Grape Phylloxera

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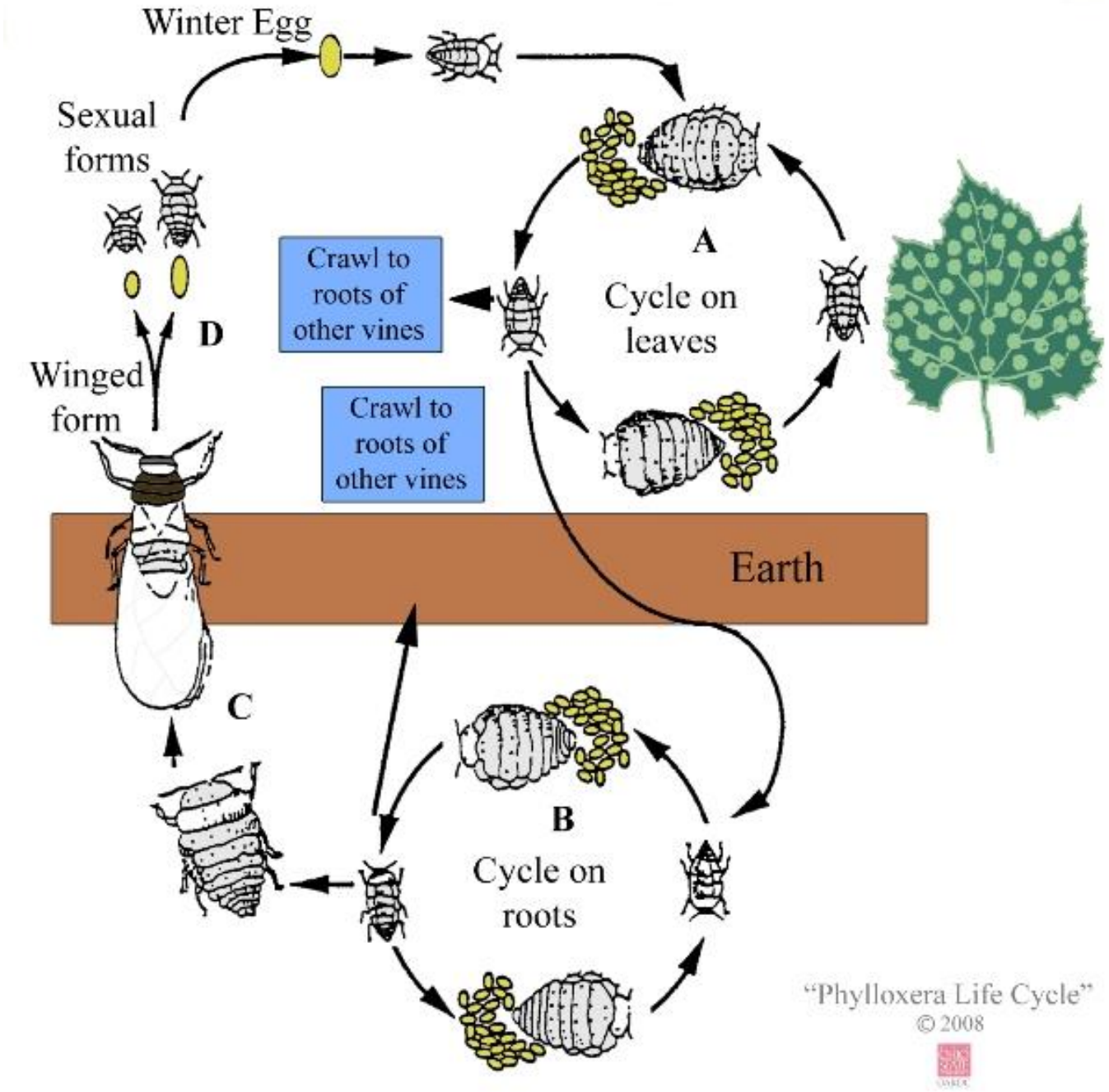
Grape Phylloxera

- Grape phylloxera is a tiny aphid like insect that feeds on roots of *Vitis vinifera* grape and certain other susceptible rootstocks
- Phylloxera feeding stunts the growth of vines and will eventually kill vines.
- It has been documented that phylloxera prefers heavy clay versus sandy soils.
- Often, phylloxera is not a consistent pest on sandy soils.
- Phylloxera is native to North America and co-evolved with American grape species.
- *Vitus vinifera* is highly susceptible to injury from phylloxera.

The introduction of phylloxera into Europe in the mid-19th Century led to the near collapse of wine grape production in Europe. "The phylloxera, a true gourmet, finds out the best vineyards and attaches itself to the best wines." (Cartoon from Punch, 6 Sep. 1890)

Pylloxera Biology

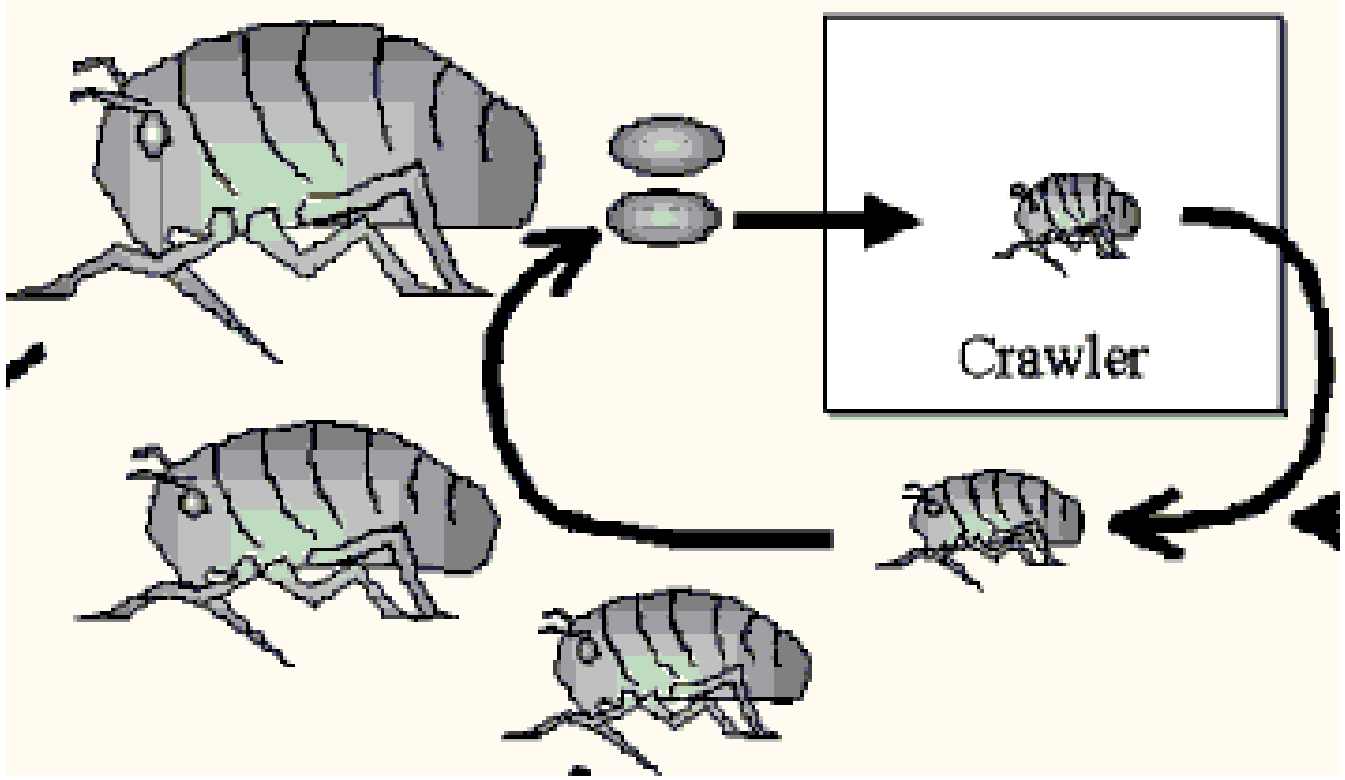
- Phylloxera have a complex life-cycle of up to 18 stages.
- These stages can be divided into four principal forms:
- sexual form
- leaf form
- root form
- winged form
- The overwhelming majority in the Western U.S. are in the root form.



- The majority of grape phylloxera adults are wingless females.
- They are generally oval shaped, but those that lay eggs are pear shaped.
- Phylloxera adult females in the root morph are small (0.04 inch long and 0.02 inch wide)
- They vary in color from yellow, yellowish green, olive green, to light brown, brown, or orange.

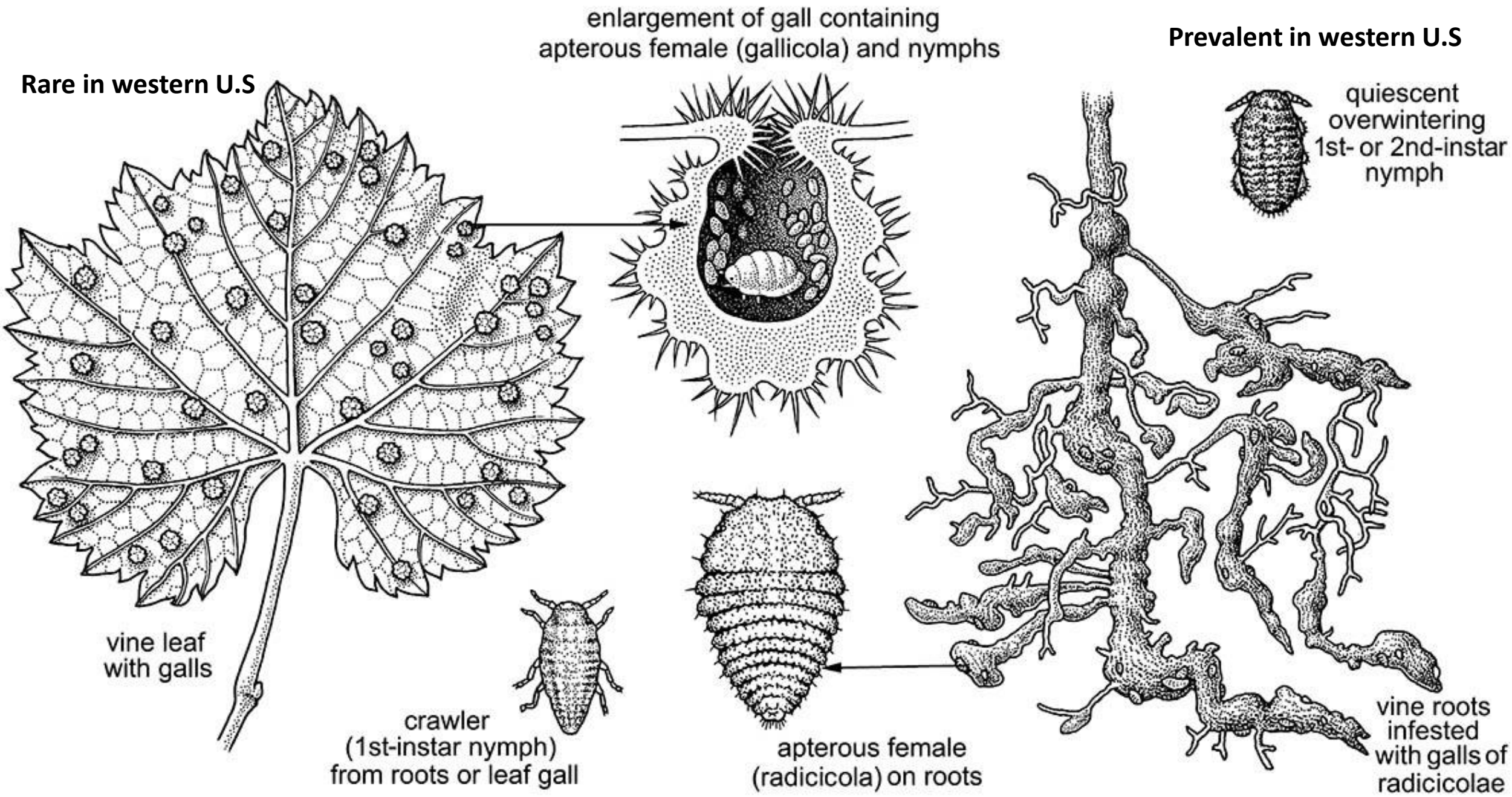
- Newly deposited eggs are yellow, oval, and about twice as long as wide.
- The eggs transform to brown as they mature to hatch.
- The first instar nymphs (developmental stage) are called crawlers

- Phylloxera are hemimetabolous insects
- Immature stages are called nymphs.
- Development proceeds in repeated stages of growth and ecdysis (moulting).
- These stages are called instars.
- Juvenile phylloxera closely resemble adults, but are smaller and lack adult features such as wings (rare in adults in the western U.S.) and genitalia.



We believe the root feeding morph is the most prevalent in Washington State

- Grape phylloxera overwinter as small nymphs on roots.
- In spring when soil temperatures exceed 60°F, phylloxera start feeding and growing.
- First instar nymphs are active crawlers and may move from plant to plant in the ground, on the soil surface, or by blowing in the wind.
- They may also be moved between vineyards on **cuttings, boots, or equipment.**


Rare in western U.S
enlargement of gall containing
apterous female (gallicola) and nymphs
Prevalent in western U.S
quiescent
overwintering
1st- or 2nd-instar
nymph
vine leaf
with galls
crawler
(1st-instar nymph)
from roots or leaf gall
apterous female
(radicicola) on roots
vine roots
infested
with galls of
radicicolae

- The leaf galling form is common in the Midwest and Northeastern U.S.
- The WSDA has had only 1 positive detect of the leaf galling form of phylloxera in Washington State.
- It was at a house in Olympia on vines brought in from outside WA.
- Supposedly the infestation was eradicated.

DAMAGE

- Grape phylloxera damage the root systems of grapevines by feeding on the root, either on growing rootlets, which then swell and turn yellowish, or on mature hardened roots where the swellings are often hard to see.
- Necrotic spots (areas of dead tissue) develop at the feeding sites on the roots.
- The necrotic spots are a result of secondary fungal infections that can girdle roots, killing large sections of the root system.
- Such root injury causes vines to become stunted and produce less fruit.

Management

- Resistant rootstocks are the only completely effective means for phylloxera management in the most severely affected areas.
- Others have far more experience then I do with root stocks.
- For those of you with phylloxera, your good ol’ days of self rooted vines are likely over.

Insecticides

- Insecticide treatments will not eradicate phylloxera populations; the chemical cannot easily penetrate the heavy soils that this pest prefers.
- Also, effectiveness of a treatment is difficult to evaluate because although many phylloxera may be killed, populations may rebound rapidly and resume feeding on the vines.
- Because it may take years of insecticide treatments to reverse severe damage, treatments to prevent damage may be a better strategy than curative treatments.
- Unfortunately there are really only 2 classes of insecticides registered on grapes. These include neonicotinoids and lipid biosynthesis inhibitors.

Insecticide Resistance

- Most vineyards in Washington State have been treated routinely with neonicitinoids in the past.
- We have seen the efficacy of imidacloprid decrease on grape mealybug. (Jonathan O'Hearn- tomorrow, stay tuned)
- It is likely that extant phylloxera populations in Washington State have a history of exposure to neonicotnyl insecticides like imidacloprid, thiamethoxam, clothianidin, or dinotefurone.
- **No proof!** But resistance to imidacloprid could be a factor in recent upswing of phylloxera infestations.

Insecticides recommended by the UC IPM program for suppression of phylloxera in California (In order of efficacy and IPM fit)

- Spirotetramat: Movento™; foliar spray at 8 oz product per acre
  - Innoculate and booster… 2 applications
- Imidacloprid: Admire Pro™, Chemigation at 0.5 lb ai/ acre
- Clothianidin: Belay™; Chemigationa at 12 fl oz/ acre
- Dinotefuron: Venom™; Chemigation at 6 oz/ acre
- Thiamethoxam: Platinum™, Chemigation at 17 fl oz/ acre
- Rotate chemicals with a different mode-of-action group number, and do not use products with the same mode-of-action Group number more than twice per season to help prevent the development of resistance.
- Unfortunately all these insecticides except Movento are neonicitinoids (same group=- mode of action)
- Movento is a lipid biosynthesis inhibitor

Where do we go from here? Research proposal…

Monitoring and managing grape phylloxera in Washington State vineyards

PRE-PROPOSAL submitted to the Washington State Grape and Wine Research Program and WSCPR.

Project Objectives: 1. Pest Biology in WA

- Obj a. Conduct lifecycle studies on endemic phylloxera in Washington State vineyards. Quantify generations per year, and validate sampling methods. (Walsh)

- We anticipate 2 generations per season based on previous research but need to confirm this. In late spring we will begin sampling roots of grapevines from infested vineyards. We will note presence/absence, and life stage. We will also validate the use of inverted bucket method for trapping phylloxera; with a focus on fall trapping.

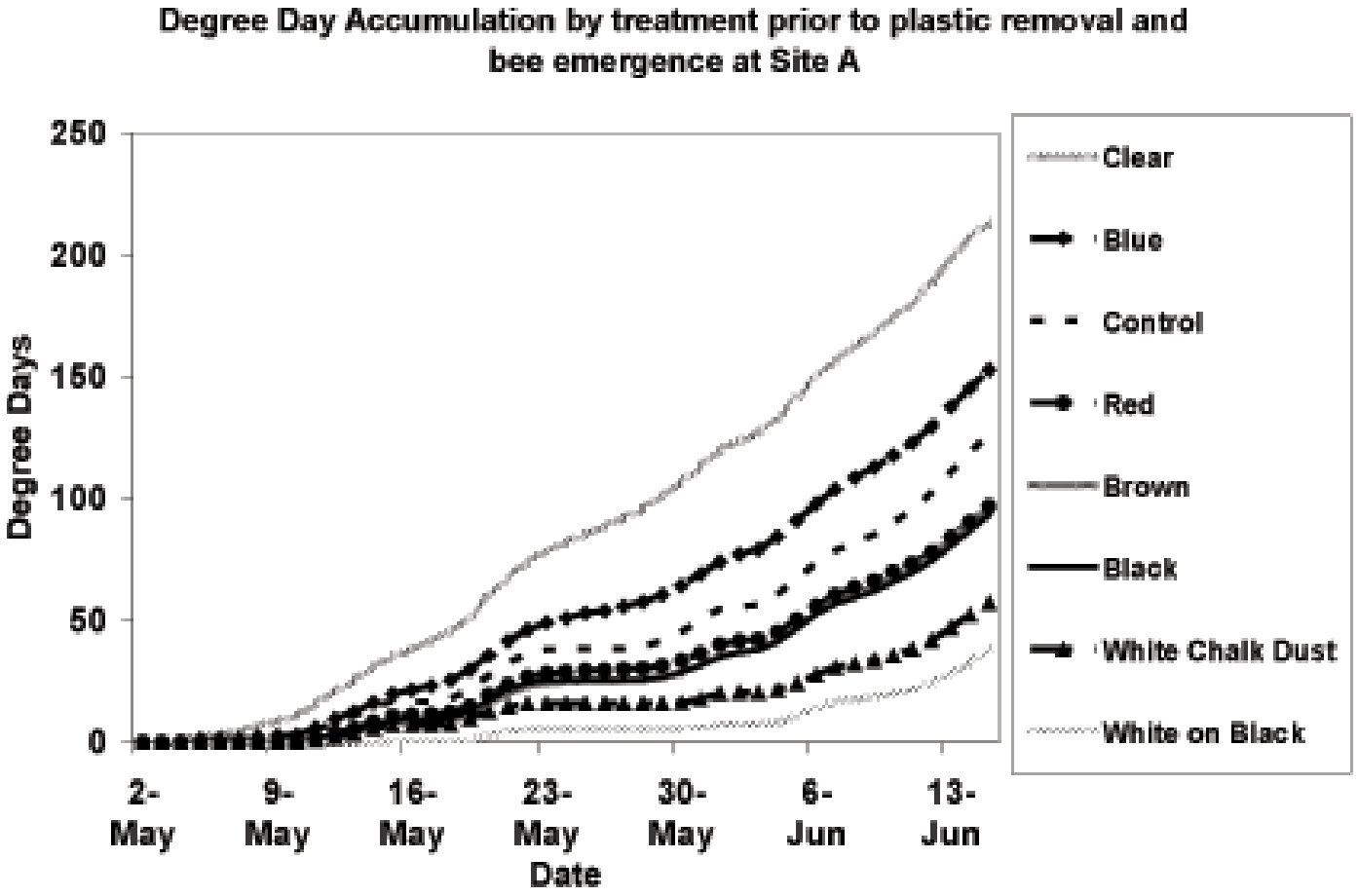
Project Objectives: 1. Pest Biology in WA

- Obj b. Complete a DNA barcoding study to quantify the number of phylloxera introductions and origin of introduction of grape phylloxera. (Walsh, Moyer)

- Tello and Forneck (2019)[1] have published a review that details all the methodology used to fingerprint phylloxera in its Northeast US range and then analyze the genetic structure of populations in areas like California, Europe, and Australia to determine point of origin.
- We will follow their methods to determine how many phylloxera populations (biotypes) have been introduced into Washington State.
- This information will determine if introductions are older or are a result of some break in quarantine chain in more recent imports.

Project Objective: 2. Management

- a. Investigate the manipulation of soil temperatures via plastic mulch on the biology of grape phylloxera. (Walsh)



Project Objective: 2. Management

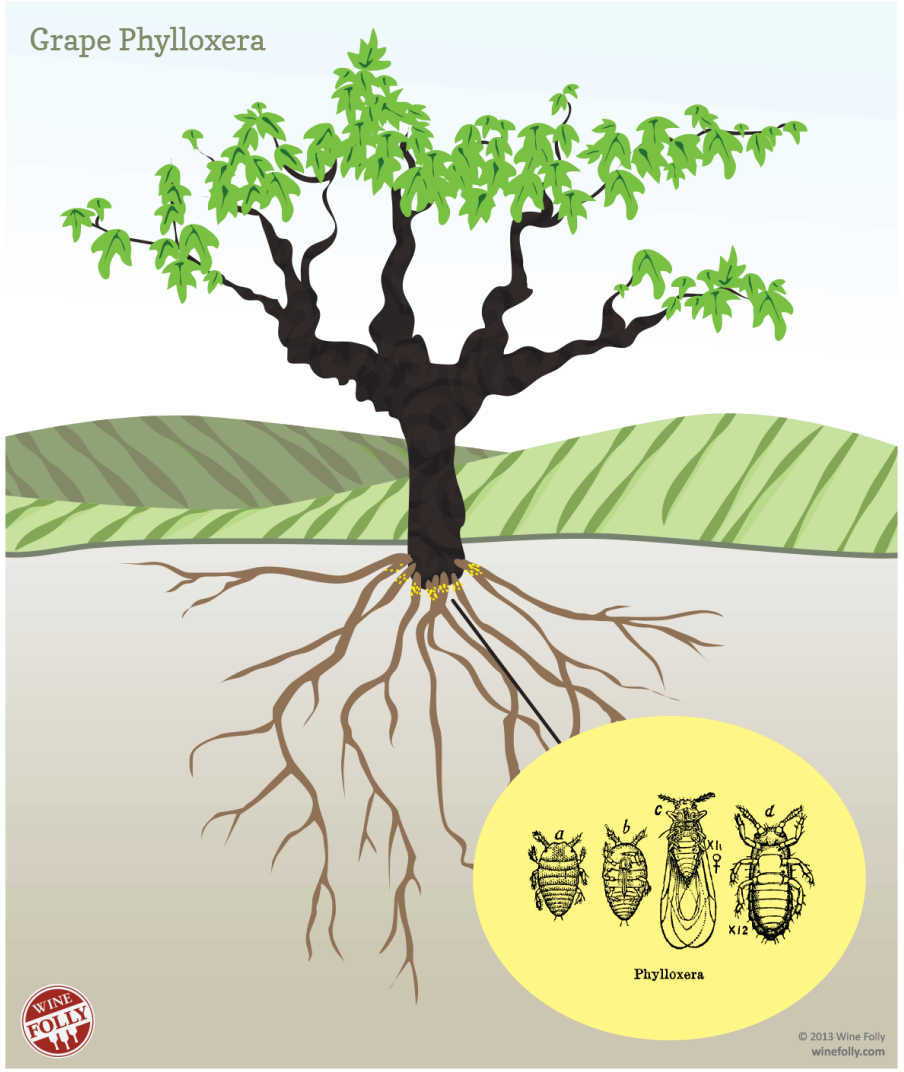
- b. Manipulate irrigation and fertilizer inputs and quantify subsequent effects on plant vigor, yield, and fruit composition on phylloxera infested grapevines. (Moyer, Hoheisel, Keller)

- We will evaluate the efficacy of alteration in water regimes and nitrogen inputs, as a short-term effort to mitigate vine vigor decline in phylloxerated vineyards.
- We will also be evaluating whether this type of practice also exacerbates subsequent decline, as seen in some situations. Vines will be monitored for vigor (pruning weights), yield, and basic fruit quality.

Project Objective: 2. Management

- Use a bioassay method to test the effectiveness of plant systemic insecticides. (Walsh)

- Insecticide bioassay methods are rarely detailed in the literature.
- We propose chemigating field plots with high, intermediate and low rates of imidacloprid.
- We will also evaluate high and low rates of Movento.
- We then will dig up roots from these plots and follow bioassays create bioassay arenas as detailed by De Benedictus and Grannett (1983)[3].
- I took general entomology (ENT 100) from Grannett at UC Davis in 1990 and this was one of the labs he taught on root stock susceptibility



Project Objective: 2. Management

- Conduct field efficacy insecticide trials with systemic and contact insecticides. (Walsh).

- Pyrethroid berm and trunk sprays and chemigation with neonics and foliar sprays of Movento

Project Objective: 3. Extension

- Develop risk-assessment mapping tool based on site conditions (soil, climate, etc), to help identify areas of high or low infestation risk. (Hoheisel, Moyer, Keller)

- Working with county GIS experts, we will develop a risk assessment map using available soil and climate maps.
- These maps can be used to quickly identify areas at greater risk for phylloxera infestation and spread, to assist in scouting efforts and decision management as to which vineyards are good candidates for the first round of rootstock replanting.

Project Objective: 3. Extension

- Use molecular methods for early detection of phylloxera infestations to improve management decision. (Walsh, Moyer, Hoheisel)

- Zhu et al. (2014) have developed a molecular-based method that can detect small amounts of phylloxera DNA if present on grape roots. We will use this method to determine its usefulness in rapid, early detection of phylloxera infestations.

Project Objective: 3. Extension

- Develop outreach materials for scouting and management training. (Hoheisel, Moyer)

Viticulture and Enology Extension News

Washington State University

Viticulture and Enology Program
WASHINGTON STATE UNIVERSITY

Spring 2030

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Michelle M. Moyer, Ph.D.

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After an outstanding 32 year career solving Washington State pest management problems Walsh announces that he's outa here.

Michelle M. Moyer
Associate Professor - Viticulture Extension Specialist
WSU Prosser IAREC

Transition Complete!

Record harvests are reported on phylloxera resistant rootstocks. Washington grape growers earning big bucks and the living is easy.

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