

PROPAGATION OF AVOCADO ROOTSTOCKS

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Mr. Chairman, members of the Society:

When your President and Secretary asked me several weeks ago if I would discuss clonal propagation of avocado rootstocks with you today, I was reluctant to accept their invitation for two reasons: (1) I have not participated directly in any of the investigations to which I shall refer, and (2) most of the results of our studies have already been reported to you either at an annual meeting or in the Yearbook. However, in reflecting upon the matter it occurred to me that this invitation afforded me the opportunity to tell you why we are interested in learning how to multiply avocado rootstocks by vegetative methods. On that basis and with the above mentioned limitations in mind, I accepted.

I am sure that some of you have wondered why we go to so much trouble to reproduce avocado rootstocks by cuttings when they can be so readily grown from seeds.

On the assumption that most of you are familiar with the techniques commonly used in the propagation of avocado trees, I shall not describe these methods. Rather I shall attempt to indicate why we are interested in learning how to multiply a rootstock by vegetative (non-seed) methods.

Avocado trees are usually propagated by one of the following techniques:

1. Budding nursery-grown seedlings to the desired scion variety.
2. Tip grafting the scion variety onto seedlings.
3. Topworking established trees.

These methods of propagation all imply the use of heterogeneous seedlings as rootstocks—each seedling different genetically from every other, even though the seeds may all have been of the same variety or all from the same parent tree.

These genetic differences may account for some of the variability in growth and fruiting frequently observed in avocado orchards. Mr. H. L. Gillespie directed our attention to rootstock variability as a possible cause of differences in the beaming behavior of Fuerte trees in his reports at the last two annual meetings of the Society (Yearbook 1952, 1953-54). This subject, concerning which we have very little information, is being extensively studied by Dr. F. F. Halma, until last year a member of our staff, now an emeritus member of the staff of the Department of Horticulture at Riverside. Dr. Leland Shannon, a junior member of our staff, is planning to undertake intensive studies of the effect of root-stocks on avocado tree performance.

The genetic heterogeneity of avocado seedlings may be advantageous as well as

disadvantageous. It is possible, for instance, that somewhere in the ancestry of an avocado race or variety a factor for resistance to root-rot was acquired. If through a series of fortunate circumstances this character has a chance to exhibit its effects and the resistance is observed, we may have the rootstock we are all hoping for. Observations by Dr. Zentmyer that avocado seedlings vary in susceptibility to root-rot lend support to this point of view. He has recently reported that some seedlings of the Duke exhibit a considerable degree of resistance. Theoretically, it is not beyond the realm of possibility that a completely resistant plant exists or will be grown.

In the event that we do find a seedling or a mature tree which appears to be resistant to root-rot, we hope to be in a position to quickly reproduce it for more extensive testing of resistance and also determine its general suitability as a rootstock. In order to accomplish this without change in genetic composition, some form of vegetative propagation must be employed—stem or root cuttings. Unfortunately cuttings of most avocado varieties are difficult to root by conventional methods. There are a few notable exceptions. Dr. A. R. C. Haas, of the Citrus Experiment Station, has found cuttings of the Zutano to root quite readily, and Mr. Frolich, of our department, reports that a clone which we have designated "Scott" because the original shoot was given to us by Mr. C. C. Scott of Orange County, can be rooted almost 100% without difficulty.

Mr. Frolich has recently demonstrated that the difficult-to-root forms can be reproduced by grafting them onto a nurse seedling and etiolating the base of the new shoots which arise from the scion. The method was described and illustrated in the 1951 Yearbook (pages 136-138).

When scion material (i.e., a shoot) is available, the etiolation technique provides a very satisfactory method for the reproduction of all varieties and seedlings attempted thus far. If, however, we wish to reproduce the root system of a grafted tree from which no root shoot material is available, we must either induce a shoot to grow from the rootstock or use pieces of the old roots to produce new plants. Fortunately it is not difficult to obtain a shoot from the root system, provided there are latent buds on the stock below the bud union. This is almost always true if the bud or graft was inserted in the stock stem above the crown roots. If, however, latent buds are not present on the stock our problem becomes more difficult because, so far as we are aware, no one has yet learned how to induce the development of an adventitious shoot from an avocado root at will, though there are reports of such shoots having been observed in orchards. We hope some day to learn how to do it.

In the event that we cannot secure a shoot from the root system we must resort to the "piece root-graft" method for multiplying it. The disadvantages of this method are that a nurse scion of another variety must always be used and the amount of suitable root material is usually limited. Dr. Haas, Mr. Frolich, and Mr. Gillespie have all used the method successfully for the production of experimental plants.

It is evident from what has just been said that we can reproduce an avocado rootstock by one or all of these methods. The cost of a nursery tree would undoubtedly be somewhat higher than for a tree grown by conventional methods. Nevertheless, in our judgment trees so grown would be well worth the additional cost if this were the only way to insure that they were propagated on a rootstock clone resistant to root-rot and

otherwise satisfactory.

You will note that I have just used the word "clone" for the second or third time during the course of this discussion. Many of you, I am sure, are familiar with this term. To some of you it may be new. The word was coined by the late Dr. H. J. Webber, former director of the Citrus Experiment Station and for many years an active member of this Society, to designate a group of individuals all descended from a single plant by vegetative propagation. For instance, all the plants of "Scott" now in existence constitute a clone because they were all started as cuttings. If, however, we were to grow seedlings of the Scott, none of them would belong to the clone. Each seedling will have a different genetic make-up and each could, if multiplied by vegetative methods, give rise to a new clone. This is a very useful concept for horticulturists. It is much more definitive and restrictive than the term variety, which may be used to designate a group of plants reproduced either vegetatively or by seed.

We hope, of course, that our resistant rootstock, when and if we find it, will transmit its resistance along with other desirable qualities to its progeny through the seed. This would greatly simplify the nurseryman's problems.

Vegetative propagation is important at another point in our avocado rootstock research program. In order that we may not overlook any possible sources of the root-rot resistance factor, several persons, notably Doctors. C. A. Schroeder and G. A. Zentmyer, have been instrumental in the introduction of many new avocado species and relatives from other areas, chiefly Mexico and Central America. Reproduction of the introduced species to provide enough plants for determinations of resistance to root-rot and suitability as rootstocks is an essential part of the introduction program. Each new form presents a special propagation problem.

If, as is the case with *P. borbonia* and *P. skutchii*, the rootstock is resistant to root-rot but is incompatible with our commercial varieties, we must either find a satisfactory interstock or turn the job over to the plant breeders in the hope that they will, by hybridization, be able to introduce the resistance factor into a compatible rootstock or vice versa.

We have yet another interest in the vegetative reproduction of avocado rootstocks, namely the securing of genetically identical root systems for experimental plantings.

If we wish to use an established clone or seedling type, we can reproduce it by one of the methods just referred to. If, on the other hand, we desire to develop a new clone from a seed or young seedling, one of the following techniques may be preferable.

More than twenty years ago Dr. H. P. Traub reported from Florida that a number of genetically identical plants could be obtained from one seed by sectioning the cotyledons and embryo before the embryo begins to grow. Using this technique Dr. R. R. Seaney and Mr. Frolich have secured as many as seven similar seedlings from the same seed (Figure 1).

A number of years ago Eggers and Halma (Yearbook 1937) observed that cuttings taken from very young avocado seedlings root readily in contrast to those from old clones, which, with few exceptions, are difficult to *root*. Halma and Frolich have recently applied the earlier observation in the development of procedures which have enabled

them to secure from 8 to 20 rooted cuttings from a single seedling (Yearbook 1952, Figure 2).

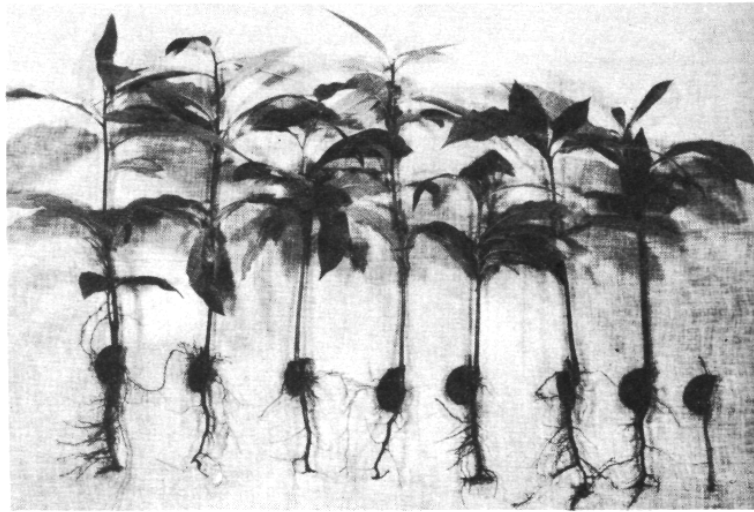


Fig. 1. Seven plants from eight segments of a single avocado seed. Grown by Seaney and Frolich. Photograph by North.

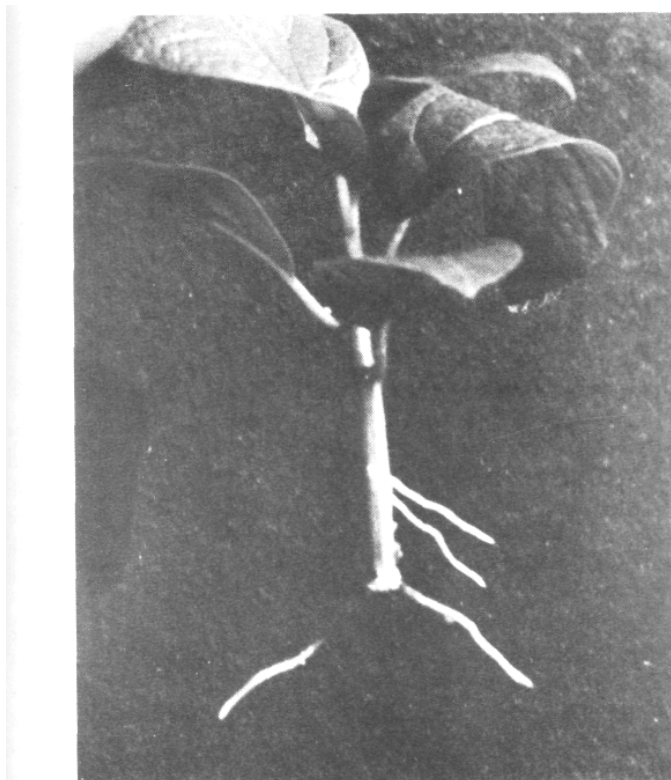


Fig. 2. Rooted cutting from young avocado seedling. Photograph by North.

Either of these methods of increasing the number of plants obtained from a single seed greatly accelerates the rate at which the number of plants in a new clone may be increased.

Earlier I indicated that so far as we are aware no one knows how to induce an adventitious shoot to grow from an old avocado root. We are attempting to learn how to do this. It is the missing link in an otherwise complete chain because, as already pointed out, if we have shoot material reproduction of any variety or seedling is relatively easy by the etiolation method.