

Using Rootstocks to Enhance Grape and Wine Quality and Vineyard Sustainable Practices

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Understanding the capabilities and limitations of rootstocks helps us choose rootstocks appropriately. We can use information about a vineyard site, management practices, the natural habitat and environmental adaptation of grape species, and selection criteria for grape rootstocks to guide us in deciding which rootstocks would be suitable for a particular vineyard. The most important reason to use rootstocks is for pest and disease management. It can be expensive and difficult to use pesticides to manage pests and pathogens in the soil and pesticides often must be repeatedly applied in order to continue the management effect. Rootstocks can provide sustainable, economical management of pests and diseases for the lifespan of the vineyard and contribute to enhancing grape and wine quality.

Rootstocks were first used for grapes because of phylloxera, a root-feeding aphid. Phylloxera can kill grapevines of the species *Vitis vinifera*, which includes the varieties Cabernet franc and Chardonnay. Following the accidental introduction of phylloxera to Europe in the 1800s, thousands upon thousands of acres of vineyards were devastated. Scientists recognized that phylloxera was introduced from North America. They reasoned that if the wild grapes of North America grew in areas infested with phylloxera without damage, the roots of these wild vines must be, in some way, resistant to phylloxera. Extensive experimentation followed to identify which selections of North American grapes and their hybrids were suitable for use as rootstocks in European vineyards. Pest and disease protection provided by grape rootstocks is the central reason that we use them in viticulture. Unlike other fruit crops, in which rootstocks are useful for propagation or stringent size control, the pest and disease resistance of rootstocks is the most important reason that grape rootstocks are used. Providing protection against pests and diseases with the choice of the appropriate rootstock is economically and environmentally sustainable.

The rootstock is the primary interface between the scion variety and the soil, moderating the interaction between them. Rootstocks take up water and nutrients from the soil and provide them to the scion. The rootstock influences the scion through increasing and decreasing scion vigor and vine size (among other influences). One goal of the grape grower is to promote sufficient growth of the scion in order to reliably produce a suitable and sustainable crop. Too much growth and the thicket of vines is difficult to pick and prune. The dense foliage shades the fruit and limits the distribution of pesticides in the canopy. Overly vigorous vines can have problems with floral initiation and fruit set. Vines that keep growing too late into the fall can have problems with winter hardiness. Not enough growth and the vine may fail to adequately ripen the crop. The goal is to reach a "just right" level of vine vigor and size.

Rootstock varieties and sites come in a range of vigor capacities. Since the rootstock and site in turn influence scion, the site should be considered in selecting a rootstock. Characteristics that influence site vigor include effective rooting depth, soil chemistry, soil particle size, slope, water holding capacity, drainage, precipitation, climate, and site history. Management practices that influence the site contribution to vine vigor and size include irrigation, fertilization, weed control, and structural modifications (such as ripping). Rootstock features that influence vine vigor and size include root architecture and distribution, drought adaptation, nutrient uptake, and even the resistance to pests and diseases. Other management practices, such as training and trellising choices, help direct the vigor of a scion that results from a particular site and rootstock. Account for the contributions of rootstock, site, and management

practices when deciding on the rootstock variety. Complement the site and management practice contributions with the rootstock—the management practices can be changed, but the rootstock choice is with you for the life of the vineyard.

Rootstocks can influence yield and berry characteristics, which in turn can influence grape and wine composition. Fruit set can be increased or decreased by rootstock variety (Delas et al. 1991); Rupestris St. George and 110R are used in California as a rootstock for the wine grape Zinfandel to encourage loose clusters (Christensen et al. 2003). Rootstocks can influence berry size, a factor in determining concentrations of anthocyanins, flavors, and aromas in wine (Nicholas, 1993). Rootstocks act directly and interact with management practices, such as training system, trellis, fertilization, irrigation, and spacing to influence vine size and growth. Rootstocks that confer large vine size tend to have a prolonged maturation period for the fruit on their scions, while lower vigor conferring rootstocks have a relatively accelerated growth and maturation (Pouget, 1987). Production of quality grapes is promoted by moderately vigorous shoots, with appropriate light exposure on the fruit and on leaves in the floral initiation zone. This can be encouraged with the use of a rootstock that matches the characteristics of the vineyard site. Rootstocks that confer large vine size may produce very large vines if grown on deep, fertile soils, to the detriment of grape quality, while these rootstocks would be appropriately used on less fertile or shallow soils. Conversely, rootstocks that confer small size may not be able to promote sufficient growth in scions when grown on challenging soils, but may perform well on deep, fertile soils.

Choosing and using rootstocks in Texas:

1) Evaluate the soil pest and disease pressure at the site. Is it a phylloxera prone vineyard, where phylloxera are present or likely to be introduced during the lifetime of the vineyard? The severity of the damage caused by phylloxera to *V. vinifera* is grave and phylloxera can be very damaging to many interspecific hybrid varieties as well. A rootstock that provides reliable phylloxera protection is recommended where phylloxera are or may be present. The nematode species and populations should be considered along with historical land use or other characteristics that may predispose the site to risks of cotton root rot, nematodes, or other soil pests. In most cases, high fraction *V. vinifera* hybrid rootstocks such as AXR#1 and 1613C should be avoided as they do not provide durable, reliable protection against phylloxera.

Texas considerations: In addition to phylloxera, nematodes of several species (including Meloidogyne species root-knot nematodes) and cotton root rot may be important in Texas vineyards. Cotton root rot is caused by *Phymatotrichopsis omnivora*, a fungus well adapted to alkali and calcareous soils. This fungus is found in northern Mexico and the southwestern United States. It has a broad host range and can persist in the soil for many years. Dog Ridge was identified as providing useful resistance to cotton root rot, although phylloxera resistant hybrids including 5BB are more resistant than own-rooted vines (Herrera Perez, 1988). Root-knot nematode resistant rootstocks include Dog Ridge, Ramsey, and Freedom; Harmony is phylloxera susceptible and should be avoided. Newly released rootstocks with resistance to multiple nematodes, developed by Walker of the University of California (Covert, 2008), should be evaluated in Texas, along with other new rootstock varieties for protection against important soil pests.

2) Evaluate the soil and other abiotic aspects of the vineyard and match rootstock to site characteristics: Determine soil pH, particle size, depth, drainage, and water holding capacity. Observe soil profile at multiple locations in the site using backhoe pits. Is the site prone to waterlogging? Is the soil high in sodium, chloride, or other ions? Determine if the site has a high capacity or low capacity to induce vine growth.

Texas considerations: In many Texas vineyards, relatively low rainfall during the growing season means that vineyards will be irrigated. The requirement for irrigation usually indicates sites with relatively lower capacity, which would be appropriate for more vigorous rootstocks, especially those with adaptation for dry sites. Examples of higher vigor rootstocks for dry sites include 1103P, 140 Ru, 110R, and St. George; for high capacity sites, lower vigor rootstocks like 420A, Riparia Gloire, and 1616C may be appropriate.

3) Evaluate the management practices to be used. In the context of site capacity, determine the trellis, training system, vine and row spacing, weed and floor management, irrigation and fertilization plan, pest

management, harvest, and other management practices that will be used in the vineyard. Some management practices will tend to increase vine size and vigor (often by increasing available water and nutrients), while other practices will tend to decrease vine size and vigor.

Texas considerations: Most Texas vineyards will be irrigated, although the diversity of other management practices is enormous. Like matching site capacity with rootstock, consider how your intended management practices will influence vine size and vigor. Management practices can be modified once the vineyard is in place; the rootstock cannot easily be changed.

4) **Evaluate the desired scion variety and selection.** Is the scion variety a weak or a vigorous grower? Can virus influenced grapevine decline be avoided through the use of a virus tested selection of the desired scion variety? Are there reports of difficulty of the desired scion variety with a particular rootstock?

Texas considerations: The diversity of varieties cultivated in Texas means that there may be very little experience with your variety grown on rootstocks—such as Blanc du Bois or Black Spanish—or your might be growing Chardonnay or Cabernet Sauvignon, nearly always grown grafted. If possible, use virus tested scions and rootstocks. Texas AgriLife Extension professionals are working with plant pathologists in Texas and around the world to provide virus tested planting material of all varieties.

5) **Evaluate rootstocks suitable for the pest and disease pressure, abiotic site conditions, management practices, and scion variety.** Determine which rootstocks satisfy the requirements you have identified for the vineyard location. Common, commercially available rootstocks are likely to be more successful in most locations than experimental, obscure, antiquated, or very new rootstocks. Cuttings of common, commercially available rootstocks are easily available to nurseries in quantity, which allows the nursery to discard poor propagation material. Viticulture and enology research is most extensive on common, commercially available rootstocks. Grape growers in your area are likely to have experience with common, commercially available rootstocks and can provide their perspective on the performance of particular rootstocks in growing condition similar to your site.

Practical applications summary:

- **Rootstocks provide protection against pests and diseases in the soil.**
- **Vine fertility, fruit quality, vigor, and size relate to site capacity, cultural practices, grapevine scion selection, and rootstock variety.**
- **Families of grape rootstocks have common characteristics.**
- **Characteristics of rootstocks reflect their selection criteria and viticulturally important attributes.**

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