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AVOCADO INARCH GRAFTING TRIALS WITH ROOT ROT RESISTANT VARIETIES

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Trials in progress indicate that inarch grafting of mature avocado trees with Duke seedlings and cuttings, partially resistant to the avocado root rot fungus, **Phytophthora cinnamomi**, appear promising. Inarching results using seedlings of small-fruited, root rot resistant avocado relatives have not been as successful.

Inarching is a method whereby two plants arc made to unite while growing on their own roots, thus providing a supplementary or substitute root system. With fruit and nut trees, young seedlings are usually planted beside an older tree and grafted into the trunk (figure 1).

Many fruit and nut trees have been inarch grafted because of damage to their roots or lower trunks. These include: citrus (1), walnuts (2), macadamia nuts (3), mangoes (4), and also various deciduous fruits such as pears (5), apples (6), and apricots (7).

In a number of cases avocado growers have had good results inarching root shoots or volunteer seedlings into the trunk or main branches of the parent of adjacent tree (figure 2.)

An avocado inarching project was initiated in 1958 (8) not only to test the possibility of inarching avocado trees in root rot areas, but also to develop inarching methods suitable to the avocado. The success of this project would avoid loss of time when a completely resistant and compatible rootstock is found.

METHODS

The two most popular inarch methods are: 1) the inverted T, used mostly on citrus, and 2) the approach graft, found most practical on walnuts.

In the first method, two cuts are made in the bark of the trunk in the shape of an inverted T. The top of a seedling, which has been cut in the shape of a wedge is inserted, tacked and covered with a sealing compound. In the approach graft method

(figure 3), a strip of bark as wide as the seedling and at least six to eight inches long is cut from the trunk of the tree. The bark and somewhat less than one-half of the thickness of the wood on the tree side of the seedling is removed for a distance equal to the length of the slot. The seedling is placed in the slot with the cambium layers of the bark meeting. It is then nailed in place with nails large enough to hold the seedling securely, and the exposed cut surfaces are completely covered with sealing compound. The top of the seedling may be tied to the trunk of the tree to prevent breaking off or cut back to three or four buds above the graft.

Figure 1. Eureka lemon tree in Carpinteria infected with shell bark. Inarched with grapefruit seedlings approximately 30 years ago by Verne Thompson. Note there are no disease symptoms on the grapefruit seedlings.

Figure 2. Thirty-five-year-old Benik avocado tree at Carlsbad. Inarched with volunteer Anaheim seedling twelve years ago by Elwood Trask.

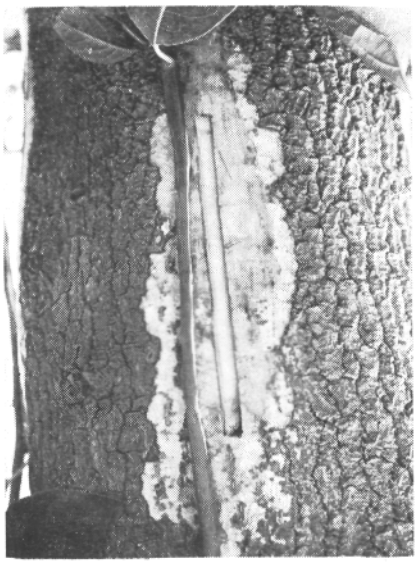

Figure 3. Approach graft method of inarching avocados. The slot cut in the back is approximately eight inches long and as wide as the seedling or cutting used for the inarch.

Figure 4. Mature Fuerte avocado tree at Fallbrook inarched with two Bolles cuttings and a Duke seedling—the one in the center. Inarches are now approximately five years old.

Three other experimental inarch methods were tested which were modifications of the approach type graft. These were: 1) the Chisel method, in which the slot or channel is cut with a half-round chisel; 2) the Overlap, where the bark was only slit above the channel and the seedling nailed under the bark; and 3) a method demonstrated by Mr. Stanley Shepard of Carpenteria in which the bark was shaved flat, down to the cambium, and the similarly shaved inarch nailed to this area.

The best results so far with avocado inarching have been with the approach type graft.

Two ways to tell if the graft has been successful are: 1) when the diameter of the inarch is appreciably larger below the union than above it, and 2) when the trunk diameter of the main tree becomes much larger above the grafts than below (figure 1).

DUKE ROOTSTOCKS

In 1958 preliminary inarching trials were started in a number of groves affected by root rot (8). Most of the seedlings and cuttings used for inarching rootstock were selections of the Duke avocado. This variety was used since somewhat more resistance or tolerance to root rot had been found in the Duke than other commercial rootstocks, such as the Mexicola and Topa Topa.

By 1961 the Duke inarching project involved 27 mature avocado trees growing in or adjoining root rot areas. There were 122 individual inarch grafts made, using 90 seedlings and cuttings. Trees under test were growing in almost all of the avocado districts, including San Diego, Los Angeles, Santa Barbara and Riverside counties. A few mature trees and inarches have died, but additional trials have been added.

As an example, in Carpenteria six mature MacArthur trees in a root rot area were

inarched in May, 1961, with 24 Duke seedlings and cuttings —4 per tree. An evaluation three years later showed that of the three grafting methods used, the approach was the best, followed by the overlap method. The poorest results were obtained from the chisel grafts. In fact, a number of these had either died-back from the graft or had completely died. Here, as in most trials, the Duke seedlings have made better growth as inarches than the Duke cuttings.

Some avocado cuttings of the Bolles and Scott (figure 4) varieties have also been inarched successfully. These names were given the original trees found on the respective properties where individual trees survived in root rot areas. The cuttings were grown at UCLA, using a method described by Frolich (9).

SMALL FRUITED AVOCADO SEEDLINGS

In April of 1962, mature Fuerte trees in a root area in Fallbrook were inarched with seedlings of **Persea borbonia**, **P. veraguasensis** and **P. caerulea**. These avocado relatives are small-fruited varieties that were collected in Louisiana, Mexico and Venezuela respectively. They have proved to be very resistant to the root rot fungus, but are non-graft-compatible with our commercial avocado varieties (10).

Each mature tree had three seedlings inarched into it using various combinations of varieties and grafting methods which were previously described. (Above.)

Figure 5. Fuerte avocado, six months after inarching with avocado seedlings of the Persea borbonia, veraquasensis and caerulea varieties.

Figure 6. Fuerte avocado tree in Fallbrook inarched with three Persea borbonia seedlings in April 1963. Picture taken 16 months later.

For the first six months the inarches looked very promising (figure 5), but after nine months some had begun to die back from the grafts.

Twelve months after inarching most of the seedlings had either died back from the

grafts or, in many cases, completely died. **P. cinnamomi** was isolated from the roots of almost all the seedlings, but this did not appear to be the main cause of death. Mircetich (unpublished data) suggests that **P. borbonia** do not appear to assimilate iron as efficiently as the avocado and other related species.

PERSEA BORBONIA TRIALS 1963

When the previous trial appeared promising at the end of six months, it was decided to expand this aspect of the inarching program.

In March of 1963, 12 mature Fuerte avocado trees in Fallbrook near a root rot area were each inarched with combinations of **P. borbonia** seedlings and Duke cuttings. There were three inarches per tree and only the approach method was used.

Sixteen months after inarching, two Duke cuttings out of a total 1 of 16 had died but were not positive for **P. cinnamomi**. Six **borbonia** seedlings out of 20 died back from graft. The remaining **borbonia** appear to be joining (figure 6), although no anatomical studies I have been made to determine actual tissue union.

DUKE-TOPA SEEDLING INARCHES

The Duke avocado, when used as a rootstock, has proved to be slower to germinate and also less uniform in growth than the usual Mexican rootstocks such as Topa Topa and Mexicola (11).

To evaluate these growth differences for inarching, in December, 1963, three mature Fuerte avocado trees in Fallbrook were inarched with six Duke and six Topa Topa seedlings—using combinations of both varieties, four per tree. All seedlings averaged ½ to 5/8 inches in diameter —the Dukes were two years old and the Topas were one and one-half years old at time of planting and grafting. Seven months after inarching all 12 are joining very well and the average diameters of both varieties are almost identical.

SUMMARY

Inarch grafting of avocado trees in root rot areas with partially resistant Duke avocado seedlings and cuttings is still in the experimental stage. After testing various methods, the approach graft has been found to be the most applicable to avocado inarching. Trials in progress for the last six years with the Duke variety appear quite promising. The Duke seedlings have made better inarches than the cuttings. Subsequent inarching trials, using small-fruited, root rot resistant but graft-non-compatible seedlings such as **Persea borbonia, P. veraguasensis and P. caerulea** have not been as successful.

Avocado inarching research is necessarily a long-term study, so no definite recommendations can be made at this time.

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