

Introduction of trunk disease diagnostic aid application and GrapeIPM.org

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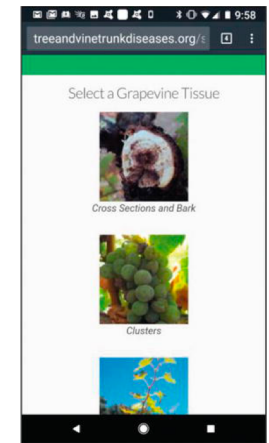
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For Seasonal vineyard and pest management conference, 19 March 2019
A pdf version is available on my blog (grapepathology.blogspot.com)

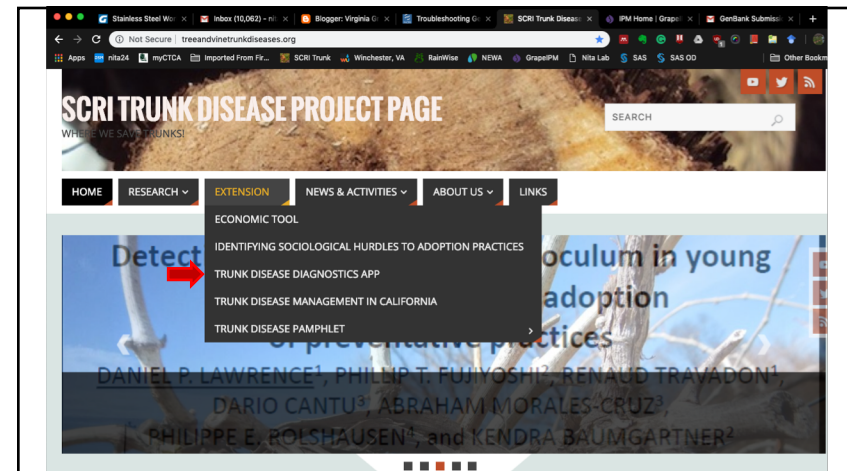
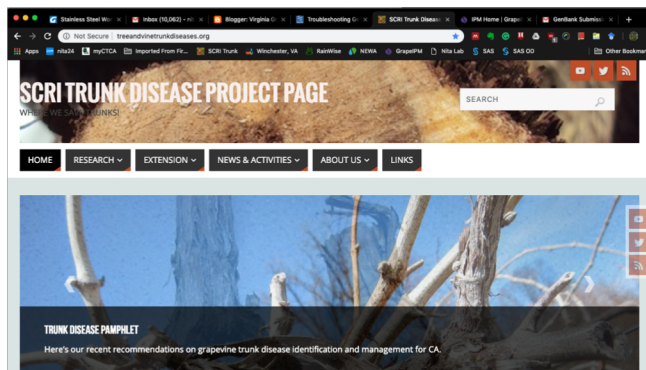


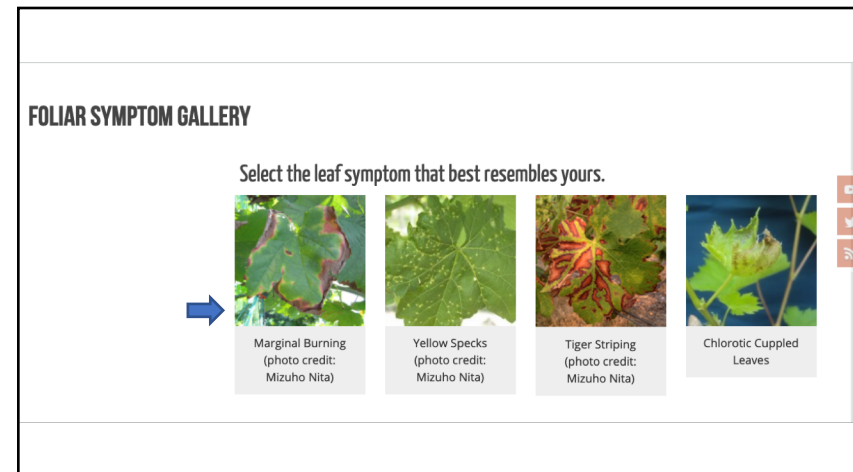
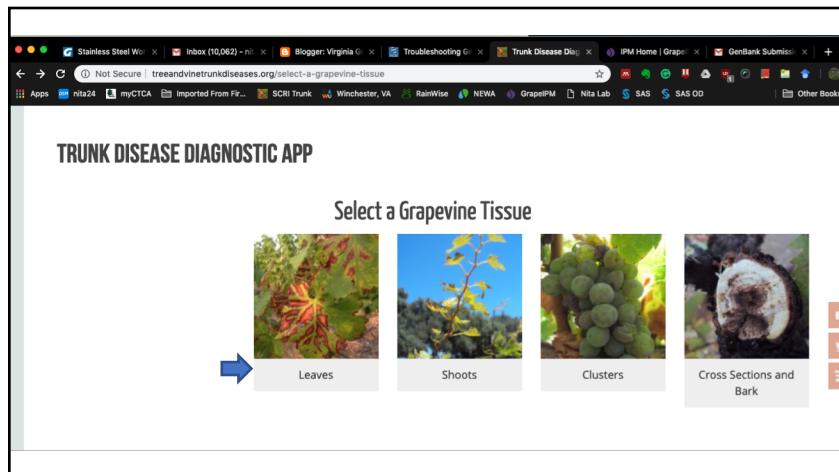
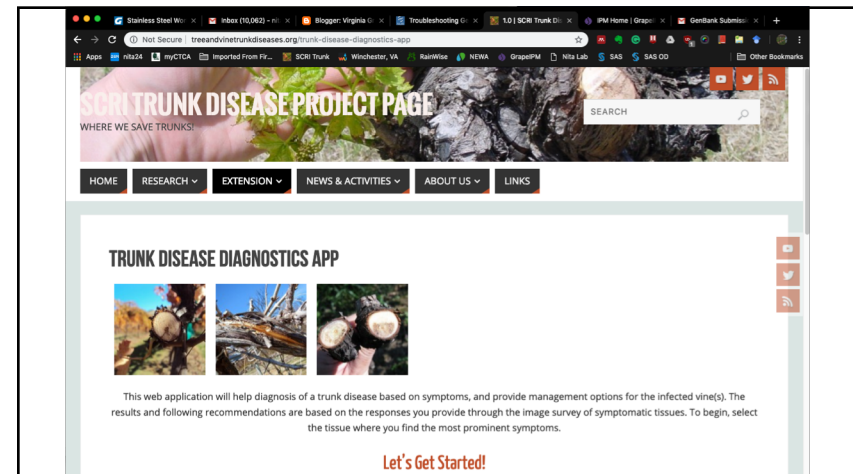
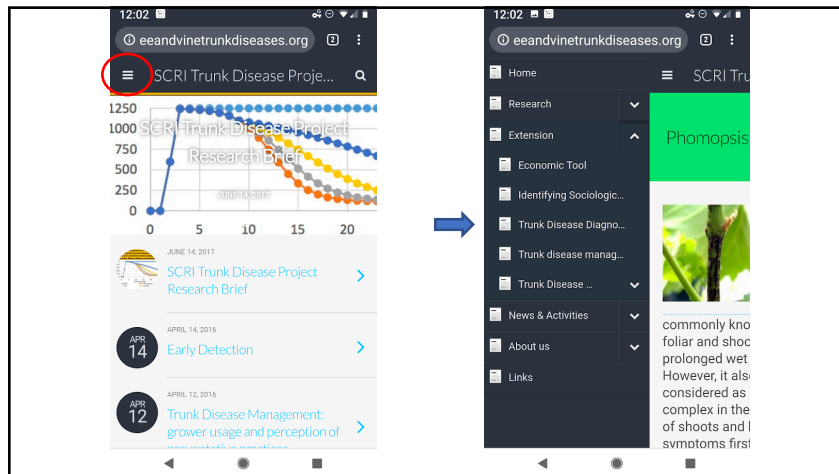
Trunk disease diagnostic aid application

- Online application to help you identify trunk diseases and other disorders that are associated with trunk/vascular tissue related issues.
- Mobile ready
- <https://www.intechopen.com/books/advances-in-plant-pathology/developing-an-online-grapevine-trunk-disease-diagnostic-aid>
- Introduced in 2016, and currently I am making more adjustments.



Treeandtrunkdiseases.org





DO YOU SEE ANY OF THESE SYMPTOMS?

Do you see shoots that have these symptoms or shriveled clusters?

Click images for details:



Yes NO

PIERCE'S DISEASE

Pierce's Disease, commonly referred to as PD, is caused by a bacterium (*Xylella fastidiosa*) that reproduces in the grapevine xylem and clogs the water conductivity system. This blockage induces heat- and water-stress type symptoms in times when water and nutrient conductivity in vines is greatest, such as late summer or around the time of veraison. The symptoms may only appear on a few shoots in the first few years of infection. Often time, uneven leaf scorching with a red or yellow margin starts from the outer edges of leaves. Another symptom of PD is called 'matchsticking' and occurs when leaves fall off, but petioles are retained on the shoot with the tip looking burnt at one end. Also infected shoots may have irregular formation of lignin which becomes apparent when shoot tissue remain green near nodes while surrounding tissues lignified and become brown. Clusters can shrivel and drop due to water stress caused by PD.



Marginal Burning

Vines become infected by a number of vector species, the glassy-winged sharpshooter and other sharpshooter and leafhopper species, that carry the bacteria and is transmitted by the insect feeding on the vine's green tissue. When spring time infections occurs the bacteria is allowed to move further through the vine, and it's more likely that the vine will not overcome the infection. The bacterium is sensitive to cold temperatures and therefore more predominate in mild wintered grape growing regions.

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Causal Agent: *Xylella fastidiosa* is a gram negative rod-shaped bacterium, specific to grapevines and is native to North America. Therefore, native and wild grapevines are more tolerant of infections, but these non-symptomatic vines can still be a source of inoculum in the vineyard or surrounding areas.

FOLIAR SYMPTOMS

Select the leaf that best resembles your symptom.



Marginal Burning



Marginal Burning



Tiger Striping:
Interveneal burning,
white cultivar



Tiger Striping

ABIOTIC FACTORS THAT CAUSE MARGINAL BURNING.



Water Stress

Water stress– One of first symptoms of water stress is the cessation of shoot elongation. Shoots on the water stressed vines tend to be short, and flowers may abort or results in smaller berries. Periderm may form earlier on shoots with the water stressed vines. Water stress occurs when the vine is unable to uptake enough water to support the canopy and crop load. Drought is the main cause of water stress; however, excess water, which can kill roots by soil oxygen deprivation, can also cause water stress-type symptoms. Check your local weather history as well as the site conditions such as soil drainage. Severe drought stress can cause leaves to yellow, brown and eventually dry and fall off.

Mechanical damage– Trunks may become damaged by mechanical means. Feeding activities by animals, girdling from wires or vegetation, or human activities such as a use of weed eater or improper removal of sucker shoots, can injure the vine. The injury itself can result in water stress-type symptoms (short internodes, yellow discoloration of leaves, etc.), but the injured trunk is often subject to be infected by plant pathogens or necrotic microorganisms, such as

grapevine crown gall.




Potassium deficiencies– Symptom is leaf reddening (red-fruited cultivars) or yellowing (white-fruited cultivars) that starts on the margins of the leaves and progresses inwards interveinally. Symptom development starts on basal leaves and moves upward, and often becomes visible near or around veraison when berries become the "sink" of the nutrients. Severe potassium deficiencies can result in curling and burning of leaf margins. Nutrient testing of vines and followed by applications of necessary nutrients is recommended.


Magnesium deficiency–Symptoms are usually expressed in older basal leaves. Leaves become yellow on along the margin, while the tissue around the main veins of the leaf remain dark green. Red cultivars express reddening rather

TRUNK DISEASE DIAGNOSTIC APP


Select a Grapevine Tissue




Leaves



Shoots



Clusters




Cross Sections and Bark


A blue arrow points to the 'Leaves' option.

FOLIAR SYMPTOM GALLERY


Select the leaf symptom that best resembles yours.




Marginal Burning
(photo credit: Mizuho Nita)



Yellow Specks
(photo credit: Mizuho Nita)



Tiger Striping
(photo credit: Mizuho Nita)



Chlorotic Cuppled Leaves

A blue arrow points to the 'Tiger Striping' option.

LEAF SYMPTOMS

Do these symptoms resemble your vine?









(Click to enlarge)

YES NO

DO YOU SEE ONE OR MORE OF THESE SYMPTOMS?

Click for image details

YES NO

ESCA

Esca, also known as grapevine measles, petri disease, or black goo, can slowly plague a vineyard into decline. Esca pathogens excrete toxins that trigger an array of symptoms. Measles-like symptoms (dark spots with purple halos) appear on fruit, especially on white-fruited cultivars, anytime from fruit set to harvest. Foliar toxin expression of esca appears as a tiger stripe pattern of interveinal necrosis with yellow or red margins. Cross section of the infected trunk, cordon, and cane reveals black spots in the vascular system that may secrete black goo. Severe cases exhibit shoot/tendrils dieback and "apoplexy" or complete defoliation and fruit abortion. Spores enter pruning wounds and colonize the vascular system anytime from November to April. New infections can have symptom expressions in the same year, and symptoms become more prevalent in years of wet springs and hot summers.



Tiger Striping

Causal agent: Several genera of pathogens can cause Esca in grapevines. *Phaeoacremonium*, *Phaeoacremonium* spp. and *Togninia* spp. are common species.

Management: The prevention at the time of winter pruning is the best approach for the management. Double pruning, protection of pruning wound using paint with boron (trade name: B-Lock), as well as chemical control, such as use of thiophanate-methyl (trade name: Topsin-M) and/or myclobutanil (trade name: Rally) to protect pruning wounds are known to reduce risk of infection to pruning wounds. Also, it is advised to prune vines on a day followed with several days of sunny condition. (I.e., avoid pruning before the rain) If you decided to use aforementioned fungicides, make sure to obtain the label for the specific uses. Although symptom appears in the vineyard after 5-10 years of planting, young vines are as susceptible as the old vines; therefore, it is advised to implement a management plan from early years of the vineyard.

For infected unproductive vines, remove infected trunk or cordon arm 12 inches below canker, and move the infected woods out from the vineyard for burying or burning. Vine health is extremely important for the recovery after the major pruning of cordon or trunk. Provide sufficient water and nutrients to encourage healthy vegetative growth.

Links:

[Grapevine Measles](#), [eXtension](#)

STUNTED SHOOTS

Symptom gallery of yellow, cupped leaves with stunted shoots, best visible in spring.
(Click images for details)



YES NO, other foliar symptoms

CANKERS

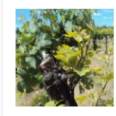
Do you see a darkened canker on the trunk or cordon?
Usually seen near stunted and yellowing shoots



YES NO

EUTYPA DIEBACK

Eutypa Dieback, also known as a part of "dead arm" complex, is a destructive woody tissue disease. Symptoms typically become visible on vineyards that are 6 or more years old, even though the infection might have occurred several years prior to symptom expression. The first symptom to appear is a canker, usually on the main trunk, a flat elongated discoloration found under the bark, surrounded by healthy tissue. Cross Section of canker reveals a "V" or wedge shaped piece of necrotic wood; however, these symptoms are very similar to that of Botryosphaeria canker. However, with Eutypa, delayed shoot emergence and stunted shoot symptoms are most visible in the spring, and may recover as the season progresses. Leaves on stunted shoots are chlorotic (yellow), cupped upwards, and are often misshaped. Non uniform berry size is another common symptom in severe Eutypa infections.



Causal Agent: *Eutypa lata*, *E. leptoplaca*, and other fungi in the Diatrypaceae family are the causal agents of Eutypa Dieback. Spore released by rain, spread by air and water to open pruning wounds.

Management: The prevention at the time of winter pruning is the best approach for the management. Double pruning, protection of pruning wound using paint with boron (trade name: B-Lock), as well as chemical control, such as use of thiophanate-methyl (trade name: Topsin-M) and/or myclobutanil (trade name: Rally) to protect pruning wounds are known to reduce risk of infection to pruning wounds. Also, it is advised to prune vines on a day followed with several days of sunny condition. (I.e., avoid pruning before the rain). If you decided to use aforementioned fungicides, make sure to obtain the label for the specific uses. Although symptom appears in the vineyard after 5-10 years of planting, young vines are as susceptible as the old vines; therefore, it is advised to implement a management plan from early years of the vineyard.

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ABIOTIC AND BIOTIC FACTORS CAUSING STUNTED SHOOTS AND LEAF YELLOWING.

Nutrient Deficiencies

Nitrogen deficiency – Deficiency symptoms appear as uniform lightening of green tissue, or yellowing of leaves when compared to vines that have received adequate nitrogen. Severe nitrogen deficiencies may result in small fruit size and poor fruit set. In the commercial setting, you may see the symptom development near veraison due to movement of nitrogen from leaves to berries. Nutrient test of plant tissue and soil followed by application of necessary nutrients is recommended.



Photo by: Agnet.org

Magnesium deficiency – Symptoms are usually expressed in older basal leaves. Leaves become yellow on along the margin, while the tissue around the main veins of the leaf remain dark green. Red cultivars express reddening rather than yellowing. Magnesium deficiencies are common in vineyards with high potassium to magnesium ratio and/or low pH in soils (<5.5 pH). Nutrient test of vines and soils followed by application of necessary nutrients and/or soil pH adjustment is recommended.

Boron deficiency – Symptoms can appear as dramatic stunting of the vine. Shoot growth can be compromised, leaves turn yellow, and fruit set can become very poor. The initial symptoms may show up as dark knotty bulges forms on tendrils near the shoot tips at bloom. It is observed on soils with high acidity (pH 3.5-4.5). Also, since boron is a soluble nutrient, it may be leached out from the soil, especially with sandy soils. Nutrient test of vines and soils followed by application of necessary nutrients and/or soil pH adjustment is recommended.

Iron deficiency – It is very common in vineyards with high pH soils. Symptom of iron deficiency is fading of green color (due to loss of chlorophyll) from the edge of leaves that progresses interveinally. This symptom is expressed throughout the season as yellowing of the leaves with veins remaining pale green. Iron can be applied by as a foliar application, and pH of the soil can also be adjusted. Nutrient test of vines and soils followed by application of necessary nutrients and/or soil pH adjustment is recommended.

Viruses

A new online pesticide decision support tool: GrapelPM.org

- Still in “beta” testing mode
- Pesticide inventory
- Pesticide planning aid
 - Export to your own calendar
- Record keeping
 - Spray
 - Vineyard activities
 - Growth stage
 - Diseases
 - Etc...
- Reporting for the EPA

| Week Beginning | % Canopy | Events & Materials | Add | FRAC | PM | DM | BR | Pho | Bot |
|----------------|----------|--|-----------|---------------|-----------|------|-----------|------|------|
| 04-29 to 05-06 | 100 % | (58) Capitan x, | Add Event | M4 | None | Good | Good/Fair | Good | Poor |
| 05-06 to 05-13 | 100 % | (513) Caneva x, | Add Event | M01 | Good/Fair | Good | Poor | Poor | Poor |
| 05-13 to 05-20 | 100 % | (520) Caneva x, | Add Event | M01 | Good/Fair | Good | Poor | Poor | Poor |
| 05-20 to 05-27 | 100 % | (527) Dithane F-45 x, Quinex x, Sulfur (Sulfonol Dispersed) x, | Add Event | 13, M2, M3 | Excellent | Good | Good | Good | None |
| 05-27 to 06-03 | 100 % | (61) Dithane F-45 x, Luna Experience x, Sulfur (Sulfonol Dispersed) x, | Add Event | 11, 7, M2, M3 | Good | Good | Excellent | Good | Good |
| 06-03 to 06-10 | 100 % | (610) Dithane F-45 x, Rally (Riviera) x, Renova x, Vibrato x, | Add Event | 3, 40, M3, LR | Excellent | Good | Excellent | Good | None |
| 06-10 to 06-17 | 100 % | (617) Dithane F-45 x, Phostrol x, Quinex x, | Add Event | 13, 33, M3 | Excellent | Good | Good | Good | None |

- Currently, it is free for beta testers
- Eventually (probably after 2021), the access fee will be charged through the Virginia Vineyard Association

GrapelPM.org current functions

- We introduced it to select growers in 2018, and we are extending the invitation to more growers this year.
- You can assign multiple vineyards or blocks (whichever you wish to call).
- You can enter the area to be applied and the size of your sprayer, and the system will give you an estimate of how much you need to mix in your sprayer too.

GrapelPM.org current functions

- The system has a pre-made list of commonly used fungicides (we are working on insecticide now), thus, what you need to do is pick the one you have in your inventory, and enter in the system's calendar.
 - If you happen to use not-so-common pesticides, we are working on an interface that allows you to enter your own.
- Once you create your plan, you can export it to a calendar (Google or iCal) to share with your co-workers.
- When you complete the spray, you check off, and at the end of the season, you can generate a table that meets the EPA's expectation for your record keeping.

GrapeIPM.org current functions

- There is a function to enter your current inventory. If you use this function, you can check what needs to be purchased when you finish your planning for the year.
- It also helps tracking your other activities and record (e.g., pruning, weeding, growth stage, disease outbreak, etc).
- Also, if you happen to have a vineyard close to one of our weather stations, you can connect to it to obtain recent weather information as well.