This is the seventh article in the series on the history of rootstocks in South Africa and it focuses on some interesting rootstocks used with success in other parts of the world. Some have been in use for many years while others are still relatively unknown. All were bred in the USA where the focus is mostly on nematode resistance. These include Freedom, Harmony, VR 039-16, RS-3 and RS-9.

Nematode resistant rootstocks

The most progressive rootstock development programme is conducted by the United States of America Department of Agriculture (USDA) research station situated near Fresno, California. The USDA has focused rootstock research on developing rootstocks with increased nematode resistance for the irrigated San Joaquin Valley. Freedom and Harmony came from this period of research and were developed in the 1960s but have not been evaluated in South Africa on an extensive scale. RS-3 and RS-9 are the first releases from a new programme that started in 1987 that focuses on broader nematode resistance. VR 039-16 is a special rootstock developed by the University of California as far back as 1948.

Freedom

Freedom is an American bred rootstock developed in 1967 by Doctors J.H. Weinberger and F.N. Harmon at the USDA Agricultural Research Service station near Fresno, California. It is a cross between open pollinated seedlings of 1613 Couderc and Dog Ridge (Vitis Champinii x Vitis vinifera x Vitis labrusca x Vitis riparia). The main reason for the crossing was the continued search for nematode (especially dagger nematode) resistant rootstocks for the San Joaquin Valley. 1613 Couderc was imported to South Africa in 1939 and was known as Fairy. It never gained importance though, mainly because of its poor phylloxera resistance and moderate vigour.

Freedom has recently been re-imported to South Africa from the USA by the South African Plant Improvement Organisation (SAPO). The first rootstock cuttings will be available within the next two years for grafting and evaluation from the foundation plot at Voor-Groenberg Nurseries. This rootstock has been used extensively in the United States, Mexico and Egypt, mostly for table grape production. It has high vigour (similar to Richter 99) and performs well on sandy/loamy soil. It is not suited to shallow, compacted and dry soils unless under irrigation. It has only moderate resistance to drought, saline soil conditions, subsoil wetness and high soil lime content. Experience gained in Egypt and Mexico confirms the above limited application under saline and high pH soil conditions.

According to American literature and Egyptian field experience, Freedom’s greatest attribute is its exceptional resistance to root knot and dagger nematodes. It has moderate resistance to root lesion nematodes, but is highly susceptible to ring nematodes. The root system exhibits much the same characteristics as 101-14, being heavily branched with many fine roots. The depth of penetration is, however, similar to Richter 99 and Ramsey. It is in contrast to the natural root systems of 1613 C and Dog Ridge, Freedom’s parents. Freedom has a long vegetative cycle and tends to delay the ripening of the crop, similar to Ramsey. The phylloxera resistance of Freedom is questionable due to its 1613 C parentage. It has, however, been used for more than 40 years in the San Joaquin Valley without any phylloxera associated problems. This area has deep, well-drained high-potential loamy soils where vine vigour can overcome the effects of phylloxera.

It seems Freedom inherited all the negative characteristics of its 1613 Couderc parent, except the nematode resistance. The strong vigour and nematode resistance inherited from Dog Ridge makes this rootstock a very good option on medium-potential sandy-loam soils under irrigation. As rootstock, Freedom grows very well and has a high production of rootstock cuttings; a nurseryman’s dream. Freedom requires extensive research in South Africa before it can be considered as a rootstock option for long-term use. Its potential probably lies in the warmer growing regions for high yielding cultivars.

Harmony

Harmony is another rootstock developed in the USA in the 1960s by the USDA. It is a cross between 1613 Couderc and Dog Ridge (Vitis Champinii x Vitis vinifera x Vitis labrusca x Vitis riparia). Harmony is known for its exceptional nematode resistance, particularly to dagger nematodes. It also has moderate resistance to root knot nematodes.

Harmony is well-suited for sandy to loamy soils with good drainage. It performs well in both irrigated and non-irrigated conditions. However, it is not suitable for shallow, compacted or dry soils unless irrigation is available. Experience in Egypt and Mexico confirms its limited application under saline and high pH soil conditions.

According to American literature and field experience, Harmony’s greatest attribute is its exceptional resistance to root knot and dagger nematodes. It has moderate resistance to root lesion nematodes, but is highly susceptible to ring nematodes. The root system exhibits much the same characteristics as 101-14, being heavily branched with many fine roots. The depth of penetration is, however, similar to Richter 99 and Ramsey. Harmony’s phylloxera resistance is questionable due to its 1613 C parentage. It has, however, been used for more than 40 years in the San Joaquin Valley without any phylloxera associated problems. This area has deep, well-drained high-potential loamy soils where vine vigour can overcome the effects of phylloxera.
under irrigation on medium-potential soils (a position somewhere between Ramsey and US 8-7) where nematodes are prevalent and potential for phylloxera attack limited. It can be used for both wine and table grapes.

Harmony

Harmony was recently re-imported by SAPO from the USA. It is an American-bred rootstock made in 1966 by Doctors J.H. Weinberger and F.N. Harmon at the USDA Agricultural Research Service station near Fresno, California. It is a cross between open pollinated seedlings of 1613 Coudere and Dog Ridge (Vitis Champinii x Vitis vinifera x Vitis labrusca x Vitis riparia), the same parents as Freedom. The main reason for the crossing was the continued search for nematode (especially dagger nematode) resistant rootstocks for the San Joaquin Valley.

Harmony exhibits only moderate vigour (similar to Richter 110) compared to Freedom. It has moderately high resistance to root knot nematodes, but only moderate to low resistance against root lesion and dagger nematodes. Its other characteristics (resistance to salinity, subsoil wetness, drought and especially lime induced chlorosis) are at best moderately low. It shows more sensitivity to calcareous soils than 101-14. Harmony should only be used on soils of high potential without any physical or chemical restrictions, with the availability of irrigation. Its phylloxera tolerance is under suspicion, similar to that of Freedom. Experiences in Mexico and Egypt have shown limitations of this rootstock on soils of marginal potential. Harmony has already failed in vineyards on the north coast of California due to phylloxera and cannot therefore be recommended in regions where this pest is present. It therefore has limited potential for South Africa where phylloxera is present in all grape growing areas.

Historically, world-wide only rootstocks with Vitis vinifera parentage have succumbed to phylloxera. How much Vitis vinifera “blood” Freedom and Harmony possess is not known, and accordingly no confidence can be placed in their long-term phylloxera resistance.

VR 039-16

VR 039-16 was bred by Professor H.P. Olmo of the University of California (Davis) in 1948. It was patented and released to the industry in 1988. It is a hybrid of Vitis rotundifolia x Vitis vinifera cv Almeria and selected specifically for its resistance to grapevine fan leaf virus and its vector Xiphinema index. This rootstock not only shows poor feeding of Xiphinema index on its roots, it also maintains vigour and yield even when infected with fan leaf virus. The reason for this anomaly with Vitis vinifera parentage may be because fan leaf virus is thought to have coevolved with Vitis vinifera in the Middle East; cultivars from this region may possess fan leaf resistance or tolerance to some degree. It does, however, only have moderate resistance to other nematode species, especially root knot nematode (similar to Richter 110).

Other characteristics of VR 039-16 are found in American literature. It has moderate compatibility when Vitis vinifera cultivars are grafted to it and tends to root with difficulty (from its Vitis rotundifolia parentage). VR 039-16 has a long vegetative cycle and ripens its fruit late. It is considered a high vigour rootstock that can support high yields. It has poor tolerance to drought, salinity and soil with high lime content. VR 039-16 should not be established on sandy soils under irrigation due to its moderate resistance to root knot nematodes. It therefore should only be used where Xiphinema index is the main nematode with the presence of fan leaf virus. Phylloxera resistance of VR 039-16 has been studied in California and has not shown any degeneration over an extended period. It, however, still carries Vitis vinifera parentage and therefore has to be evaluated over a much longer period before commenting on this very important aspect.

It could be an interesting option for use in the lower Breede River Valley where Xiphinema index and fan leaf virus are known to exist.

RS-3

RS-3 rootstock is an inter specific cross between Ramsey (Vitis Champinii) and Schwarzmann (Vitis riparia x Vitis rupestris) produced by doctors David Ramming and Michael McKenry of the USDA Research Service near Fresno, California. It was released in 2004. RS-3 has recently been imported to South Africa by SAPO and established in the foundation plot at Voor-Groenberg Nurseries. The first grafted plants were supplied to the industry in 2013. Initial results show that RS-3 has moderate vigour that can be confirmed from its performance in a non-grafted state. Californian research also claims moderate vigour in the grafted state.

The most impressive characteristic of this rootstock is its excellent resistance to a wide spectrum of nematodes. Californian literature states that RS-3 is the first medium-vigour rootstock with resistance to all species of root knot nematode, Meloidogyne spp., including virulent populations of M. incognita, M. arenaria and M. chitwoodi. It is also resistant to root lesion nematode, Pratylenchus vulnus; pin nematode, Paratylenchus hamatus; and dagger nematode, Xiphinema index. It is slightly susceptible to citrus nematode, Tylenchulus semipenetrans, and supports less than half the population level normally associated with ring nematode, Mesocricicnema xenoplax. To date it has not supported populations of any nematode species in great numbers, thus we refer to it as having broad nematode resistance.

Other reports list RS-3 to be somewhat sensitive for subsoil wetness and salinity, characteristics it inherited from its Schwarzmann parentage. It can be postulated that higher potential soils should be preferable for this rootstock. Phylloxera resistance should be adequate considering its non-Vinifera parentage. No other information currently exists for RS-3, but it could have potential in both the wine and table grape industries for vigorous cultivars on high-potential irrigated sites with nematode infestations.

RS-9

RS-9 rootstock is an interspecific cross between Ramsey (Vitis Champinii) and Schwarzmann (Vitis riparia x Vitis rupestris) made by doctors David Ramming and Michael McKenry of the USDA Research Service near Fresno, California. It was also released in 2004. RS-9 has recently been imported to South Africa by SAPO and established in the foundation plot at Voor-Groenberg Nurseries. The first grafted plants were supplied to the industry in 2013. Initial results show that RS-9 has moderate to low vigour (similar to 101-14) that can be confirmed from its performance in a non-grafted
state. Californian research also claims moderate to low vigour in the grafted state, definitely less than RS-3.

RS-9 has nematode resistance characteristics similar to RS-3 except it is more susceptible to ring nematode but more resistant to *Xiphinema index*. The only difference between RS-9 and RS-3 seems to be the lower vigour of RS-9. Phylloxera resistance should also be adequate since RS-9 have the same parentage as RS-3. The lower vigour of RS-9 may limit its use in the table grape industry, but it definitely should be tested and evaluated for its use as wine grape rootstock. Higher soil potential sites would probably be preferred. Other characteristics such as drought tolerance, salinity, subsoil wetness and *Phytophthora cinnamomi* resistance must first be evaluated in field trials over an extended period before commenting on its potential for South African conditions.