Xylella Is Not the Cause of Olive Tree Leaf Scorch, Dieback, and Death in California

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The olive tree, *Olea europaea*, has a long history in California. The Franciscans introduced olives during the development of the California missions in the 18th century. The olive became an integral part of California agriculture in the 19th and 20th centuries and still is today although acreage devoted to fruit production is declining. The olive is also a favored landscape tree in California, prized for its historical value, rugged, rustic good looks, superb adaptation to the California environment and growing conditions, and pest and disease resistance.

However, in the last 25 years or so, leaf scorch and twig and branch dieback have affected landscape olive trees in California, sometimes severely so, even leading to death. For many years it was thought that the bacterium *Xylella fastidiosa*, which is vectored by the glassy-winged sharpshooter, was the cause of this malady (**Fig. 1**). However, research and peer-reviewed publications have shown that, while *Xylella fastidiosa* is often recovered from affected olive trees, it is weakly pathogenic and is not the cause of these leaf and branch diseases and death. In fact, a complex of several fungi are the primary culprits causing olive tree leaf scorch, twig and branch dieback, and death in California (Krugner et al. 2014, Urbez-Torres et al. 2013, 2020).

Xylella fastidiosa has several, host-specific forms, which cause diseases on specific plants. These include *X. fastidiosa* subsp. *fastidiosa*, which cause Pierces's Disease of grapes; *X. fastidiosa* subsp. *sandyi* , which causes Oleander Leaf Scorch; *X. fastidiosa* subsp. *pauca*, which causes the dreaded and deadly Quick Decline of Olives that is devastating the olive industry in Italy but it not present in California; and *X. fastidiosa* subsp. *multiplex*, which causes diseases in peach, plum, and some other trees and is detected on but is not causing disease on olive trees. Indeed, in these cases olive trees might be an alternate host of *X. fastidiosa* subsp. *multiplex* that contributes to disease development in other plants (Krugner et al. 2014, Urbez-Torres et al. 2013, 2020). Thus, it is mostly an unwise use of time and resources to spray pesticides to control sharpshooters on landscape olive trees when what they are vectoring is not causing a significant disease. A spray program for sharpshooters on olives might only be warranted in the rare case that the olives might be serving as an alternate host to nearby *Xylella*-disease-susceptible landscape ornamentals like *Prunus* spp.

The complex of fungi that does cause leaf scorch, twig and branch dieback, and, in some instances death of olive trees in California includes, among several others, well known fungal species like

1. An olive tree in Lakewood, California showing classic symptoms of leaf scorch and branch dieback. Note the constricted root space and dense companion plants. This tree was irrigated several times a week, throughout the year. It is now dead.

Diplodia, *Dothiorella*, *Phomopsis*, *Neofusicoccum*, and *Botryosphaeria.* However, even these fungi are not strongly virulent and pathogenic and typically need stressed trees for full disease development (Krugner et al. 2014, Urbez-Torres et al. 2013, 2020). Thus, the best management practices to prevent and reduce olive tree leaf scorch, twig and branch dieback, and death are to provide optimal cultivation and grow stress-free trees (Santos, pers. comm.). In some cases, fungicides might be required on a temporary basis to suppress the fungal pathogens until the tree has recovered from the stress-producing, improper cultivation; but, they are not a substitute for providing optimal cultivation.

A similar and parallel situation might be occurring with *Liquidambar styraciflua* (American sweetgum), a popular landscape tree throughout California. Over the last 25 years or so it, too, has shown sometimes severe dieback, decline, and death, which has also been attributed to *Xylella*. However, again, it might not be *Xylella* but rather the fungal disease complex, acting in concert with poor cultivation and stressed trees, that is responsible for the decline and death. More work is needed on *L. styraciflua* to confirm the cause of its decline.

Despite this research-based evidence, perhaps because it was not well promoted or publicized or people just ignored it, many landscape managers, designers, and architects thought that *Xylella* was spelling the end of the olive industry in California, which would result in a shortage or lack of highly desirable landscape olive trees. However, while olive acreage might be declining in California, it is not because of *Xylella*, which has shown not to be a significant pathogen of olive, or even the fungal complex that can attack stressed olive trees; rather, the decline in olive acreage is because olive growers are switching to more profitable crops, like pistachios (Fichtner and Flynn, pers. comm.).

Thus, optimal site selection and preparation and cultivation to grow, healthy, stress-free landscape olive trees is the key. Here are some points to consider:

1. Olive trees originate in the Mediterranean region and are well adapted to a climate like that of Southern California, one with cool, typically moist winters and warm, dry, mostly rainless summers. Once established, olive trees are superbly adapted to little if any summer irrigation in coastal Southern California, and irrigation practices should reflect this adaptation.
2. If winter precipitation is average, little irrigation would be required for established trees. However, it appears that as the climate become warmer and drier, supplemental winter irrigation might be appropriate if winter precipitation is inadequate. Also, occasional, deep, summer irrigations, perhaps once every four to six weeks on established trees in coastal Southern California, would probably be beneficial.

3. The best irrigation strategy is to push water deeply at each irrigation event, applying sufficient water to moisten the root zone to 30 cm deep yet still avoid wasteful runoff. Drip irrigation would be best. Avoid wetting the trunk.
4. Companion plants used with olive trees should also be "Mediterranean-type" plants, ones that when fully established can survive with little or no summer irrigation in coastal Southern California.
5. Companion plants should be kept at least two meters away from the trunk to reduce competition for water and nutrients and to eliminate root disturbance from typical landscape horticultural practices.
6. Maintain a five-cm layer of good quality mulch from the trunk out to at least two meters.
7. In designing new planting sites for olive trees, ensure adequate root zone space, perhaps at least three- to four-meter wide parkways and cutouts. Under proper management, olive trees are long-lived and can form large, spreading surface roots or root plates that, if given inadequate space, encroach on hardscape and then are root pruned, a severe practice that invariably leads to stressed trees.
8. If cultivation is optimal and trees are healthy, stress-free, and well established, they should typically need little irrigation, fertilizer, and pruning, and they should also be disease-free.
9. When old, large, desirable olive trees of great character are dug from orchards in the San Joaquin Valley and transplanted into the Southern California landscape, the trees, which have lost a tremendous amount of roots and leaf canopy, the latter purportedly to "balance out the root loss," are severely stressed. While they will survive with proper cultivation, full establishment typically takes several years and during this prolonged establishment period the trees are unusually susceptible to root and foliar diseases. Thus, under these condition, optimal cultivation is of paramount importance. Many trees never fully recover from this severely stressing event and are attacked by the fungal complex.
10. Consider substituting for declining olive trees in the landscape with other species that would likely be more tolerant of regularly irrigated landscape situations. For example, *Metrosideros excelsa* (New Zealand Christmas tree) has similar leaf color and texture as olive trees but is more tolerant of a regularly irrigated landscape.

In summary, contrary to popular thought, a complex of fungi, not the bacterium *Xylella*, causes leaf scorch, twig and branch dieback, and even death of landscape olive trees in California. However, these fungi are relatively weak pathogens and typically attack and cause damage only on stressed trees. Thus, providing optimal cultivation to produce healthy, stress-free trees is critical to avoiding these fungal diseases or mitigating their effect on landscape olive trees.

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