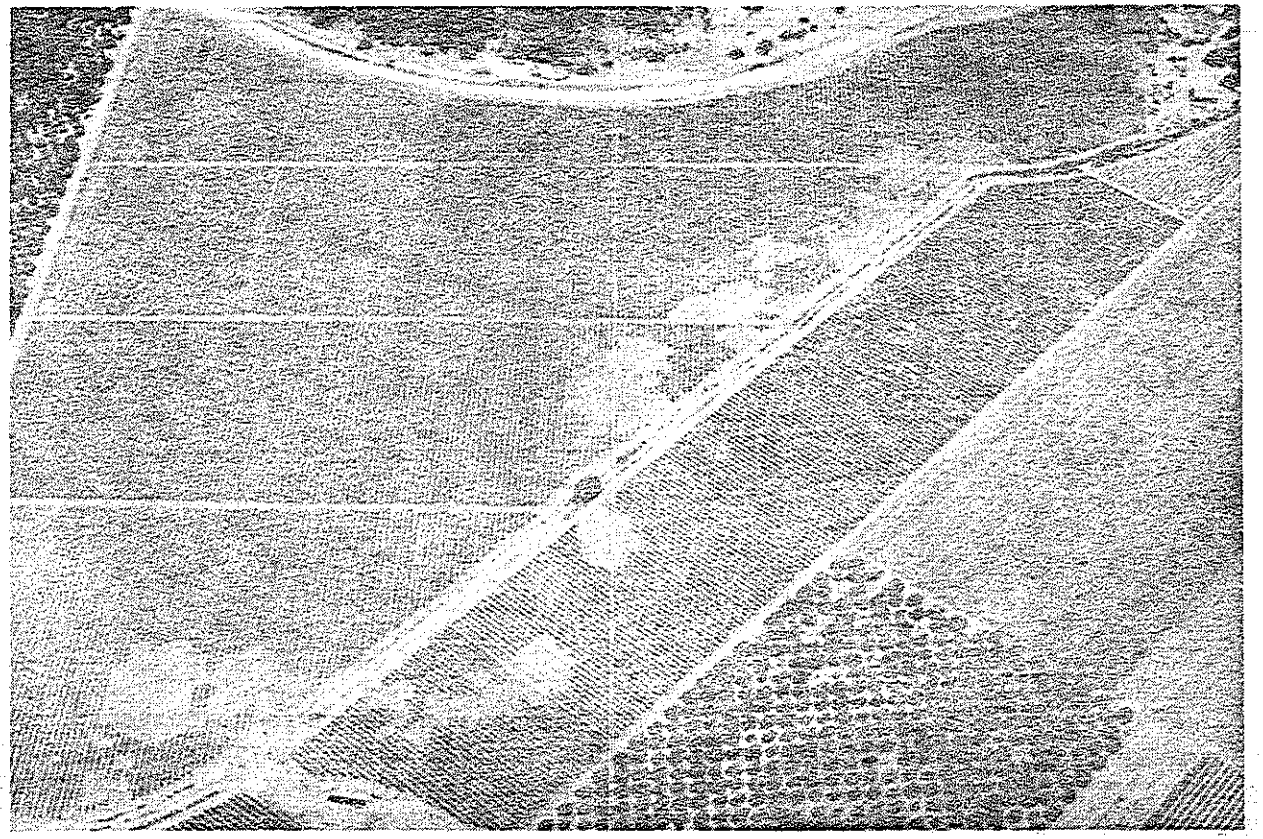
HOW TO APPRAISE AND CORRECT VINEYARD BIOLOGICAL PROBLEMS THAT CAUSE DECLINE



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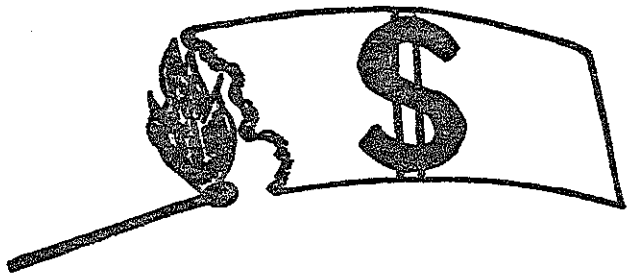
VINEYARD DECLINE--THE PROFIT ROBBER



FRONT COVER: Aerial view showing oak root fungus problem in old stream channel area.

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HOW TO APPRAISE AND CORRECT VINEYARD BIOLOGICAL PROBLEMS THAT CAUSE DECLINE

TABLE OF CONTENTS

HOW TO APPRAISE AND CORRECT VINEYARD BIOLOGICAL PROBLEMS THAT CAUSE DECLINE

WHAT IS VINEYARD DECLINE?

Vineyard decline is a complex problem that can be found in most vineyards. The degree of decline can vary from a few vines to large acreages.

Decline causes economic losses to the grower.

Decline can be caused by soil conditions, poor irrigation practices, nutritional deficiencies or excesses, or biological factors, or a combination of these.

This publication will discuss the common biological factors causing decline.

For information on physical and chemical problems of soil, refer to:

- Systematic Appraisal of Irrigated Coastal Soils for Grapes, Parts I, II, and III (Monterey County publication)
- AXT-n239 Soil Physical Environment - U. C. Agricultural Extension publication
- AXT-417 Diagnosing Soil Physical Problems - U.C. Cooperative Extension publication

WHAT ARE THE BIOLOGICAL FACTORS THAT CONTRIBUTE TO VINEYARD DECLINE?

Common problems that lead to yield reduction, quality deterioration, and profit losses are:

1. Nematodes
2. Phylloxera
3. Viruses
4. Oak root fungus
5. Perennial weeds

HOW ARE THE BIOLOGICAL FACTORS APPRAISED?

There is no single standard approach. The main thing is to arrive at the correct identification of the problem(s) in order to avoid unnecessary expenditures and loss of time and profits.

Laboratory identification may be required. In other cases visual symptoms may suffice. A backhoe is a most helpful tool for looking at root problems and gathering samples. Aerial photographs can be most useful for surveying the extent of the problem.

DETAILED DESCRIPTION AND CONTROLS OF BIOLOGICAL PROBLEMS FREQUENTLY FOUND IN VINEYARDS

PHYLLOXERA--HOW ARE THEY IDENTIFIED?

Check the root system on weak or dying vines. Look for minute, oval or pear-shaped insects. A 10-x magnifying hand lens is needed to see these yellow-green to yellowish brown root aphids. The eggs are shaped like tiny yellow footballs.

Adults have small horizontal lines across their bodies. The adult female can be found on older roots with her eggs piled up around her. See figure 2, page 13.

-Feeding phylloxera cause swelling and distortion on young rootlets, thus destroying them.

-Phylloxera problems are more prevalent on heavier soils: loams ⟶ clay loams; however, phylloxera have caused damage in some sandy loam soils.

Distorted rootlet fed on by phylloxera

-Easiest time to find phylloxera is late summer when the population is the highest.

-Control: If phylloxera are present, then second generation vineyards should be established on resistant rootstock. Some of the common phylloxera-resistant rootstocks used in California are listed in the chart below.

Evaluate your soils and choose the rootstock best adapted to your conditions. For more information, see University of California publications

-AXT-47 Grape Rootstock Varieties

-Leaf. 114 Nematode Resistant Rootstocks for California Vineyards

Chemical controls for phylloxera are being tested; commercial control and vine responses must be demonstrated before growers can use this means of control.

The grape phylloxera attack only grapevines. When converting orchard or row crop land, one may assume the hazard of phylloxera is limited to introduction.

Rootstock	Phylloxera Resistance	Nematode Resistance	Adapted Soils Types
St. George	Very good	None	Heavier
AXR #1	Good	None	Heavier
1613*	Moderate	Root-knot strains	Sandy loams to loams
Dogridge**	Moderate	Good	Sand
Salt Creek**	Moderate	Good	Sand
Harmony**	Moderate	Root-knot strains	Sandy loams to loams

*Lower San Joaquin Valley only
**San Joaquin Valley only

When replanting old vineyards in phylloxerated areas it is safest to assume that phylloxera are present, and resistant rootstock should be used.

Phylloxera can be introduced by contaminated soil or equipment, and by infected rootings.

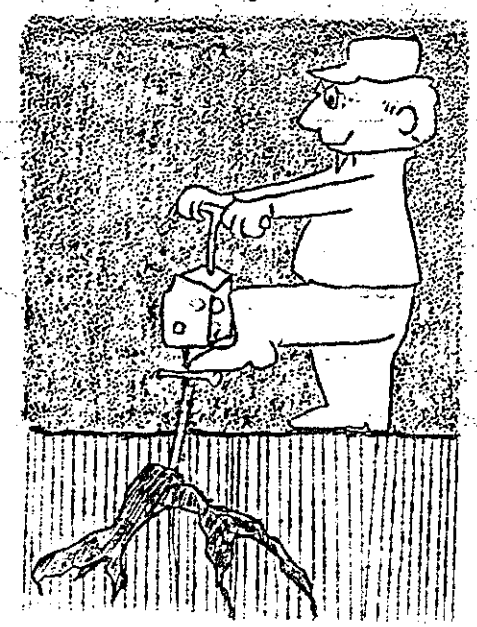
OAK ROOT FUNGUS (ARMILLARIA ROOT ROT)

WHAT TO LOOK FOR

Check the root system on dead or dying vines. Look for whitish to cream colored mycelial growth under the outer bark next to the wood on older roots. (Figure 4, page 14.) Roots on dead vines will have a water-soaked, decayed appearance. Mushroom colonies occasionally may be found at the base of old infected vines. These occur in late winter or early spring following rains. The odor of decaying roots heavily infected with Armillaria will be that of mushrooms.

CAUTION: *Be careful not to spread infected root pieces throughout the vineyard.*

Remove the infected vines and burn in place. Be sure to remove as many of the roots as possible. Usually a backhoe is a helpful piece of equipment that can be used in root removal.



Infected areas of the old vineyard should be pulled out and fumigated before any land leveling, ripping, or other land preparations are attempted.

Avoid spreading this disease by equipment. Most tree crops and all grape varieties and grape rootstocks are susceptible.

Aerial photographs will help in identifying the size of infected locations in existing vineyards or tree crops. (Figure 1, page 13.)

CONTROLS

When removing infected vines in an existing vineyard, be sure to remove one or two healthy vines beyond the infected area.

Soil preparation prior to treatment is important. Be sure the soil is dried out in the entire rooting area. Usually planting of a cover crop such as sudangrass is necessary to dry the soil, especially if the soil is deeper than three or four feet. After the soil is dried, deep ripping is advisable to allow penetration of the fumigant. Work the top soil to break up big clods.

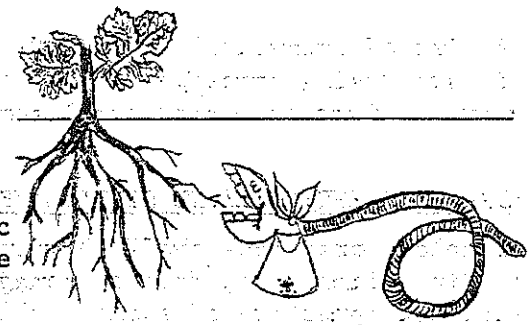
Fumigants registered for use are carbon bisulfide or methyl bromide. Usually, application of these chemicals is made in late fall prior to heavy rain and before soil temperature drops below 55° F. These fumigants are hazardous materials and should be applied by a commercial operator or someone with experience. Rate of chemicals will vary according to soil depth and other soil conditions.

For more information on Armillaria root rot, see University of California publication

-Cir. 525 Armillaria Root Rot of Deciduous Fruits, Nuts and Grapevines

NEMATODES

WHAT ARE NEMATODES?



Nematodes are slender, active, round worms. Parasitic nematodes that destroy grape roots are microscopic in size and cannot be seen with the naked eye. Damage results from feeding on the roots with their hollow, needle-like mouth part, which is used to puncture the walls of the plant tissue and extract the contents.

WHAT DO NEMATODE-INFESTED VINES LOOK LIKE?

Infected vines are stunted and weak with short shoot growth. This weakened condition usually occurs in a fairly large area, not an occasional scattered vine throughout the vineyard. Check the roots of stunted vines. Look for absence of feeder roots, swelling or knots on the larger portion of the root, and distortion on the tips of the rootlets. Compare figures 6 and 7 on page 14.

Microscopic laboratory identification of the species present is important for determining the proper chemical control measures or the rootstock to be used.

WHAT NEMATODE SPECIES CAUSE DAMAGE IN CALIFORNIA VINEYARDS?

The common and scientific names of important nematodes in vineyards are as follows:

Common	Scientific
Root Knot:	
Cotton	*Meloidogyne incognita*
Javanese	*M. javanica*
Root Lesion	*Pratylenchus vulnus*
Dagger:	
American	*Xiphinema americanum*
(none)	*X. index*
Citrus	*Tylenchulus semipenetrans*

WHAT IS THE BEST WAY TO SAMPLE FOR NEMATODES?

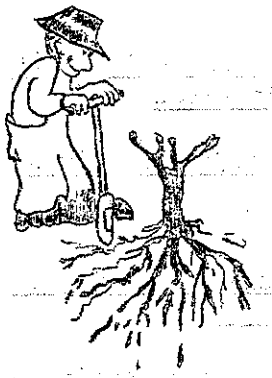
Doug Johnson, University of California Extension plant nematologist, suggests the following "Do's" and "Don'ts" for taking nematode samples:

DO take moist soil for a nematode determination.

DON'T expect to find nematodes in dry soil. When taking soil samples for a nematode determination, dig into moist soil--discard the air-dry surface layers. Sample trees and vines in the root zone within 1 or 2 feet of the tree or vine, at a depth of between 6 and 18 inches--deeper if necessary to obtain moist soil. Include roots if possible.

Sample row crops in the root zone in the bed at a depth of between 6 and 18 inches--deeper if necessary to obtain moist soil.

Sample bare ground at a depth of 6 to 18 inches --deeper if necessary to obtain moist soil.



Sample with a soil tube or shovel. If using a tube, take 10 to 20 cores from the area sampled--enough to make approximately 1 quart of soil. If using a shovel, take approximately 1/4 cut of soil from near the shovel tip; sample several locations collecting enough soil to make approximately 1 quart of soil.

Sample weak areas in a field on the margins of the spot--the region between the normal and the weak areas. Include roots when possible. A greater number of soil cores in a small area is better for determining the nematode situation in a field.

DON'T include more than 10 acres in a single sample.

DON'T store samples in the sun or in a hot car any longer than necessary. Most of the nematodes are killed at temperatures above 110° F.

If possible, collect and ship soil samples in plastic bags. This will reduce the possibility of the sample's drying in transit.

DON'T ship samples by mail on Thursday or Friday, particularly during the summer, as they may sit in a hot post office over the weekend and the heat will "cook" the nematodes. If a sample is to be held over a weekend, store it in a refrigerator and send out on Monday morning.

LABEL the samples adequately.

WHERE SHOULD NEMATODE SAMPLES BE SENT FOR IDENTIFICATION?

A list of commercial laboratories that specialize in processing nematodes can be obtained from your farm advisor or agricultural commissionner's office.

WHAT ARE THE PREPLANT CONTROL MEASURES?

Preplant practices should be directed toward providing clean soil, free of damaging nematodes. The cultural practice of summer fallowing and deep plowing prior to planting is helpful.

Proper soil preparation before chemical controls is the key to success. It is important to break up any restrictive soil barriers, such as plow soles or hard pans, so the fumigant can penetrate. Be sure to deep rip or slip plow the soil when it is dry. It may be necessary to plant a deep-rooted crop, such as sudangrass, in the spring to extract the deep soil moisture.

After ripping and deep plowing, break up the large clods and smooth the soil before chemical application.

The best time to apply preplant fumigants is in the early fall before heavy rains and before the soil temperature drops below 50° F at the 6-inch depth. One of the fumigants normally used for preplant treatment contains 1,3-dichloropropene (1,3-D) as the active ingredient. Commercially this is marketed as D-D®, Telone®, and Vidden D®. The rate of application varies as to previous crop history, soil

® Indicates registered trade name.

texture, and soil depth. Applications are usually done by a commercial operator. Remember to apply 1,3-D early. On light soils a waiting period of at least one week for every 10 gallons of fumigant is required between treatment and planting. Heavy soils require a longer waiting period. Early fall rains causing wet, cold soils require an even longer waiting period before planting. Damage to the new plants can occur if the waiting period is not adequate.

Methyl bromide (CH_3Br) has been used in recent years for preplant fumigation, especially following removal of old vineyards that were infected with fan leaf virus or oak root fungus. The nematode Xiphinema index can spread fan leaf virus; therefore, it is especially important to eliminate these nematodes.

Rates of 250 to 400 pounds per acre of methyl bromide have been used, usually mixed with chloropicrin. A polyethylene tarp is used to cover the treated field. This slows the escape of the fumigant. *Methyl bromide is a hazardous material and should be applied only by an experienced applicator.*

WHAT ABOUT NEMATODE-RESISTANT ROOTSTOCKS?

Resistant rootstocks are being used to establish second generation vineyards. Also, nematode-resistant rootstocks can be used as replants to establish good vines in a sandy, weak, nematode-infested area. Choice of rootstocks is determined by soil type, nematode species present, and proven performance in a given vineyard district.

The common nematode-resistant rootstocks used in California are Dogridge, Salt Creek, Harmony, and 1613. Dogridge and Salt Creek stocks are good in very sandy areas but can cause a vigor problem on fertile soils. Harmony is a relatively new stock that appears promising. The 1613 rootstock does not produce good quality grapes in the coastal district and results in poor vine growth in the northern San Joaquin Valley. In the lower San Joaquin Valley it has been variable in performance.

All rootstocks must be budded or grafted to the desired variety.

The easiest method for replacing vines in a small nematode-infested area within an established vineyard is the use of bench grafted vines.

For more information on nematodes, see University of California publications

- -Cir. 533 Nematodes and Their Control in Vineyards
- -Leaf. 114 Nematode Resistant Rootstocks for California Vineyards
- -AXT-47 Grape Rootstock Varieties
- -Leaf. 153 Field Budding and the Care of the Budded Grapevine

WEED PROBLEMS

HOW DO WEEDS AFFECT VINEYARDS?

Weeds affect vines primarily through competition for water, nutrients, and in some cases, sunlight. However, some weed species make it nearly impossible to harvest the vines cleanly.

WHAT ARE THE COMMON WEEDS WHICH LEAD TO VINEYARD DECLINE?

For the most part, the perennial weeds--field bindweed (morning glory), bermudagrass, Johnsongrass and, in some cases, yellow or purple nutsedge--are the problem weeds. Annual weeds can be a problem but are more easily controlled with tillage or appropriate herbicides.

HOW ARE FIELD BINDWEED, JOHNSONGRASS, OR BERMUDAGRASS CONTROLLED?

Field Bindweed

A safe and effective post-plant method of controlling field bindweed is now possible with the application of trifluralin by subsurface layering. The herbicide is applied by means of a spray blade, or disced to a soil depth of 4 to 6 inches. Other methods have given a degree of control; however, only the spray blade is currently labeled for use.

Preplant control of field bindweed has allowed near eradication in many cases. Rates of preplant fumigants (Methyl bromide and 1,3-D) used to kill nematodes are quite effective in killing the perenniel root structures but not the seeds. Since seedlings grow rapidly, care should be taken to control them with annual weed control herbicides or cultivation before the seedlings re-establish their perennial structures. (Fumigation for bindweed

control is not yet legal, but fumigation for nematodes is--and control of both nematodes and bindweed is possible.)

Repeated applications of 2,4-D may be effective. Check with your county agricultural commissioner to determine if it can be used in your area; a permit is required.

Johnsongrass and Bermudagrass

Frequent discing will keep Johnsongrass or bermudagrass in check in the centers of the rows; but hand labor, row plowing, herbicides, or a combination of all three may be necessary for control in the vine rows. In some instances growers have had success with weeder geese. Some crop loss can result if the geese are left in the vineyard after the fruit begins to sweeten. Geese have not been used extensively in vineyard weed control.

Dalapon, a partially effective herbicide, will control both grasses if applied monthly at low rates. CAUTION: *Care should be taken to keep Dalapon spray off grapevines. Be sure to direct the spray onto the bermudagrass and don't allow runoff to reach the soil. Dalapon should be applied soon after irrigation to allow breakdown of the herbicide before the next irrigation.*

The mechanical incorporation of trifluralin (during the dormant season) has helped to control Johnsongrass and bermudagrass in University of California field trials. With repeated annual use, stands have been greatly reduced with no hazard to vine growth other than possible damage from the row plow.

For more information on weed control, refer to University of California publications

- -Leaf. 216 Chemical Weed Control in Vineyards
- -MA-41 Bindweed Control in Vineyards
- -MA-66 Sprayblade Application for Bindweed Control
- -MA-64 Soil Fumigation for Bindweed Control

VIRUS DISEASES

HOW DO VIRUS DISEASES AFFECT VINEYARDS?

Many of the viruses cause a gradual decline that reduces yields and fruit quality and shortens the life of the vineyard. Worse yet, some do a great deal of damage to the vineyard before growers discover the cause. In some cases, the virus-diseased vines appear quite thrifty because the very low yields reflect an invigorating influence.

WHAT ARE THE COMMON VIRUS DISEASES THAT CAUSE PROBLEMS IN CALIFORNIA VINEYARDS?

Fan leaf, yellow mosaic, vein banding, yellow vein, leaf roll, and corky bark are all common in California. However, symptoms vary considerably among varieties and often change as the growing season progresses. Tables on pages 10, 11, and 12 describe early and late season symptoms, expected economic importance, prevention, etc., for the common virus diseases. It is not easy to identify specific virus diseases unless one has had previous experience.

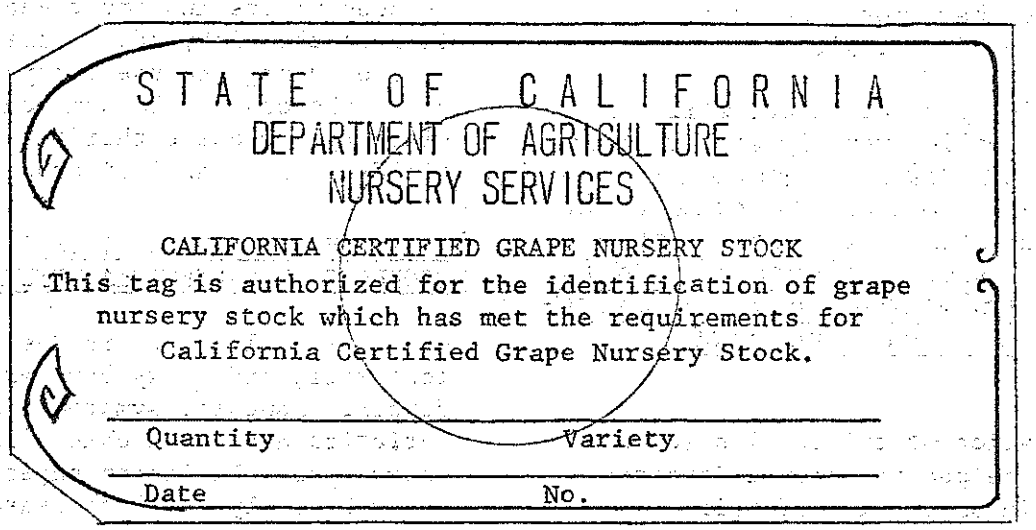
HOW ARE VIRUS DISEASES PREVENTED?

Primarily, virus diseases are prevented by establishing new plantings with certified virus-free planting stock which is obtained from nurserymen who are in the Grapevine Registration and Certification Program. The grower will receive a blue tag indicating that these vines are certified. See illustration below.

For fanleaf, yellow mosaic, vein banding, and probably yellow vein virus diseases (the fanleaf complex), replanting with virus-free stock is not enough. This is because the aforementioned viruses are soil borne, and the nematode species Xiphinema index (dagger nematode) has been shown to transmit the virus disease to new plantings. Preplant fumigation is necessary when both the virus and nematode are present to insure against rapid reinfection of the replanted vines.

Refer to the section on nematodes for control procedures.

Further information on virus diseases in grapevines may be found in the textbook, "Virus Diseases of Small Fruits and Grapevines," published by the University of California Division of Agricultural Sciences.



Virus Disease	Economic Importance	EARLY SEASON SYMPTOMS			LATE SEASON SYMPTOMS			Transmission	Prevention
		Leaves	Shoots	Flowers	Leaves	Shoots	Crop		
Fanleaf	Very severe reduction in yield; straggly clusters	Deformed, fanlike appearance; light mottling of the young leaves	Stunted, retarded early growth; shoots slender and tend to zigzag at nodes	Clusters usually small and shell badly; in advanced cases the flower clusters wither away	After early summer, new leaves are normal	Invigorated mid-season growth, early maturity of canes. Often double nodes and short internodes	Very straggly clusters; some vines have no crop--others very poor	Nematode--*Xiphinema index*; infected propagation wood and rootstocks	Use certified virus-free planting stock. Preplant fumigate with high rates of 1,3-D
Yellow mosaic	Very severe reduction in yield; straggly clusters	Chrome yellow coloring, ranging from mottling, speckling and spattering of light or pale yellow to complete yellowing of leaves	Yellow colored shoots; marked stunted growth	Flower clusters may be yellow; the flowers usually shell off	As leaves age, some of the yellow is replaced by green and some fades to a cream color that later bleaches and finally burns and dries up	Markedly stunted vines	Usually little or no crop is produced	Same as fanleaf	Same as fanleaf

Virus Disease	Economic Importance	EARLY SEASON SYMPTOMS			LATE SEASON SYMPTOMS			Transmission	Prevention
		Leaves	Shoots	Flowers	Leaves	Shoots	Crop		
Vein banding	Severe reduction in yield; shot berries and very straggly clusters			Excessive flower shell off, set of many shot berries	After mid-summer leaves show a light green or chrome yellow banding of the veins	Markedly invigorated vine due to low yield	Reduced crop, very straggly clusters	Soil-borne; thought to be spread by nematode Xiphinema index, infected scion wood, and rootstocks	Same as for fanleaf
Yellow vein	Ranges from only slight reduction in yield to entirely fruitless vines				Range from a yellow speckling in the palm of the leaf to a distinct yellow vein banding. Most frequent on lower 10 leaves	Markedly invigorated vine due to low yield	Except for seedless varieties, very straggly clusters, with some to nearly complete shot berries. Some vines fruitless	Thought to be soil-borne; known to be spread by infected propagation wood and rootstocks	Use certified planting stock. Preplant fumigation thought to be necessary

Virus Disease	Economic Importance	EARLY SEASON SYMPTOMS			LATE SEASON SYMPTOMS			Transmission	Prevention
		Leaves	Shoots	Flowers	Leaves	Shoots	Crop		
Leaf roll	Up to 25% reduction in yield. Reduced quality due to poor sugar; poor color in red varieties				Sometimes a distinct downward roll of leaf margins and interveinal chlorosis; (sick yellow for white varieties but red for colored varieties)	Reduced vine vigor	Reduced sugar; poor color development in colored grape varieties	Infected propagation wood and rootstocks	Use certified planting stock
Corky bark	Low vigor and productivity	Leaves smaller than normal. In some varieties the young leaves at the shoot tips are light yellow	Reduced vigor; budding out in spring may be delayed, and some vines show dead spurs		Leaves smaller, become pale earlier, roll downward, and persist on the vines after those on normal vines have abscised (leaves of red fruited varieties may turn red)	The bark of the current season's growth splits, with cracks running down the length of the canes. The shoots are limber and mature irregularly with green and brown areas mixed. Shoots have droopy look but shoot tips are upright	Significant crop reduction	Infected propagation wood and rootstocks	Use certified planting stock

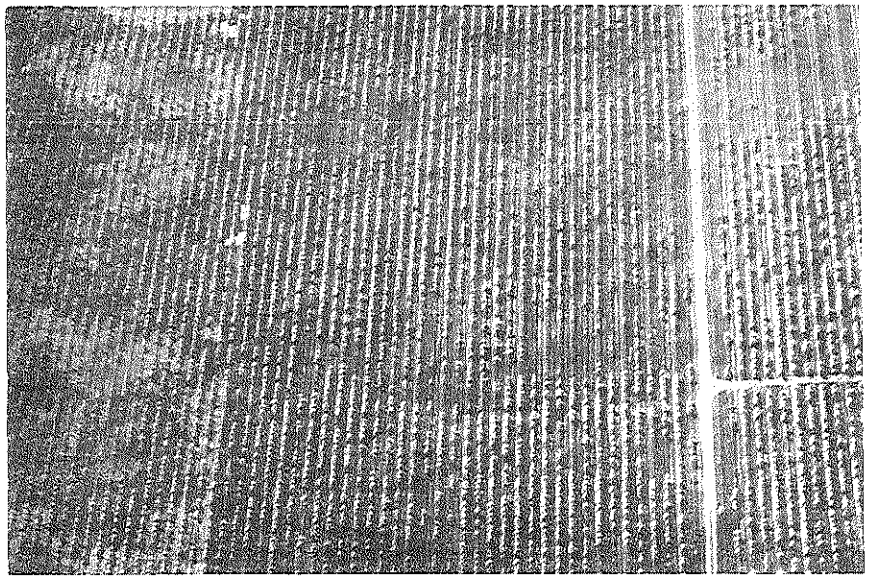


Fig. 1 Aerial photograph used to identify the weakened and missing vines caused by decline.

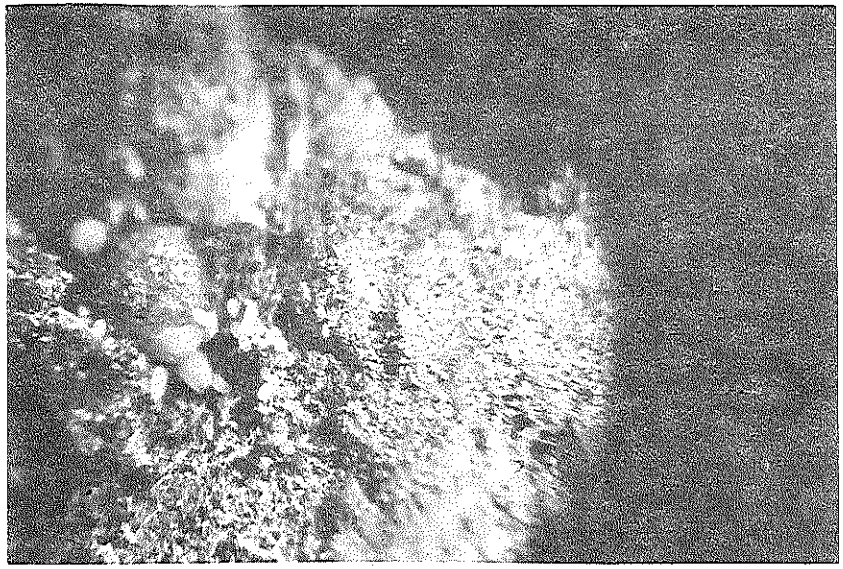


Fig. 2 Female phylloxera surrounded by eggs. Magnified 10 times.
(Photo by H. Kido)

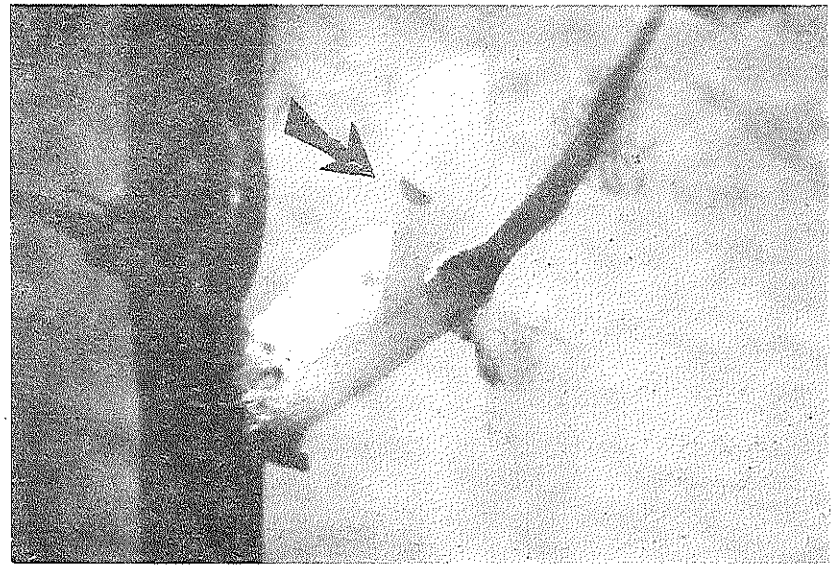


Fig. 3 Deformed rootlet caused by phylloxera (arrow) feeding.
(Photo by A. Marin)

Fig. 4 Oak root fungus mycelium on a grape root. Note bark removed to expose whitish mycelium which develops between the wood and bark.

Fig. 6 Roots injured by nematode feeding. Note the distorted tips and the knots on the larger root. (Photo by D. J. Raski)

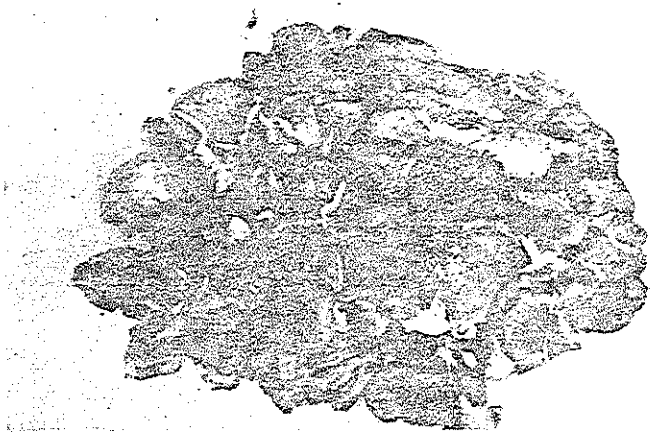


Fig. 5 Typical oak root fungus mushrooms.

Fig. 7 Healthy grapevine roots. (Photo by D. J. Raski)

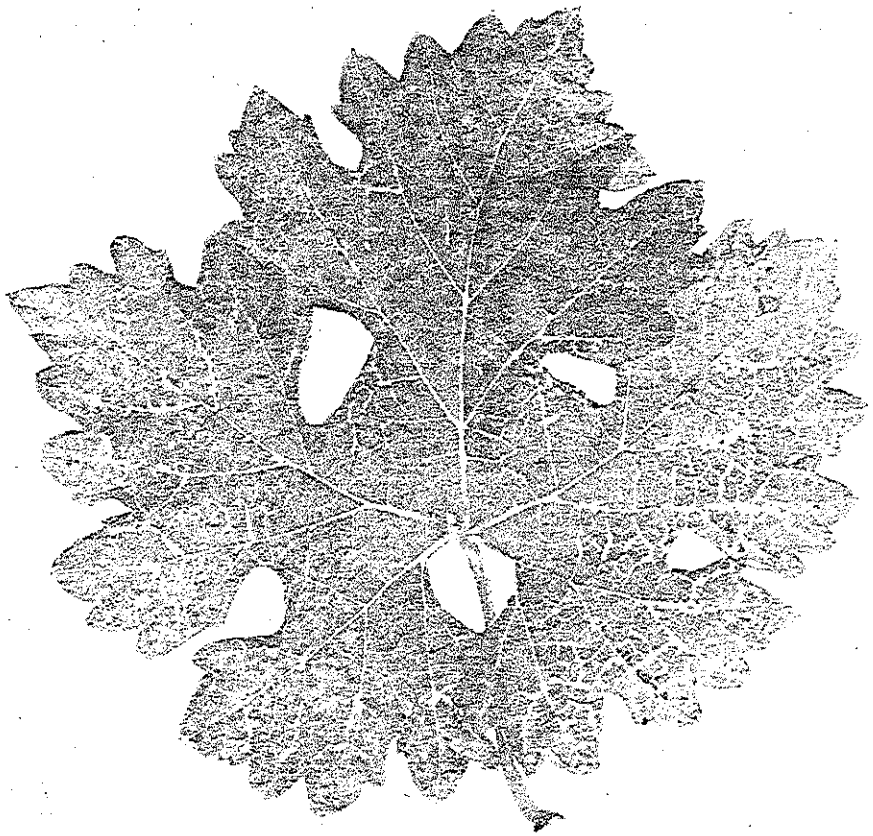


Fig. 8 Vein banding virus. The lighter areas along the veins are the symptoms to look for.
(Photo by A. C. Goheen)

Fig. 9 Leaf roll virus. Symptoms are a downward rolling of the leaf margin, with colored varieties turning red, and white varieties a sick yellow.
(Photo by A. C. Goheen)