

Viticulture - Characteristics of the vine - Rootstocks & Grafting

ROOTSTOCKS

- Without Phylloxera, it's unlikely any vines would be grafted to non-vinifera rootstocks.
- Cost of grafting is high, 4-5 times as much as ungrafted vines.
- Most consider environmental conditional when selecting a rootstock.
- Advantages (adjusting yields, vigour, ripening times) that even unaffected areas are being planted with grafted vines.
- Important to chose the rootstock that grafts easily to the variety.
- The four species commonly used for rootstocks have evolved in distinct regions of North America and hence vary in many of their characteristics other than their resistance to Phylloxera.
- Rootstock crosses have been developed with difference in nematode resistance, salt and drought tolerance, susceptibility to lime-induced chlorosis, vigor on high potential sites, nutrient uptake, yield, and fruit quality.
- These crosses are the basis of commercial rootstocks.

REASONS TO

- Phylloxera
 - Main reason to use rootstocks.
- Nematodes
 - Used in order to confer resistance to nematodes.
- Tolerance to lime
 - *V. vinifera* is lime-tolerant, but *V. riparia* and *V. rupestris* suffer from iron deficiency (chlorosis) in chalky soils.
 - Hybrids have been developed with *V. berlandieri* that is more resistant to lime.
 - Must assess soil prior to planting.
- Tolerance to acidity
 - Excess acidity can lead to aluminum toxicity.
- Tolerance to salinity
 - High levels of salinity will disrupt water intake and vine nutrition.
- Tolerance to drought stress
 - Some more tolerant to damp conditions, more drought tolerant, some more sensitive to soil compaction.
- Effects on vine vigor
 - Different rootstocks have different levels of vigor and can be selected in order to moderate soil fertility.
 - Vigourous rootstock used in poor soils.
 - Weak vigour in fertile soils.
 - Weak vigour used in cool climates to encourage earlier ripening.
- In a replant situation

GRAFTING

- Cuttings usually grafted onto American rootstocks prior to propagation.
- Traditionally, rootstocks were planted in the vineyard first, then field-grafted, but this practice has been largely abandoned.
- A critical union marriage of a thin layer of cells known as the vascular cambium.
- A cylindrical layer of cells close to the outer circumference of the stem or truck producing phloem on the exterior side and xylem on the interior.
- Dhloem - vascular tissue that conducts sugars and nutrients.
- Xylem - tissue that conducts water and dissolved minerals, and provides structure support.
- Grafting takes advantage of the wound healing response in plants.
- When an incision has been made the response is the growth of de-differentiated cells (cells that have reverted to an unspecialized state), thus respond by producing callus.
- Callus provides the tissue through which vascular continuity is restored, and those vascular signals influence the undifferentiated callus cells to become cambial cells.

BENCH GRAFTING

- Bench grafting is carried out indoors during late winter early spring.
- Prior to grafting, the scion and rootstock cuttings are stored in damp sawdust, and soaked for 24-48 hours to make them less brittle.
- Grafting used to be done by hand (whip technique) but almost always by machine (omega technique).
- Afterwards, the scion is quickly dipped in molten paraffin wax up to just below the union to prevent drying.
- Then stored in crates containing sand or sawdust.
- Crates are kept at 90% humidity, with good drainage, 21-29C (69-84F) for 3-4 weeks.
- During this time, the scion and the rootstock join together with a callus of cells.
- Once callusing is complete they are removed and trimmed to remove any roots from the scion or shoots from the rootstock.
- Then re-dipped in molten paraffin wax and transferred to a cold store 1-4C (33-39F) prior to planting into a nursery or planted into pots and kept at 18-21C (64-69F) for 7-10 days then moved to a temperate greenhouse.
- Grafted root cuttings either sold as rooted cuttings (have spent 1 year in nursery) or as potted plants that can be planted out 10 months of grafting.

TOP GRAFTING

- Top grafting can be used to change cultivars in an established vineyard.
- Chip budding and T budding most common.
- Bud from the new varietal is inserted into the trunk of the old.
- Cleft-grafting is less common, and involves sawing the trunk of the vine, splitting it vertically and inserting canes of the new variety into the cleft.
- These methods require scion cuttings to be collected in the winter (stored at low temps and high humidity) and an almost complete decapitation of the old plant above the graft union.
- Works well, best on young vines in warm climates, but aftercare is very important in success.

Parentage	V. riparia	V. rupestris	Vinifera x rupestris
Rootstock	Riparia Gloire de Montpellier	Rupestris du Lot	AXR1 (=ARG1)
Vigour	+	+++++	++++
Preferred soil type	Humid, cool fertile	Deep, poor, healthy	Versatile
Lime tolerance	Low	Low	High
Resistance to drought	+	+++	++
Tolerance of phylloxera	+++++	++++	+
Resistance to nematodes	+++	+++	++
Notes	Suitable for production of quality wines. Sensitive to compact soils. Prefers moist soils.	High vigor Mediterranean rootstock. Sensitive to coulure and compact soils.	Offers some of the lime tolerance of vinifera, but unfortunately shows inadequate tolerance of phylloxera. Easy to graft, yields high quality fruit with good yields, but limited tolerance of phylloxera. Formerly used widely in California.

Parentage	Riparia x rupestris Halfway between surface and deep rooting. Average vigor, grafts well, good affinity with scions. Good resistance to phylloxera, but poor resistance to chlorosis.		
Rootstock	3309 C (Couderc)	101-14 (Millardet et de Grasset)	Schwarzman
Vigour	+++	++	++
Preferred soil type	Cool, fertile, permeable	Cool, fertile, damp	Deep, moist
Lime tolerance	Low	Low	Low
Resistance to drought	+	+	+
Tolerance of phylloxera	++++	++++	++++
Resistance to nematodes	++++	+++	+++++
Notes	Fruits well. Widely used in France, Germany, Switzerland. Particularly recommended for acid soils.	Suitable for production of quality wines.	Ideal in areas with serious nematode problems.

Parentage	Riparia x berlandieri Surface or semi-surface. Good rooting, high resistance to chlorosis. Good affinity with scions and resistance to phylloxera.		
Rootstock	161 - 49C (Couderc)	420A (Millardet et de Grasset)	5C (Teleki)
Vigour	++	++	+++
Preferred soil type	Cool, fertile, permeable	Cool, deep, rich, permeable	Wide range: chalky, clay, compact type
Lime tolerance	High	Medium	Medium
Resistance to drought	+	+	+
Tolerance of phylloxera	++++	+++++	++++
Resistance to nematodes	++	+++	++++
Notes	Widely used in France, Germany, Switzerland. Good fruiting. Good for acid soils.	Good for quality vineyards.	Suitable for quality vineyards in northern regions. Poor potassium (K) uptake.

Parentage	Riparia x berlandieri (continued)		
Rootstock	5BB (Teleki Selection Kober)	S04 Selection Oppenheim	125AA (Kober)
Vigour	++++	+++	++++
Preferred soil type	Wide range: cold, fertile, permeable	Fertile, humid, cold	Very wide range
Lime tolerance	Medium	Medium	Medium
Resistance to drought	++	+	+++
Tolerance of phylloxera	++++	++++	++++
Resistance to nematodes	++++	++	+++
Notes	If fertile soil, not to be planted with varieties sensitive to coulure. Poor uptake of K and Mg.	Very fruitful. Most popular in Europe. Poor uptake of Mg -> coulure and stem atrophy. Several clonal variations available.	Not recommended for varieties sensitive to coulure.

Parentage	Berlandieri x rupestris Good for planting in dry and stony conditions. Deep or semi-deep rooting systems. Good vigour. Good resistance to chlorosis and drought. Better lime tolerance than straight rupestris.			
Rootstock	99R (Richter)	110R (Richter)	140 RU (Ruggieri)	1103 P (Paulsen)
Vigour	+++++	+++++	+++++	+++++
Preferred soil type	Average fertility, deep, permeable	Deep, poor clay-calcareous	Poor, dry	Poor, dry average compactness
Lime tolerance	Medium	Medium	High	Medium
Resistance to drought	+++	++++	++++	++++
Tolerance of phylloxera	+++++	++++	++++	++++
Resistance to nematodes	++++	+++	+++	+++
Notes	Fruits well. Used in south of France.	Good rootstock for dry regions. Poor uptake of K and Manganese.	Suitable for Mediterranean vine growing countries.	Warm climate rootstock. Saline resistant.

Parentage	Berlandieri x vinifera Good resistance to lime and chlorosis. Some with poor resistance to phylloxera.		
Rootstock	Fercal	41B (Millardet et de Grasset)	333EM (Ecole de Montpellier)
Vigour	+++	+++	+++
Preferred soil type	Dry, shallow, calcareous	Dry, calcareous	Humid, compact
Lime tolerance	Very high	High	High
Resistance to drought	++++	+++	++++
Tolerance of phylloxera	+++	++	++++
Resistance to nematodes	+++	++	++
Notes	Shows Mg deficiency if K applications are too great.	Used in Champagne and Charentes. Some susceptibility to phylloxera. Good fruiting, good uptake of Mg.	Champagne, Charentes, Midi. Can cause coulure.

Parentage	V. Champini Important for regions with severe nematode problems, but tends to be extremely vigourous, and unsuitable for high quality grapes.
Rootstock	Dog Ridge
Vigour	+++++
Preferred soil type	Poor, light-textured
Lime tolerance	Low
Resistance to drought	++
Tolerance of phylloxera	++
Resistance to nematodes	+++++
Notes	For use in regions with serious nematode problems, but lower quality potential than Schwarzman, and weak phylloxera tolerance.