_\_ for \_\_\_\_\_.
      - iv. \_\_\_\_\_ for \_\_\_\_\_.
    - c. \_\_\_\_\_ There is no penalty.
  - D. If grapes are rejected, what do you do with them?
    - a. I have another use for them (please explain) \_\_\_\_\_.
    - b. Other \_\_\_\_\_.

<sup>2</sup> For example, do workers move from the least infected plot to the most infected to minimize secondary infections?