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Grape Rootstocks for Kentucky Vineyards

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Selecting rootstocks for vineyards is a pre-planting decision. The decision as to whether a vineyard owner shall use a rootstock rather than own-rooted vines, and which of the resistant rootstocks should be chosen for a specific cultivar depends on the interaction of the vineyard site, cultivar and the rootstock. Choosing a rootstock is a result of this complex interaction. The choices for Kentucky and Midwestern grape growers remain limited. However, the area of rootstock selection for the Midwestern grape industry remains an active area of research and there will be more choices for the region's growers in the near future.

Why grape growers need to consider a rootstock?

Using grafted stocks increase operating expense and makes subsequent vine management difficult, if the scion has sufficient tolerance to the problem that the grower is concerned about. The rootstocks are resistant, meaning that they have been bred or selected to provide resistance and tolerance to an insect, unfavorable soil condition, disease or an environmental condition such as drought.

The rootstocks are used to provide the following benefits:

1) Provide increased resistance and tolerance to soil borne pests such as phylloxera and nematodes.
2) Provide increased lime tolerance in the soil.
3) Produce larger root system in the soil.
4) Provide cold tolerant roots and trunks.
5) Counter the replant effects from initial high phylloxera populations.
6) Reduce transmission of viruses by nematodes.
7) Provide increased salt tolerance.

High soil pH in Kentucky soils

In parts of Kentucky, calcium carbonate (limestone) constitutes a major proportion of the soil and therefore, grapevine roots can not absorb sufficient iron to provide the vine's needs. Iron is an essential micronutrient for plants where it is a key component of chlorophyll. Under high soil pH conditions, due to lack of iron uptake the grapevines display chlorosis (yellowing) symptoms. The ability of a grapevine to obtain sufficient iron atoms in the presence of a high concentration of calcium carbonate is called lime tolerance. The need for lime tolerance was not recognized until after the introduction of phylloxera in Europe when lime intolerant American species replaced the lime tolerant vinifera rootstocks.

Native American (*Vitis labruscana and V. aestivalis*) varieties are lime intolerant. This means that to grow native American (and a few hybrids) varieties on higher pH soils, growers may need to use a lime tolerant rootstock. Most rootstocks used in Kentucky can only be considered moderately lime tolerant. Of the widely available rootstocks, both 5BB and 5C are noted for good lime tolerance. Both trace their tolerance to *V. berlandieri* genes.

The need for lime tolerance and for other desirable horticultural characteristics such as ease of propagation has repeatedly caused problems for grape growers. *V. vinifera* has been crossed with phylloxera resistant species with the aim of combining lime and phylloxera tolerance. Such crosses have found favor in several production areas of the world, but unfortunately, the phylloxera resistance has proven to be too narrow. Vineyard districts where growers have relied on vinifera hybrid rootstocks have seen the emergence of resistant phylloxera populations.

Resistant rootstocks for Native American and French American hybrid varieties

The phylloxera resistance of Native American and French American hybrid varieties is variable, but rarely high. They have adequate resistance to phylloxera to grow and maintain adequate vine size when the initial phylloxera pressure is low. However, the yield potential of these varieties will increase when they are grafted onto a phylloxera resistant rootstock. Experience in Illinois and New York State illustrated that the long term effects of using **3309 Coudrec** rootstock on non-divided 'Seyval blanc' and

'Concord' grapevines increased cane prunings by about one pound per eight foot spaced vine and yield was increased 1.25 tons/acre/year.

Combination of Native Species to Derive Rootstocks

All rootstocks derive from the combination of three native species: *Vitis riparia*, *Vitis rupestris*, and *Vitis berlandieri.* See the tables at the end of the document for more detailed characteristics.

Riparia x Rupestris crosses: Rootstocks derived from these crosses prefer deep, fertile and moist soils. The rootstock **3309 Coudrec** is the one most commonly used in the Eastern United States. Dry, shallow and alkaline soils are not suitable for this rootstock. It also has high susceptibility to root-knot nematode. Another example of rootstock in this group would include **101-14 Millardet et de Grasset.**

Berlandieri x Riparia crosses: *V. berlandieri* is native to the southwestern USA where it has adapted to limestone soils and drought. However, rootstocks in this group are more vigorous than those from Riparia x Rupestris crosses especially under available precipitation. The rootstock **5C** is the most common member of this group. It is well suited to heavy soils and has good resistance to nematodes. Even though **5C** has higher yields than the Riparia x Rupestris crosses, it has shown increased cold injury in the Eastern United States. Other examples of rootstocks in this group include **5BB**, **SO4**, and **420A**.

Berlandieri x Rupestris crosses: Rootstocks from this group are adapted to warm regions and are very resistant to drought. The rootstocks from this group are very vigorous so they are adapted to the poorest of growing conditions. They have high tolerance to phylloxera and to calcareous soils and were developed for Mediterranean like growing conditions and non-irrigated vineyards. Examples of this group include **99R**, **110R**, **140Ru** and **1103P**.

Cross	Rootstock	Vigor[a]	Fruit set[b]	Maturity[c]	Soils	Pests and diseases	Propagation
Common	**Riparia Glorie de Montpelier**	Low to moderate	Improves flowering and berry set	Advances	Deep, moist and fertile soils with good drainage. Not recommended for calcareous soils	Highly resistant to phylloxera	Roots and grafts easily
	Rupestris Saint George	Very vigorous	Induces poor fruit set	Delays maturity	Deep soils with penetrable sub-soil. Suffers from drought if the soil is poor	Highly resistant to phylloxera. Very sensitive to root knot nematode and sensitive to dagger nematode	Roots and grafts easily

[a] Vigor: Rate of shoot growth in each season.
[b] Fruit set: Increase/decrease in flower formation and berry set.
[c] Maturity: Precocity of the grafted cultivar.

Cross	Rootstock	Vigor[a]	Fruit set[b]	Maturity[c]	Soils	Pests and diseases	Propagation
Riparia x Rupestris	**3309 Coudrec**	Low to moderate	Improves flowering and fruit set	Advances	Deep, well drained soils. Inappropriate for heavy soils. Moderate resistance to lime-induced chlorosis. Induces K deficiency on clay soils	Highly resistant to phylloxera	Easy to graft and root
	101-14 Millardet et de Grasset	Low to moderate	Improves fruit set	Advances	Requires moist, deep soils. Acceptable performance on clay soils even if poorly drained. Moderate resistance to lime-induced chlorosis	Highly resistant to phylloxera and moderately resistant to nematodes	Easy to graft and root

Cross	Rootstock	Vigor[a]	Fruit set[b]	Maturity[c]	Soils	Pests and diseases	Propagation
Berlandieri x Riparia	**SO4**	Moderate to vigorous	Induces poor fruit set	Advances	Light, well drained soils of low fertility. Tolerates high lime in soils. It assimilates Mg poorly	Highly resistant to phylloxera and nematodes	Roots easily but does not graft well
	5BB Kober	Vigorous	Induces poor fruit set	Delays	Tolerates high levels of lime in soil. Poor K uptake	Good resistance to phylloxera. Poor resistance to phytophtora	Roots and grafts well
	5C Teleki	Moderate	Improves fruit set	Advances	Good choice for heavy soils. High tolerance to calcareous soils	Highly resistant to phylloxera and good resistance to nematodes	Roots and grafts well
	420 A	Low to moderate	Improves fruit set	Delays	Well suited to poor, heavy textures oils. Good resistance to lime induced chlorosis	Highly resistant to phylloxera and good resistance to nematodes	Does not root and graft easily

Cross	Rootstock	Vigor[a]	Fruit set[b]	Maturity[c]	Soils	Pests and diseases	Propagation
Berlandieri x Rupestris	**99 Richter**	Very vigorous	Induces poor to moderate fruit set	Delays	Performs well on acid soils. Tolerates high level of lime in soils. Poor Mg assimilation	Highly resistant to phylloxera and good resistance to nematodes	Roots well but does not graft well
	110 Richter	Moderate to vigorous	Induces poor to moderate fruit set	Delays	Performs well on acid soils. Not recommended for poorly drained shallow clays	Highly resistant to phylloxera and good resistance to nematodes	Roots and grafts well
	140 Ruggeri	Very vigorous	Induces poor fruit set	Delays	Not recommended for deep, fertile soils. Most resistant to lime in the soil	Highly resistant to phylloxera and good resistance to nematodes	Grafts well but not easy to root