



Prune brownline progresses rapidly in young prune trees on peach or Myrobalan plum rootstock. Trees decline and die in one to several years after first symptoms appear.



Dark line in wood and in bark piece removed at union of scion and rootstock is distinctive symptom of prune brownline. In early stages, the line is not continuous around the tree.

The cause and control of prune brownline disease

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Pruno brownline, a recently-recognized disease of prune trees, is widespread in northern California, causing considerable losses in Solano, Yolo, and El Dorado counties. The disease has also been found in Sutter, Tehama, Yuba, and Placer County orchards, but the extent of its occurrence in other California prune-growing areas has not been determined.

The disease is known to affect the French prune, Empress plum, and President plum cultivars of prune trees (*Prunus domestica*) propagated on Myrobalan plum (*P. cerasifera*) and peach (*P. persica*) rootstocks.

What to look for

The first signs of prune brownline disease are poor growth of terminal branches, along with early development of fall colors and defoliation. Later symptoms include a lack of new growth, defoliation and dieback of terminal shoots, yellowing of leaves with upward curling and burning at the margins, and heavy fruit sets. Eventually, trees decline and die.

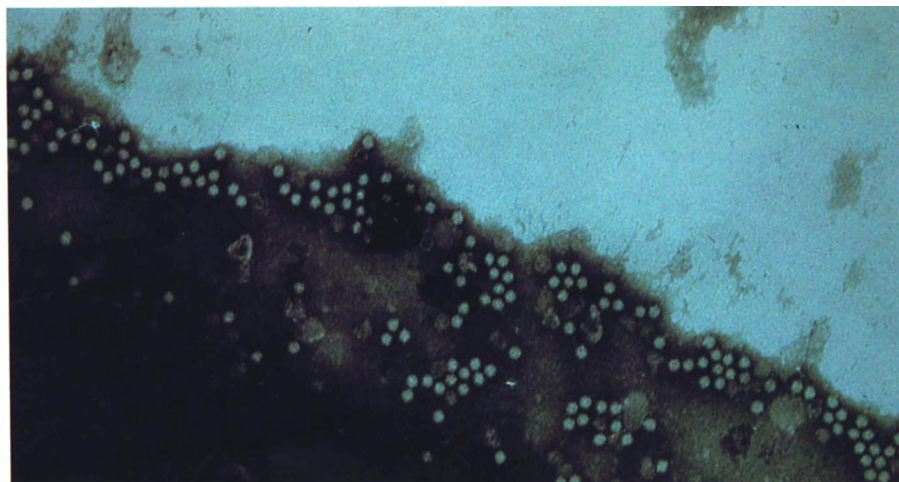
The time between the first appearance of symptoms and collapse of affected trees varies from one to several years. The disease progresses more rapidly in young trees and those on peach rootstock than in older trees or those on

Myrobalan rootstock. Prune brownline may affect trees in groups of a few to more than a hundred within an orchard.

Although the symptoms are similar to those caused by various soil-borne pathogens, nutrient deficiencies, and incompatibility between scion and rootstock, prune brownline can be easily diagnosed by examination of the scion and rootstock at the graft union. Diseased trees usually show a scion overgrowth at the union; if a small section of bark is removed, a layer of dark tissue, or brownline, is clearly visible in the wood and in the removed bark piece exactly at the union of the scion and rootstock. In the early disease stages, the brownline is not continuous around the tree, so it is necessary to check the union at several points. The brownline gradually spreads around the circumference of the graft union until the tree is girdled and collapses.

Natural spread

We have found that the soil-borne, tomato ringspot virus is consistently associated with Myrobalan and peach rootstocks of prune trees affected by brownline. In greenhouse studies, we mechanically transmitted a virus repeatedly from Myrobalan and peach rootstocks of affected orchard trees to cucumber, cowpea, bean, and tobacco



Soil-borne tomato ringspot virus was consistently associated with prune trees affected by brownline. The virus, shown here in an electron micrograph, is widespread in California and causes several diseases of stone fruit trees. It is graft-transmissible and spread by dagger nematodes.

plants. Host range symptoms and serology tests showed that the virus was tomato ringspot. Since tests showed this virus was not present in French prune, Empress, or President plum scions, the disease apparently is not spread through scion budwood or pollen to healthy trees.

We were able to transmit tomato ringspot virus and reproduce prune brownline by grafting root chips or root bark patches from Myrobalan or peach rootstocks of naturally diseased trees to Myrobalan or peach rootstocks of healthy prune trees. Typical disease symptoms developed after two years, with a 60 to 100 percent rate of graft transmission. Prune brownline did not develop when root chips or root bark patches were grafted to prune scions of healthy trees or when scion buds or bark patches from diseased prune trees were grafted to scions or rootstocks of healthy trees.

Strains of tomato ringspot virus are known to be widely distributed and to cause several diseases of stone fruit trees in California, such as yellow bud mosaic in peach and almond, and stem pitting in peach and apricot. To determine if the different strains of this virus associated with such diseases can cause prune brownline, we graft-inoculated Myrobalan and peach rootstocks of healthy prune trees with the following five strains: prune brownline, peach yellow bud mosaic, cherry leaf mottle, and stem pitting from California and from the eastern United States. All five tomato ringspot virus strains induced prune brownline in the graft-inoculated trees.

Prune brownline usually spreads naturally within orchards from diseased to adjacent healthy trees. Tomato ringspot virus is known to be transmitted by dagger nematodes (*Xiphinema* spp.) feeding on roots of diseased plants and subsequently on roots of healthy plants. Dagger nematodes commonly occur in prune orchard soils, and we have shown



French prune trees on Myrobalan plum rootstock in foreground have acquired prune brownline disease, but adjacent trees, propagated on Marianna 2624 rootstock, remain healthy and virus-free.

in previous studies that they can transmit several strains of tomato ringspot virus to both Myrobalan plum and peach trees.

In the field, we have observed brownline-affected prune trees on Myrobalan seedling, clonally propagated Myro 29C plum, and peach (Lovell and Nema-guard) seedling rootstocks, but we have never seen the disease on any prune tree on Marianna 2624 plum rootstock. We tested prune trees on Myrobalan, peach, and Marianna 2624 rootstocks for their relative resistance to tomato ringspot virus infection and prune brownline disease. When we grafted root bark patches from prune brownline-affected trees to rootstocks of healthy trees, tomato ringspot virus was transmitted to and caused prune brownline in trees on Myrobalan and peach rootstocks, but trees on Marianna 2624 rootstock remained healthy and virus-free. Apparently, Marianna 2624 plum is resistant to infection by tomato ringspot virus, and prune trees on this rootstock are unaffected by prune brownline disease.

In yearly observations (during five to eight years) of five prune orchards with brownline-affected trees, we found that the disease spread much more rapidly in some orchards than in others. Since tomato ringspot virus is soil-borne, orchard floor and water management practices that caused soil or water with dagger nematodes to be moved regularly from diseased into healthy areas may have contributed to more rapid spread of the disease.

Our research has shown that prune brownline is caused by tomato ringspot virus, which is graft-transmissible and spread by nematodes, and which is present only in the Myrobalan or peach

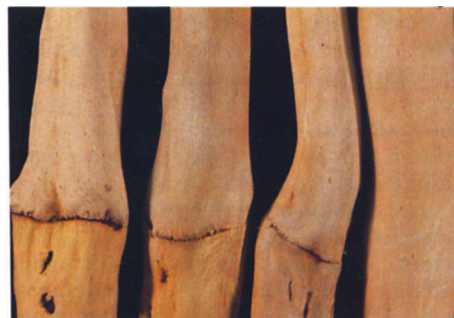
rootstocks of diseased prune trees. The brownline at the graft union apparently results from a hypersensitive type of resistance reaction by the prune scion to contact with virus in the rootstock; this reaction eventually causes girdling and death of affected trees.

Control

It is possible to control prune brownline disease by removing affected trees along with adjacent symptomless trees, which may already have virus infections started in their roots. In transporting diseased trees out of the orchard and in all other cultural operations, care should be taken not to move soil from diseased into healthy areas. Prune trees on Marianna 2624 instead of peach or Myrobalan rootstocks should be used to replant brownline-affected areas within orchards or to plant new orchards on sites with a history of tomato ringspot virus diseases.

In addition, fumigation of diseased areas to reduce the virus-transmitting dagger nematode population will decrease the chances of prune brownline continuing to spread within an orchard. These areas should also be kept weed-free for two growing seasons, since some of the weeds commonly found in fruit orchards are known to be reservoirs of tomato ringspot virus.

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Graft union of prune and Lovell peach, Nema-guard peach, and Myrobalan plum developed brownline when inoculated with patches from diseased tree, but Marianna 2624 rootstock (right) was unaffected.