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## Root and Trunk or Crown Diseases

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**Crown Gall** (*Agrobacterium vitis*): Crown gall is a bacterial disease that infects more than 2,000 species of plants (including brambles). Crown gall of grape is a major problem in cold climate regions. Wounds are necessary for infection to occur. Observations suggest that freeze injury and mechanically induced wounds are highly conducive to infection. The disease is particularly severe following winters that result in freeze injury on cold-sensitive cultivars, such as those of *Vitis vinifera*. Crown gall is characterized by galls or overgrowths that usually form at the base of the trunk. Galls form as high as 3 feet or more up the trunk (aerial galls). Galls generally do not form on roots. The disease affects all grape cultivars. Vines with galls at their crowns or on their major roots grow poorly and have reduced yields. Severe economic losses result in vineyards where a high percentage of vines become galled within a few years of planting.

The disease first appears as small overgrowth or galls on the trunk, particularly near the soil line. Early in their development, the galls are more or less spherical, white or flesh-colored, and soft. Because they originate in a wound, the galls at first cannot be distinguished from callus. However, they usually develop more rapidly than callus tissue. As galls age, they become dark brown, knotty, and rough. The bacterium can survive in the soil for many years even in the absence of grapevines.

**Management:** Control procedures include: (1) planting only nursery stock which is free of any obvious galls on crowns or roots; (2) not planting into a field where crown gall has occurred previously, unless a non-host crop, such as strawberries or most vegetables, is grown for two or more years before replanting; and (3) minimizing winter injury to root and crown systems.

In addition to the above procedures, a nonpathogenic bacterium, *Agrobacterium radiobacter*, strain K-84, is commercially available for biological control of crown gall. The biocontrol agent may be applied to roots of healthy plants when they are first set out. After planting, the control becomes established in the soil around the root zone and prevents crown gall bacterium from entering this region. However, the biocontrol agent will not cure plants which are already infected before its application.

## Insects

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### Fruit Pests

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**Grape Berry Moth** (*Paralibesia viteana*): The moth is about 3/8 - 1/4" long and has a broad gray band across the middle of its wings. The larva is grayish-green and about 3/8" long when full grown. Larvae are found in the blossoms, young fruit clusters, and newly-formed berries; later they are found in green and ripening berries. Larvae feeding in the green and ripening berries cause most losses. Green berries will be seen to have a maroon coloration on one side, especially where the berry comes closest to or contacts a nearby berry in the same cluster. Such coloration indicates that a larva has fed on one berry, burrowed into another, and connected them with webbing. Ripening berries infested with larvae are detected by the wrinkled, shrunken appearance of the fruit.

**Management:** Remove wild grape plants from areas adjoining the vineyard. Till between rows to bury overwintering larvae. Pheromone traps are available to monitor onset of activity and pressure. Traps should be placed in the vineyard prior to the onset of GBM activity, usually around bloom. Threshold numbers for these traps have not been verified for New England, but they are useful to determine the onset of GBM activity. Mating disruption is being used successfully in some vineyards with the application of Isomate™ pheromone ties. These ties emit GBM pheromones slowly over time and when dispersed throughout the vineyard, make it difficult or impossible for male and female GBM moths to find one another and mate. These ties are recommended for vineyards 5 acres in size or larger. They are available from Pacific Biocontrol in Davis, California and Micro Flo in Lakeland, Florida. Contact your local Extension Specialist for help getting Isomate™ ties.

When damage is seen, it is too late to treat. It may be necessary to treat with insecticide the following season. See pest management schedule for recommended materials and timing. Applications should be made post-bloom, 10 days later and again in late July or early August.

Table 44. Effectiveness of insecticides for management of grape insects.

Material	PESTS								
	GBM	LH	GP	GCGL, JB	GCGR	GFB, CW	GMB	M	RC
Agrimek (abamectin)	++	?	?	0?	0?	0?	?	++	0?
Ecozin (azadirachtin)	?	++	?	++	?	+	++	+	++
*Guthion (azinphos-methyl)	+++	+	?	++	+++	++	?	0	++
Dipel ( <i>Bacillus thuringiensis</i> )	++	0	0	0	0	0	?	0	0
Sevin (carbaryl)	+++	+++	0	+++	0	+++	?	0	+++
JMS Stylet Oil (parafinic oil)	?	?	?	?	?	?	+++	+++	?
Diazinon (diazinon)	0	++	0	0	0	0	?	0	0
Kelthane (dicofol)	0	0	0	0	0	0	?	+++	0
*Thiodan (endosulfan)	?	++	+++	?	?	?	?	0	?
Vendex (fenbutatin-oxide)	0	0	0	0	0	0	?	+++	0
Danitol (fenpropathrin)	+++	+++	+	+++	?	++	++	++	?
M-PEDE (insecticidal soap)	0	++	0	0	0	0	?	?	0
Pyramite (pyridaben)	0	++	0	0	0	0	?	+++	0
Provado (imidacloprid)	0	+++	?	0	0	0	+++	0	0
*Lannate (methomyl)	++	++	?	?	?	?	?	?	?
Imidan (phosmet)	+++	+	?	+	++	?	?	0	+

+++=highly effective; ++= moderately effective; += slightly effective; 0= not effective/not labeled; ?= effectiveness unknown

Key to pests: GBM= grape berry moth; LH= leafhoppers; GP= grape phylloxera; GCGL= grape cane gallmaker; JB= Japanese beetle; GCGR= grape cane girdler;

GFB= grape flea beetle; CW= cutworm; GMB= grape mealy bug; M= mites; RC= rose chafer.

\*restricted use pesticides

## Foliage and Cane Pests

**Grape flea beetle** (*Altica chalybea*): This is a metallic blue beetle about 3/16 - 1/4" long that jumps when disturbed. It is found on swelling buds during the spring. The flea beetles overwinter as adults and emerge during April. They chew holes in the ends and sides of buds that are beginning to swell. Such damage destroys the capacity of a bud to develop a primary or secondary shoot. Once the buds have grown to a length of 1/2" or more, the beetles cannot cause significant injury.

**Management:** See pest management schedule for recommended materials and timing.

**Grape Phylloxera** (*Phylloxera vitifoliae*): The presence of this soft-bodied insect ( about 1/16" or less in length) is indicated by galls or knob-like protrusions on the underside of leaves. It is found primarily on leaves of vinifera varieties, especially after bloom. The damage results from new leaves remaining curled and unproductive on the vine.

**Management:** Plant resistant rootstocks. Remove infected leaves. Spray applications should be made immediately after bloom and again 10 days later. See pest management schedule for recommended materials and timing.

**Grape Leafhopper** (*Erythroneura comes*) and **Potato Leafhopper** (*Empoasca fabae*): These soft-bodied, elongated insects about 1/8" in length, walk quickly when disturbed and hop when touched. The grape leafhoppers are yellow and white or red and white. The potato leafhopper is light green and has a distinctive side-ways walk. Leafhoppers appear primarily in mid-summer and are found on the underside of leaves, especially young ones. Feeding activity causes white blotches on leaves, leaf curling, and eventual leaf drop.

**Management:** When leafhoppers number 3 or more per leaf, apply an insecticide (preferably when most of the nymphs have hatched). See pest management schedule for recommended materials and timing.

**Japanese Beetle** (*Popillia japonica*) and **Rose Chafer** (*Macrodactylus subspinosus*): These clumsy, large beetles can feed heavily on the foliage of many different plants. Japanese beetles are a shiny copper color, almost round in shape with legs that tend to stick out. They will play dead when disturbed, dropping to the ground. Rose chafers are very similar behaviorally but dull green in color and more oval in shape. They can be found on both leaves and fruit. The feeding damage to leaves results in skeletonizing of the leaves with only the veins left;

injured fruit is unsalable. Japanese beetles are about 1/2" long and copper-colored, with metallic green markings. They feed on grape foliage, skeletonizing the leaves during the mid and late summer. The larvae, or grubs, live in the soil, feeding on roots of grasses.

**Management:** The beetles can be controlled with sprays of Sevin or malathion. Traps are also available which use a sex and/or feeding attractant to capture the adults in a can or plastic bag, but such traps may not provide adequate control. Place traps near, but not in the planting, as traps within a planting may suffer increased localized damage from beetles which are attracted, but do not fall into the trap. See pest management schedule for recommended materials and timing.

**Two-spotted spider mite (*Tetranychus urticae*):** Spider mites are very small (1/50"), insect-like creatures that feed on grape foliage, sucking out plant juices and causing a white stippling or bronzing of the leaves. Under heavy infestations, leaves will turn brown and be covered in a fine webbing. Adults may also move onto the fruit, reducing consumer appeal by their presence. There is currently little available for chemical control of this pest. Foliar sprays of diazinon may suppress populations of spider mites, but this chemical may also reduce populations of natural predators which feed on the spider mites.

**Management:** There have been some reports that soaking sprays of water applied at relatively high pressure may temporarily suppress mite populations. Several companies now commercially produce predatory mites which feed on spider mites. These predators can be released in grape plantings and may provide some control of spider mites, but research is needed to determine appropriate release rates and timing. It is important, however, to encourage natural enemies of spider mites by reducing the use of pesticides which may harm natural enemies. Contact your local Extension Specialist or call (916) 324-4100 for a copy of Suppliers of Beneficial Organisms in North America, an excellent sourcebook for natural enemies such as predatory mites. This reference is also available via the Internet at <http://www.cdpr.ca.gov/docs/ipminov/bensuppl.htm>.

**Grapevine Aphid:** These aphids are dark brown

and about 1/32 - 1/16" in length. They appear on young shoots and leaves during summer months. When abundant, aphids prevent proper extension of shoots, expansion of leaves, and development of fruit.

**Management:** When present, an overhead irrigation system can be used to reduce aphid numbers on the vines. This is not a "tested" method but has been recommended anecdotally. Similarly, spraying with water at high pressure can have the same result: washing the aphids off the vine.

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## Vertebrate Pests

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**Birds:** Birds are a major pest problem in grapes. Left unchecked, they can destroy enough of the crop to ruin the profitability of a vineyard. The loss of chemical deterrents has made bird control a more difficult task in recent times, but effective means are still available.

Netting is the most effective way to keep birds out of the vineyard. Although initial costs can be high, most netting will last for many years if cared for properly. Netting should be hung over some sort of support structure built around the vineyard. Usually posts are set nine feet above the ground around the perimeter of the vineyard, and wire is run from pole to pole to form a grid over the planting. The netting is hung over this grid when the fruit begins to turn color. Some temporary nine foot poles may be placed within the vineyard at intersections of the grid to keep the netting from drooping. Bury the edges of the netting or anchor it to the ground to keep birds from crawling underneath. Remove the netting when the harvest is complete, and store in a cool, dry place.

Visual scare devices have variable effectiveness on birds. Scarecrows, balloons, kites, or stuffed owls may work on certain bird species in certain areas, but none seem to have widespread dependability. When using scarecrows, "scare eye" balloons, stuffed owls, or snakes, put them in the vineyard only when the fruit begins to ripen, and move them regularly, at least once a day. Six scare-eye balloons per acre are recommended. Take them out of the field as soon as harvest is over. This will reduce the chance of birds becoming accustomed to the devices, and increase the longevity of their effectiveness. Kites and helium-filled balloons positioned high above the planting with a silhouette of a hawk

hanging from them have provided good results in some areas.

Noise deterrents, such as propane cannons, alarms and recorded distress calls seem to have the least effect on birds in vineyards, but may greatly annoy neighbors. A combination of noise and visuals may be effective, however. Several operations have hired people to regularly drive motorcycles and/or ATVs through the vineyard when the fruit is ripe, and this seems to keep birds away quite well. Be sure to make drivers aware of where pickers are however, to avoid possible accidents.

Bird Shield™, a new repellent formulated from methyl anthranilate, is currently being registered for use on blueberries, cherries, and grapes. Methyl anthranilate is commonly used as a grape flavoring in human food preparations. Bird avoidance is based on odor quality and irritation. To humans, this chemical has a grape-like or fruit odor and a slightly bitter, pungent taste. Unfortunately, efficacy data do not support recommending this material at this time.

Table 45. Grape pest management schedule†.

<b>Dormant</b>			
<b>Pest</b>	<b>Spray Material, Rate/A (pre-harvest interval)</b>	<b>Cultural Practices and Scouting Notes</b>	<b>Comments</b>
Anthracnose	Lime sulfur solution, 5-10 gal (0)		This dormant application is aimed at reducing overwintering inoculum on canes.
<b>Bud swell (before buds show green)</b>			
Eutypa dieback	Benlate 50WP, 3.2 oz/gal, (50)**	Prune out infected wood early in the season; make cuts well below cankers. Renew trunks every 8-10 years.	Paint or spray on immediately after pruning, before rain, dew, and spores some in contact with fresh wood.  **Existing stocks of <b>Benlate</b> may be used until Dec. 31, 2003.
European red mite and/or scale insects	Superior oil, 2 gal (70-second viscosity) Cythion 8EC, 1 pt (3)	Vinifera and French Hybrids are more susceptible to mites; scout for mites from bud break to 10-inch shoot.	Do not exceed a maximum of 2-3/4 pt of <b>Cythion</b> per acre per year.
Flea beetle	Imidan 70W, 1-1/3 to 2-1/8 lb (14) Sevin 50WP, 2-4 lb (7)		Scout planting for presence of flea beetle before spraying to avoid unnecessary sprays.
<b>Bud break to pre-bloom (after 1/2 inch new shoot growth)</b>			
Black rot	Dithane DF, 1.5-4 lb (66) Elite 45 DF, 4 oz (14) Flint 50 WG, 11-12 oz (14) Abound 2SC, 11.0-15.4 oz (14) Sovran 50 WG, 3.2-4.8 oz (14) Nova 40W, 1.5-2.0 oz	Early control of black rot is important where this disease has been a problem in the past.	<b>Abound:</b> see label for comments on resistance management and toxicity to apple trees. <b>Elite</b> and <b>Nova</b> can be used both as preventative and post infection materials. See label for details and restrictions. Strobilurin fungicides like <b>Flint</b> , <b>Abound</b> and <b>Sovran</b> should not be applied more than 3 time in succession to avoid the development of resistant fungi.