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Preplant Considerations for New Vineyards

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Introduction

Rootstock choices, soil fumigation, irrigation methods and soil ripping are examples of interrelated subjects which must be considered when replanting a vineyard. The choice of a rootstock is determined by the anticipated soil pest(s) but also influenced by soil texture and scion variety. The decision to fumigate is based on the presence of soil pests but is impacted by cropping history and the potential for soil pests build-up. The decision to install low volume irrigation is usually based on water conservation concerns, but soil pest problems can be reduced by more frequent irrigation and better fertilizer placement and timing. Additionally, soil pests are more effectively controlled with applications of products through a dripper system. A guideline for preplant decision-making is presented in the two tables attached.

Soil Texture

This is an important consideration in variety and rootstock selection due to its effect on vine growth and potential nematode and/or phylloxera damage. Soil texture largely influences vine growth due to its effects on water holding capacity and nutrient availability. Generally, finer-textured soils have a higher water holding capacity and higher native fertility thereby producing vines of higher growth potential as compared to sandy soils. Thus, own-rooted vines in absence of phylloxera and rootstocks of moderate vigor such as Harmony will perform satisfactorily in fine textures. In contrast, a high vigor rootstock such as Ramsey is usually of excess vigor on sandy loams and loams but is well suited to loamy sands and sands.

Soil texture also influences pest pressure by its effect on nematode and phylloxera movement. Sandy soils are more conducive to nematode build-up and damage for a number of reasons. However, some nematodes such as citrus nematode commonly occur in clay soils. Phylloxera is better adapted to fine textures apparently due to the soil's tendency to shrink and crack upon drying, providing for greater phylloxera movement. The rule of thumb for over a half-century has been "Nematodes in coarse-textured soils; phylloxera in finer-textured soils". Soil Conservation Service and University of California published soil maps are available to describe soil types and textures throughout much of California.

Cropping History

Land having a recent history of susceptible, shallow-rooted annual crops can leave an abundance of root knot nematodes in the soil. For example, California-selected alfalfa cultivars are good hosts for a specific root knot nematode, *Meloidogyne hapla*. Acala-type cotton, by contrast, is a specific host for *Meloidogyne incognita* race 3, a more damaging nematode to grape than *M. hapla*. The ability to predict nematode damage is based as much on cropping history and soil texture as it is on nematode population levels at planting time. In the absence of live roots the egg or survival stages of many nematode species can be expected to persist another 18 months after annual cropping.

The woody roots of old grapes or other perennials provide a large, residual habitat to a diversity of nematode species. This habitat may not disappear for as many as ten years after old vines are removed. Deep soil ripping helps to hasten the disappearance of root systems as well as improve the movement of water through the modified soil profile. If one replants grapes on nonfumigated, nonripped soil after any other perennial crop common to Central California, the new vines commonly show irregular growth as early as July of the first year. The lack of uniform growth will be accentuated by soil streaks and the presence of known soil pests. This situation is referred to as the replant problem. Old vineyard sites having a history of grape fan leaf virus or old tree sites with a history of root lesion nematode can pose especially serious replant problems for vineyardists.

Regional Differences

There are subtle differences in the makeup of soil pest populations depending on location. This can be a result of where and when the pest was first introduced as well as pest preference for specific soils, climates or crops. From Lodi to Mexico and from Salinas to Santa Barbara, the warm weather root knot nematodes (*Meloidogyne* spp.) are common. With the exception of the Coachella Valley, this is also a suitable habitat for root lesion nematodes (*Pratylenchus valnus*). The citrus nematode, *Tylenchulus semipenetrans* is most common in locations where citrus orchards are common. *Xiphinema index* is most damaging in coarse-textured soils but is most common in sites where rootings of exotic planting material have been introduced. The ring nematode (*Criconemella xenoplax*) is most common in the sandiest of soils wherever root knot nematode may also occur. Phylloxera, *Daktulosphaira vitifoliae,* damage is most apparent in shallower soils and fine-textured soils but it has wide distribution in the San Joaquin Valley and the Central Coast.

Choosing a Rootstock

No grape rootstocks available today will provide complete resistance to all root knot nematode populations. Biotype or pathotype problems should be expected if the rootstock to be replanted has parentage similar to a previously planted rootstock (e.g. previously 1613C planted to harmony or Freedom). In land without a history of rootstocks, Harmony or Freedom do well about 85% of the time. There are some root knot populations that reduce vigor of Harmony and Freedom but do not cause visible root galls. There are other root knot populations that cause obvious galling on all commercially available rootstocks. Evidence indicates that these aggressive root knot nematode pathotypes are being selected out of the existing vineyard rather than being transported into it.

The most popular Central Valley rootstocks tend to be invigorating. An overly vigorous vine can adversely influence fruit maturation and wine composition as well as reduce vine fruitfulness, berry numbers and size and overall yields. Trellising, reduced irrigation and fertilizers, or increased bud numbers are methods for managing excessive vigor.

Durability of Root Knot Nematode Resistance

The breaking of root knot nematode resistance among Harmony, Freedom and Ramsey rootstocks can occur 10 to 20 years after replanting or much sooner if the land was previously planted to 1613 rootstock. This loss of resistance is occurring on the sandiest soils but not necessarily on finer textured soils. On sandier soils there are also a number of examples when 40-to 50 year-old Thompson Seedless are exhibiting a greater incidence of galled roots, with galls spaced within a quarter of an inch of each other on new roots. A loss of resistance means that members of the nematode species which were previously unable to reproduce on the rootstock are now able to reproduce on it. These newly created pathotypes are typically more aggressive than the previous population.

In crops such as citrus, walnut and peach there are examples of rootstocks with resistance to root knot nematode lasting 40 years and longer. When aggressive root knot nematode populations from Harmony, Freedom or 1613 are placed onto Nemaguard Peach the nematodes do not reproduce.

Thompson Seedless and Harmony and especially Freedom and Ramsey also possess tolerance of nematode feeding. That is, it takes a great deal of nematode feeding and root galling before vine damage becomes noticeable.

By 1995 we have numerous vineyard examples of resistance breakage by root knot nematodes. There are also several examples of dwindling tolerance among Harmony and one example each of this occurrence with Freedom and Ramsey.

Pre-plant Soil Preparation

Fumigation - this treatment, properly applied, will kill old roots and partially sterilize the surface 5 to 6 feet of soil profile. Nontarped treatments perform best if one year of fallowing precedes a fall treatment.

Dry Fallowing - this treatment may require 1 to 4 years while waiting for a sufficient number of the roots of previously planted crops to die. A wet fallowing is expected to rot roots and hatch soil pests faster as long as no weeds are permitted to develop.

Ripping - This practice enables one to dislodge and remove old roots and improve water infiltration. The breakup of hardpan and soil compaction will also enable better root distribution of the new vines. Slip plowing or deep plowing are alternatives to ripping.

Alternatives to Fumigation and Fallowing

It has been postulated that by growing nonhost crops for the soil pests of concern it may be possible to irrigate the land and more rapidly rot old roots. Unfortunately, the choices of non-host crops are limited due to the wide host range of root knot nematodes and the numerous types of nematodes which can damage grapevines. For the most recent list of non-host and resistant crops, refer to Phytonematology Study Guide, University of California DANR and Cooperative Extension Publication 4045. The future use of our principal preplant soil fumigants is in question. Less volatile soil treatments are under study as possible replacements.

Summary Recommendations

Soil pest management options for vineyard establishment are becoming increasingly expensive and limited. One needs to consider the long-term nature of the investment. Costs must be spread over the vineyard's life, along with trellising and irrigation system costs. Therefore, the best investment is usually the one that includes optimum protection over a 20+ year vineyard life. However, it is equally important that the pest suppressive benefits of a rootstock or soil treatment also exhibit longevity.

The benefits and economic value of good soil preparation and pre-plant fumigation are fairly obvious. Unfortunately, rootstock choices are somewhat limited, and their long-term benefits may change with changing nematode species and biotype. The value of rootstocks is the soil pest resistance and tolerance they provide after the vineyard is established. Rootstocks are essential for phylloxera and nematode problems where soil texture and pest history assure a problem.

To maintain resistance mechanisms in rootstocks, do not replant vines having parentage similar to that of the previous vineyard. If there is a high incidence of root galling and vine damage on the old Thompson Seedless roots do not replant Thompson Seedless. Do not replant Harmony, Freedom or Ramsey after each other or after 1613 rootstock that has failed due to root knot nematodes in sandy soil. Consider a crop other than grapes where the above situations are expected.

When replanting grapes anywhere a soil pest problem has developed and regardless of the rootstock choice, soil fumigation is the only known method for killing old roots and the nematodes within. It is the old roots that can provide a decade-long source of nematode reinfection to the new replants. Nematode populations present where resistance has been broken are more aggressive than other more common populations. Although rootstocks are relatively expensive, they do not obviate the need for a soil fumigation where soil pests have become a problem. The use of approach grafting or interplanting with resistant rootstock should only be attempted when true, durable resistance becomes available.

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Table 1. Considerations when planting a Central to Southern California vineyard.

Situation	Land History Scenario	Soil Texture	Scion Variety (see Table 1)	Preplant Soil Preparation Options			Rootstock Selection[1]
				Fumigate[2]	Fallow	Other	
1	Previously annual crops susceptible to root knot nematode (e.g., cotton, bean, tomato, melon)	fsl or finer[3]	any	low rate	1 yr.	rip and plant[7]	OR[3]
		sl	3	low rate	1 yr	rip and plant[7]	OR
			1,2	low rate	1 yr.	rip and plant[7]	H,5C[5]
		ls	3	low rate	2 yrs.	---	OR
			any	low rate	1 yr.	--	F,5C[5]
		s	any	low rate	1 yr.	--	F,R,5C[5]
	Annual crops which are poorer nematode hosts (e.g. alfalfa, VFN tomato, many cereals, or rangeland)	fsl,sl	as above	--	--	rip and plant[7]	as above
		ls,s	as above	--	1 yr.	--	as above
2	Replanting an own-rooted vineyard or kiwifruit site, nematode present but not phylloxera	fsl	any	normal rate	4 years	3 yrs. alfalfa or nonhost	OR
		sl	any	normal rate	4 years	3 yrs. alfalfa or nonhost	H,F,5C[5]
		ls,s	any	normal rate	4 years	3 yrs. alfalfa or nonhost	F,R,5C[5]
3	Replanting a vineyard previously grafted onto 1613,H,F,R,DR	fsl	any	normal rate	4 years	3 yrs. alfalfa or nonhost	H,5C[5],F
		sl,ls,s	any	normal rate	4 yrs.	3 yrs. alfalfa + 1 yr. sudan	Bioassay with various rootstocks for nematode development
4	Replanting after citrus, olive or grape with citrus nematode (phylloxera may be present)	any	any	normal rate	4 yrs.	3yrs., many nonhost crops	F,5C[5],3309[5]
5	Replanting after walnut, stone fruit, or apple; root lesion present	any	any	normal rate	4 yrs.	3 yrs. alfalfa or nonhost	F,H
6	*Xiphinema index* present	fsl,sl	any	normal rate	4 yrs.	3 yrs. alfalfa + 1 yr. sudan	H
		ls,s	any	normal rate	4 yrs.	3 yrs. Alfalfa + 2 yrs. Sudan	F,R
	GFLV also present[6]	any	any	--	10 yrs.	--	H,F or consider 039-16[5]
7	Phylloxera present with any important nematodes	fsl or finer	any	normal rate	4 yrs.	3 yrs. many nonhost crops	H,5C[5], 3309[5]
		sl or coarser	any	normal rate	4 yrs.	3 yrs. alfalfa or nonhost	F,H,R

[1]OR = own root; H = Harmony; F = Freedom; R = Ramsey (Salt Creek); 5C = Teleki 5C; 3309 = Coudere 3309; DR = Dog Ridge; 039-16 = VR 039-16.
[2]1 yr. of fallowing before fumigation is preferred.
[3]fsl = fine sandy loam, sl = sandy loam, ls = loam sandy, s = sand.
[4]Rootstocks may be used in place of own roots to impart vigor in varieties such as Redglobe, even though nematodes are not a problem; they may also be used in very fine soil to protect from phylloxera.
[5]5C, 3309, and 039-16 have very limited field experience.
[6]GFLV refers to Grape Fan Leaf Virus which is transmissible with *X.index.*
[7]If nematode samples reveal more than 20 nematodes/250 cm3 soil sample, do not just rip and plant.

Note: Drip irrigated vineyards are more tolerant than furrow irrigated vineyards to stress associated with nematode damage.

Table 2. Ranking of scion varieties and their potential for nematode damage on their own roots.

1. Highly Susceptible Scions	
Higher Vigor	**Lower Vigor***
French Colombard	Muscat of Alexandria
Flame Seedless	Chardonnay
Cabernet Sauvignon	Alicante Bouschet
Ruby Seedless	Italia
Carignane	Redglobe
Ruby Carbernet	
*Rootstock to impart greater vigor should be considered.	
2. Susceptible Scions	
Black Corinth (Zante Currant)	
Black Monukka	
Fiesta	
Chenin blanc	
Christmas Rose	
Zinfandel	
3. Scions known to exhibit some field tolerance to root knot nematode	
Thompson Seedless:	root penetration ability of root knot is reduced.
Rubired:	poor nematode development on roots 5 months or older but highly susceptible to *X. index* in coarse soils.
Perlette:	similar to Thompson Seedless except large galls may occur.
Emperor:	reduced rates of root penetration.
Grenache:	highly susceptible to ring nematode but tolerant of most root knot populations.
Barbera:	some unknown mechanism to limit root knot nematode development.
Tokay:	some unknown mechanism to limit root knot nematode development.