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USE OF THE ETIOLATION TECHNIQUE IN ROOTING AVOCADO CUTTINGS

Edward F. Frolich and Robert G. Platt
Technician IV, Department of Agricultural Science. University of California, Los Angeles. Extension Subtropical Horticulturist, University of California, Riverside.

Recently, the Department of Plant Pathology, University of California, Riverside, needed several hundred rooted cuttings from selected avocado seedlings in order to establish test plots for *Phytophthora cinnamomi* root rot research. These seedlings had been selected at Riverside as being more resistant to avocado root rot than the stocks currently used in commercial practice. Vegetative propagation of these selected root-stocks is necessary because seedlings of the same clones vary in their resistance to root rot (14.18). In addition, some of the selections had not fruited so seed was not available.

These rootstocks could be produced either by root pieces (6) or by stem cuttings. Regeneration from root pieces in the avocado is possible, but the amount of propagating material would be limited, the operation laborious and in many cases results arc unpredictable. Stem cuttings from young avocado seedlings root quite readily (2); however, all of the selections to be used in this work were several years old and had passed beyond the young or juvenile stage. A few old clones of avocado can be rooted moderately well (10,11,16). Work in Israel suggested that rooting could be improved in some clones by the use of rooting hormones (8). Varying success has also been obtained by the use of different grafting and air-layering techniques (7,17). Preliminary trials with the selections to be reproduced did not appear promising with regular green cuttings so it was decided to use the etiolation method.

It has long been known that etiolation (producing tissue in the dark) has a very beneficial effect on root production in other plants (5,12). It had been shown earlier that this technique also could lie used with the avocado (3,4).

Even though etiolation might prove more costly than some of the other methods, it was decided to use it in this project because experience had shown rooting percentages were more predictable with the more difficult-to-root varieties and also the resulting trees made normal growth when planted in the field (9). As used here, the term etiolation means developing plant tissue in the absence of light. With most varieties of avocado, tissue produced in the light will not differentiate roots nearly as well as tissue produced in the dark. It is necessary, however, to have leaves on the cutting, which arc only produced in the light. This means it is necessary to produce a shoot, the base of which is grown entirely in the dark, but the top of which is grown in the light.

The following is a description of the etiolation technique presently used at UCLA.

Almost any large avocado seed is used. Most Guatemalan seed are satisfactory as are seed of Lula and Zutano. The seed are planted in quart cans filled with soil. Larger containers were[1] tried in the past, but the resulting cuttings did not root as well as those from small cans. Shoots from nurse plants grown in smaller si/eel containers tend to be less vigorous and produce[1] roots more readily than stronger growing shoots from nurse plants in large containers. When the seedlings have reached a diameter of about ':¡ inch near the base (Fig. 1) they are tip-grafted (1,13) with the variety to he rooted (Fig. 2). The graft is made as close to the soil level as possible in order to facilitate later operations. These arc called nurse plants. A nurse plant can normally be used to produce more than one crop of cuttings although the number of cuttings and vigor of shoot growth will decrease with the second or third use. It has been found, however, that rooting is faster on the weaker shoots of successive crops.

The scion is then allowed to grow until the union is well established (Fig. 3). The shoots of the scion are then cut back to near their base (Fig. 4) and when buds again show signs of growth the whole plant is placed in the dark room. Some growers prefer to place plants in the dark room right after grafting, but in some cases higher mortality of the grafts resulted when done in this way. The dark room is maintained at 70° to 75°F (Fig. 5). The plants should be kept in as complete darkness as possible; however, it is necessary to have some light when putting in new plants or removing those which have made sufficient growth. The inhibition by light seems to be in direct relation to total quantity, that is, the light intensity times the total time exposed.

After shoots in the dark have made three to four inches of growth (Fig. 6), the plants are placed again in the light and a tarpaper collar is placed around the stem and filled with vermiculite to continue exclusion of light from the base of the shoots. Any other opaque material such as sand, sawdust or peat moss could be used for filling the collars. Just the tip of the shoots are left exposed to the light (Fig. 7). The plants are shaded with cheesecloth for a few days to prevent sunburn until chlorophyll develops in the shoot and a few leaves have developed (Fig. 8).'

In the absence of a dark room shoots can be etiolated by placing a collar around them when they start to grow and filling with vermiculite every day so as to just leave the tips exposed. The etiolation effect seems to be on the tissue just back of the tip and not on the very tip itself. This requires more labor than the dark room and also results generally in less shoots per plant. If the growing point of one shoot is exposed to the light it inhibits growth on any shoots in the dark.

The shoots arc allowed to grow until several leaves have matured (Fig. 9). Fig. 10 shows a cutting with the collar removed ready to be detached for rooting. Note the base of the cutting (below arrow) which was covered by the collar and vermiculite is devoid of chlorophyll. Fig. 11, left, shows a detached cutting ready to place in the propagating case. On the right is the same type cutting, after rooting, six weeks to two months later. Fig. 12 shows a view of cuttings in the propagating case.

The propagating frames are closed glass-covered cases with electric cable for bottom heat. The cuttings arc placed in flats filled with industrial #1 grade vermiculite. No rooting hormones are used with this particular type cutting as a few previous trials showed no beneficial effects. The propagating beds are watered every day and cheesecloth shades are used as necessary to control excessive temperature build up. The leaves on the cuttings should riot be allowed to wilt. Bottom heat is set for a minimum of 75°F. Air temperatures in the case run from 60^{C} up to 90°F. Results are better at the lower air temperature, but at certain times of the year it is not possible to keep the temperature down.

Where a propagating case is not available the shoots can be rooted by removing a ring of bark (at arrow) near the base of the shoot (Fig. 13), then replacing the collar and vermiculite. This involves more labor than detaching the shoots and trouble is experienced with the girdles healing over. The girdle can, however, be wrapped with string to delay this healing over. This method also has the disadvantage of weakening the nurse plants so they cannot be used over as many times. Fig. 14 shows rooting on the girdled shoot and Fig. 15 a close-up of Fig. 14.

When the shoots have produced roots they are transplanted to four-inch peat pots filled with soil. Roots are trimmed so that no roots are bent when placed in the pot, After potting, the plants are again held in a closed case until new root growth starts. They are then hardened off gradually by having the cases cr>en for increasing periods of time each day. When several roots have grown through the pot (Figs. 16 and 17) the cutting is transplanted to a three-gallon can of soil and allowed to grow to the required size for either grafting or planting in the field (Fig. 18).

The established rooted cuttings can be grafted with commercial varieties the same as seedlings. In the earlier stages the cuttings arc very sensitive about being defoliated. When grafting it is necessary to retain some foliage on the cutting rootstock. This is done by either grafting above existing foliage or by using a side graft. Foliage is maintained on the rootstock until the scion has produced a good supply of leaves.

There are considerable differences in the various selections handled in this project. The 'Scott' will root quite well from ordinary green cuttings and does not require etiolation. The 'Duke 6' and 'Duke 7' can also be rooted from green cuttings, but percentages are low and unpredictable.

Both the 'Duke 6' and 'Duke parent' are susceptible to excess boron damage. This occurred at UCLA where the water used for irrigation contains an average of one-half parts per million boron. The damage occurs from boron accumulating in the leaves of these two selections. When 'Hass,' Fuerte,' 'Zutano,' or 'Bacon' scions were grafted onto these, the leaves of the scions appeared quite normal. The 'Scott' in some soil mixes developed copper deficiency symptoms while the other varieties grew normally. Cuttings of 'Duke 6' and 'Duke parent' have given trouble when side-grafted. The percentage graft take is satisfactory, but due to excessive callous formation around the union a mechanical weakness could be expected later on. There is much less of the problem when these two varieties arc tip grafted.

The cost of production would vary among the different varieties. For the most part plants grown from the 'Duke' selections produce more shoots from each nurse plant than do plants from 'Guatemalan #22.' As many as five or six .shoots can sometimes be obtained at one time from the various 'Duke' selections while in the 'Guatemalan #22' generally one or two, or very seldom as many as three shoots are produced. The

"Guatemalan #22' is also more difficult to successfully graft on the original seedling when the nurse plant is produced. Once shoots are produced, however, this variety tends to root somewhat more readily than some others.

REFERENCES

1. Beck. W. R. 1947, Quick propagation of avocado nursery. Calif. Avocado Soc. Yearbook. 32: 74-76.
2. Eggers, E. R. and F. F. Halma. 1937. Rooting avocado cuttings. Calif. Avocado Soc. Yearbook. 22: 121-125.
3. Frolich, E. F. 1951. Rooting Guatemalan avocado cuttings. Calif Avocado Soc. Yearbook. 36: 136-138.
4. Frolich, E. F. 1961. Etiolation and the rooting of cuttings. Proc. 11th Ann. Mtg. Int. Plant Prop. Soc. pp 277-283.
5. Gardner, F. E. 1939. Etiolation as a method of rooting apple variety stem cuttings. Proc. Amer. Soc. Hort. Sci. 34: 323-329.
6. Gillespie, H. L. 1952. Asexual reproduction of rootstock from heavy-producing Fuerte avocado trees. Calif. Avocado Soc. Yearbook. 37: 97-101.
7. Gillespie, H. L. 1957. Stem rooting varietal clones by means of "juvenile growth phase" leafy-stem nurse cuttings. Calif. Avocado Soc. Yearbook. 41: 94-96.
8. Gustafson, C. D. and A. Kadman. 1969-70. Effect of some plant hormones of the rooting capacity of avocado cuttings. Calif. Avocado Soc. Yearbook. 53: 97-100.
9. Halma. F. F. and E. F. Frolich. 1952. An approach to the evaluation of avocado root stock variability. Calif. Avocado Soc. Yearbook. 52: 154- 158.
10. Haas, A. R. C. 1937. Propagation of the Fuerte avocado by means of leafy twig cuttings. Calif. Avocado Soc. Yearbook. 22: 126-130.
11. Haas, A. R. C. 1937. Further progress in the rooting of Fuerte avocado cuttings. Calif. Avocado Soc. Yearbook. 22: 130-132.
12. Knight, R. C. and A. W. Witt. 1937. The propagation of fruit tree stocks by stem cuttings. Jour. Pomol. 6: 47-60.
13. Platt, R. G. and E. F. Frolich. 1965. Avocado propagation. Univ. of Calif. Circ. 531.
14. Storey, W. B. 1955. Evaluation of avocado varieties and rootstocks. Calif. Avocado Soc. Yearbook. 39: 146-148.
15. Wallace, A. 1971. Responses of Duke 6 avocado cuttings to boron. In Regulation of the Micronutrient Status of Plants by Chelating Agents and Other Factors, A. Wallace, editor, pp 178-180.
16. Wallace, A. and C. P. North. 1957. The Scott avocado. Calif. Avocado Soc. Yearbook. 41: 82-84.
17. Young, L. B. 1961. Vegetative propagation in avocado by means of marcottage and the rooting of cuttings. Calif. Avocado Soc. Yearbook. 45: 63-66.
18. Zentmyer, G. A. and W. A. Thorn. 1956. Resistance of the Duke variety of avocado to Phytophthora root rot. Calif. Avocado Soc. Yearbook. 40:169-173.

FIGURE 1

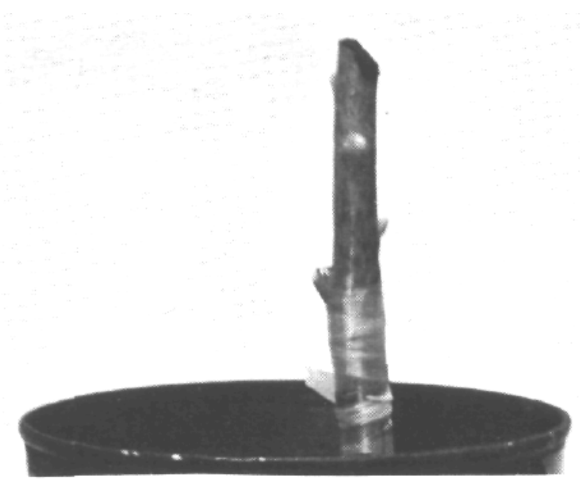

FIGURE 2

FIGURE 3

FIGURE 4

FIGURE 5

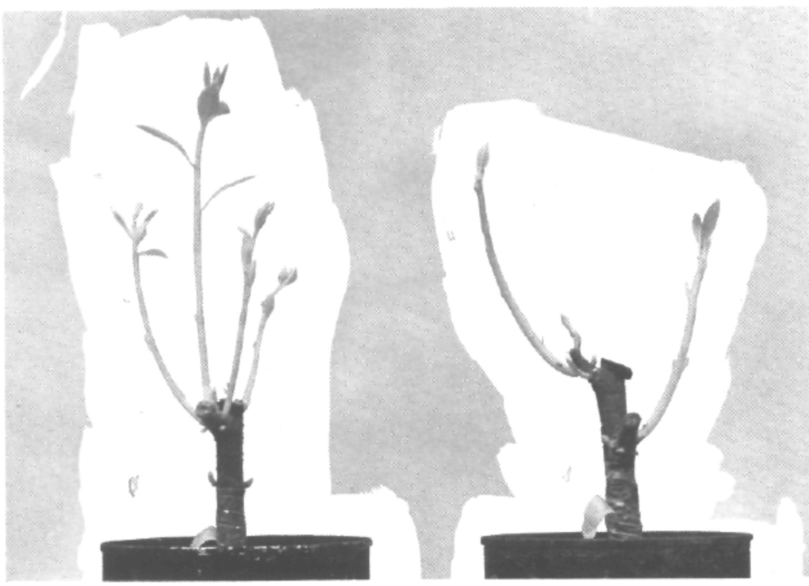

FIGURE 6

FIGURE 7

FIGURE 8

FIGURE 9

FIGURE 10

FIGURE 11

FIGURE 12

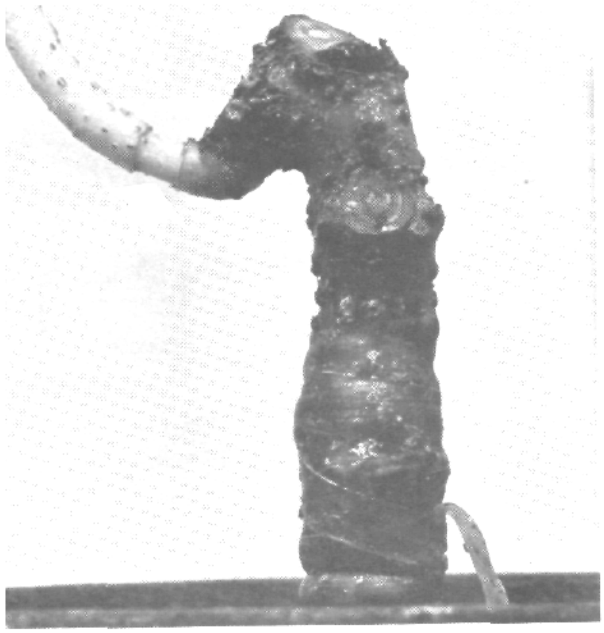

FIGURE 13

FIGURE 14

FIGURE 15

FIGURE 16

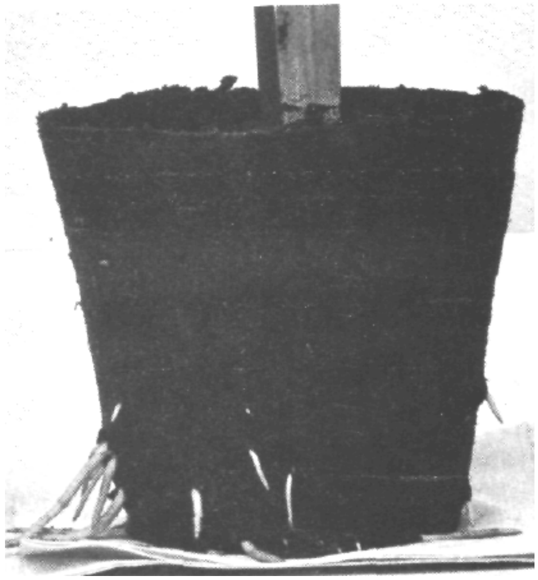

FIGURE 17

FIGURE 18