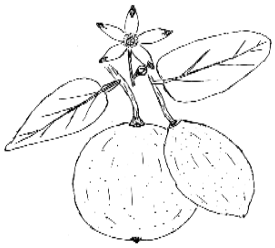

Limette

Newsletter Citrus Friends Europe **Issue 5**

Citrus Rootstocks

Well, this double issue of the Citrus Friends Newletter Limette should discuse the need of knowledge about citrus rootstocks, because the knowledge of different citrus rootstocks is often the key to success or failure.

History and the need of rootstocks

Citrus was long propagated by seed, but some factores made the propagation by the process of uniting a desired fruits quality onto a desired adapted root and stem to the nearly only used propagation methode in the world. These factors are diseases and different growing conditions. Citrus was propagated from seed till the middle of the 19. century, but the greatest threat was the occurence of foot and root rot in badly drained soils, like clay or loamy soils or in plantations with heavy rainfall or close to the sea or river sides. High water tables and often wet soils softened the bark of the stems, leading to damage and scalling of the bark, giving so entrance for damaging fungus Phytophthora spp. which colonisised the cambial layers and lead to tree death by girdling the stem. Same can be told for the roots were the living tissue died, leaving the tree without successfull nutrient and water uptake.
With the grafting procedures, later with the successfull and professional use of the budding process a desired fruit type was able to be grown on a different rootstock cultivar, which protected the fruit cultivar from the major disease of foot rot. Citrus aurantium was the major rootstock, because of its tolerance to different soil conditions, cold and foot rot. With the appearance of the new citrus threat Citrus Tristeza Virus (see Limette No. 3) combinations with SourOrange as rootstock failed and were replaced with other combinations, like Rough Lemon (Citrus jambhiri) in Brasil. The breeding trials of Walter T. Swingle lead to other successfull rootstock hybrids, resulting from crosses of the very cold hardy and CTV resistant species Poncirus trifoliata with Citrus species, like the Citrange (Poncirus trifoliata x Citrus sinensis) and the Citrumelo (Poncirus trifoliata x Citrus paradisi).
But with all trials and research something had found: There is not any single multipurpose rootstock found yet! Each grower must check his growing conditions, disease restrictions and his objectives to find the right and successfull scion/rootstock combination for his personal demand. Localy found habits in rootstock usage or statements about the 'the best rootstock' show not the right knowledge about this First Step of Success: The choice of the right rootstock.

How to choose the right rootstock

Well, a grower, regardless if he wants to grow a single tree or thousand of trees must first make the choice of the fruit he wants to grow. Someone who tries to raise grapefruit in areas with low heat can do, but will fail because high quality grapefruit able to eat can only harvested in areas with little cold. Someone who will try to harvest lemons in tropical humid areas will evenly fail because lemons suffer quickly from fungal diseases if grown in to humid climatics. So one must knew which fruit will be successful to grow, before he should make the next step. Next step is watching the temperatures: In areas prone to prolonged freezes citrus trees may not survive or the costs for shelter and heating may inhibit a successfull harvest. Also short but more desasterous frosts can damage citrus trees more as long hot summers in areas with high radiation sunshine can do. So the special climatic environment may also limit successfull tree survival. Citrus aurantium, Cleopatra Mandarine and Poncirus trifoliata ranging as the most cold tolerant rootstocks, but Poncirus trifoliata needs a prolonged time of cold to completely adapt. After cold weather, it is often prone to short term freezes

as the others. Also in humid, hot areas several rootstocks do better than others: Volkamer Lemon, Rangpur Mandarinelime and Rough Lemon do much better than Poncirus trifoliata. Then the growers looks to the ground: Sandy soils are often infertile, require more irrigation and fertilisation as sticky loamy soils, but the least soils are often badly drained and require more labor to keep soil alkalinity and drainage in order, than sandy soils. Also calcarous soils often found close to mountains, were the ground is often rich in dolomic limestone or close to old costal borders, were lime levels are resulting from ancient shell limestone layers in the ground. Some areas are contaminated due layers of salts, like in costal areas and in some desert growing areas. And for all these conditions different rootstocks will exists. As example: In sandy soils Citrus aurantium will grow good, but Carrizo Citrange and Volkamer Lemon grow much better, but Poncirus trifoliata will not do well.In heavy clay soils, Citrus aurantium will grow well, as Poncirus trifoliata will do if levels of soil pH will not raise above 7,0. Volkamer Lemon and Carrizo Citrange do not well in these grounds. Soils rich in limestone require a special care and rootstock choice: Citrus aurantium is the major used rootstock, followed by Cleopatra mandarine and Volkamer Lemon. Poncirus trifoliata and its hybrids still often fail in such soils. Soils in costal areas or with other salty componds found inlands are also a special condition, were Cleopatra mandarine, Rangpur Mandarinelime and Citrus aurantium are the major rootstocks, others will not be a successfull choice.

Next eye is kept on local present diseases, like fungal, bacterial and viral threats, also some soil born pests like nematodes.

So in areas with virulenst strains of the tristeza virus intolerant rootstocks like Citrus aurantium and Citrus macrophylla must be avoid, as some not resistant scion varieties which will die even if propagated on tolerant rootstocks, like Citrange Troyer or Carrizo, Swingle Citrumelo, Rough and Volkamer Lemon, Rangpur Lime and several Mandarine type Rootstocks, like Citrus sunki, Citrus depressa and Citrus reshni.

After considering all these factors someone must do his own decission, carefully even watching about stock and scion combatibility: Certain mandarin scions and lemon varieties are not compatible with trifoliate rootstocks also scions of Rough Lemon and Volkamer Lemon do not well onto these rootstocks.

Well if the growers has made his decission, he will have the best fitting stock-scion combination for his climatic environment and his growing conditions.

A last word of for attention: Cold hardiness is mostly influenced by the scion variety. If someone uses an very cold intolerant scion variety, like true limes, an very cold tolerant rootstock like Poncirus trifoliata will not much raise the cold tolerance of the scion variety, only very cold hardy scion varieties will take advantage from frost tolerance of their understock.

Following a short description of some major rootstock varieties:

Citrus aurantium

Sour Orange was once the major rootstock in all growing regions of the world, but the evidence of the Citrus Tristeza Virus has limited its use today to areas free of this virus or for special scion combinations were the typical scion decline reaction after CTV infection will not occur, like with lemon varieties. In the mediterran basin, were often severe strains of the virus are not present Sour Orange is still today widly in use, especialy because the soils do not permit the wide use of trifoliata hybrids. Sour Orange produces premium fruit quality, for processing and the fresh fruit market. The fruits onto this rootstock are medium sized and rich in internal as external quality. This rootstock produces rich crops and grows strong, but not as strong if compared with the lemon types. Sour Orange has a dense and deep root system which induces a good drought tolerance. Citrus aurantium is one of the most cold hardy rootstocks inducing a very good cold tolerance to its scions. Sour Orange has a good tolerance to saline conditions, but not as much as Rangpur or Cleopatra, but is one of the most tolerant rootstocks for calcerous soils, so still predominant in arizona, texas, morocco, sicily and areas of greece and turkey. Sour Orange is tolerant to flooding conditions and so good tolerant to phytophthora foot root, but in cold, wet soils Citrus aurantium suffers quickly from root rot, because of the death or absence of the mycorrhizial fungus. Without Sour Orange is often not able to take up enough water and nutrients. Many hybrids are today in rootstock trails as Tristeza tolerant replaces for the excellent SourOrange rootstock. An CTV tolerant

SourOrange substitute would be the goal and maybe the most planted rootstock in further citrus growing areas worldwide.

Citrus reshni, Citrus sunki and Citrus depressa

Citrus reshni, the Cleopatra mandarine, Citrus depressa, the Shekwasha mandarine and Citrus sunki, the Sunki mandarine exhibit the increasing sections of rootstock types. Like the most mandarine type rootstocks these rootstocks induce good cold tolerance and are tolerant to the major virus diseases present in the commercial growing regions. The medium deep rooting system induces only a medium drought tolerance and most mandarine type rootstocks are not as tolerant to flooding conditions as Sour Orange, Citrus macrophylla and Poncirus trifoliata. But Cleopatra Mandarine is one of the most tolerant stocks for saline conditions, but not as tolerant for calcerous conditions as Sour Orange or Rough Lemon. Shekwasha and Sunki exhibit more tolerance, but are not as saline tolerant as the former Cleopatra. The fruits on these rootstocks are often smaler, if compared with Sour Orange or Lemon types, and only have medium quality, but mandarine types are often good croppers with mandarine, grapefruit and orange scions. Still a backdraw is the often not stable yearly crop and that most mandarine stocks come slow into a bearing age representing a continuos income for the growers in stable yearly crops. However, if virus tolerance, calcerous soils and good fruit quality are the concerning factors mandarine type rootstocks are a good choice. All mandarines exhibit the same cold tolerance as Sour Orange or Poncirus trifoliata.

Citrus jambhiri

After the evidence of Citrus Tristeza Virus the dominat SourOrange rootstock was largely replaced by this lemon type rootstock. Rough lemon has a very deep rooting system, thus is more drought tolerant as Sour Orange and the mandarine types. Rough Lemon is very vigorous, so trees grow large and spreading if left unpruned. The fruits harvested on lemon types rootstocks are of not as high quality as those harvested on trifoliate, mandarine or Sour Orange Rootstocks. Fruits are large, having a rough often peppled thick rind. Juice is low in soluble solids and contains more water than if compared with Sour Orange fruits. But high yields can be expected annualy, so lemon types are often predominant in the use for the citrus fruit processing crop. Citrus jambhiri is not tolerant to flooding conditions, so suffers quickly from root rot and foot rot by Phytophthora induced lessions. Also Rough Lemon is not successfull on heavy clay or loam soils, but will endure deep infertile sandy soils with proper irrigation and fertilisation. Citrus jambhiri is as most lemon types not very cold tolerant, thus those rootstocks exhibit the best regrowth after freeze damage. However the risk of such freeze damages are more of concern if lemon type rootstocks are used.

Volkamer Lemon

Citrus volkameriana is a Rangpur type, but exhibits the same horticultural characterisitcs as Rough Lemon. So trees on Rough Lemon stocks are largly replaced by trees on Volkameriana stock. Fruit quality is slightly better and the rind is of better texture, but fruits commonly not match the quality standarts of those produced onto trifoliate rootstocks or Sour Orange. Volkameriana seems to be the most vigorous rootstock of all, so requires much more prunning shedules than other stocks.

Rangpur Mandarinelime

Trees on that stock are predominant in Brasil, because of its good tolerance to saline soil conditions. Also calcerous conditions will as good tolerated as exhibited by most mandarine stocks. But Rangpur is intolerant to some diseases as foot rot, Cachexia disease and Citrus Exocortis Virus. Rangpur does not develop such a dense and deep root system as Volkamer Lemon, but is as drought tolerant than Sour Orange or the Citranges. All other characteristics are compareable to Volkamer Lemon or Rough Lemon.

Poncirus trifoliata and its Hybrids

Poncirus trifoliata is for the most growers in cold areas the first choice, because of its cold-hardiness. But Poncirus trifoliata can only impart the same cold hardness as given by Cleopatra Mandarine, Shekwasha or Sour Orange. Only if the scion is very cold-hardy, in example Sastuma Mandarine scions Poncirus trifoliata enhances cold hardiness. Fruit quality is very good, but often the fruit size is very small, often of the smallest sizes harvested on all rootstocks. Also without proper irrigation often the fruit quality developed is inferior,

large crops of small and dry fruits decrease the quality, so Poncirus does not fit to infertile sandy soils, but deep, fertile soils, often badly drained in cold planting areas are primary planted with Poncirus trifoliata as rootstock. The trifoliate orange has only a shallow root system, so is very prone to drought and irrigation is often a must, even in areas with proper rainfall. Also making the main feeder roots prone to damage by ground cultivation works, or repotting actions for plants in containers. Poncirus is not a good choice for warm or hot climatic environments without cold time periodes, because Poncirus trifoliata cannot tolerate constant warm temperatures without seasonal temperature changes, so it does not fit for the tropics or sub-tropics.

Poncirus Hybrids

Poncirus Hybrids used as rootstocks are today commonly used. Poncirus Hybrids, such with Sweet Orange are called **Citrange** and with Grapefruit are called **Citrumelo**. Carrizo Citrange is one of the most planted rootstocks worldwide, its sister Troyer predominat in California. Citranges can be planted in the deep sandy soils in many citrus growing areas, but do not fit to heavier soils as their parent Poncirus trifoliata. Citranges are not as cold hardy than Sour Orange, but better than Lemon Type rootstocks. Citranges are very disease tolerant, but lack as their parent Poncirus the tolerance to saline or calcerous grounds. Fruit quality is good and fruit size is medium. Citrumelos produce slightly larger fruits than citranges and are less cold hardy, fruit quality and tolerated planting soils are compareable. Citranges and Citrumelos develop a better root system which reaches medium deeply, so exhibit a better drought tolerance than its parent Poncirus trifoliata, but are not as drought tolerant as Rough Lemon for example. Carrizo seems in field trials to be somewhat more drought tolerant than Troyer..

Some other Poncirus Hybrids are still in trial today, as other mandarine or Sour Orange Hybrids and Selections.

Further informations about Citrus Rootstocks can be read in the Publications from the University of California and Florida and the french INRA Institute. Also the attached table gives and quick view to the major rootstock charateristics. This table was first made by Dr. Wutscher, published by Davis and Albrigo, later revised by Castle and the table attached here was again revised and edited in cooperation of the autor with Dr. Wutscher from the USDA Florida/USA.

Club News

The first Citrus Friends Club Meeting was held at 30. July at the home of the Club Member Mr. Billig at the town of Remagen. Members from the Netherlands and Germany had come, for many others the way to come was to far. But all members who joined the meeting confirmed to meet more often, and if possible with all other members, too. Because other members had other interests, other collections and other experiences and the different growing countries would give, too, a good stuff to discuse about.

So the Club is seeking for a nice place for the first complete meet of the Citrus Friends Europe, easy to reach for all members, not expensive, must have something to do with citrus, and not with the need to do complex travels. This Point of course may never be found, but all points considered to fit in this demand should be discused and as soon as possible all members should meet. Maybe the french chapter of of the Citrus Friends Europe can manage this thing.

Also in cooperation with the Citrus collection at the island of Corsica, at the SRA INRA-CIRAD Research Station, some club members were able to order high quality, certificated budwood from available varieties. As collective order the price per budeye did not exceed the price of 1,5 Euro inclusive transportation costs. An acceptable price for this high quality propagation material. The members only lack a inexpensive source for rootstocks of the mentioned types.

Unfortunately the SRA INRA-CIRAD Station does not hand out budwood of typical rootstock varieties, so these varieties cannot merged to our collections, as source of ornamentals, unusual fruits and for self-propagators as seed source to grow own rootstocks for further propagation. Its only possible to obtain seeds, but seedling will come in our climatic environment after decades to first flowers, if they would ever.So rootstock varieties are still high in demand for the mentioned reasons.

Also the good news is, that our club still increases in members, as also offical sites, like botanical gardens begin to ask the club for help and support.