GRAPE, OBSCURE, OR VINE

Which mealybug is it, why should you care?

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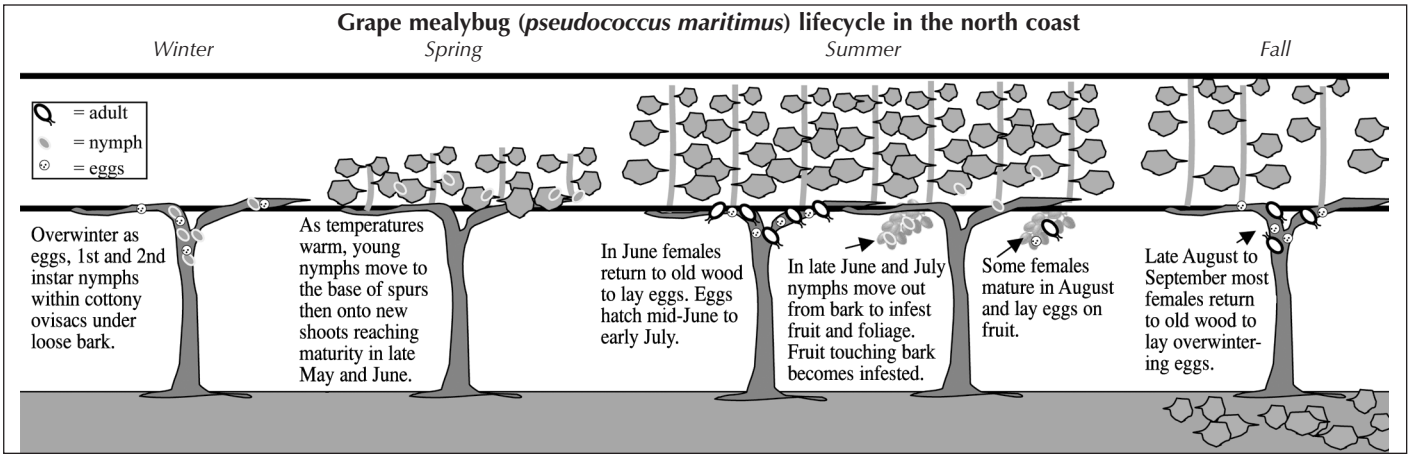
Three mealybugs species now occur in wine grape regions of California: grape mealybug (*Pseudococcus maritimus*), obscure mealybug (*P. viburni*) and vine mealybug (*Planococcus ficus*). It is important to distinguish among them because their life cycles are different, and thus chemical control measures (if necessary), must be tailored to the specific pest.

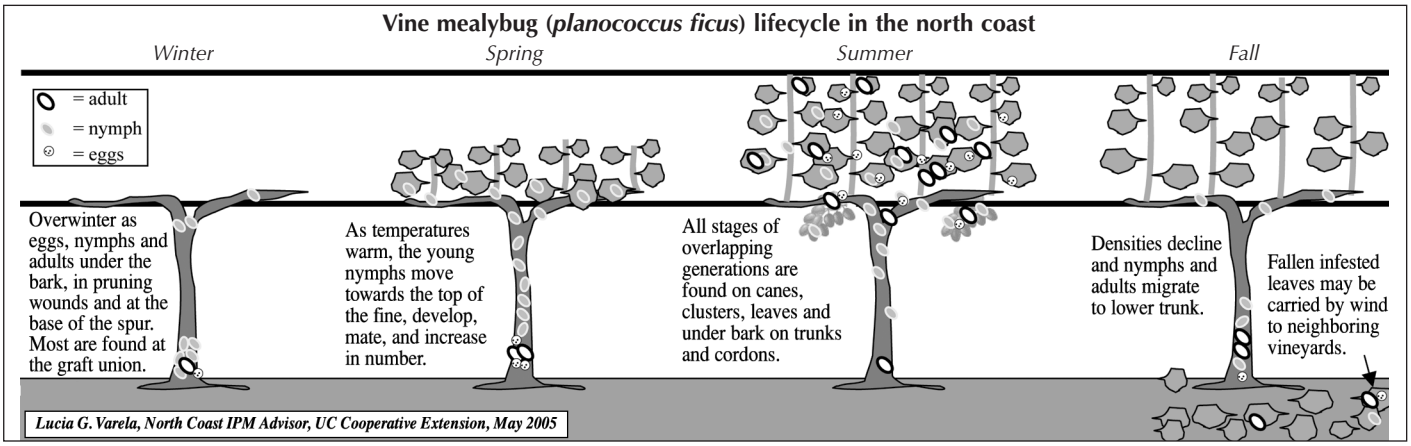
The recently introduced vine mealybug is spreading throughout the grape growing regions in California. It can reach damaging levels very quickly by contaminating grape clusters with mealybugs, honeydew, and sooty mold. North and Central Coast growers have been battling vine mealybug for three to six years respectively and it has been a problem in San Joaquin Valley vineyards since the mid 1990s.

Movement of vine mealybug to new regions has necessitated aggressive chemical management and modified farming practices to curtail its spread and the damage it can cause. As a result, vine mealybug has grabbed headlines and become a focus of attention for growers and wineries.

A strong effort is underway to detect new vine mealybug infestations early in order to control the insect and prevent further spread, both within the block where it is first discovered and to adjacent vineyards.

This extra scrutiny has also increased concerns regarding two other mealybugs that are more commonly found in vineyards. While searching for signs of vine mealybugs, growers and Pest Control Advisers (PCAs) frequently find grape mealybug or obscure mealybug. They now have to recognize the similarities and differences in three species of mealy-





bugs to correctly identify, monitor and control them.

Origins and need for chemical control

Grape mealybug is native to North America and exists in many parts of California. It has probably gone unnoticed in many vineyards and has not caused economic damage due to low populations. Because it is native, a large complex of natural enemies exists and thus it is often under good biological control.

Obscure mealybug is an introduced species that has been present in California since the late 1800s. Because it is an exotic pest, it has few natural enemies. Obscure mealybug has a narrower tolerance to cold temperatures than the grape mealybug and is found primarily in coastal regions. Currently, the largest populations of obscure mealybug are found in the Central Coast.

Vine mealybug is an economic pest of vineyards in the Mediterranean regions of Europe, Africa, and the Middle East. It has also been introduced into South Africa, South America, and the southeastern U.S. Vine mealybug has a few natural enemies in California that were introduced in the 1940s for control of a related species, the citrus mealybug.

Occasionally, control of grape or obscure mealybug requires chemical application(s). Fruit can become infested with these mealybugs when populations are high, especially when clusters touch older wood on the vine such as the cordon. In contrast, vine mealybug infestations can reach much higher population levels than grape or obscure and cause more damage to clusters and the vine. At this time, chemical applications are required to control this pest.

Honeydew and ant tending

Mealybugs feed on the phloem and excrete a sugary solution called honeydew. Ants are often found in association with mealybugs because they will feed on the sugary excrement. In fact, the ants will tend the mealybugs and keep away natural enemies in order to maximize the production of honeydew.

The degree of honeydew production varies by species and increases from small to significant amounts with grape, obscure, and vine mealybugs respectively.

Honeydew can be seen as shiny and sticky areas on leaves, clusters, and trunks. A wet trunk is an indication that a colony of mealybugs is feeding under the bark and honeydew is seeping through the bark. Argentine and gray ants are the most common ant species that tend mealybugs to obtain honeydew.

The amount of honeydew visible on a vine depends not only on the mealybug species but also on the number of ants tending the colonies. When ants are not present, honeydew produced by all mealybugs can result in wet trunks because the ants are not consuming it. Although it is more common to see wet trunks with vine mealybug infestations, a large population of grape mealybugs in the absence of ants will also result in wet trunks.

Morphological differences

The mealybug covers its body with a waxy secretion that creates a white, mealy appearance in all three species. Wax also accumulates on hairs that extend around the circumference of the body, forming white fringe-like filaments. The appearance of the white filaments distinguish the vine mealybug from those in the genus *Pseudococcus* (grape and obscure mealybug).

GRAPE AND OBSCURE MEALYBUGS: The body shape of the immature and female grape and obscure mealybug is rectangular with rounded anterior and posterior ends (Figure I, right). The hairs surrounding the body are longer than those of the vine mealybug. Since the hairs are longer, the wax accumulates more thinly along the length (the filaments may appear crooked, bent or otherwise irregular).

The waxy filaments in grape and obscure mealybug are longer, thinner, slightly less parallel and thus have a more untidy appearance than those of the vine mealybug. More noticeable are the hairs at the posterior end of the abdomen that are considerably longer than the ones surrounding the rest of the body. The result is two to four long, caudal filaments that appear as tails.

If the insect is not disturbed, tails are easily seen in large immatures or in adult females and are the strongest characteristic with which to distinguish *Pseudococcus* mealybugs from

Table I: Distinguishing characteristics of grape, obscure and vine mealybugs.

	Mealybugs		
	Grape *Pseudococcus maritimus*	**Obscure** *Pseudococcus viburni*	**Vine** *Planococcus ficus*
Body shape	Rectangular	Rectangular	Oval
Filaments surrounding body	Thin, non-uniform	Thin, non-uniform	Thick, uniform
Filaments posterior end	Thin, long	Thin, long	Thick, short
Defensive fluid	Reddish, orange	Clear	Clear
Diapause (dormant period)	Yes	No	No
Generations	2	2 to 3	4 to 7
Synchronized generations?	Yes	No	No
Stages overlap throughout year?	No	Yes	Yes
Overwinters under the bark **primarily** in:	Upper trunk, cordons, spurs	Trunk, cordons, spurs	Graft union, pruning wounds on trunk, base of spurs. (roots in light soils)
In summer lays eggs	Under bark on old wood, bunches	Under bark on old wood, bunches	Under bark on old wood, bunches, throughout the canopy above the fruit zone
Honeydew production	Moderate	Moderate to high	High

Figure I. Vine mealybug female (left) with oval body shape, thick, even (uniform) filaments and short tails and grape mealybug (right) with rectangular body shape, thin, slightly unparallel (non-uniform) filaments and long tails (photo: Jack Kelly Clark).

vine mealybug. It is more difficult to see the long tails in younger stages, however *Pseudococcus* immatures can still be distinguished by the rectangular body shape and by the thin, irregularly formed filaments surrounding the body.

Grape and obscure mealybugs can also be distinguished from each other by the color of a defensive fluid they secrete when threatened. The fluid is exuded as a droplet from pores at the anterior and/or posterior end of the body. Gently poke the insect with a sharp object without puncturing the body until the fluid is excreted. If the color of the fluid is reddish orange, the insect is grape mealybug (Figure II); if it is clear, then it is obscure mealybug (Figure III).

Figure II. Reddish orange fluid excreted by grape mealybug (photo: JKC).

VINE MEALYBUG: The body shape of the immature and adult female vine mealybug is oblong (Figure I, left); wider at the center of the body as compared to the anterior and posterior ends. The hairs surrounding the body are short in comparison to those of *Pseudococcus* mealybugs. Wax accumulation on the hairs result in short, uniform, and thick filaments. The posterior end of the adult female has **slightly** longer filaments than those that surround the body, but they do not appear as long tails.

Vine mealybug, like obscure mealybug, exudes a clear defensive fluid when threatened.

Life cycles

GRAPE MEALYBUG has two generations per year: overwintering and summer generation. This mealybug evolved to live in temperate climates where it spends the winter in an arrested state called *diapause*. Diapause is a prolonged dormancy regulated by hormones triggered by environmental conditions. The ability to diapause, and which life stage diapauses, is genetically determined.

In grape mealybug, the egg is the most resistant stage to cold weather, thus it is this diapausing stage that overwinters. The eggs are laid in a white, cottony egg sac under the bark on the trunk, in the head of the vine or on cordons. Egg sacs are formed when the female secretes long waxy threads during oviposition. The cottony mass, called an ovisac, conceals the eggs.

In late winter the youngest nymphs (called crawlers), emerge and, shortly before bud break, they move from old wood to the spurs where they gather under the thin bark on one-year-old wood. After bud break, a portion of the population moves to the basal leaves and shoots while the rest remain under the bark primarily on the upper portion of the trunk, head, and cordons. When high grape mealybug populations exist in older vines with thick bark, they may also be found under the bark much lower on the trunk.

Figure III. Clear fluid excreted by obscure mealybug (photo: Kent M. Daane).

The overwintering generation develops through the spring, reaching maturity in late May and June. At that time, the adult female returns to the

Figure IV. Vine mealybug colony in the axils of the petiole and cane (photo: Mark Battany).

old wood to oviposit. Each female lays 100 to 300 yellow to orange eggs, then she dies. The eggs hatch in seven to 14 days.

Summer generation nymphs move to the shoots, foliage, and clusters that are touching old wood. Only eggs or crawlers are found in late June or early July; mostly immatures are seen through July. Adult females will appear in late summer and early fall. Some females will oviposit in the fruit clusters but the majority of females return to old wood to lay overwintering eggs.

Because grape mealybug has a diapausing stage, the life cycle is synchronized and the two generations do not overlap. Thus, at certain times during the growing season, specific stages are not present while others predominate. For example, the lack of females and eggs in mid to late July is a strong indication that the immature mealybugs seen on vines at that time are grape mealybug. Similarly, at bud break, only crawlers along with remaining ovisacs are found. When only one or two stages of mealybug are present at a given time, the insect is most likely grape mealybug.

OBSCURE MEALYBUG does not have a diapausing stage, thus it has all life stages present throughout the year; this distinguishes it from the grape mealybug. It has two to three overlapping generations per year and overwinters as eggs inside ovisacs and as nymphs under the bark, mostly on the upper portion of the trunk or on cordons.

In some central coast vineyards, obscure mealybug has been observed on weeds such as malva during the winter when the vines are dormant. After bud break, a portion of the nymphal population moves onto new shoots and basal leaves; however, a large number remain hidden under the bark.

In the summer, populations may increase dramatically and all stages are found on above-ground portions of the vine, specifically under the bark on the trunk, cordons, and spurs; basal portions of the shoots and leaves; and on clusters that touch older wood. In fall, nymphs migrate from the canopy to the trunk and cordons and remain on old wood under the bark.

VINE MEALYBUG, like obscure mealybug, does not diapause and all life stages might be present year-round on a vine. It has several generations per year, depending on temperature. In the San Joaquin Valley, it can have up to seven generations. In the cooler North Coast, it has approximately four.

During the winter months, eggs, crawlers, nymphs, and mated females are found under the bark. The majority of the population is found on the lower trunk at the graft union or near the soil line. They are also found in old pruning wounds on the trunk, at the crotch in a bilateral cordon-trained vine, or at the base of the spur. In light soils present in the Coachella and San Joaquin Valleys and some areas in the Central Coast, they are found on vine roots. This has not been seen in the heavier soils of the North Coast.

Reproduction slows considerably in the winter months, and by late February and March, the majority of stages found are older nymphs or fully developed females that have not started laying eggs. In late March and early April, overwintering nymphs develop into adult females which begin to lay eggs in ovisacs.

When the crawlers of the spring generation emerge, they move up the trunk, find a spot to feed and continue to develop. The spring generation develops under the bark on trunks and cordons through May and by late spring, nymphs can be found on basal leaves.

In summer, populations can increase dramatically and all stages of overlapping generations are found on canes, clusters, leaves, and petioles well above the fruit zone and under the bark on the trunk, cordons and spurs.

In the canopy, vine mealybug forms colonies in the axils of the petioles and the cane (Figure IV). Females lay eggs on all above-ground parts of the vine. Only vine mealybug lays eggs on leaves and they may be found above the fruit zone. Starting in about November, population densities decline and nymphs migrate to the lower trunk.

Timing of control measures

It is very important to time insecticide applications to coincide with periods of maximum vulnerability of each pest. Due to the different life cycle for the three species, control timing differs. For information on which chemicals to use, please consult the University of California Grape Pest Management Guidelines at http://www.ipm. ucdavis.edu. There are two guidelines that address mealybugs. The titles of the two guidelines are 1) *Mealybugs (Pseudococcus)* for grape and obscure and 2) *Vine mealybug.*

GRAPE MEALYBUG: This pest is best controlled at the crawler stage. As described previously, grape mealybug is seldom a pest; control is needed only when populations are high and a high percent of the fruit touching the old wood is infested. Grape mealybug prefers vigorous vines. Keep records of infested fruit near harvest and map the infestation at that time.

The most effective treatment is to control crawlers from the overwintering generation during delayed dormancy, just prior to bud break. In vineyards with a history of infestation at harvest, monitor the spurs before bud break. Gently peel the thin bark from the tip of the spur and look for the orange-to-yellow crawlers on one spur per vine in at least 30 vines. If 20% of the spurs are infested, a treatment may be warranted.

In May, monitor the beginning of the summer generation by examining the base of spurs for mature females and for ant movement on the vine. A treatment may be needed if more than 20% of the spurs are infested in late spring.

A post-harvest application should **never** be used to control grape mealy-

Growers work together in vine mealybug workgroup

BY Nick Frey, Executive Director Sonoma County Grape Growers Association

When vine mealybug (VMB) was first discovered in the Carneros region, the growers and wineries organized a workgroup led by Katey Taylor (viticulturist for Domaine Chandon). The workgroup provided trap placement and reading services for growers. The program expanded in 2005 to include growers outside of Carneros. Clearly, these growers recognize the value of working together to combat this exotic pest.

Carneros growers were able to manage VMB infestations in 2005 and harvest fruit that met quality expectations. This was achieved with the use of insecticides. Several new infestations were found by vineyard workers when leafing or cluster thinning. In addition to field workers, the group suggested that fruit samplers also be trained to identify VMB. When they remove berries or clusters, mealybugs inside the clusters are revealed.

It is also clear that VMB is spreading naturally now. No longer are infestations only associated with new vine plantings. If you have a vineyard near an infested vineyard, you are at higher risk of becoming infested with VMB. However, new infestations are not necessarily along the edge of the infested site.

Both Katey Taylor and Lucia Varela (University of California Cooperative Extension [UCCE]), emphasize the importance of growers working together to slow the spread of VMB. If you are interested in joining the VMB Workgroup in 2006, contact Katey Taylor (katey_taylor@chandon.co[illegible]. Participation is not limited to growers in the Carneros area.

The 2005 VMB workgroup program had 339 trap sites. Of those, 90 sites had VMB males. They do not, as yet, know the number of female infestations associated with the 90 sites that trapped males. As learned previously, trappings in September/October detected the largest number of VMB males, nevertheless early trapping is still worthwhile because early detection is critical to reduce fruit damage and loss and to have any chance of eradicating an early stage infestation.

Trapping should continue after an infestation is found to track the effectiveness of insecticide treatments in reducing VMB numbers. The consensus of the group is that everyone needs to trap for VMB and everyone needs to talk to their neighbors to learn if or where VMB exists relative to their property.

The 2005 VMB workgroup results suggest that trap densities of greater than one per 30 acres may be needed. In windy locations such as Carneros, traps may be close to infested plants and yet not catch any males. To be successful, traps need to be placed downwind of the infestation which may be a challenge in a windy region such as Carneros. It is also suggested that more traps be added to the trapping grid during September and October when male numbers are highest.

If growers fail to identify or treat a VMB infestation, fruit quality will be affected and ultimately vine health will decline. Experience to date indicates VMB monitoring, pesticide treatment and sanitation can cost as much as $1,000/acre under certain circumstances if the grower's objective is eradication.

It is clear that new sustainable controls for VMB are needed. Potential new strategies include registration of a new systemic insecticide with greater efficacy than Admire, especially on heavy soils, new ant-bait stations to reduce ant populations (likely available in 2007), mating disruption and new biological control agents now being evaluated.

Among the biological control agents, it is hoped that parasites can be released that will attack different VMB life stages. Two species of parasites under evaluation by Kent Daane (UC Cooperative Extension Specialist) are very aggressive in laboratory tests.

There is a growing consensus that VMB is here to stay. Thus, we must make efforts to limit or slow its spread. Trapping and talking with neighbors are critical actions every grower should take. We also need to develop cost-effective IPM programs that rely less on heavy insecticide use. There are promising options, but more work is needed to create a successful IPM strategy.

The Sonoma County Grape Growers Association encourages the formation of additional VMB workgroups. Cooperation among growers is critical. Winery support is important, including training berry samplers to identify VMB. UCCE north coast staff will continue to provide training for vineyard employees and berry samplers in 2006. ■

bug. Depending on the harvest date, at this time the majority of the population is in the egg stage inside the ovisac under the bark. No chemical kills the eggs, thus applying a treatment at this time will disrupt natural enemies and not control this pest.

OBSCURE MEALYBUG: The most effective treatment timing for this species is also the delayed dormant period; spurs can be monitored with a protocol similar to that listed above for grape mealybug. If additional treatments are required, systemic insecticides applied with irrigation water can be very effective in late spring, more so in vineyards with light soils.

If spring or summer foliar treatments are necessary, attempts should be made to minimize adverse effects on the resident population of beneficial insects commonly present in vineyards. This can be achieved by leaving areas of the vineyard untreated, and by utilizing insect growth regulators that primarily target mealybug pests.

VINE MEALYBUG: If vine mealybug is found in a vineyard, treatment is recommended. The objectives for chemical control are to obtain clean fruit and to avoid development of populations in the canopy. Large populations in the canopy may hasten spread during leaf fall (which may occur prematurely due to vine mealybug feeding). Reducing the numbers of vine mealybug in the canopy prior to harvest is essential to prevent spread of the pest during harvest.

At the delayed dormant period, just prior to bud break, the majority of the population is under the bark in the lower part of the trunk. Effectiveness of a treatment at this time may be improved if bark is removed on the most infested vines prior to the application. In areas with light-textured soils, an effective spring and early summer control is a soil-applied systemic insecticide at bloom as a single or a split application.

Summer foliar applications are warranted to insure clean fruit and to avoid having a large population in the canopy at harvest. When making summer applications you may be limited by pre-harvest intervals. The earlier you find an infestation the more chemical control options you have to control this insect before harvest. It is strongly recommended that all vineyards be monitored with vine mealybug pheromone traps for early detection. For information on trapping, please consult the references cited below.

The most effective timing to reduce vine mealybug populations is *immediately after harvest* before the nymphs begin to move to lower parts of the trunk. This is when the highest percentage of the population is exposed in the canopy and on outside of the bark. Good control at post harvest will minimize the overwintering population and may reduce the need for a delayed dormant spray, when control is less effective. ■

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