Every California vineyard is eventually infected with trunk disease. Trunk diseases significantly reduce yields in mature vineyards by either killing fruiting positions or decreasing vine vigor. These impacts accumulate each year, as there are no effective methods to eradicate the wood infections. Trunk diseases are the limiting factor of vineyard longevity and one of the main reasons why many vineyards are replanted after only 15 to 20 years. Fortunately, there are ways to prevent and manage trunk diseases, especially when adopted early in a vineyard's life. A new online tool allows growers to evaluate costs and long-term economic benefits of using preventative practices at different stages in a vineyard's maturity.

What is Trunk Disease?

Trunk diseases cause an internal wood infection, which can appear as a wood canker or as discolorations in the wood. These infections kill the woody parts of the vine from which new shoots grow (spurs and canes) and disrupt the flow of nutrients from the shoots down to the roots, and water and soil-derived nutrients from the roots up to the shoots. Infections accumulate over time, causing greater yield losses each year until the vine is either dead or not productive. The four main trunk diseases in California are Botryosphaeria-, Eutypa-, and Phomopsis-diebacks, and Esca. These diseases cause chronic infections of the wood that cannot be eradicated. Although caused by different pathogens, trunk diseases present the following general canopy symptoms: dead spurs, dead cordons, stunted shoots, and/or symptomatic leaves. It is not important to identify the exact trunk disease in your vineyard since the treatment is the same for all four, and it's likely that if you have one trunk disease, you have one or more of the others as well.

How Prevalent is the Disease?

Every vineyard in California will eventually develop one or more trunk diseases. Although some varietals are more resistant to one trunk disease than others, no varietal is resistant to all trunk diseases. As a vineyard ages, the percentage of vines with symptoms increases. In year 10, observations by trunk-disease scientists predict a disease incidence of 20% if no disease prevention is attempted. By year 15, it can increase to 75%. This sharp increase in disease incidence is not due to a higher level of susceptibility in years 10 to 15, but rather that visible identification of canopy symptoms occurs years after wood infections are already well established.

Common Practices for Prevention

The most effective approach is starting prevention practices while the vines are young and healthy in order to minimize infections of pruning wounds. Pruning wounds are the main entry point of the fungal spores into the grapevine. Growers are encouraged to adopt one or more preventative practices by year three or as soon as the vines are trained to a trellis system. Early adoption maximizes the economic benefits (productivity and profitability) of the vineyard over the course of its lifetime.
Practices that reduce infections include the following:

1. **DELAYED PRUNING**

   Pruning wounds are most susceptible to infection during rain events since trunk pathogen spores are produced and dispersed with rain. In February or March, when rain is less likely, pruning wounds can heal in a matter of days. Wounds take longer to heal early in the dormant season, so waiting to prune until later in the season reduces the chance of infection, while not increasing costs.

2. **PRUNING-WOUND PROTECTANTS**

   The application of pruning-wound protectants is known to be an effective means of minimizing infections. Pruning-wound protectants should be applied after pruning and, most importantly, before rain. Fungicides Thiophanate-methyl (Topsin M®) and myclobutanil (Rally®) are registered for control of trunk diseases. Non-fungicidal materials (e.g., Vitiseal™) are also available, but there are few published studies on its effectiveness.

3. **DOUBLE PRUNING**

   This approach is more common in large vineyards when delayed pruning is not feasible. Double pruning splits pruning into two passes, the first is done with a mechanical pruning machine in December cutting the canes to 8 to 10 inches. No cuts are made down to the cordon. Pruning debris is pulled off the trellis wires by hand. The second pass is done by hand in February, when the canes are pruned down to the spurs. With the second pass, any portions of the canes that became infected after the first pass are pruned away. The second pass should go more quickly since most of the growth was removed in the first pass. The pathogens grow slowly, so there is little danger of the disease spreading from a wounded cane to the cordon between the first and second pass. Double pruning is not appropriate for cane-pruned vineyards that annually retain long canes.

**Post-Infection Treatments**

Although prevention is always the best strategy, once disease incidence is high, management based on prevention alone is no longer optimum, and you should consider post-infection management practices as well.

**DID YOU KNOW?**

Wood-canker diseases significantly limit the profitable lifespan of vineyards. Annual yield losses due to Eutypa-dieback and Botryosphaeria-dieback, two widespread grapevine wood-canker diseases (aka trunk diseases), translate into a 14% reduction in gross producer value.

Once a vine is infected, the only way to eradicate the infection is to replant or conduct vine surgery. **Vine surgery** involves cutting out the infected wood and retraining the vine from the shoots below. Retraining a new cordon is possible if only one cordon has dead spurs. The base of the trunk can also be used to retrain a new vine. Sometimes vines will push new shoots from the base of the trunk. Retrain one of these and cut away the old vine during the growing season, when risk of infection is at its lowest. If no shoots form at the base, cut the vine off above the graft union (but not in early winter, when risk of infection is high) to encourage new shoots to form. This method allows the retrained vine to utilize the existing root system, returning to proper yields faster than putting a replant in its place.

Although this is the only option once a vine is infected, the practice is risky because healthy-looking wood can harbor an infection, and all the infected wood may not be removed. One published study on vine surgery revealed between 6-60% of the vines still had trunk diseases several years later. (Source: Kendra Baumgartner, PhD and Jonathan Kaplan, PhD).

An important practice to preventing the spread of trunk disease is **sanitation**, which involves pruning away dead spurs or cordons with wood cankers, and burning or removing infected wood from the vineyard. When it rains, all trunk pathogens produce spores from infected wood. Therefore, removing or burning wood eliminates local sources of inoculum.
Trunk Disease Management Tool

Using an online assessment tool, growers can run customizable scenarios for their vineyard to help inform their decisions on when to begin implementing trunk disease preventative practices. The online tool is based on years of research on trunk diseases in California and the economic analysis of implementing preventative practices in winegrape vineyards and other specialty crops (see the SRCI Trunk Disease Project Research Brief for more information: http://treeandvinetrunkdiseases.org/wp-content/uploads/2017/06/170612_CTGC.pdf).

Trunk diseases are detrimental to vineyard longevity and can lead to premature replanting. These high start-up costs and yield losses are not repaid. The free online tool was designed with the goal of increasing the profitability of vineyards by encouraging practices that reduce disease incidence with the net result of maintaining yields, profitability and lengthening the lifespan of vineyards.

CUSTOMIZE THE TOOL & COMPARE SCENARIOS
The tool allows growers to run various scenarios based on the growing region, price per ton, vineyard age, expected yields and other parameters. The tool calculates the costs and benefits of implementing preventative practices over time (see Figure 1). Growers will be able to see how long it takes for preventative practices to pay off, when the last profitable year might be (based on when preventative practices were adopted) and the expected yield losses over time when preventative practices are not used.

PRINT REPORTS AND COMPARE RESULTS
Users can generate reports and graphs to calculate vineyard yields at various disease control efficacy rates and/or cumulative net returns (returns – costs) per acre over 25 years for a healthy vineyard, an untreated infected vineyard, and infected vineyards where action is taken.

WATCH A SHORT TUTORIAL VIDEO
To see a video demonstration on how to use the tool, go to: https://vimeo.com/227788450.

ACCESS THE TOOL
For more information on the cost effectiveness of preventative practices and to run customizable scenarios for your vineyard, visit the Trunk Disease Online Management Tool: http://www.sustainablewinegrowing.org/economic-tools.php.

LEARN MORE
For more information on detection tools, disease resistance, recent research and other information related to trunk disease, visit the SCRI Trunk Disease Project Page: http://treeandvinetrunkdiseases.org/.

CALIFORNIA SUSTAINABLE WINEGROWING ALLIANCE

Project funded by a CDFA Specialty Crop Block Grant  June 2017