



Sudden Death of Tanoak, *Lithocarpus densiflorus*

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Fig. 1. Tanoak forest showing different stages of dieback. Wilted, faded and brown foliage clinging to entire crown since mid-spring draws the attention of concerned residents. More than 100 trees have been killed by this mysterious disease in the area shown.

Tanoak, tanbark-oak or chestnut-oak, *Lithocarpus densiflorus* is a large tree (some varieties are shrubby) that grows naturally in Marin County and many other areas of the state. It is rarely planted as an ornamental but if the tree begins to grow from seed in the garden, our residents favor it because this tree grows rapidly and in the past has not suffered significant dieback from biotic or abiotic agents. In the summer of 1995, the first serious episodes of spontaneous tanoak death were reported in Mill Valley. Homeowners residing in the urban forest interface observed death of tanoaks in the forest close to their properties. I visited these sites and found several large trees with brown foliage scattered among apparently healthy trees. I checked the root system of one brown tree and found well-developed oak root fungus, which led me to the conclusion that *Armillaria mellea* was the cause. In early spring of 1996 the tanoak death rate reached epidemic proportions (Fig.1).

Symptoms of this unusual tanoak dieback

From a distance, the first prominent symptoms are drooped (wilted) new shoots (Fig.2A). Shoot wilting

is spontaneous and occurs throughout the crown. Older leaves become pale green. Approximately two-three weeks later the foliage turns brown but remains clinging to branches, visibly announcing the death of tanoak.

Chisel cuts into the inner bark and sapwood at breast height of affected trees, reveal saturated tissue that drip burgundy-red sap. Samples of the symptomatic branches, whether at the time of drooping or later when all foliage becomes brown, have not shown staining in vascular tissues. Close inspection of a lower trunk may show an exudation of dark-brown sap that stains a few squares inches of the bark surface (Fig. 2B). Samples of the bark, inner bark and phloem-xylem tissues beneath stains were cultured in different laboratories several times without revealing pathogens. However, the western oak bark beetle was found beneath the bark.

In the summer, the bark splits and breaks as a result of drying. Gum often exudes from these splits, and is then occupied with prominent clusters of *Hypoxylon* spp. fruit bodies (Fig. 2C). Long striations of a different tan to pinkish discoloration become visible on the bark surface. Examination of the root-crown

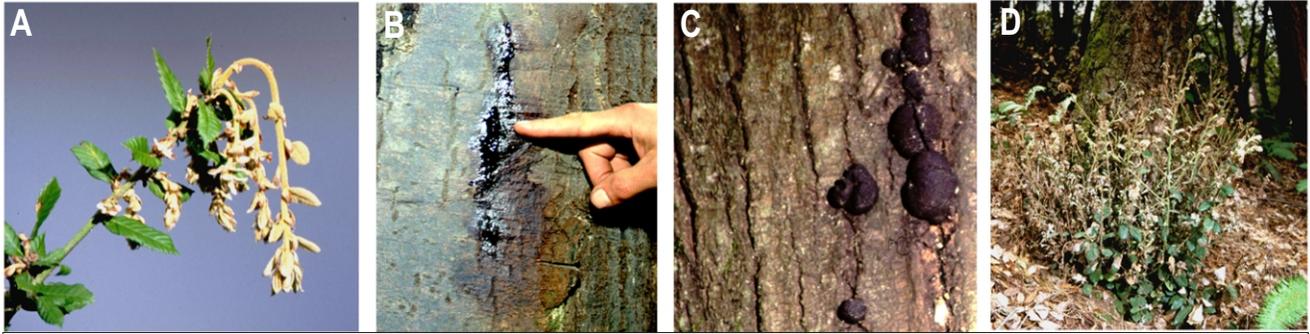


Fig. 2. Wilted shoots (A) signal the sudden death. None of the tree recovered after the wilt appeared. (B) Oozing near the base of tree stem. (C) *Hypoxylon*'s fruiting bodies. (D) Suckers display dieback resembling treatment with phenoxy herbicides.

area has not revealed development of oak root fungus nor *Phytophthora* disease on most dying trees. Roots of tanoaks undergoing above ground symptoms often have a pungent alcoholic odor, but appear sound. The following year after tree dies, suckers sprout near the base. Soon their tips bend, become chlorotic and die (Fig. 2D).

A very noticeable feature of the dead tanoaks is massive infestation of the whole stem with ambrosia beetles in mid summer.

Sampling, and information from experts

Five times samples of dying tanoaks were sent to State Laboratories and University of California Plant Pathology Departments at Berkeley, Davis and Riverside. At the beginning I suspected that tanoaks were infected with chestnut blight fungus, *Cryphonectria parasitica*, mainly because the initial symptoms closely resembled those caused by chestnut blight, which occasionally infects, without killing, some oak species in the east. Besides selecting branch-twig samples with different stages of wilted, dying and dead tissues, I also focused on abnormalities (swellings at the tree base) to collect samples of inner bark. No pathogens were ever isolated from the branches or stem sections, and no *Armillaria* or *Phytophthora* was cultured from the roots. In three separate samples each *Hypoxylon sp.*, *Pseudomonas tolaensis* and *Diplodia quercina* were found.

Speculations about causes of the dieback

Sudden death of tanoaks is localized in the Mill

Valley-Mount Tamalpais region and Inverness.

Differences of opinion exist among plant pathologists and tree experts as to whether the cause of dieback is a single pathogen or if this species has been locally predisposed to physiological weakening by drought or other environmental factors that have caused damage. Opinions may have merit but with one recent exception: very young trees have been killed as though they were treated with a systemic herbicide. It seems probable that drought was an important factor in placing the mature trees under stress that triggered their death. However, the same hypothesis does not hold for young trees that are dying now.

There is no question, that after these trees have gone through the progressive stages of the above-described symptoms, their vigor rapidly declines and they become vulnerable to secondary insect pests such as bark beetles *Pseudopityophthorus pubipennis*, which produce a pile of fine red boring dust near tiny holes, and ambrosia beetles *Monarthrum spp.*, which produce a pile of fine white boring dust near tiny holes. While *Pseudopityophthorus* occupies the phloem-xylem portion of the tree, ambrosia beetles penetrate deeper to the heartwood region. These insects are not capable of invading healthy trees but are very destructive to weakened ones. Since several hundred tanoaks have died since 1995 these trees have become an especially favorable target for building up bark beetle and ambrosia beetle epidemics.

Recommendation: Prompt removal of dead trees is the only control that can be advised at this time. Cut logs and stored firewood should be covered with clear plastic sheeting to prevent beetle emergence and infestation...

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