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SELECTION OF AVOCADO ROOTSTOCKS

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OPSOMMING

*Die meriete van verskeie onderstamme word bespreek. Dit word voorgestel dat Suid-Afrika die beste toetsterrein in die wëreld is om onderstamme te selekteer vir bestandheid teen **Phytophthora cinnamomi.** 'n Skema vir seleksie word voorgestel.*

SUMMARY

*The merits of various rootstocks are discussed. It is suggested that South Africa is the best place to screen rootstocks for resistance to **Phytophthora cinnamomi.** A scheme for rootstock selection is proposed.*

INTRODUCTION

The avocado industry a round the world has been developed by using seeded rootstocks. These rootstocks have tremendous variability, expressed in the form of non-uniform trees in the orchards. Although this non-uniformity is a big disadvantage, it is important from the point of view of providing sources for selection. Once the selection of outstanding trees has been made, clonal propagation of the rootstock should take place.

SEEDLING ROOTSTOCKS

All around the world, avocado rootstocks are chosen according to their propagative characteristics, rather than their horticultural characteristics ¡n the orchard. Some examples of this are the Topa-Topa rootstock in California and the Edranol in South Africa; but, generally, the avocado race, from which the rootstocks are taken is selected according to its horticultural characteristics. The Mexican race has some preference in California, because it is resistant to low temperature, including frost. The West-Indian race is the rootstock seed supplier in Florida, since it is the most resistant to lime in the soil, and also because it seems to be more adapted to the West-Indian and hybrid cultivars they grow there.

In Israel, during the last decade, nurseries have been propagating seedling rootstocks according to the order of preference of growers. Step by step the number of rootstock types has been reduced from 600 to 100, which have been found to be better than the others in regard to soil factors and productivity. In South Africa, Edranol seeds are the

most common source of seedling rootstocks. Years ago, nurseries used Mexican seedlings as seed sources, but later on it was found that many of them are symptomless carriers of the "Sun Blotch" viroid. According to reports, Nabal Guatemalan rootstocks were found to be successful in the orchards, but as this cultivar became non-commercial the nurseries stopped using it's seeds. On the other hand the West-Indian race, which became very popular in Israel because of its resistance to both salinity and lime, could be a source of seeds in South Africa, since many seedlings still grow in the coastal region of Natal. But because some growers had poor results in the past, and because it was suspected that all West-Indian seedlings are hidden carriers of Sun-Blotch viroid they eliminated the use of this race.

The use of one source of seeds only, although it has variability, seriously narrows the genetic spectrum of rootstocks that can be expected from many different seeded rootstocks. Guatemalan Edranol seedlings in South Africa do not suffer from chlorosis because the soils are completely free from lime. But this does not mean that seedlings of this cultivar are the best in regard to drought resistance or tolerance of poor aeration, or as potential sources of resistance to root-rot.

CLONAL ROOTSTOCKS

Clonal rootstocks have been developed successfully for some other fruit crops, and they can be expected to be the future rootstocks of the avocado.

Theoretically, clonal rootstocks should be uniform, but further experiments should be laid out to confirm this theory. Uniformity is an advantage only when outstanding rootstocks are available. Moreover, clonal propagation is the only way to conserve and utilize the outstanding characteristics of these rootstocks. Any claim about the possible non-uniformity of clonal rootstocks, or the possible influence of nurse rootstocks on heredity of the clonal ones — has not yet been proven.

On the other hand, uniformity resulting from the use of clonal rootstocks could be a disaster, if the propagated rootstocks prove to have negative characters. Hence, clonal propagation should follow the selection of rootstocks from seedlings, and should include an acceptable number of clonal sources in order to reduce the potential hazard.

Selection of avocado rootstocks for clonal propagation can be applied in various ways in different directions according to the problems that require to be solved. In California, a long-term selection for root rot resistance started more than twenty five years ago, and has resulted in about twenty rootstocks being available for further study at the present time. In Israel, another long-term selection commenced at the same time, in order to select rootstocks resistant to salinity. Later on, some other soil stress factors were included, and researchers also began to duplicate outstanding productive trees. Today, more than one hundred clonal rootstocks are under investigation in Israel.

It should be mentioned here, that never should a clonal rootstock be selected for one purpose only, because it could be sensitive to other soil factors, or it could induce low productivity. The right way *is* to select a variety of rootstocks for a variety of different combinations of local conditions.

In South Africa, the severity of avocado root rot justified a search for resistant

rootstocks. Professional people were convinced that the industry is too small to develop its own rootstocks so introductions have been made from the Californian selections. First of these introductions, Duke 7, is widely propagated now, and as in California, it has become most popular in recent plantings. Again, as in California, some investigations show sensitivity of this rootstock to poor aeration. It is however too early to judge the success of this rootstock, but most growers are happy with the good development of the young trees. Any rootstock, and especially Duke 7, should be evaluated after several additional seasons, when the rainfall is heavier, and the drought disappears. The second oldest Californian rootstock Duke 6 — has been found to suffer stem pitting, and many young trees have degenerated and died. Fortunately, this rootstock has not been used in large numbers. The third introduction, Hunt alas, is known to be infected with "Sun-Blotch" viroid disease, and could be used only if and when viroid free material is developed. Another introduction namely G22 was found to be non-resistant in California. Further propagation of this rootstock in South Africa will probably be unnecessary. Two later introductions, namely, G6 (Mexican type) and G-755 *(Persea schideana* type), are now at a stage where they could be propagated in larger numbers. There are also some very new introductions, which are still in quarantine.

Californian rootstocks nave been selected by means of a laboratory test, and field performances are unknown. Information that is lacking at present includes: The resistance of root rot of the fully grown grafted tree, the adaptation to different soils, and the productivity of the grafted tree.

The soils in South Africa differ very much from those in California. They are heavier, and less aerated. In South Africa avocados are grown under summer rainfall conditions with long dry winter months.

In South Africa there are many orchard trees that have escaped destruction by Phytophthora root rot. Some of them have already been identified on Westfalia Estate. One very interesting tree survived in Lancefields orchard near Tzaneen forty years after the whole orchard had been infected and destroyed. Those 'escaped' trees should be well adapted to the local soil conditions, and some of them are also known as excellent fruit producers. These could be the best selection source for South Africa. It is suggested that *P. cinnamomi* finds its best ecological conditions in South Africa and is probably the best place to select resistant rootstocks for this disease. (See also appendix 1: Avocado rootstock-scion selection scheme).

Once selection of outstanding trees has been done, clonal propagation should take place. For many years lack of appropriate methods prevented the development of clonal rootstocks. Later Frolich at U.C.L.A. developed his propagation method, based on his re-juvenilisation ideas, but it was again many years until this method became commercial, with new developments being made by Brokaw and others. (See also appendix 2 for description of the different methods).

The different methods which have been developed since then are all based on Frolich's ideas and will not be discussed here. These methods are based on the use of nurse rootstocks as in the original Frolich method and on some other related variations for example where one nurse seedling rootstock is used to propagate 20-40 clonal

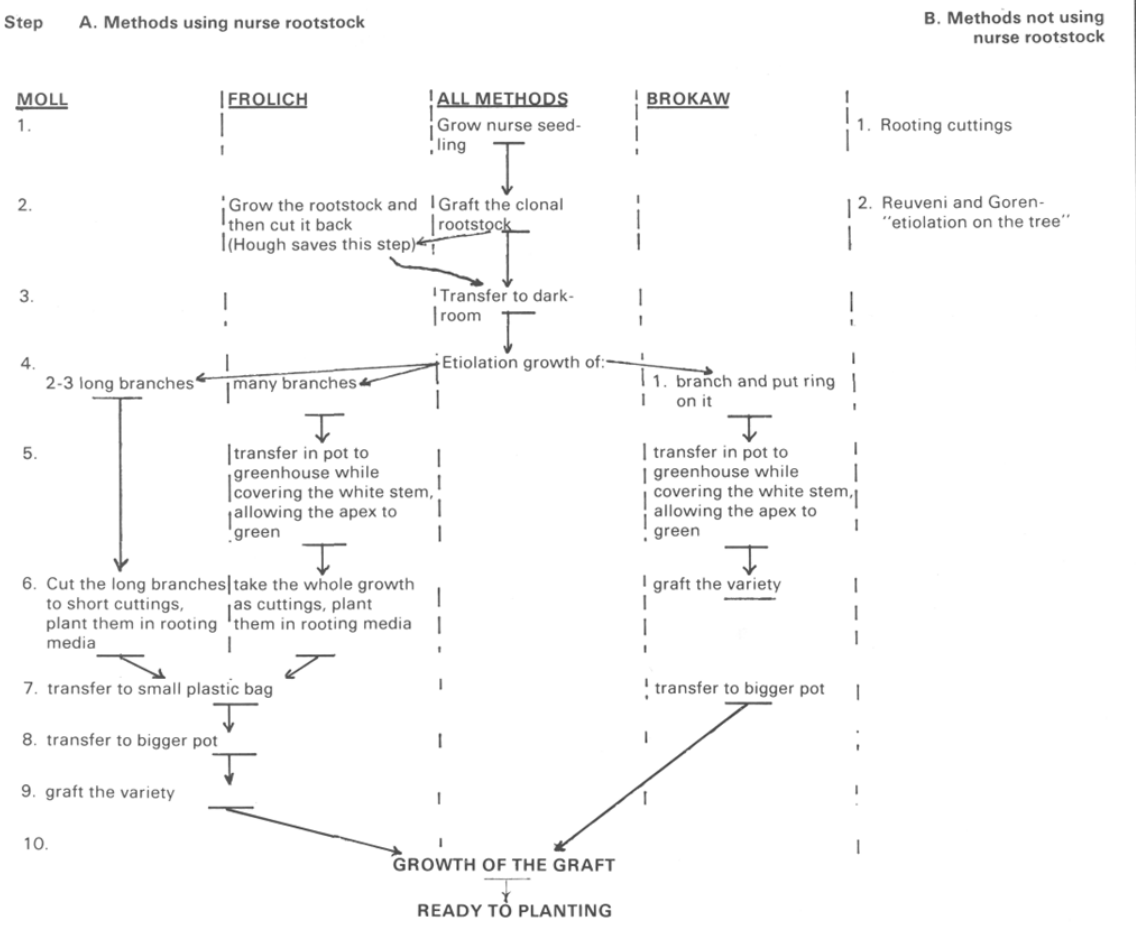
rootstocks, and in Brokaw method where one nurse rootstock is used for each propagated tree. The different nurse rootstocks have a big variability among them, even if they have been taken from the same mother tree. This fact could induce some variation in the completed product i.e. — the grafted tree on a clonal rootstock that is planted in the orchard. It could not induce any change in the heritage of the clonal rootstock, and it is neither logical nor acceptable that any genetical material will move through the plant system from the nurse seedling to the clonal rootstock or elsewhere. The uniformity of trees could be affected only in the establishment stage, with regard to the start of growth and development. Later on the nurse rootstock dies back, and the influence is stopped. Some suspicions concerning the uniformity of the clonally propagated trees was claimed when some new viruses, named avo viruses 1, 2, 3, 4 — were discovered. However up to the present no clear relationship has been found between this discovery and the avocado trees' appearance or behaviour, or with any disease.

Only if further research proves such relationships or the unequal presence of the viruses in different seedlings of the same source, or that transmission through the graft union is achieved — should this factor be taken in account, and then it will probably be necessary to eliminate the use of nurse rootstocks in clonal propagation procedures.

APPENDIX 1 AVOCADO ROOTSTOCK-SCIONS SELECTION SCHEME

1. Follow-up of the development, tree condition and production of the population of the trees in existing orchards.
2. Establishing new experimental plots in different parts of the country, including as many sources of propagation material as possible. (See appendixes 6, 7).
3. Establishing mother blocks as a seed source, graftwood source and clonal rootstocks source.
4. Current indexing of the propagation material in the mother orchards for viroids and viruses.
5. Continuation of introductions of selected rootstocks from other countries.
6. Establishing international germplasm bank.
7. Developing better clonal propagation methods, in order to eliminate the use of nurse rootstocks, and to eliminate the presence of viruses and viroids, and to speed up the whole procedure.
8. Evaluate clonal rootstocks that emerged from selections among seedlings from different sources.
9. Evaluate productivity (and other characteristics) of resistant rootstocks.
10. Evaluate resistance of the rootstocks of very productive trees (copy trees).
11. Find the best rootstock and the best rootstock-scion combination for each cultivar, under different local growth conditions.

APPENDIX 2: Comparison of different methods for clonal propagation of avocado



Evaluation of the methods

MOLL	FROLICH	ALL METHODS	BROKAW	B. Methods not using nurse rootstock
A new method, on commercial scale.	Never became commercial on a wide scale	Has some hazards resulting from the use of nurse rootstock.	The most commercial method.	Avoids the hazards resulting from the use of nurse rootstocks.
Needs small quantity of propagation material	Needs small quantities of propagation material	This method is the only one used on commercial scale around the world	The most successful one	Limited success in cuttings.
Results in more cuttings per used unit.	Longer time for the propagation. process.		Needs more propagation material. both seeds and graftwood.	Long procedure in "Reuvenis"
Long time for the process.	10 steps.		The nurse rootstock remains with the plant while planting.	Neither are in commercial use.
Limited to the rootstock Duke 7 or other rootstocks that do not defoliate during or after etiolation.			8 steps	
10 Steps.				