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ASEXUAL REPRODUCTION OF ROOTSTOCK FROM HEAVY-PRODUCING FUERTE AVOCADO TREES

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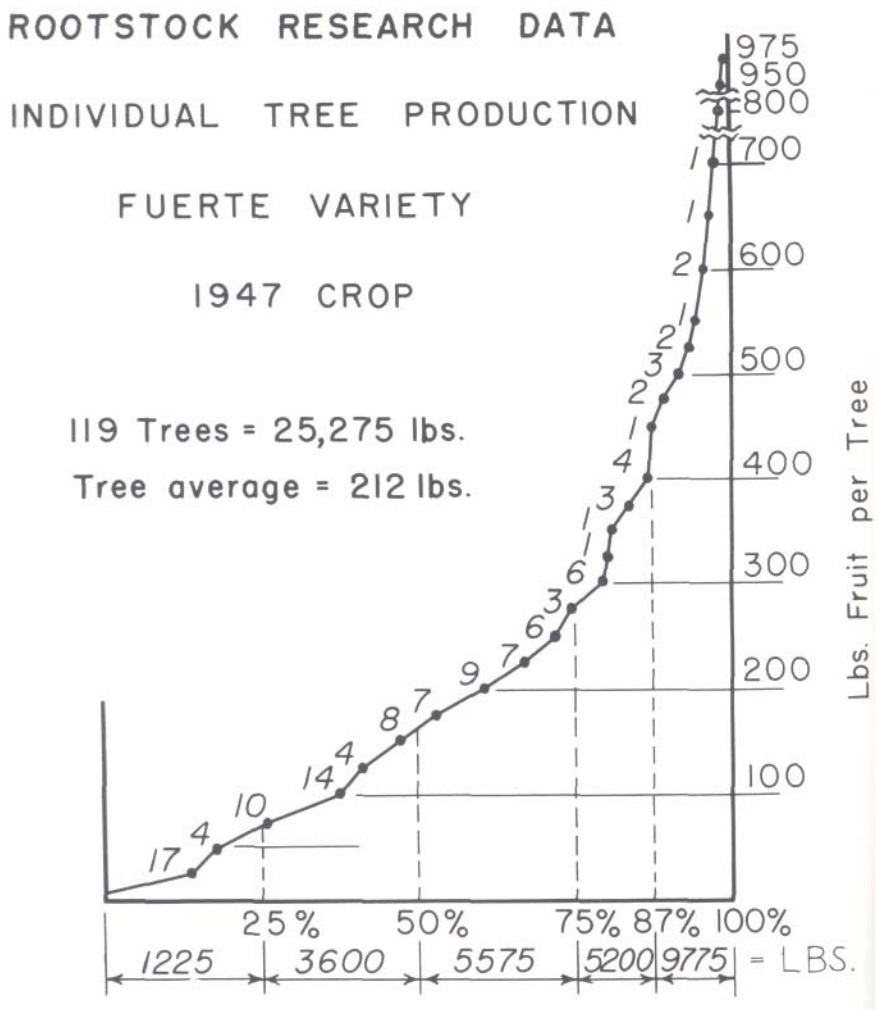
He has had the cooperation and advice of several persons in conducting his project—notably, from Burnell E. Yarick, Los Angeles County Farm Advisor, and Kenneth Casper, Yorba Linda grower.

The key to profit for the individual avocado grower is *production.* 1 hat has always been so; it will be increasingly so as the industry grows older. It is too much to expect marketing people to work miracles to maintain the low-producing grower in the style to which he wants to be accustomed, when the number of such growers keeps increasing. The combined output of hundreds or thousands of low-producing growers adds up to total crops that cannot be reasonably marketed at prices that will keep all such growers prosperous and happy. Amazing marketing accomplishments have occurred, but they cannot do the impossible.

In the history of this industry, various approaches to the goal of greater per-acre yield have been tried—without notable success. Proper grove management helps, but only up to a point. New varieties have been tried by the hundreds, but none has satisfactorily met the needs. Much effort and time have been spent in the propagation of so-called variety "strains"; but the results have been questionable, at best. Yet, there are some groves—and, especially, some trees—that produce better than others of the same variety. Obviously, something has been overlooked. By observation and reasoning, the author concluded that the "something" that has been ignored is underground—that the root of the problem is in the root of the tree. The Fuerte being the leading variety in the eyes of both the grower and the consumer, investigation of the problem concerned itself with this variety.

About seven years ago, work was started on a rootstock research project based on the premise that the root had more influence on production than the bud of the variety—the root in all cases being of seedling origin, and the bud being several times removed from the originating seedling of the particular variety.

A grove of Fuertes belonging to Kenneth Casper, of Yorba Linda, became the focal point—because it is a good producing grove in total, and because a few of the trees in it are outstanding producers. Conditions in this grove are remarkably uniform. Soil, temperature, tree size, variety, and rootstock are virtually identical throughout. But production per tree is not.



Individual tree production records for this grove were initiated and maintained. Production was found to range from less than 25 pounds per tree to over 1100 pounds, with tree size and location in the grove appearing to account for very little of this diverse bearing behavior. Suspicion that the "root factor" played an important part in this erratic performance now appeared to be well founded.

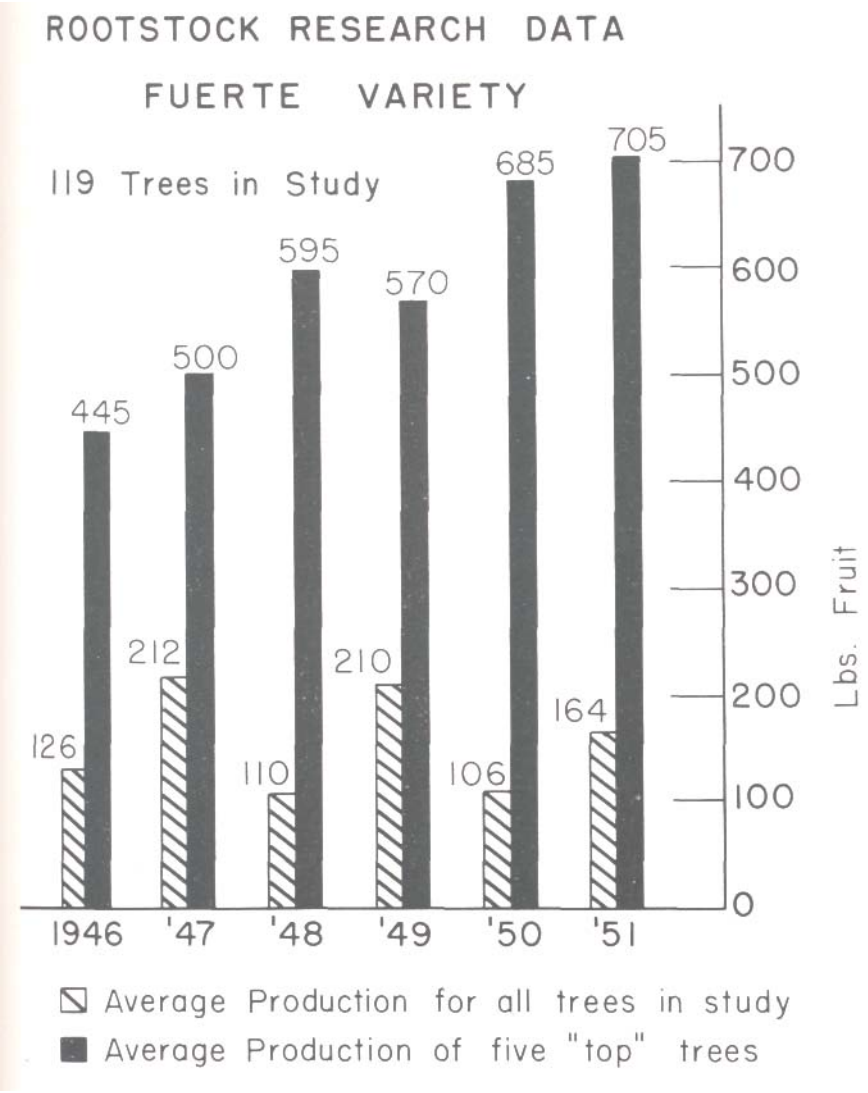
In the State of California there are approximately one million Fuerte variety avocado trees. All have one thing in common: They are all asexually descended from buds cut from the parent Fuerte seedling originating at Atlixco, Mexico. But—*under each of these Fuerte trees is a genetically individual seedling rootstock,* the result of a chance pollinated blossom.

All of the trees studied in the Casper grove have common parentage.

They were all budded from the identical Fuerte tree—itself grown from a bud cut from one of the famous Whedon Fuerte trees. As has been recorded elsewhere, these Whedon trees were among the original trees grown from buds cut from the original Fuerte seedling located at Atlixco, Mexico.

Rootstocks for this grove were likewise from a single source. All were grown from seeds from a regular-producing Mexican seedling owned by Herb Anderson, of Yorba Linda.

This seedling was subsequently top-worked to Fuerte, and has maintained good production of that variety; but its progeny —the rootstocks upon which the Casper grove stands—range in production, as noted, from 25 to 1100 pounds per individual tree.



Because the avocado does not produce a seeded fruit unless the blossom is pollinated, with mixed parentage resulting at least part of the time ; and because of the hundreds of chance "crossings" in the background of the Anderson rootstocks in the Casper grove, the bearing behavior of this grove of Fuertes can be considered as a "normal" condition.

According to Mendelian Law, all living things transmit hereditary traits by means of physical particles in their reproductive cells. These particles are known as "genes;" and it has been established that there are hundreds, perhaps thousands, of different ones in the hereditary constitution—two or more genes for every trait, but always in pairs and half from each parent. It is known that changes occur in the genetic make-up of a species when exposed to X-rays and some drugs, but usually the normal genes remain in control.

By 1949, it was evident, from production records, that one-eighth of the Casper trees

were producing over one third of the fruit. A ratio existed of one good producer out of each eight trees, and a ratio of one *outstanding* producer out of each 23 trees.

In an endeavor to cut this ratio in half, the author developed the "Adjuvant" method of propagation. This method consisted of growing two seedlings, parented by a regular and high producing Mexican, in the same container. At an appropriate time, the two seedlings were worked together to a common bud, to produce a single top on two joined rootstocks.

The resultant trees have so far exhibited plenty of vigor, and on the average have outgrown single-rooted check trees planted at the same time and of the same rootstock and bud source. None of these "Adjuvant Rooted" trees are old enough, or have produced sufficient fruit, to enable a comparison to be made as to their productive capacity. A few more years will have to pass. However, at the best the "Adjuvant" method is expected to reduce the average of duds per acre by only one half. It does not eliminate the genetic factor, only minimizes it. To eliminate this factor entirely, "exact" duplication of the root tissue appeared to be the only way. Only by this means would we have exact replicas of these high-producing Casper Fuerte trees.

Root grafts are nothing new; they have been used for years in apples, grapes, and roses. These methods, described in *Bailey, Vol. 2: Grafting,* proved to be entirely unsuited to the avocado. Halma, in the October. 1951, issue of *Citrograph,* describes a method originated and used by him to reproduce root tissue of the Campbell Valencia. Frolich, propagator at U.C.L.A., using this method succeeded in reproducing root tissue of a comparatively young avocado. We, using this same technique, averaged about 3 percent "grow" with this *25* year old Casper root tissue. The aforementioned method consists of grafting a leafed clone, cut from a young seedling, to a section of root. Regeneration is dependent upon the synthesizing ability of the leaves remaining on the clone. Lose them, and you're through.

We finally stubbed our toe on the obvious. The avocado seed has a supply of nutrient sufficient to grow a seedling for a protracted period without anything but moisture. It's safe to say that 50 percent of the dooryard seedlings in California got their start supported by three toothpicks over a glass of water. Here was the "key" to our problem.

A parent tree was selected, to be the source of both root and top of this asexual propagation. The selected tree had produced 3,876 pounds of mature fruit in six years, 1946 through 1951. The annual average was 646 pounds. This is impressive production, and would have been more impressive but for limb breakage in 1949. Five large limbs were lost in September of that year, with attendant fruit loss. One limb alone held over 1,500 immature fruit.

Vigorous young seedlings with cotyledons attached were selected, and their tap roots cut off. To the bottom of the seedling trunks, root cuttings were whip-grafted. The seedling stocks were then cut off, and a scion from the same parent tree whip-grafted on. These "embryo" trees were then placed in a cable-heated propagating box, with the "seedling" section supported above the vermiculite growing medium to prevent production of adventitious seedling roots. This left no alternative but for the embryonic sandwich to grow this grafted root cutting or perish. Three months later, we were "over the hill." We now had trees that are exact tissue duplicates of this high producing

parent, except for the seedling sandwich.

Elimination of this seedling "sandwich" poses no problem, because instead or grafting on the top it can be budded to the root after it has been grown to suitable size. It just takes a little longer.

One of these "true line trees"—Casper No. 1 root and top—was previewed at the annual meeting of the California Avocado Society, June 7, 1952.

What will these asexually produced trees do? No one can say now— all are several years from bearing age. Because they are exact duplicates of the parent, logic is in their favor as to reproducing the bearing habit of the tree. The term "parent" in fact, does not properly apply. These new trees are actually *parts* of the source tree, and as such presumably have all of its characteristics.

The cost of propagation by the technique described is several times higher than for the conventional, or field grown, seedling rooted tree. The price of nursery trees so propagated, to the grower, will necessarily reflect this greater cost borne by the nurseryman. It will be a small price to pay, however, if per-tree production of fruit can be substantially increased. Time will supply proof of what logic says will be the outcome.