This is the sixth article in the series on the history of rootstocks in South Africa and focuses on the application and adaptations of the commercial rootstocks Paulsen 1103, Ruggeri 140, SO 4, US 8-7 and 143 B in the South African grape industry. Detailed attention is given to the most suitable soils and the regions where they have been planted extensively and also where they have disappeared over time and the reasons why. Comments are also made on the future of each rootstock.

**Paulsen 1103**

Paulsen 1103 was developed by Frederico Paulsen on the island of Sicily in 1895. Strangely enough it was only imported to South Africa in 1962. It is a cross of *Vitis Berlandieri* x *Vitis rupestris* and has similarly good grafting compatibility with most *Vitis vinifera* cultivars as is the case with Richter 99 and Richter 110. Only recently was it discovered that it completely fails when grafted to Red Globe (it was also found to be the case in Egypt).

Paulsen 1103 can be considered a rootstock somewhere between Richter 99 and Richter 110. It found very good application in the drier and warmer Mediterranean islands and countries like Spain, southern Italy, northern Africa and Greece. Paulsen 1103 has very good resistance to lime induced chlorosis, which is common in these regions, it has good drought resistance and adapts well to high summer temperatures. One can say it performs well in “harsher” Mediterranean climates which are very similar to that found in the Western Cape. One of the reasons why it did not find a foothold in South Africa, may be the fact that it did not offer many advantages over Richter 99 at the time of its introduction 30 years later.

Paulsen 1103 is considered to have medium high to high vigour, somewhere in between Richter 99 and Richter 110. It performs well on similar soils as Richter 99, in other words shallow compacted and dry soils; it tolerates more sandy gravel topsoils than Richter 110 and has a deep, well-branched root system which gives it good drought tolerance. It does have one advantage over Richter 99 and that is that it can tolerate subsoil wetness, which Richter 99 cannot do. It has, however, one drawback in that it has low tolerance to *Phytophthora cinnamomi*. Its resistance to salinity is better than Richter 99, but less than Richter 110. The statement that Paulsen 1103 is somewhere between the two Richters makes a lot of sense. Paulsen 1103 is steadily increasing in popularity in both the table and wine industries. Paulsen 1103 gives much more balanced growth during the early season compared to Ramsey for naturally vigorous cultivars, aiding the process of bunch thinning during bloom. It also has a positive effect on colouration for red and black cultivars. In some areas it replaced Richter 110 on the sites with higher soil potential due to the slightly better vigour it induces.

Paulsen 1103 has moderate to good resistance to root-knot nematodes, but offers only moderate resistance to dagger nematodes.

We do not have much experience of this rootstock in South Africa, but based on its characteristics and the little experience we do have, one can speculate as to its further potential for expansion. Paulsen 1103 will perform similar to Richter 110 for quality production on the red calcareous soils of Robertson/Ashton. It may even outperform it on the harder subsoil limestone layers over lain with sandier top-soils. It can also be used on the colluvium slopes of the coastal areas such as Durbanville and around Stellenbosch (higher slopes of sandstone gravel) where Richter 110 is not an option, as well as Elgin/Grabouw and the Hemel-en-Aarde Valley on the gravelly shales.

Paulsen 1103 definitely has a place in the South African grape industry, but it will not replace Richter 99 in the “drier” dry-land areas of the Agter-Paarl and Swartland with tougher Swartland and Klapmuts soil forms. In these areas Richter 99 does not have its equal in terms of drought tolerance. However, Paulsen 1103 can be an option on the deep red Hutton and Oakleaf soil forms as found on the...
hillside slopes around Malmesbury and Darling and under supplementary irrigation in the Coastal areas it can definitely replace Richter 99. Paulsen 1103 is a good alternative and growers do not have to be afraid of poor performance (drought tolerance) where supplementary irrigation is available, but under intensive irrigation sandy soils should be avoided due to a risk of nematodes. The continued introduction of new table grape varieties may see Paulsen 1103's increased use, especially for coloured varieties.

**Ruggeri 140**

In 1897 Ruggeri 140 was developed by Professor Antonio Ruggeri in Messina on the island of Sicily, but only imported to South Africa in 1964. It is a cross between *Vitis Berlandieri* x *Vitis rupestris*, but does not have the same good grafting compatibility with *Vitis vinifera* cultivars as its other “siblings” Richter 99, Richter 110 and Paulsen 1103. There are also indications that it may have grafting incompatibility with Red Globe. The main attributes of Ruggeri 140 is its exceptional resistance to lime induced chlorosis (the best of all the *Vitis rupestris* x *Vitis Berlandieri* crosses, tolerating up to 25% active lime) and drought tolerance. These were the main requirements for grapes in southern Italy and Sicily at the start of the 20th century.

Ruggeri 140 has not found much application in the South African wine and table grape industries. Its high drought tolerance could originally have been seen as a possibility to increase the grape-growing areas in the dryland regions in the Swartland to even lower rainfall locations, or the possible replacement of Richter 99 as dominant dryland rootstock. Trials, as well as commercial experience have shown that this, however, is not the case. It may have performed better in southern Europe than Richter 99, Richter 110 and Paulsen 1103 under dryland conditions due to its better tolerance to the high lime content of the soils, but this is not clear. The fact remains that it did not perform better under dryland conditions than Richter 99. Interestingly enough Ruggeri 140 showed the best application under the low pH soil conditions of the Western Cape.

The other characteristics of Ruggeri 140 include high vigour (similar to Richter 99), but poor tolerance to soil wetness and especially *Phytophthora cinnamomi*. It generally has low resistance to the most common nematode species and is not recommended for sandy soils under intensive irrigation. Resistance to salinity is only slightly better than Richter 99. It actually offers very little when compared to the other rootstocks in the range available in South Africa. I doubt if Ruggeri 140 will prosper in the South African industry, since its main competitors, Richter 99 and Richter 110, have already claimed the positions where Ruggeri 140 could have made an impact had it been introduced earlier.

**SO 4**

In 1896 SO 4 was selected in Germany from a Teleki Group 4 seedling and imported to South Africa in 1964. The breeder, Zsigmond Teleki, hailed from Hungary, however the name SO 4 actually derives from the selection made at the German research station in Oppenheim from a Teleki Group 4 seedling, hence the name “Selection Oppenheim nr 4”, or SO 4. Teleki sent 10 of his best selections to Oppenheim where Franz Kober, the director of the institute, made the selection of SO 4. It is a cross of *Vitis Berlandieri* x *Vitis riparia*, the only rootstock of these parents used commercially in South Africa (others include Teleki 5BB and Teleki 5C). SO 4 does not have the same grafting compatibility as the two Richters and Paulsen 1103. It is a generous producer of rootstock cuttings as a rootstock mother the same grafting compatibility as the two Richters and Paulsen 1103. SO 4 does not have the same grafting compatibility as the two Richters and Paulsen 1103. It is a generous producer of rootstock cuttings as a rootstock mother the same grafting compatibility as the two Richters and Paulsen 1103. There are also indications that it may have grafting incompatibility with Red Globe. The main attributes of Ruggeri 140 is its exceptional resistance to lime induced chlorosis (the best of all the *Vitis rupestris* x *Vitis Berlandieri* crosses, tolerating up to 25% active lime) and drought tolerance. These were the main requirements for grapes in southern Italy and Sicily at the start of the 20th century.

SO 4's most well-known characteristics are a very high tolerance to lime induced chlorosis (25% active lime), a high resistance to nematodes, good fruit set, and early maturation of the fruit of the scion cultivar. The aforementioned was especially important in Germany where early maturation of fruit was required (Germany’s high latitude is at the limit for successful grape production) and high soil lime content in a cool and moist climate induced iron deficiencies easier than in warmer and drier climates. SO 4 was therefore very suitable for Germany and other eastern European countries. The short vegetative cycle of SO 4 also allowed complete maturity of the canes before the cold of winter set in. By the end of the 1970s SO 4 was the most widely used rootstock in France due to the early maturation of the fruit it induced and its good performance under the nematode infested sandy soils of southern France under irrigation. It, however, became unpopular for quality production due to the vigour being too high.

SO 4 is utilised on a very small scale in South Africa and is still relatively unknown. Apart from its exceptional tolerance to free lime (25% active lime) in the soil and early maturation of the crop (similarities with 101-14), it has very good tolerance to root-knot and dagger nematodes. It induces medium vigour in the scion variety (slightly less than Richter 110) and has very good resistance to sub-soil wetness. *Phytophthora cinnamomi* resistance is high, but SO 4 has low salinity and drought resistance. To perform well, SO 4 should be planted on soil of at least medium high fertility. It should not be planted on dry compact soil types because under these conditions vigour will not be adequate. It is a rootstock more suited for quality grape production than mass production.

Although SO 4 is planted on a limited scale in South Africa, the few commercial plantations in Robertson/Ashton have shown good application on the lime-rich subsoils, similar to where Richter 110 is planted with great success. It should not be established for dryland production in the Swartland due to its low drought tolerance. It could have good application on the duplex soils of the Helderberg basin for cultivars with a moderate natural vigour (Merlot, Pinot noir and Chardonnay) for which 101-14 will have too little vigour. It could also be an alternative to Richter 110 for the same cultivars with moderate vigour on the deep red Hutton, Clovelly and Oakleaf soil forms due to the early maturation that SO 4 induces (in this case with supplementary irrigation). Higher yields should be obtainable with SO 4 than with 101-14 due to its higher vigour and resilience. SO 4 is the most important rootstock in Uruguay and southern Brazil where it is planted on fine textured sandy soils and high organic matter-rich black duplex soils that receive summer rainfall.

Although SO 4 is used as a table grape rootstock in parts of Italy and Brazil, it has not found application in the SA table grape industry. Small commercial plantings have been made with naturally high vigour coloured cultivars in an attempt to reduce the dependence on Ethephon for colour development. SO 4 has a medium short vegetative cycle that could be advantageous. It has been reported that vines grafted to SO 4 sometimes exhibit magnesium deficiency symptoms. The much larger diameter of the scion cultivar compared to the rootstock is a common phenomenon when viewing the area around the graft union of mature vines. This is not a sign of incompatibility, but a rootstock characteristic.

**US 8-7**

US 8-7 is a South African bred rootstock developed by Professor Chris Orffer of the University of Stellenbosch during the early 1950s. It formed part of the USVIT (University of Stellenbosch Viticulture) range of rootstocks made by crossing Richter 99 and Jacquez. A number of these crossings were included in field trials from 1974 of which US 8-7 and US 2-1 showed the most promising results. US 8-7 is the only one that has been commercialised on a larger scale over the past decade.

US 8-7 is a versatile rootstock that performs well on a range of soils. It induces medium high vigour, similar to Richter 110. It has the same soil preference as one of its parents (Jacquez) – deep allu-
vial loamy soils with some moisture in the deeper soil layers, but also performs well on shallow duplex soils with subsoil wetness (where 101-14 would grow well). Under these conditions US 8-7 provides excellent results. It should not be planted on deep dry sandy and compacted dry soils, even under intensive irrigation; it simply does not have the vigour to perform under such conditions. These soils are better suited for Ramsey. US 8-7 induces early ripening of the crop, similar to SO 4. The short vegetative cycle reduces the risk of sour rot on cultivars with compact bunches where Ramsey would be too vigorous.

It has some of Ramsey’s characteristics of good resistance against nematode, (root-knot nematodes), salinity, and subsoil wetness (not as good as Ramsey, but close to it). It has very good resistance to Phytophthora cinnamomi, but only moderate drought tolerance. The popularity of US 8-7 has increased dramatically over the past decade and it has taken the position as an intermediate rootstock on loamy alluvial soils where Ramsey would be too vigorous. At the same time Richter 99 would not be suitable due to its sensitivity to prolonged soil wetness under intensive irrigation. Also taking into account US 8-7’s good nematode resistance, it became a very good replacement for Richter 99, the traditionally preferred rootstock for the intensively irrigated alluvial soils of the Berg, Breede, and Olifants River Valleys. It has an impressive root system as a young vine in the nursery and therefore establishes easily. US 8-7 also performs well on the duplex soils of the Helderberg basin where it provides better vigour than 101-14 under irrigation and can support a larger crop size. It also found application in the Rawsonville/Slanghoek area on the mixed stony riverbed soils where Jacquez used to flourish. The rootstock can be used as dual purpose for both quality and quantity depending on the soils and region where it is planted. The short vegetative cycle allows the vine to react quickly to differential fertiliser and irrigation applications.

US 8-7 has not been planted extensively in the table grape industry. It could be a suitable rootstock for coloured cultivars on high potential soils of the mid- and late season regions of Paarl and the Hex River, but also on the alluvial and fertile “binnemegronde” (ground at the sides of the river) of the Orange, Olifants, and Berg River valleys. The one questionable characteristic of US 8-7 is its phylloxera resistance due to its parentage of Jacquez (Vitis aestivalis x Vitis cinerea x Vitis vinifera) and Richter 99. One cannot forget the experience with Jacquez that lasted for 60 years before succumbing to phylloxera. The same happened in the USA where AXR#1 (Aramons – Vitis rupestris x Vitis vinifera) faltered after 30 years of use. It is interesting to note that only rootstocks with Vitis vinifera parentage have failed over time due to inadequate resistance to phylloxera. To date though US 8-7 has never shown sensitivity to phylloxera.

143 B

143 B was developed in 1882 in France by Professor Alexis Millardet and the Marquis de Grasset. It is a cross of Vitis vinifera cv Aramon x Vitis riparia and was imported to South Africa around 1930. It was one of the first rootstocks developed by hybridising Vitis riparia with Vitis vinifera species in an attempt to increase the resistance of the Vitis riparia rootstocks to lime induced chlorosis. It did not survive very long in Europe due to its poor resistance to phylloxera, a characteristic of most of the Vitis vinifera based rootstock hybrids. 143 B has moderate compatibility with most Vitis vinifera species. Nowadays only Sultana and Merbein Seedless (for raisin production) are grafted to 143 B in South Africa.

143 B quickly became a very popular rootstock in South Africa after its introduction due to its ease of rooting (most vines were field grafted at the time), the good vigour it induced and the high and consistent cropping levels on especially fertile silty alluvial soils. Under these soil conditions vines grafted to 143 B survived for many years with excellent yields. When established on more marginal soils (shallow, dry and compact or deep and sandy), the vines started to decline after eight to12 years. This is probably due to a combination of nematode and phylloxera attack. It has a medium short vegetative cycle and induces early maturation, similar to SO 4 and US 8-7. 143 B has many good characteristics which include a good tolerance against drought, salinity, subsoil wetness and Phytophthora cinnamomi. These characteristics made it an important rootstock combined with 101-14 in the Jacquez era, since it could be established on soils not particularly suitable for Jacquez (shallow, strong structured soils; Estcourt, Swartland and Sterkspruit soil forms that were poorly drained, or contained salinity, and/or without irrigation). It induces moderately high vigour (similar to US 8-7 and Richter 110), but has poor resistance to a broad range of nematodes (it fails within a few years on sandy soils).

At present 143 B occupies a very small, but important place in the South African grape industry. It remains the most important rootstock for the raisin grape industry in the lower Orange River Valley on the heavy organic matter-rich alluvial soils where risk of phylloxera and nematode attack is low. The main reason for this choice of rootstock is that the main raisin grape cultivars, Sultana and Merbein Seedless, are less prone to restricted spring growth (known in Afrikaans as “groeistand verskynsel”), a very common physiological phenomenon in the lower Orange River Valley, associated with high nitrogen levels and poor reserves of the vines before bud break. It is the only region that still plants 143 B, irrespective of its poor history of phylloxera sensitivity. 143 B only found application as rootstock in South Africa and Austria.
At the time of the rootstock survey by the Stellenbosch Wine Institute in 1966 the following information for 143 B was on record: By 1939 it was already a popular rootstock due to its easy rooting and good vigour. It had good compatibility with commercial Vitis vinifera cultivars, except Merbein, showed early bud break and good drought tolerance. The commercial potential of this rootstock looked promising. Professor C.J. Theron said in 1955 that it was too early to make comments about the long term potential of 143 B, but due to the good drought tolerance (better than Jacquez and 101-14) it had to be investigated further.