Epidemiology of Grapevine leafroll associated virus-3 and regional management

Information provided in

UC CE University of California Agriculture and Natural Resources Cooperative Extension

Kari Arnold, PhD klarnold@ucanr.edu
Area Orchard & Vineyard Systems Farm Advisor, Serving Stanislaus County
February 21, 2019

Acknowledgements

Funding sources:

American Vineyard Foundation (AVF)

California Grape Rootstock Improvement Commission

California Grape Rootstock Research Foundation

The Fruit Tree, Nut Tree and Grapevine Improvement Advisory Board (IAB)

Collaboration:

Foundation Plant Services

Neil McRoberts

QBE Lab

Deborah Golino

Vicki Klaassen

Maher Al Rwahnih

Monica Cooper

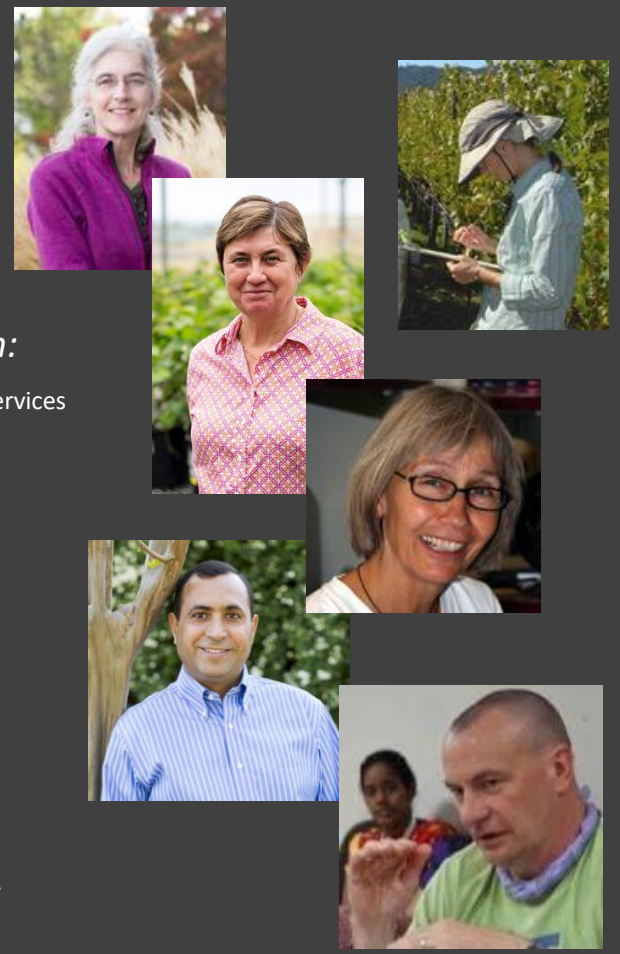
Rhonda Smith

Andrew Walker

Sue Sim

Grower Community

Students



CALIFORNIA PD/GWSS BOARD
Partnership for Winegrape Pest Solutions

Unified Grant Management for Viticulture and Enology

Information provided in this presentation is not for publication nor to be cited without permission of the author

UC CE University of California Agriculture and Natural Resources Cooperative Extension

Kari Arnold, PhD klarnold@ucanr.edu
Area Orchard & Vineyard Systems Farm Advisor, Serving Stanislaus County
February 21, 2019

Today's Roadmap

- Virus Introduction
- GLRaV-3 Epidemiology
- Regional Management

Information provided in this presentation is not for publication nor to be cited without permission of the author

UC CE University of California Agriculture and Natural Resources Cooperative Extension

Kari Arnold, PhD klarnold@ucanr.edu
Area Orchard & Vineyard Systems Farm Advisor, Serving Stanislaus County
February 21, 2019

Virus Introduction

- Grapes are asexually propagated….
- ….and so are viruses
- Rootstock and scion
- Graft transmissible
  - Top-working is risky
- Many viruses likely entered the US in infected material
- Over 70 virus and virus like diseases in grapes

Information provided in this presentation is not for publication nor to be cited without permission of the author

UC CE University of California Agriculture and Natural Resources Cooperative Extension

Kari Arnold, PhD klarnold@ucanr.edu
Area Orchard & Vineyard Systems Farm Advisor, Serving Stanislaus County
February 21, 2019

Leafroll

- Limited sugar, 1-4° Brix
- Color reduced
- Yield reduced
- Irregular ripening, delayed
- TA increased
- Graft incompatibility
- Disease severity depends on variety, clone, rootstock, site, year, leafroll type

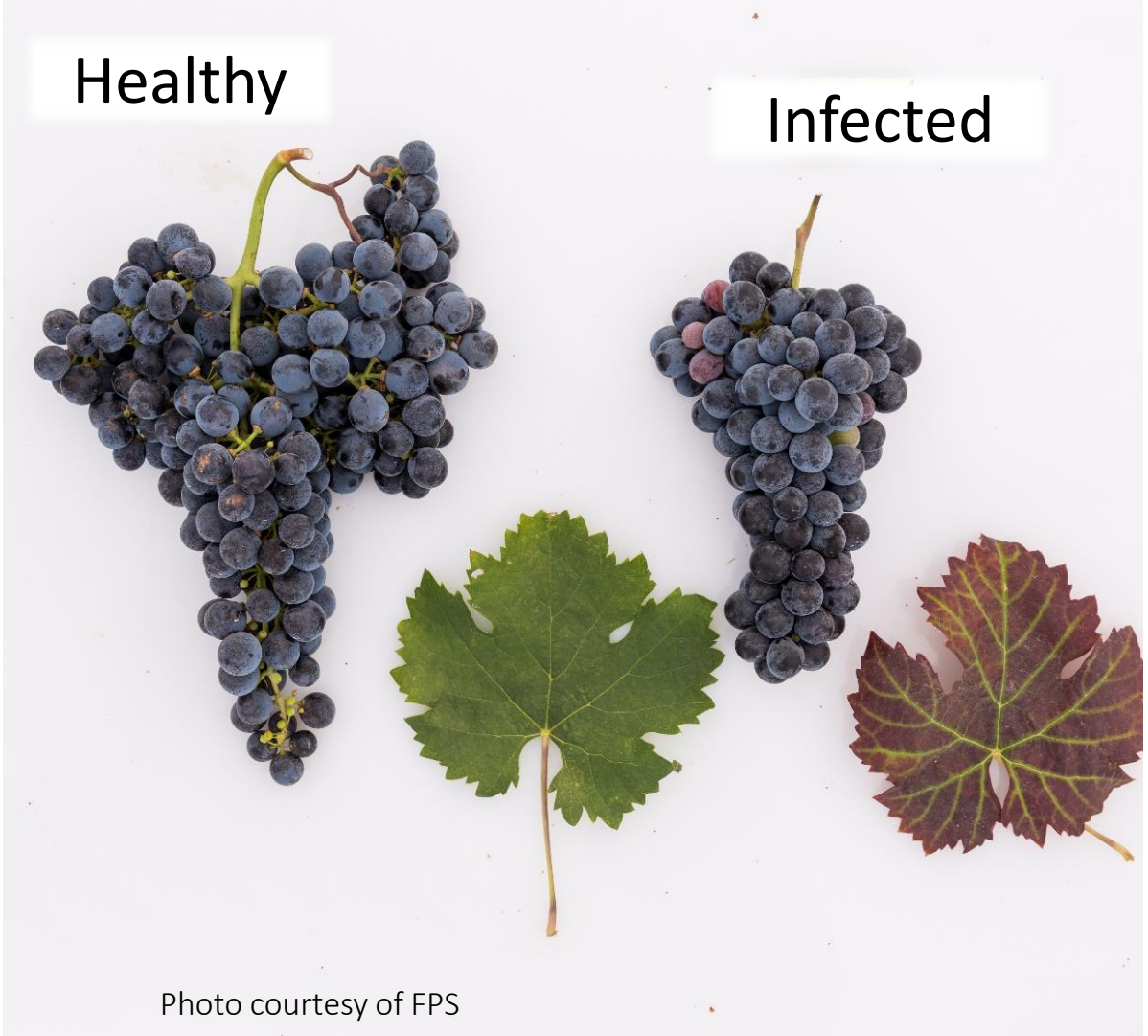


Photo courtesy of FPS

Information provided in this presentation is not for publication nor to be cited without permission of the author

UC CE University of California Agriculture and Natural Resources Cooperative Extension

Kari Arnold, PhD klarnold@ucanr.edu
Area Orchard & Vineyard Systems Farm Advisor, Serving Stanislaus County
February 21, 2019

Money

Information provided in this presentation is not for publication nor to be cited without permission of the author

UC CE University of California Agriculture and Natural Resources Cooperative Extension

Kari Arnold, PhD klarnold@ucanr.edu
Area Orchard & Vineyard Systems Farm Advisor, Serving Stanislaus County
February 21, 2019

How much?

Reducing the Economic Impact of Grapevine Leafroll Disease in California: Identifying Optimal Disease Management Strategies

Katie D. Ricketts,[1]* Miguel I. Gomez,[1] Shady S. Atallah,[1] Marc F. Fuchs,[2]
Timothy E. Martinson,[3] Mark C. Battany,[4] Larry J. Bettiga,[5]
Monica L. Cooper,[6] Paul S. Verdegaal,[7] and Rhonda J. Smith[8]

Information provided in this presentation is not for publication nor to be cited without permission of the author

Kari Arnold, PhD klarnold@ucanr.edu
Area Orchard & Vineyard Systems Farm Advisor, Serving Stanislaus County
February 21, 2019

California Grapevine Registration and Certification (CGR&C) program
Provides virus tested true to type planting material
$50 MILLION/YEAR BENEFIT

The Economic Benefits from Virus Screening: A Case Study of Grapevine Leafroll in the North Coast of California

Kate Binzen Fuller,[1,4]* Julian M. Alston,[2] and Deborah A. Golino[3]

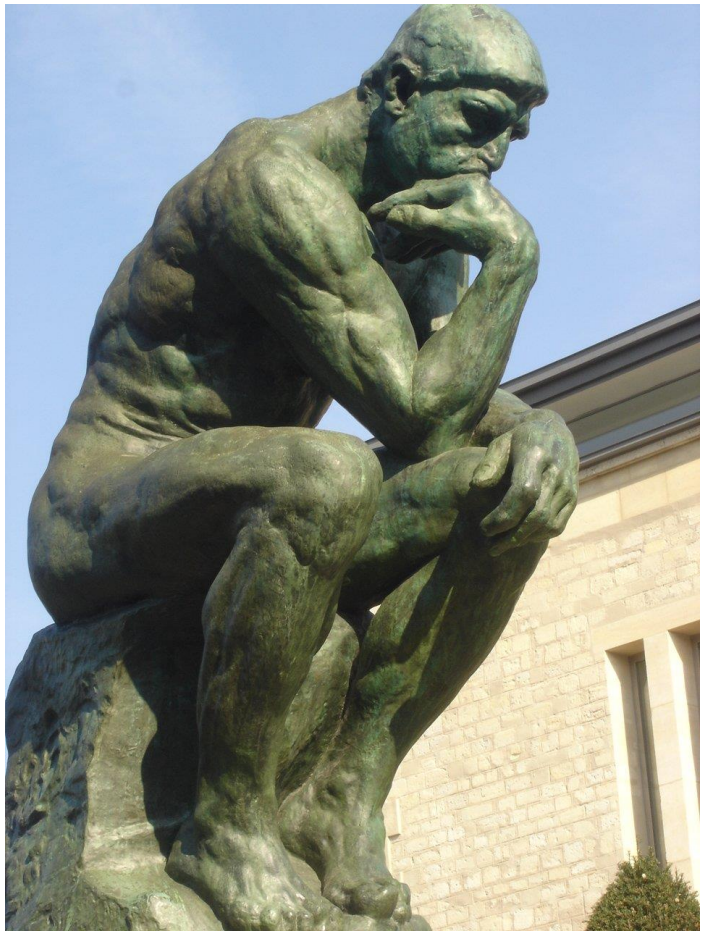
Certified Material

Information provided in this presentation is not for publication nor to be cited without permission of the author

UC CE University of California Agriculture and Natural Resources Cooperative Extension

Kari Arnold, PhD klarnold@ucanr.edu
Area Orchard & Vineyard Systems Farm Advisor, Serving Stanislaus County
February 21, 2019

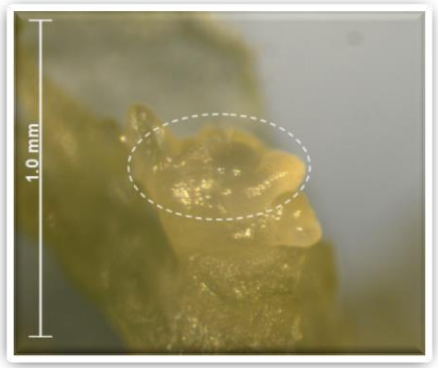
How does that work?



Information provided in this presentation is not for publication nor to be cited without permission of the author

Kari Arnold, PhD klarnold@ucanr.edu
Area Orchard & Vineyard Systems Farm Advisor, Serving Stanislaus County

Grape Virus Elimination Therapy



Excise meristem dome and
1-2 pairs of leaf primordia

Treated

2011 – 154 selections

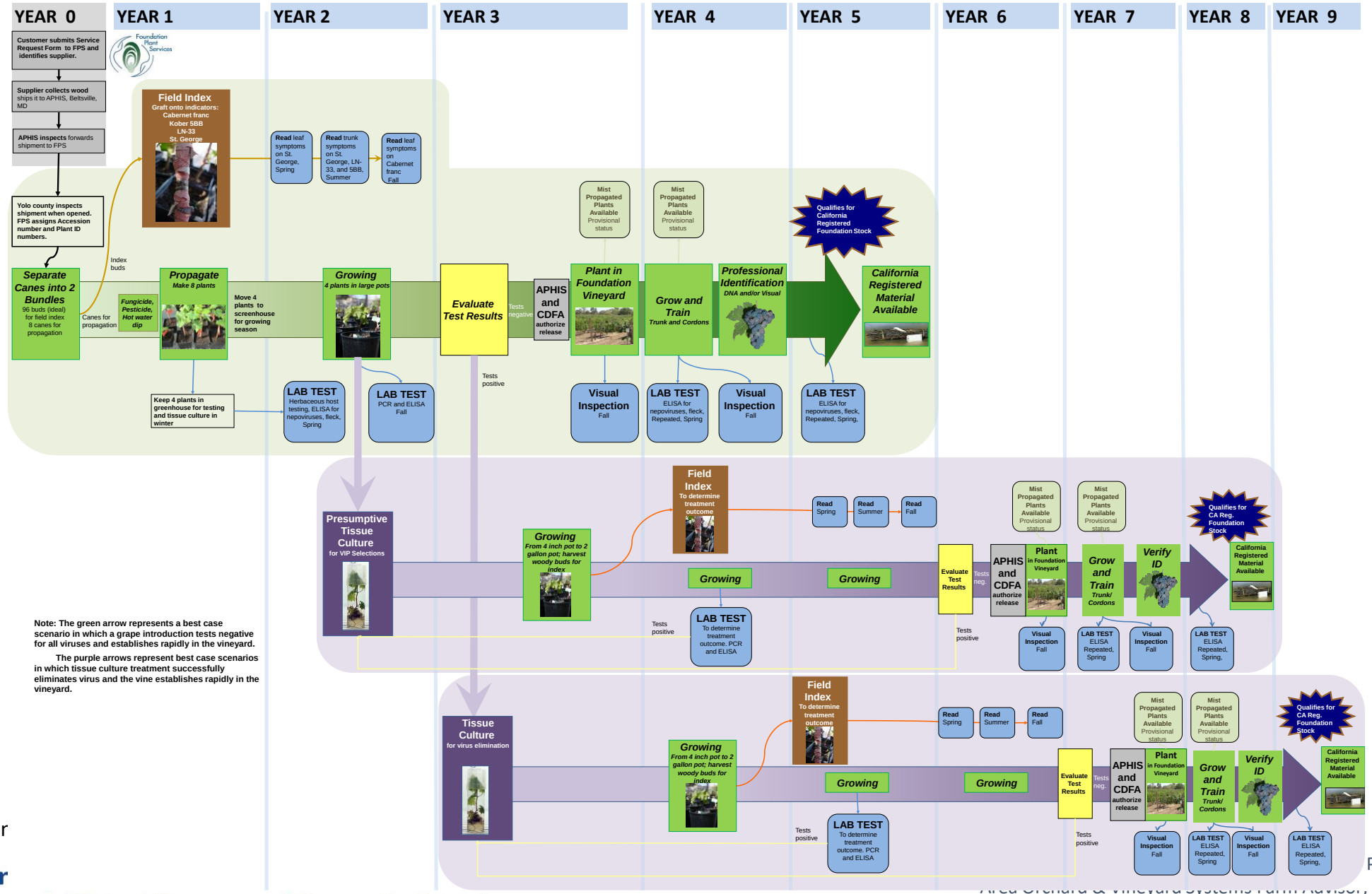
Information provided in this presentation is not for publication nor to be cited without permission of the author

UC CE University of California Agriculture and Natural Resources Cooperative Extension

Kari Arnold, PhD klarnold@ucanr.edu
Area Orchard & Vineyard Systems Farm Advisor, Serving Stanislaus County
February 21, 2019

Process Description: Grapevine Importation through Foundation Plant Services, UC Davis (Simplified)

Document # FPS2012-01 © UC Regents S. Sim Revised March 6, 2012



Note: The green arrow represents a best case scenario in which a grape introduction tests negative for all viruses and establishes rapidly in the vineyard.

The purple arrows represent best case scenarios in which tissue culture treatment successfully eliminates virus and the vine establishes rapidly in the vineyard.

Information provided ir

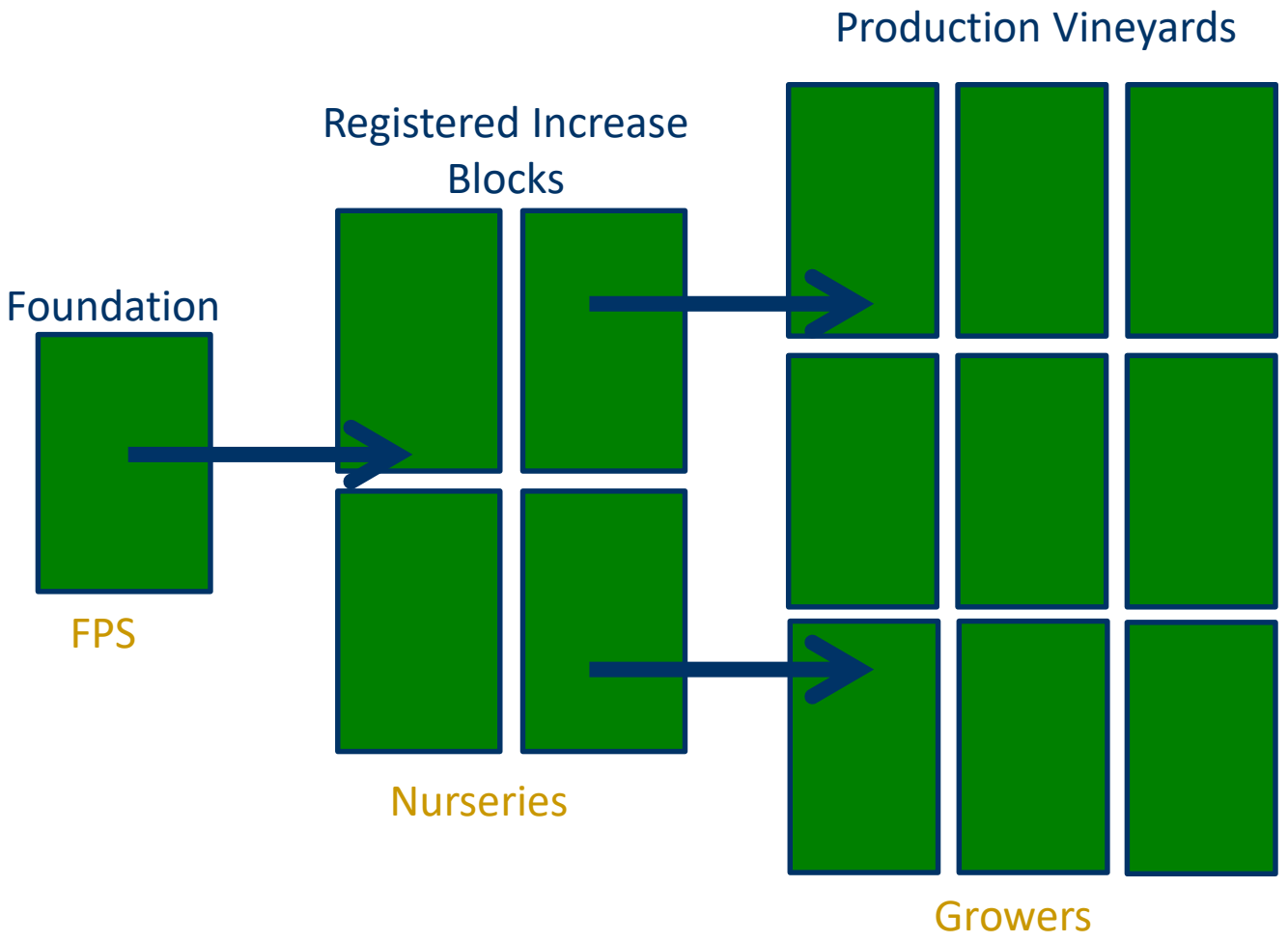
UC CE Univer Agriculture and Natural Resources Cooperative Extension

PhD klarnold@ucanr.edu

Area Orchard & Vineyard Systems Farm Advisor, Serving Stanislaus County

February 21, 2019

Supply Chain



Information provided in this presentation is not for publication nor to be cited without permission of the author

Kari Arnold, PhD klarnold@ucanr.edu
Area Orchard & Vineyard Systems Farm Advisor, Serving Stanislaus County
February 21, 2019

Backyard safaris….?

Information provided in this presentation is not for publication nor to be cited without permission of the author

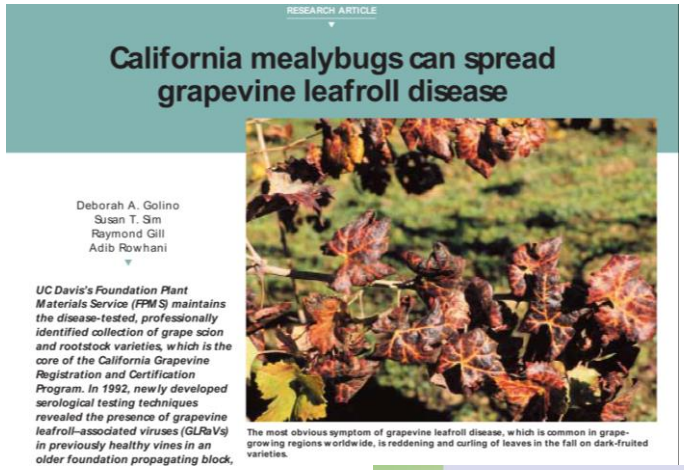
UC CE University of California Agriculture and Natural Resources Cooperative Extension

Kari Arnold, PhD klarnold@ucanr.edu
Area Orchard & Vineyard Systems Farm Advisor, Serving Stanislaus County
February 21, 2019

Leafroll spreads…

1989

Rosciglione, B., and Gugerli, P. 1989. Transmission of grapevine leafroll disease and an associated Closterovirus to healthy grapevine by the mealybug *Planococcus ficus* Signoret. Pages 67-69 in: Proc. ICVG, 9th.


RESEARCH ARTICLE

California mealybugs can spread grapevine leafroll disease

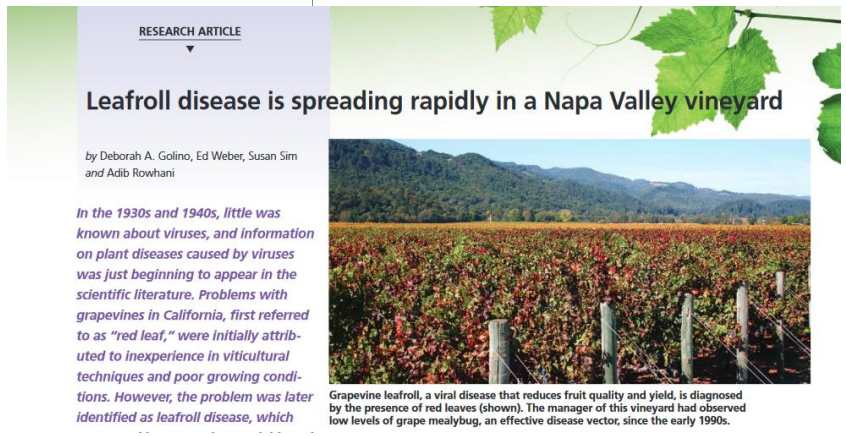
Deborah A. Golino
Susan T. Sim
Raymond Gill
Adib Rowhani

UC Davis's Foundation Plant Materials Service (FPMS) maintains the disease-tested, professionally identified collection of grape scion and rootstock varieties, which is the core of the California Grapevine Registration and Certification Program. In 1992, newly developed serological testing techniques revealed the presence of grapevine leafroll–associated viruses (GLRaVs) in previously healthy vines in an older foundation propagating block,

The most obvious symptom of grapevine leafroll disease, which is common in grape-growing regions worldwide, is reddening and curling of leaves in the fall on dark-fruited varieties.

2002

2008


RESEARCH ARTICLE

Leafroll disease is spreading rapidly in a Napa Valley vineyard

by Deborah A. Golino, Ed Weber, Susan Sim *and* Adib Rowhani

In the 1930s and 1940s, little was known about viruses, and information on plant diseases caused by viruses was just beginning to appear in the scientific literature. Problems with grapevines in California, first referred to as "red leaf," were initially attributed to inexperience in viticultural techniques and poor growing conditions. However, the problem was later identified as leafroll disease, which

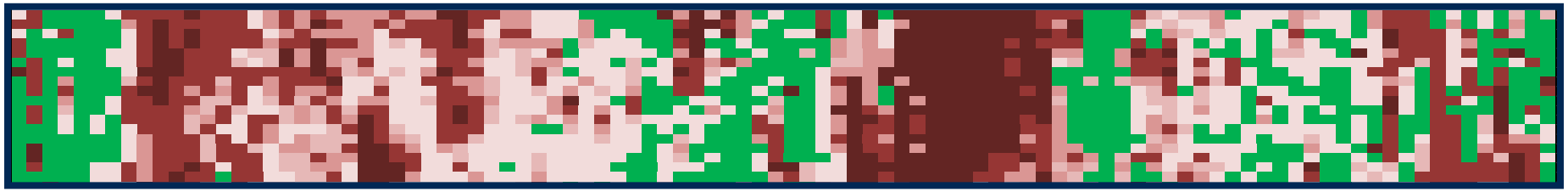
Grapevine leafroll, a viral disease that reduces fruit quality and yield, is diagnosed by the presence of red leaves (shown). The manager of this vineyard had observed low levels of grape mealybug, an effective disease vector, since the early 1990s.

Information provided in this presentation is not for publication nor to be cited without permission of the author

UC CE University of California Agriculture and Natural Resources Cooperative Extension

Kari Arnold, PhD klarnold@ucanr.edu
Area Orchard & Vineyard Systems Farm Advisor, Serving Stanislaus County
February 21, 2019

How does it spread?



Phytopathology • 2017 • 107:418-426 • http://dx.doi.org/10.1094/PHYTO-06-16-0235-R

Ecology and Epidemiology

*e-Xtra**

A Synoptic Analysis of the Temporal and Spatial Aspects of Grapevine Leafroll Disease in a Historic Napa Vineyard and Experimental Vine Blocks

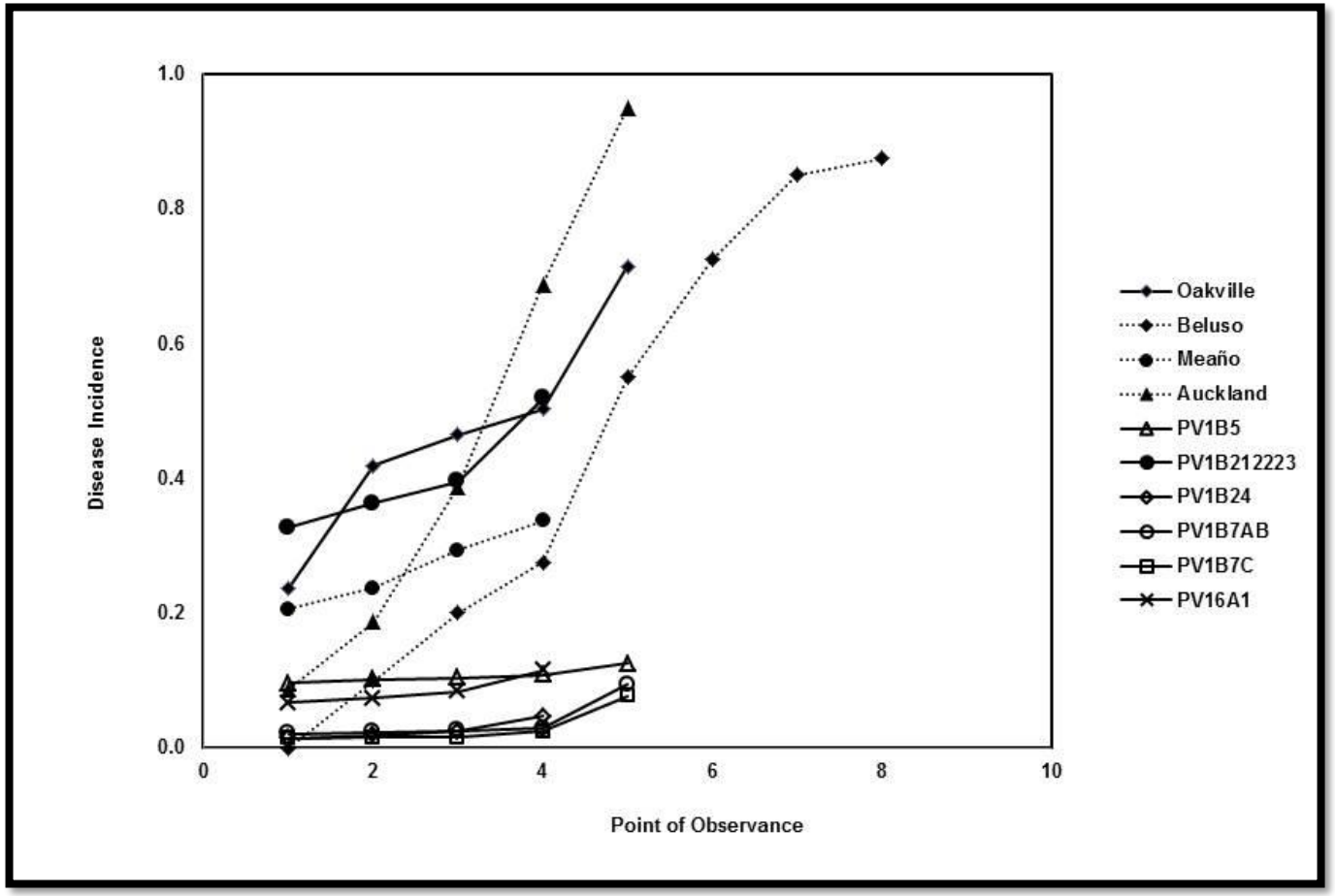
K. Arnold, D. A. Golino, and N. McRoberts

All authors: Department of Plant Pathology, and second author: Foundation Plant Services, University of California, Davis 95616.
Accepted for publication 2 December 2016.

Information provided in this presentation is not for publication nor to be cited without permission of the author

Kari Arnold, PhD klarnold@ucanr.edu
Area Orchard & Vineyard Systems Farm Advisor, Serving Stanislaus County

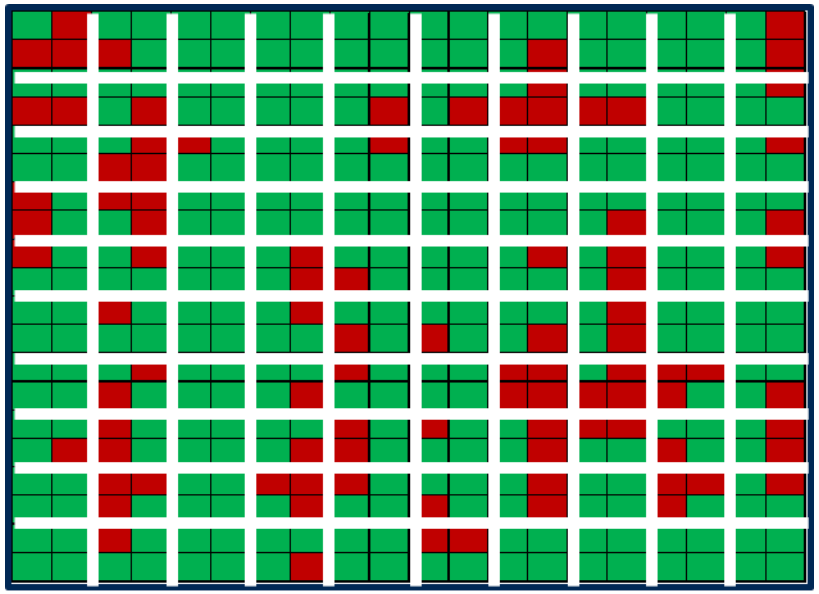
Temporal Analyses



Information provided in this presentation is not for publication nor to be cited without permission of the author

Kari Arnold, PhD klarnold@ucanr.edu
Area Orchard & Vineyard Systems Farm Advisor, Serving Stanislaus County
February 21, 2019

Spatial Analyses



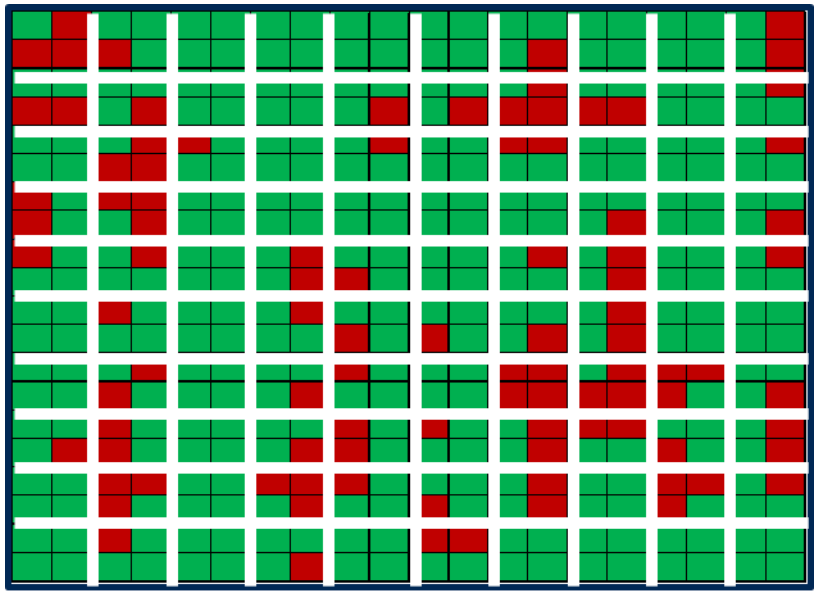
1. Overlay vineyard block maps with sampling grid, *n*=4
2. Count vine disease status in each quadrat, proportions
3. Examine the statistical properties of the incidence at two scales

Laurence V. Madden, Gareth Hughes, and Frank van den Bosch. The Study of Plant Disease Epidemics. 2007. APS Press, St. Paul, MN.

Information provided in this presentation is not for publication nor to be cited without permission of the author

Kari Arnold, PhD klarnold@ucanr.edu
Area Orchard & Vineyard Systems Farm Advisor, Serving Stanislaus County
February 21, 2019

Spatial Analyses



Disease incidence: Proportion of infected plants in the block

DI=96/400=24%

Quadrat Incidence: Proportion of infected quadrats in the block

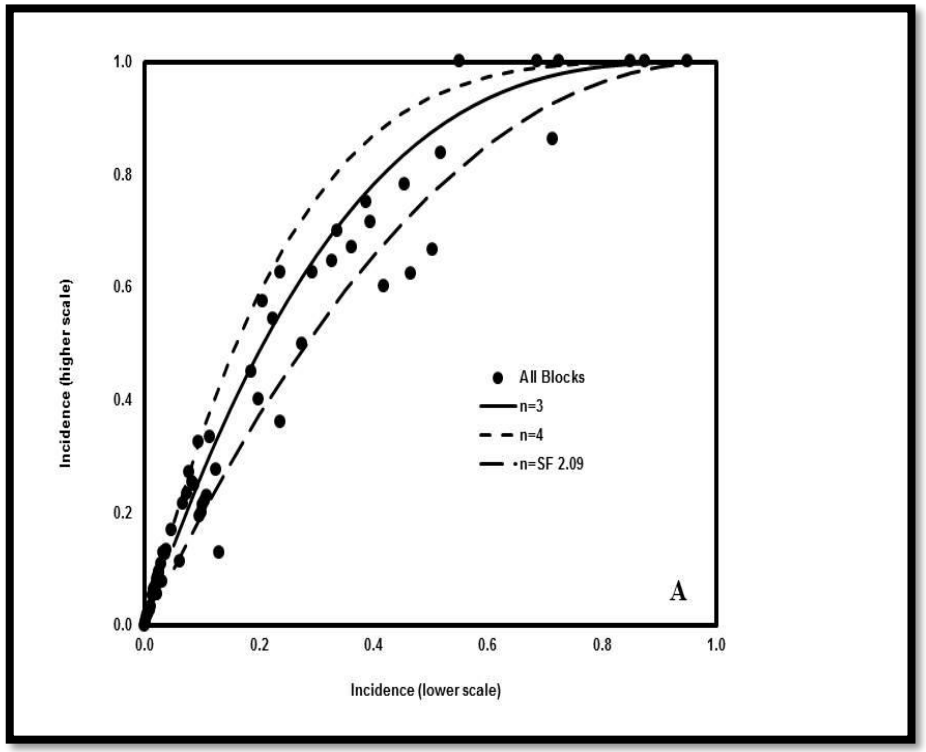
QI=58/100=58%

Laurence V. Madden, Gareth Hughes, and Frank van den Bosch. The Study of Plant Disease Epidemics. 2007. APS Press, St. Paul, MN.

Information provided in this presentation is not for publication nor to be cited without permission of the author

Kari Arnold, PhD klarnold@ucanr.edu
Area Orchard & Vineyard Systems Farm Advisor, Serving Stanislaus County
February 21, 2019

Spatial Analyses



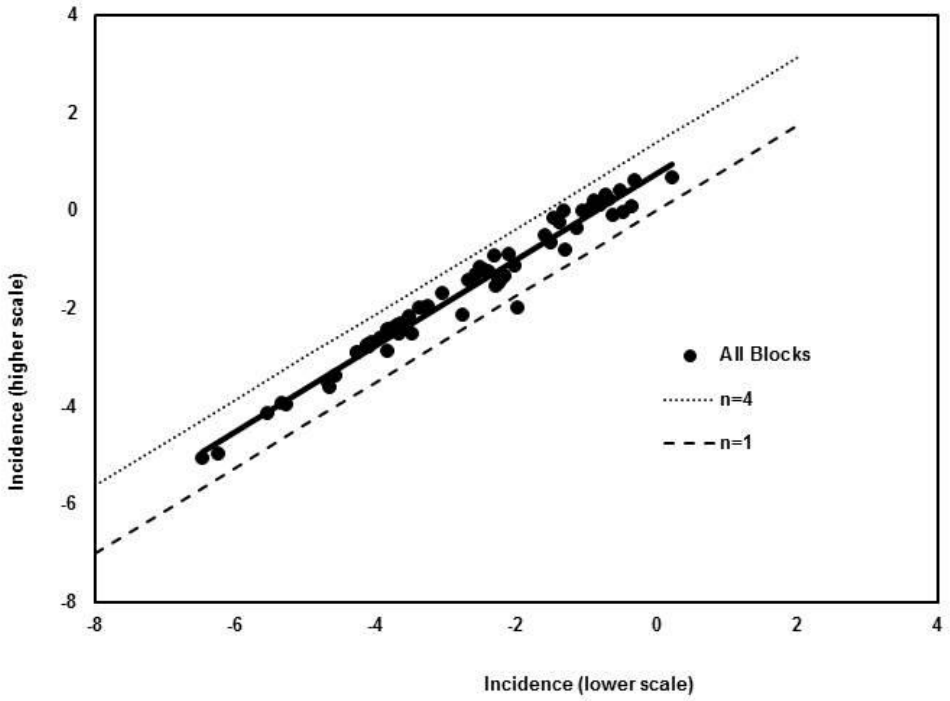
Nearest neighbors are more likely to become infected than vines farther away

Information provided in this presentation is not for publication nor to be cited without permission of the author

UC CE University of California Agriculture and Natural Resources Cooperative Extension

Kari Arnold, PhD klarnold@ucanr.edu
Area Orchard & Vineyard Systems Farm Advisor, Serving Stanislaus County
February 21, 2019

Spatial Analyses



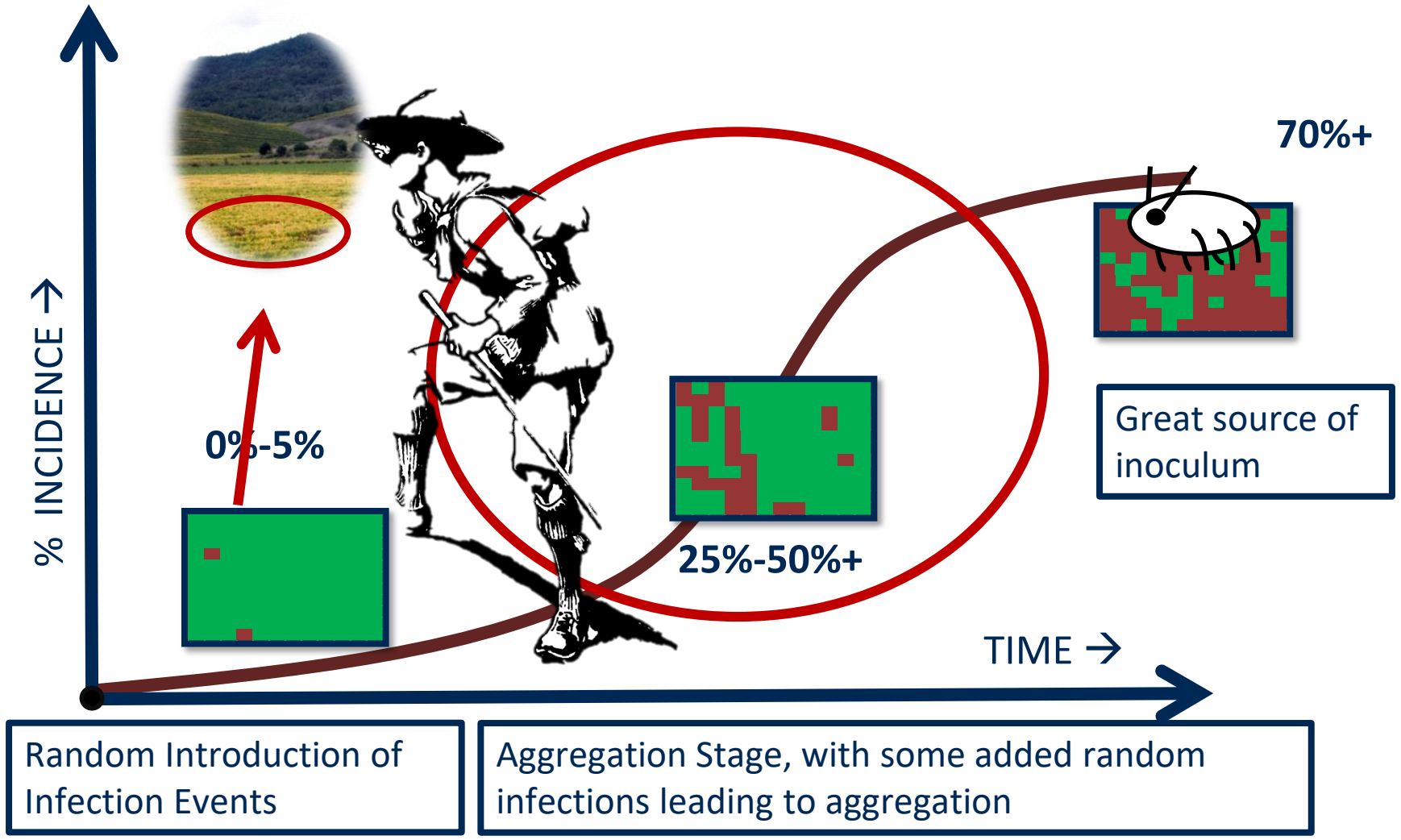
Spatially very similar

Information provided in this presentation is not for publication nor to be cited without permission of the author

UC CE University of California Agriculture and Natural Resources Cooperative Extension

Kari Arnold, PhD klarnold@ucanr.edu
Area Orchard & Vineyard Systems Farm Advisor, Serving Stanislaus County
February 21, 2019

Leafroll Epidemiology



Information provided in this presentation is not for publication nor to be cited without permission of the author

UC CE University of California Agriculture and Natural Resources Cooperative Extension

Kari Arnold, PhD klarnold@ucanr.edu
Area Orchard & Vineyard Systems Farm Advisor, Serving Stanislaus County
February 21, 2019

Information provided in this presentation is not for publication nor to be cited without permission of the author

UC CE University of California Agriculture and Natural Resources Cooperative Extension

Kari Arnold, PhD klarnold@ucanr.edu
Area Orchard & Vineyard Systems Farm Advisor, Serving Stanislaus County
February 21, 2019

Napa Valley

Information provided in this presentation is not for publication nor to be cited without permission of the author

UC CE University of California Agriculture and Natural Resources Cooperative Extension

Kari Arnold, PhD klarnold@ucanr.edu
Area Orchard & Vineyard Systems Farm Advisor, Serving Stanislaus County
February 21, 2019

Napa Valley, CA, leafroll

Vector: Grape mealybug

<1% leafroll

Replant infected blocks, rogue new infections, fallow

Information provided in this presentation is not for publication nor to be cited without permission of the author

UC CE University of California Agriculture and Natural Resources Cooperative Extension

Kari Arnold, PhD klarnold@ucanr.edu
Area Orchard & Vineyard Systems Farm Advisor, Serving Stanislaus County
February 21, 2019