

# History of Teleki rootstocks and origin of 5C, 504

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The *Vitis berlandieri* x *V. riparia* hybrid rootstocks are one of the most important groups of phylloxera-resistant rootstocks used for winegrape culture. In most viticultural countries their use is increasing. Of this group, the Teleki hybrids are the most widely utilized. Several of these hybrids resulted from grape breeding activity in France during the last half of the 19th century. However, the most widely used *V. berlandieri* x *V. riparia* hybrids were selections originating with Sigmund Teleki.

Origin of the Teleki rootstocks is shrouded in mystery and many of today's misunderstandings regarding them are a result of poor historical records. Despite their popularity, grapegrowers know little about these rootstocks, how they originated or how their numbering system was derived.

We can learn much about the performance of these rootstocks through new field experimental trials at UC Davis, being funded by the American Vineyard Foundation. This report will examine the history of the Teleki rootstocks and some of the confusion that still surrounds them.

An example of this confusion is the recent discovery that the rootstock 504 was misnamed in California and is correctly Teleki 5C. These two rootstocks and others derived from the Teleki collection of *V. berlandieri* x *V. riparia* hybrids appear very similar, but have unique genetic origins.

Most of this report originated from several key sources, foreign language articles largely unavailable to English-only readers (see References).

In the 1890's, Teleki, a grapegrower near Villany in southwestern Hungary, was preparing to reconstruct his vineyards after phylloxera infestation. Phylloxera had ravaged the vineyards of western Europe for most of the three previous decades. At that time, selections of *Vitis riparia* and *V. rupestris* were being widely used as phylloxera-resistant rootstocks. Other American hybrids such as 'Jacquez' (also known as 'Lenoir', a hybrid of *V. aestivalis*, *V. cinerea*, and *V. vinifera*), 'Clinton' and

'Violla' (both *V. labrusca* x *V. riparia*) were also being used as rootstocks, but their phylloxera resistance was not as strong. These species and hybrids suffered from lime-induced chlorosis, a common problem on Europe's limestone soils and throughout Teleki's vineyards.

In 1896, Teleki wrote to E. Réseguier, the well-known French nurseryman in Alenya, requesting seeds of *V. berlandieri*. At that time, French viticulturists were unhappy with the performance of *V. riparia* and *V. rupestris* selections, and *V. riparia* x *V. rupestris* hybrids in high limestone sites. They had begun experimenting with *V. berlandieri*, an American species from the limestone hills of west Texas.

Réseguier himself must have played a prominent role in the selection of various forms of *V. berlandieri* since the pure species selections 'Réseguier #1' and 'Réseguier #2' were apparently named after him. Teleki wanted to experiment with *V. berlandieri* rootstocks in his own vineyard

in Hungary to test their potential lime tolerance. He was forced to request seed from Réseguier, rather than cuttings, because the distribution of grapevine cuttings in Europe was prohibited to prevent the spread of the fungal disease Black Rot (*Guignardia bidwellii* Ellis).

During the winter of 1896, Teleki received 10 kg (22 lbs) of seeds from Réseguier and the following spring he germinated about 40,000 seedlings. He expected to see vines which were pure *V. berlandieri* but, to his astonishment, the vast majority appeared to be hybrids of *V. berlandieri* with other American *Vitis* species; some of the seedlings even appeared to be part *V. vinifera*.

Teleki was never able to establish why the seeds had such a mixture of hybrid types, but nevertheless, he commenced a six-year effort to select and categorize this composite population. We can assume that Teleki was sent seed from many female *V. berlandieri* vines (10 kg of seed is considerably more than one vine can supply).

Wild grape species such as *V. berlandieri* are dioecious, which means that the vines have either male or female flowers, but not both; cultivated species such as *V. vinifera* are usually hermaphroditic (having complete flowers with both sexes). Unless pollination is carefully controlled, the male

Table 1.  
Origin of *Vitis berlandieri* x *V. riparia* rootstocks available in California.

Rootstock selections originating from the Teleki seedlings	
504	German selection from Teleki Group 4, prior to 1914, released 1927
8 B (divided into COS 2 & COS 10)	Teleki, 1896
5 A	Teleki, 1896
5 BB	Kober from Teleki 5A = 1902
5 C	A. Teleki, from Teleki 5A (?), 1922
125 AA	Kober from Teleki 5A (?) = 1902
Cosmo 2	Cosmo from 8B, 1931
Cosmo 10	Cosmo from 8B, 1931
Rootstocks originating from controlled crosses	
420 A Mgt	Millardet et de Grasset, 1887
33 EM	Foëx, 1899
34 EM	Foëx, 1899
157-11 C	Couderc, 1889
161-49 C	Couderc, 1888 ( <i>V. riparia</i> x <i>V. berlandieri</i> )
225 Ru	Ruggeri, 1897

It for a female vine can be any neighboring source of pollen. Teleki must have received seed from female *V. berlandieri* vines residing in a mixed collection of *Vitis* species.

From his 40,000 seedlings Teleki eliminated vines which appeared to have any *V. vinifera* parentage for fear that they would not be sufficiently resistant to phylloxera. He also discarded any vines showing lime-induced chlorosis. From the 'survivors' of this first round of selection he categorized 10 types according to phenotypic (i.e. visual) characteristics, and numbered them from 1 to 10.

The group, which included numbers 1, 2, and 3, appeared to be pure *V. berlandieri*. Although this is what Teleki originally hoped for, he was forced to discard these vines because they were too difficult to propagate. This poor rooting was a characteristic of *V. berlandieri* that plant collectors and breeders discovered, although the cause remains unknown. Group number 10 seemed to be *V. berlandieri* x *V. rupestris* hybrids; these vines were apparently not considered to be useful and are not available today.

The remaining vines appeared to be hybrids of *V. berlandieri* and *V. riparia*. Teleki arranged them into two sub-groups based on their leaf shape. Vines were numbered 4 or 6 if their leaf shape more closely resembled *V. riparia*; or numbered 7, 8, or 9 if their leaf shape was similar to *V. berlandieri*.

Pierre Galet reports that within each sub-group Teleki distinguished numbers, say 4 from 5, by the more or less bronze color of young shoot tips, although it is not entirely clear how this was done. Further, Teleki assigned a letter to his categories: A if the shoots were glabrous (hairless); or B if the shoots were pubescent (hairy).

For example, vines in group 5A had *V. riparia*-like leaves and glabrous shoots while those in 8B had *V. berlandieri*-like leaves and pubescent shoots. Teleki extensively distributed these two sub-groups of phenotypes (4-6 and 7-9) to interested viticulturists.

Teleki approached the selection of *V. berlandieri* rootstock hybrids with his era's limited knowledge of genetics. With the benefit of hindsight, we can clearly see Teleki's mistake. He was not working with cuttings from clones, his plants were seedlings and each was a unique individual. He grouped genetically distinct seedling vines by phenotype and gave them a unifying categorical name.

Their genetic differences may have been as viticulturally insignificant as differences in leaf branching, or sex of the vine. Or these genetic and inherent differences could have been viticulturally important such as differences in their ability to propagate,

vigor, pest resistance or adaptability to various soil conditions.

When Teleki distributed cuttings from plants within a group, for example 5A, recipients were likely to receive plants with different genotypes. These vines, all labeled 5A, may have differed in growth rate, mineral uptake, or propagative ability.

In addition to viticultural differences, these vines could also have differed in subtle ampelographic characteristics such as degree of opening of the petiolar sinus or type of serrations on the leaf edge. There is no indication that Teleki separated his seedlings on the basis of flower sex; thus seedlings within a group could also quite conceivably differ in sex. Different people receiving Teleki's '5A' could have been assessing and then ampelographically describing different plants with the same name. This appears to be exactly what happened.

When Italo Cosmo of Italy examined vines from the Teleki grouping 8B, he discovered that the plants were viticulturally different. From that group of 8B vines, he identified and clonally propagated two selections which are in use today, Cosmo 2 and Cosmo 10. Another Italian, Ferrari, also selected and propagated a form of Teleki 8B which today bears his name Teleki 8B selection Ferrari.

According to Helmut Becker, several discrepancies occurred in the naming of 8B selections in Europe. He states that considerable variation exists in the 8B series, some of which differs from Teleki's original description of 8B. The extent of variability can be seen when the selections of Buxtea, Dragasani (37 and 57), unnamed material in Germany, and the Cosmo and Ferrari selections are compared. They differ morphologically and viticulturally. If the story was to stop here, with different vines bearing the same name in Europe, it would be confusing enough. However, others added to the quandary. In 1904, Teleki sent 10 "of his better numbers" (as Galet puts it) to Franz Kober, Viticulture Inspector at Klosterneuburg, Austria, near Vienna. Kober applied his own classification system to the vines, as follows:

A—New growth bronze, shoots red and pubescent;

B—New growth bronze, shoots red and glabrous;

C—New growth green, shoots green (or with slight reddening on the side exposed to the sun) and pubescent;

D—New growth green, shoots green with nodes red and glabrous.

According to Galet, Kober assigned a double letter to vines with greater vigor,

such as AA, BB, etc., but he also rated them numerically according to vigor, with higher numbers indicating greater vigor.

We are most familiar with Kober's selections 125AA and 5BB. The origin of these two rootstocks remains unclear from available references. One Italian reference states that 125AA was selected by Kober from a Teleki 5A population; other references do not mention 125AA's origin. 5BB is generally believed to have been selected from Teleki's group 5A, although it cannot be ruled out that the '5' refers to Kober's unspecified vigor rating scheme.

Andor Teleki, Sigmond's son, wrote, "Although it can no longer be proved today, all external characteristics of the 5A and 5BB types indicate that they originally derived from the same seedling, hence they are identical..."

Preliminary data from a rootstock trial in Monterey county, CA (L. Bettiga, personal communication), points to a performance difference between 5A and 5BB, indicating that these vines might be genetically different. However, in the UC Davis collections, the two plants appear very similar, and to date, we have been unable to distinguish them biochemically (isozymes from eight enzyme systems have not distinguished them). Our 5A may be the same as the 5BB selection from 5A, or it may be another distinct plant from the 5A grouping. Given what we now know about the Teleki hybrids and given the preliminary results from Monterey, we are keeping these two rootstocks separate, until we have more data.

Teleki 5C resulted from selections done by Alexandre Teleki, Sigmond's other son. D.P. Forgrätz states that it originated from 5A, but other rootstock references do not confirm this. Galet discusses the variability within what is called 5C and listed several different selections, some of which are distinguished on the basis of their sex and others by shoot pubescence and color.

It is not at all clear what the letter C refers to or how it originated, but most references claim there is a resemblance to 5A/5BB, as there should be if 5C was derived from the 5A group. However, our 5A and 5BB both are female and have upturned leaf margins, while 5C in California is a male vine and has a planar leaf margin. As will be discussed next, 5C actually appears more closely related to 504.

Selections from Teleki's group 4 were introduced to Germany's viticulture station in Oppenheim prior to World War I and by 1927 a clonal selection had been identified as 504, meaning Selection Oppenheim 4 (H. Becker, personal com-

unication); it is also referred to as Selection Oppenheim 4. This rootstock is sometimes incorrectly written as SO4.

There are many clones of SO4. Galet states that 78 were recognized in France. Mr. Morisson-Couderc, the French nurseryman, believes that the clonal types of SO4 can be distinguished in terms of their morphology and propagation ability (personal communication — Morisson-Couderc). Several phenomena may account for the number of SO4 'clonal' types — SO4 may be remarkably pliable genetically, contaminated with viruses, or have a multiple seedling origin.

SO4 has been incorrectly identified in California; most of the older selections are correctly named 5C (see Walker and Boursiquot). During the summer of 1990, Jean-Michel Boursiquot and the first author reviewed 23 selections of these two rootstocks at UC Davis. After a week of studying shoot tips, tendrils, leaves, shoots and flowers, they were able to categorize the selections as either SO4 or 5C.

During the following fall, proteins (enzymes) of these selections were characterized by differences in their ability to move in an electric field (electrophoresis) and these differences (referred to as isozymes) confirmed the ampelographic data. The problem is resolved, however, the two rootstocks are remarkably similar morphologically. SO4 and 5C are most easily distinguished on the basis of their tendril branching (SO4's tendrils are predominantly three-parted while the majority of 5C's are two-parted) and shoot color

(SO4 shoot tips are bronze to reddened, while 5C's are mostly green). However, both characters are variable and overlapping extremes can be found on either rootstock.

As stated at the outset, not all of the *berlandieri* x *riparia* hybrids in use today came from Teleki's seedlings. A number of controlled crosses were made by grape breeders of the late 1800's including 33EM and 34EM of Foëx, 157-11 and 161-49 of Couderc, and 420A of Millardet et de Grasset. Misunderstandings regarding these rootstocks are more easily resolved, because unlike the Teleki hybrids, they originated as single vines from controlled crosses, i.e. with known male and female parents.

Experimental field trials are now underway to look at viticultural and enological differences among the *V. berlandieri* x *V. riparia* hybrid rootstocks. We expect to see differences in vigor, fruit set, fruit maturity, berry quality and wine quality. In 1990, 13 of these rootstocks were examined for propagative ability, including rooting, bench-grafting, and field establishment. Preliminary results show differences among rootstocks, and the experiments were repeated in 1991.

We have also been able to distinguish these 13 rootstocks from each other biochemically by observing differences in isozyme banding patterns. A unique feature of these biochemical tests is our ability to utilize pieces of the bark from below the rootstock/scion union as samples. Although the test is time-consuming and relatively expensive, it allows the identity

of a rootstock to be determined even if foliage is not present.

The confusion surrounding this group of rootstocks clearly points to the need for an international rootstock reference collection. Ampelographers and specialists in rootstock research must be able to depend on the consistency of a rootstock description and results from experiments conducted on that rootstock at various viticultural centers.

Classic examples of confusion continue to be found and muddy our understanding of how a given rootstock can be expected to perform. If ampelographic experts could agree upon a single best representative of a given rootstock or variety, a reference collection could be established. This collection could be distributed internationally and consensus could be reached on rootstock identity and nomenclature. ■

#### References

Bazzanella, G. 1980. Il Portinnesto dalla Vite. Unione Diplomatica Istituto Agrario S. Michele, Trento.

Becker, H. 1968. Les porte-greffes *Berlandieri* x *Riparia*. *Prog. Agric. Vitic.* 168: 196-208.

Cosmo, I. 1979. *Portinnesti della Vite*. 2nd Edition. Edagricole, Bologna.

Galet, P. 1988. *Cépages et Vignobles de France*. Tome 1. *Les Vignes Américaines*. 2nd edition. Imprimerie Paul Déhan, Montpellier.

Pongrácz, D.P. 1983. *Rootstocks for Grape-vines*. David Phillip, Publisher, Cape Town, South Africa.

Teleki, A. 1907 *Der Modern Weinbau, Die Rekonstruktion Der Weingarten*. Hartlebens Verlag.

Walker, M.A. and Boursiquot, J.M. Ampelographic and isozyme data correcting the misnaming of the grape rootstock SO4 at University of California, Davis. *Am. J. Enol. Vitic.* (In press).

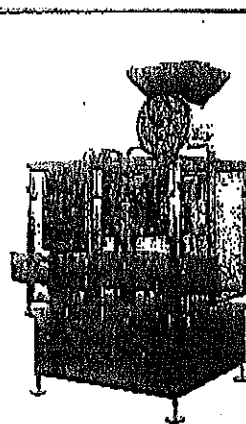


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