University of California Cooperative Extension Fresno County

Vine Lines

Stephen J. Vasquez, Viticulture Farm Advisor

Potential Effects of Cold Weather on Vineyard Health

Stephen Vasquez, Matthew Fidelibus and Peter Christensen

The cold, dry weather of the past two winters has increased crown gall infections in vineyards throughout the San Joaquin Valley. The bacterium *Agrobacterium vitis* lives in soil, and is systemic in the grapevine. It may form galls in vine tissues subjected to mechanical damage, especially freeze damage (Fig. 1). Galls on roots, trunks and cordons can disrupt the vine's vascular tissues, and severe infections may result in yield reductions or vine death. The unusually low temperatures of December and January (2006-07), which occurred in the absence of precipitation, provided optimal conditions for crown gall. Many young grapevines were killed, whereas older vines lost canes, spurs, cordons or trunks. Permanent structures that were not killed outright displayed poor growth and galls (Fig. 2).

Local growers who notice galls on their vines should not panic. In the San Joaquin Valley, the galls usually dry up as warm weather develops. In such cases, the galls do not usually cause severe problems. However, the bacterium will remain within the vine, and in areas with optimal conditions, persistent galls may grow and girdle the vine over time. Normal low temperatures during the winter do not usually damage grapevines in the San Joaquin Valley. However, succulent green tissue is much more vulnerable to frost damage. Factors which determine the extent and severity of frost damage include shoot growth stage, the minimum temperature reached, and the duration of time that the tissues are at or below critical temperatures (Table 1). A mild frost shortly after budbreak may only damage a few leaf cells, causing necrotic (brown to black) spots which will appear to be unevenly distributed throughout the leaf blade or shoot.

(Continued on page 2)

Tiny Wasp Wipes Out Glassy-Winged Sharpshooter in Tahiti

A research team led by Mark Hoddle, a biological control specialist at UC Riverside, has nearly eradicated the glassy-winged sharpshooter, a major agricultural pest, from the island of Tahiti and several other French Polynesian islands in the South Pacific Ocean. To achieve total pest suppression, the researchers used biological control, an inexpensive method that provides permanent control and can be applied to areas where the sharpshooter has become a nuisance.

The method involves introducing *Gonatocerus ashmeadi*, a microscopic parasitic wasp, into an ecosystem under siege from the glassy-winged sharpshooter. The tiny stingless wasp attacks glassy-winged sharpshooter eggs by drilling a tiny hole in the egg through which the parasite lays its own egg. The wasp larva that hatches from the egg then eats the inside of the glassy-winged sharpshooter egg, killing it. The wasp larva completes its development inside the host egg and then emerges as a tiny winged parasite that searches for more glassy-winged sharpshooter eggs to kill.

"We had the technology to do the job cheaply and in a way that brought about permanent control of the glassy-winged sharpshooter in Tahiti and its neighboring islands," said Hoddle a Cooperative

(Continued on page 4)

Cold Weather

(continued from page 1)

Normal low temperatures during the winter do not usually damage grapevines in the San Joaquin Valley. However, succulent green tissue is much more vulnerable to frost damage. Factors which determine the extent and severity of frost damage include shoot growth stage, the minimum temperature reached, and the duration of time that the tissues are at or below critical temperatures (Table 1). A mild frost shortly after budbreak may only damage a few leaf cells, causing necrotic (brown to black) spots which will appear to be unevenly distributed throughout the leaf blade or shoot. If enough cells are damaged, the leaves will become distorted as they grow, and the entire leaf may die as the remaining shoot grows. As frost intensity increases, so will injury. It is not uncommon for moderate frosts to kill shoot tips and flower clusters on vines in low lying areas of the vineyard (Fig. 3). Severe frosts will kill entire shoots to the cane. When temperatures are low enough to kill whole shoots, the damage is often uniform throughout the vineyard. Shoots killed by frost will turn a dark brown to black color within a few days of freezing.

Unusually warm weather in January and February will advance budbreak and expose more green tissue to frosts which may occur in March and April. Thus, early budbreak can increase the risk of frost damage. Budbreak in Fresno County normally occurs on March 15th (+/- 7 days) for Thompson Seedless, which is about when budbreak was noted in 2008. Since then we have had some exceptionally warm, pleasant weather. Such weather can give growers a false impression that the risk of frost has passed but early spring weather patterns frequently shift between highs and lows with devastating results. Growers should follow the weather forecast closely for extremes between highs and lows. In general, as growth progresses through spring, grapevines become more susceptible to frost, but fortunately, the likelihood of a severe frost decreases as the season progresses.

Figure 1. Crown gall on young vines that experienced freeze damage.

(Continued on page 3)

Cold Weather

(continued from page 2)

On clear nights when frost forms, the coldest air is found near the ground. As the night progresses, a cool layer of air continues to build and the shoots nearest the ground are the first to experience damage. Grapevines trained at one height are more susceptible than those trained at 12-15 inches higher. For example, a Thompson Seedless vineyard grown to a height of three feet will be more susceptible to frost than one trained at 12-15 inches higher. For example, a Thompson Seedless vineyard grown to a height of three feet will be more susceptible to frost than one trained on a open gable or overhead trellis with a head height of 48-54 inches.

Previous research has shown that a temperature of 28˚F one foot above the soil can be two degrees warmer at three feet above ground. At twenty to twenty-five feet above the soil line the temperature will gain another two degrees. At some point the temperature will again begin to decrease, forming an inversion layer. The greater the temperature change between the soil line and twenty-five to thirty feet above ground level the greater the chance of avoiding frost damage.

When frost has been predicted, growers should take note of their vineyard's growth stage so a strategy can be developed. Vineyards that have not yet begun to break may not require special attention. When green shoots are longer than six inches, soils may need to be prepped in advance of cold weather. Table 1 shows the relative susceptibility of grapevine tissue at different growth stages and critical temperatures.

(Continued on page 5)

Table 1. Frost damage to various growth stages of grape.

Growth Stage	Critical Temperature*
Buds	25-27˚F
Buds with wool (eraser stage)	< 26˚F
Budbreak	< 30˚F
Shoots < 6" in length	< 31˚F
Shoots > 6" in length	< 32˚F

*Critical temperatures are based on research under controlled environments. Vineyard characteristics (location, cultivar, etc.) may increase or decrease susceptibility to frost damage. These values should only be used as a point of reference when developing a frost protection program.

Figure 2. Crown gall formation on Thompson Seedless that was grafted to a new cultivar.

Glassy-winged sharpshooter in Tahiti

(continued from page 1)

Extension specialist in the Department of Entomology and the director of the Center for Invasive Species Research. "When biological control – the use of a pest's natural enemies to keep the pest's population growth in check – works, it is very effective and safe in most cases. The parasites spread naturally and on their own, and they fly, requiring little, if any, continuous human assistance over a wide geographic area."

With no type of natural control in Tahiti, the excessive number of glassy-winged sharpshooters was a major social, economic, and agricultural nuisance on the island. The pest was especially present in high numbers in urban areas along the coast where it was severely affecting the health of trees and bushes upon which massive numbers of pests were feeding. When the island's government scientists approached Hoddle for guidance in 2003, he agreed to assist.

After safety evaluations, Hoddle and his colleagues released nearly 14,000 parasitic wasps at 27 sites in Tahiti between May 2005 and October 2005, resulting in rapid parasitism of glassy-winged sharpshooter eggs. By December 2005, the wasp had colonized the entire island of Tahiti, and glassy-winged sharpshooters decreased in number at all study sites to less than 5 percent of their original population density.

As a result of the rapid and dramatic reduction in the population of the glassy-winged sharpshooter in Tahiti, several problems associated with the pest diminished, such as excessive feeding on plants, high levels of sharpshooter excrement raining from trees, and home and shop invasions by hundreds of sharpshooters at night due to the pests' attraction to lights.

"Populations of the glassy-winged sharpshooter have been successfully maintained at a very low level in Tahiti for over two years, the time our experiments ended," Hoddle said. "Tahitian farmers have said their fruit production has improved in comparison to years when the sharpshooter was in abundance. The success of biological control with host-specific natural enemies demonstrates that alternative technologies that are not chemically driven can be very effective in suppressing invasive species."

Native to the southeastern United States and northeastern Mexico, the sharpshooter is a half-inch long leafhopper, dark brown in color, that has threatened the wine, table grape, and raisin industries in California since the 1980s because of a lethal bacteria that it spreads when feeding on plants.

The glassy-winged sharpshooter is a vector of *Xylella fastidiosa*, a bacterial pathogen that has potential to wipe out the grape, peach and almond industry, as well as many ornamental bushes and trees. *X. fastidiosa* causes Pierce's disease that can kill a grapevine in just two years.

X. fastidiosa kills plants by blocking the water conducting system, or xylem. The blockages reduce water flow to leaves. Water stress is visible as scorched leaves, which quickly dry and drop. Plants often die when these symptoms become obvious.

Because of its ability to spread a plant pathogen, the sharpshooter threatens native biodiversity and agriculture, in addition to grapes, the bacteria it spreads kills almonds, peaches, plums, olives, oleanders, and liquidambar.

A voracious eater, the sharpshooter can consume up to 100 times its body weight per day in plant fluids, and produces copious amounts of watery excreta that often "rains" down from trees, causing a social and recreational nuisance.

The glassy-winged sharpshooter, which invaded Tahiti in 1999, is also proving to be a nuisance in Easter Island (arrived 2005) and the Cook Islands (arrived 2007). It was also a pest in Hawaii (arrived 2004) until *G. ashmeadi*, which controlled glassy-winged sharpshooters in Tahiti, accidentally arrived in Hawaii.

Hoddle was joined in the study by Julie Grandgirard, Jerome N. Petit, George K. Roderick and Neil Davies of UC Berkeley. The French Polynesian government provided financial and logistical support for the project in French Polynesia.

Next in his research, Hoddle will work on a variety of pest species in their home countries to explore what controls their local populations. "We are being proactive in our research by understanding these pests in their home environments," Hoddle said. "That way we will be better prepared for these new pests should they arrive unexpectedly one day at our doorstep."

(continued from page 3)

Soil Characteristics

In order to minimize damage caused by frost, vineyard soils should be prepared for maximum heat absorption during the day and release at night. **Optimal conditions include soils that are free of vegetation, firm in texture, and moist.** Moist dark soils improve their ability to absorb heat during the day and radiate it at night as ambient temperatures drop. Soil texture will also have an impact on heat absorption. Vineyards planted to sandy soils are more prone to frost damage because they lack the ability to retain water. Additional water may be needed if winter precipitation has not been adequate to maintain soil moisture. Prior to a predicted frost, the goal should be a uniformly distribute irrigation, that allows for maximum heat absorption. Table 2 shows the benefits of a bare, firm moist soil in contrast to the least affective frost conditions. Soils that have been recently cultivated or disked need to be irrigated soon after the soil has been disturbed. Cultivated soils do not retain heat well because they are dry and have numerous air pockets. Native vegetation or cover crops that insulate soils from absorbing heat should be mowed or disked and followed by irrigation or significant precipitation.

Figure 3. Thompson Seedless vineyard displaying significant frost damage. The vineyard middles were disked but were not packed and irrigated.

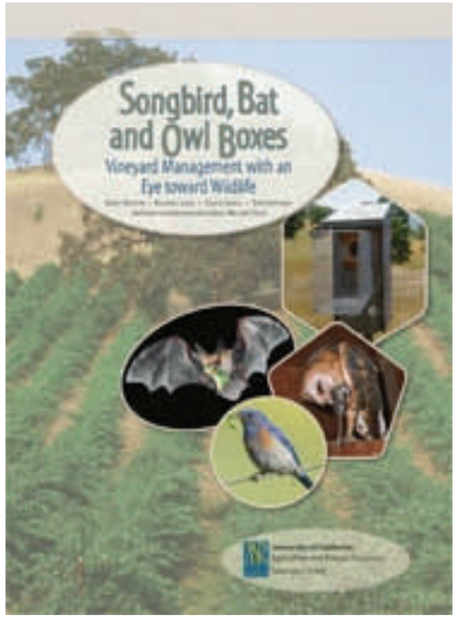
Irrigation during a frost event can be beneficial. On nights that low temperatures are expected pumps should be turned on early enough that the entire vineyard is covered. Depending on size it may only be feasible to irrigate the most susceptible areas (low lying)

(Continued on page 6)

Table 2. Comparisons between optimal soil conditions for frost.

Soil Characteristics	Vegetation	Temperature Benefit	
Bare, firm, moist	None	warmest	Optimal
Moist	Shredded cover crop	0.5 ˚F	
Moist	Low growing cover crop	1-3 ˚F colder	↓
Dry, firm	Freshly disked	2 ˚F colder	
Dry to moist	High cover crop	2 ˚F colder	Least optimal

New Publication
Songbird, Bat and Owl Nest Boxes



Songbird, Bat and Owl Nest Boxes Vineyard Management with an Eye toward Wildlife This handy new 51-page guide from the University of California explores the benefits of the biodiversity and aesthetics of songbirds, bats, and owls and suggests "win-win" situations as these species lose their traditional nesting habitats in Oak woodlands.

Each section includes descriptions and photographs of common songbird, bat, and owl species; a discussion of feeding, diet, and nesting behavior; design instructions; and guidance on placement, mounting, monitoring, and maintenance.

Using this guide, you'll also learn about biology and habitat requirements, ideas and methods for integrating nest boxes with vineyard management, literature sources, and online resources where you can get more information.

Beautifully illustrated with 28 color photographs, 41 figures, and 3 tables.

Songbird, Bat and Owl Boxes

ANR publication 21636, ISBN 978-1-60107-485-0, is $15.00 + plus tax and shipping and can be purchased at your local UC Cooperative Extension office or by logging onto http://anrcatolog.ucdavis.edu.

Cold Weather

(continued from page 5)

where cold air tends to drain. Doing so will improve the chances of protection.

Vineyards that are drip irrigated should not have their row middles cultivated. Drip irrigation should be turned on to wet as much soil as possible. Growers will have to be especially vigilant to the weather forecast in order to start irrigating well in advance of the frost event. Cover crops or native vegetation should be mowed prior to budbreak and often as is necessary after the vines awaken. Row middles should not be cultivated unless a significant rain event has been predicted. Doing so could result in significant losses if frost should appear. It only takes a single frost event (one night at freezing or below) to experience a complete loss.

Stephen Vasquez is the UC Cooperative Extension viticulture advisor in Fresno County. Matthew Fidelibus and Peter Christensen are UC Cooperative Extension viticulture specialist and viticulture specialist, emeritus, respectively. Photo credits: UC Regents

Calendar of Events

Local Meetings and Events

San Joaquin Valley Regional Research Roadshow
June 26, 2008
1:00 p.m. — 4:30 p.m.
Armenian Cultural Center
2348 Ventura Avenue, Fresno, CA
Contact: Peterangelo Vallis (559) 618-1856

U.C. Davis University Extension Meetings

(800) 752-0881

Managing the Small Vineyard II
May 10, 2008
9:00 a.m. — 4:00 p.m.
Room 198, Young Hall, East Quad,
UC Davis, CA
Instructor: Donna Hirschfelt
Section: 074VIT204

****Introduction to Wine Analysis for Home Winemakers***
May 17, 2008
8:00 a.m. — 6:00 p.m.
Room 123, Enology Building, California Ave.
UC Davis, CA
Instructor: Michael Ramsey
Section: 074VIT203

****Introduction to Wine Analysis for Professional Winemakers and Winery Lab Workers***
May 24, 2008
8:00 a.m. — 6:00 p.m.
Room 123, Enology Building, California Ave.
UC Davis, CA
Instructor: Michael Ramsey
Section: 074VIT205

Grapevine Leafroll Disease — An Increasing Problem for California Vineyards
June 10, 2008
8:30 a.m. — 4:30 p.m.
Freeborn Hall, North Quad
Davis, CA
Instructor: Deborah Golino
Section: 074VIT206

*Participants must be 21 years of age or older to enroll and attend.

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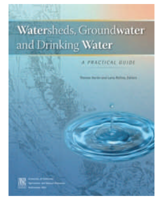
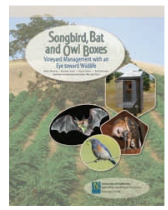


Watersheds, Groundwater and Drinking Water: A Practical Guide
ANR Publication 3497
Price - $40.00 + tax and shipping

This handy guide is a "must-have" for environmental scientists, water technicians, educators, and students. Water shed and groundwater hydrology fundamentals are discussed.



Songbird, Bat, and Owl Nest Boxes
ANR Publication 21636
Price - $15.00 + tax and shipping

This guide explains the benefits of the biodiversity and aesthetics of songbirds, bats and owls. Methods on how to integrate nest boxes within a vineyard are discussed.

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In This Issue: