Cherry Buckskin Disease (X-Disease)

Hosts: Cherry, Peach/Nectarine, Plum (Japanese), Almond

Cherry buckskin or X-disease is one of the most serious diseases of sweet cherries in California. At the present time it occurs in the northern San Joaquin Valley and in Sierra foothill orchards, but has not been detected in the southern San Joaquin Valley or in coastal orchards. Buckskin disease is caused by a phytoplasma that may also affect peaches grown near cherries. Japanese plum and almonds have occasionally been observed to be infected and are also suspected reservoirs for the disease. Apricots and prunes are not hosts for the pathogen. Buckskin disease is spread by certain leafhopper species and is managed by planting disease-free stock, removing diseased trees, and controlling leafhopper vectors.

Symptoms and Damage

Symptoms of buckskin disease vary depending on the stone fruit scion wood that is infected, the rootstock, and the strain of pathogen involved. Two different strains of phytoplasma cause Buckskin disease on sweet cherry in California: the Green Valley or "common" strain and the Napa Valley strain. The Green Valley strain occurs most frequently, causing cherry buckskin disease and peach X-disease in northern San Joaquin Valley orchards. The Napa Valley strain appears to be limited to Napa and Sonoma Counties.

Cherry. Symptoms on cherry depend primarily on the rootstock. Cherries on Mahaleb rootstock develop different symptoms than cherries on Colt, Mazzard, or Stockton Morello.

When scion wood on Mahaleb rootstock is infected, a rapid decline occurs that is similar to what may be caused by Phytophthora root and crown rot, Armillaria root rot, or rodent damage. The decline is caused by rapid killing of the rootstock cells just below the graft union. Foliage that is of normal size turns pale with a reddish tint and curls upward. Trees die by late summer or early the following year. In trees high worked on Mahaleb scaffolds, only the infected branches develop symptoms. Fruit usually look normal. To distinguish buckskin disease from root rot diseases and rodent injury, examine the wood under the bark at the graft union. On Mahaleb rootstock, buckskin disease causes pits and grooves in the wood at the graft union; often in advanced stages of decline, it causes a browning of the phloem in the bark.

On Colt, Mazzard, or Stockton Morello rootstock, affected leaves are smaller than normal, may be pale green and more upright, and foliage may be sparse. Terminals may appear denser because of growth from normally dormant buds. Some dieback of shoot tips occurs as the disease progresses. Foliar symptoms may be subtle in the year or two after initial infection and are difficult to distinguish from other causes of "unthrifty" growth. Fruit on branches affected by the most common Green Valley strain are smaller, lighter in color, pointed, and are born on short, thick pedicels. They have low sugar, poor flavor and may have a leathery ("buckskin") surface. Only a single branch may show fruit symptoms in the early stages of the disease. In contrast, fruit on trees affected with the Napa Valley strain is also small and pale but appears rounder and has pedicels that are longer than normal.

Peach. The general incidence of X-disease on peaches is low in California; however, severe outbreaks occur occasionally in orchards that are near cherries affected by the disease. One or two years following initial infection, leaves develop yellow spots that turn brown and fall out, leaving a shothole appearance by mid-May or June. In the summer, leaves turn yellow, develop a severely tattered appearance, and curl inward from the edge. Fruit on affected branches are smaller than normal and have poor flavor. Affected leaves drop prematurely throughout the summer and trees continue to decline in vigor.

Seasonal Development

Phytoplasmas are microbes that multiply within the nutrient-conducting tissues (phloem) of plant hosts. The buckskin disease phytoplasma can be spread by budding and grafting, but orchard trees are most often infected by insect vectors. The most significant spread of buckskin from one stone fruit tree to another goes from cherry to cherry and from cherry to peach. Spread from infected peach to other peach trees or to other stone fruit is not known to occur. In the Sierra foothills, the disease may spread to cherry or peach from nearby infected chokecherry and bitter cherry.

The two most important vectors of buckskin in cherry in California are the mountain leafhopper, *Colladonus montanus*, and the cherry leafhopper (Flor's leafhopper), *Fieberiella florii*. In Sierra foothill orchards the leafhopper, *Scaphytopius acutus* also appears to be an important vector. The mountain leafhopper overwinters on winter annual weeds, particularly near streambanks or canals. Adults, which may be plentiful in sugarbeet fields during late winter or spring, migrate to favored weed hosts (curly dock, burclovers) in orchards when sugar beets are harvested in spring. Mountain leafhopper usually is the most abundant vector species found on cherry, but cherry is not a preferred host and the leafhopper does not reproduce on cherry. The mountain

leafhopper is thought to be more important in introducing buckskin disease into cherry orchards than in spreading the disease between cherry trees within an orchard. In contrast, the cherry leafhopper feeds and reproduces on a wide range of woody plants. This leafhopper is considered to be more important in spreading buckskin from tree to tree within the orchard because cherry is a favored host. *Scaphytopius acutus* is suspected of playing a similar role in foothill orchards. Maximum spread from cherry occurs from July through October, when high concentrations of pathogen are present in the leaves of infected trees. Hosts for the buckskin phytoplasma and leafhopper vectors are listed in the table at the end of this article.

Leafhopper vectors acquire the buckskin pathogen while feeding on infected plants. The most important reservoirs for the phytoplasma are cherry trees and certain weeds – California burclover, *Medicago polymorpha*, clovers, *Trifolium* spp., and dandelion, *Taraxacum officinale*, but many other weed species have been demonstrated experimentally to be able to harbor the phytoplasma . In the Sierra foothills**,** two native shrubs, chokecherry, *Prunus virginiana*, and bitter cherry, *Prunus emarginata*, are also important disease reservoirs. However, these wild cherry hosts do not occur in Central Valley or coastal production areas. After leafhoppers feed on an infected host, a certain amount of time must pass before the vector can transmit the phytoplasma to another host. During this time, called the latent period, the pathogen multiplies and spreads within the vector. The average latent period for the cherry buckskin phytoplasma in leafhoppers is about one month or longer, depending on temperature and vector. After completing the latent period, the leafhopper can transmit the pathogen for the rest of its life.

Once a tree is infected, the pathogen multiplies and spreads within the tree's phloem. In most cases the pathogen will spread downward into the trunk and rootstock and upward into the rest of the tree. The exception is Mahaleb cherry rootstock which is resistant to infection. It reacts to the presence of the phytoplasma in such a way that a layer of rootstock cells is killed at the graft union of the infected scion and rootstock, girdling the infected scion, but preventing the invasion of the rootstock. If scion wood has been topworked onto each of several Mahaleb scaffold branches, the pathogen can not spread internally from one infected scion branch to other scion branches of the same tree.

Symptoms of buckskin disease can appear as quickly as 2-3 months after infection, but it usually takes 6 to 9 months. Because the pathogen spreads mostly in late summer or fall, symptoms usually are first seen in the next growing season after infection. If a tree is infected by the buckskin pathogen in early spring, however, symptoms may develop that same season.

Management Guidelines

The effective management of buckskin involves a program of removing diseased trees, treating the orchard for leafhopper vectors, managing nearby ornamental leafhopper hosts, and controlling weed hosts that harbor leafhoppers and the buckskin disease phytoplasma.

Infected cherry trees are the most important source of inoculum for the spread of the disease in California. On high grafted Mahaleb rootstocks, remove the diseased scaffold branches by sawing off below the graft union. Trees on low grafted Mahaleb rootstocks or other susceptible cherry rootstocks should be completely removed. Before removing diseased trees, treat the orchard with an insecticide to kill potential leafhopper vectors to prevent their spread to other orchards. If stumps of Colt, Mazzard, or Stockton Morello are not removed right away, be sure to kill any suckers immediately, since they may serve as reservoirs of the buckskin inoculum. In foothill locations, remove any chokecherry or bitter cherry shrubs that are near cherry orchards. The removal of diseased peach trees is not critical, since the pathogen does not spread from them; however, infected trees will continue to decline and become nonproductive.

Begin a leafhopper vector management program if you find buckskin disease in your cherry orchard or a nearby cherry orchard. Apply a delayed dormant application of oil and an effective insecticide to control overwintering cherry leafhoppers. Then immediately after harvest, apply an insecticide for both cherry and mountain leafhoppers and repeat treatment every 4 or 6 weeks, depending on the residual activity of the material you use. Maintain an effective insecticide residue in the orchard from July through October. Monitor the orchard for buckskin disease symptoms shortly before or after harvest, mark any diseased trees, and remove them as soon as possible after the first treatment, while effective insecticide residue remains on the foliage. The materials available for leafhopper control may cause secondary outbreaks of mites, so monitor carefully for mites in orchards that you are treating for leafhoppers.

Treat ornamental shrubs in the vicinity of cherry orchards to control cherry leafhoppers, using a material that is registered for leafhopper control on residential ornamentals. Make the first ornamental treatment in March or early April to control overwintering nymphs before they mature and migrate to cherry orchards. Make the second treatment in the later half of June to control nymphs that have hatched from overwintering eggs.

A leafhopper vector monitoring program using yellow sticky traps may provide information on the types of leafhoppers present and sources of infestation, but such a program has not proven useful for making treatment decisions. You can use commercially produced yellow sticky traps or make traps out of yellow boards or rigid plastic sheets about 5 x 6 inches, treated on both sides with a sticky material such as Stickem Special or Tanglefoot. Place 6 to 10 traps throughout each orchard, hanging them as high in the trees as you can easily reach, and check them once a week.

Grafting scions onto individual Mahaleb scaffold branches is one way to manage buckskin disease in cherry. If an individual scion limb becomes infected, the pathogen will not spread to other parts of the tree through the Mahaleb rootstock. As soon as you observe buckskin disease symptoms, treat the orchard for leafhoppers, remove the diseased branch by cutting it off below the graft union, and then topwork with clean scion wood.

Control weed hosts of the pathogen in and around cherry orchards; for the most part, these are bur clover, dandelion, and sweet clovers. Also control curly dock, which is a breeding host for mountain leafhoppers but not a reservoir of the pathogen.

Excerpted and updated from "Integrated Pest Management for Stone Fruits", UC IPM Manual 3389, (Published 1999) by Janet Caprile, Farm Advisor(February 2008).

Hosts for the buckskin disease phytoplasma and the leafhopper vectors

Common Name	Scientific name	Buckskin Disease Phytoplasma	Cherry Leafhopper	Mountain Leafhopper
HERBACEOUS HOSTS				
alfalfa	*Medicago sativa*	**O**	**O**	**X**
California burclover	*Medicago polymorpha*	**X**	**O**	**X**
clovers	*Trifolium spp.*	**X**	**O**	**X**
curly dock	*Rumex crispus*	**O**	**O**	**X**
dandelion	*Taraxacum officinale*	**X**	**O**	**O**
sweet clovers	*Melilotus spp.*	**X**	**O**	**X**
Cahaba white vetch	*Vicia sativa x V. cordata*	**O**	**O**	**O**
other vetches	*Vicia spp.*	**---**	**O**	**(X)**
WOODY HOSTS				
almond	*Prunus dulcis*	**(X)**	**(X)**	**O**
apple & crabapple	*Malus spp.*	**O**	**(X)**	**O**
apricot	*Prunus armeniaca*	**O**	**(X)**	**O**
bitter cherry	*Prunus emarginata*	**X**	**(X)**	**O**
boxwood	*Buxus m. japonica*	**O**	**X**	**O**
ceanothus	*Ceanothus spp.*	**O**	**(X)**	**O**
chokecherry	*Prunus virginiana*	**X**	**(X)**	**O**
hawthorn	*Crataegus spp.*	**O**	**(X)**	**O**
lilac	*Syringia spp.*	**O**	**X**	**O**
myrtle	*Myrtus communis*	**O**	**X**	**O**
peach	*Prunus persica*	**(X)**	**(X)**	**O**
pear	*Pyrus spp.*	**O**	**(X)**	**O**
plum (Japanese)	*Prunus saliciana*	**(X)**	**(X)**	**O**
privet	*Ligustrum spp.*	**O**	**X**	**O**
prune	*Prunus domestica*	**O**	**(X)**	**O**
pyracantha	*Pyracantha spp.*	**O**	**X**	**O**
sweet cherry	*Prunus avium*	**X**	**X**	**(X)**
viburnum	*Viburnum tinus*	**O**	**X**	**O**

X = PREFERRED HOST
(X) = OCCASIONAL HOST
O = NOT A HOST
--- = no information