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ROOTING AVOCADO CUTTINGS

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INTRODUCTION

Because of their lack of cold tolerance, the production of commercial avocado varieties in Florida is limited to an area extending from the central citrus region south. However, avocado varieties differ tremendously in their cold tolerance. Some are limited to extreme southern Florida but some Mexican race seedlings and clones have been observed to be at least as hardy as the 'Owari' satsuma. Furthermore, avocados recover much more rapidly than citrus following freeze damage and, unlike commercial citrus varieties; the hardy types ripen their fruit during a frost-free period—late summer.

Some of the cold-hardy selections are presently satisfactory for dooryard varieties and local markets. It is reasonable to assume that, through a breeding program, the development of cold-hardy commercial varieties adaptable to the extreme northern fringe of the citrus area, where there are good soils and relatively cheap land, is possible.

Because of the cold hazard and the rapid recovery of avocados following freeze damage, there would be a decided advantage in growing asexually produced avocados on their own roots. In addition, should some seedling rootstock prove superior, there would be an advantage in producing clonal rootstocks.

For these reasons, work was initiated in 1963 to determine the feasibility of rooting cuttings of the cold-hardy types growing in the Gainesville area.

REVIEW OP LITERATURE

A review of literature indicates that a wide range of avocado varieties can be satisfactorily rooted by marcots or air layers (11). This is a cumbersome method and does not lend itself to commercial production; however, it indicates that avocados in general have the capacity to produce roots from stem material.

Attempts to propagate avocados from stem cuttings have met with varied degrees of success, and some reports are given without the presentation of data or a clear description of the procedure.

In some of the earliest work, Swingle and Robinson in 1924 (9) reported the percent rooting of cuttings taken from previously girdled stems was too low to be practical; however, much better results were obtained from stem cuttings of seedlings. Throughout the literature, good success has generally been obtainable with juvenile seedling material (3, 8).

Attempts to root old clonal material have generally met with failure (2, 3, 4) unless special procedures that preclude their use in commercial propagation were used (4, 5, 7). There are exceptions. The 'Zutano' and 'Scott' varieties reportedly root readily without any special treatment (2, 6, 10).

MATERIALS AND METHODS

General. All experiments were conducted under intermittent mist regulated so that the leaves were just kept moist (3 seconds on, 55 seconds off). In the initial experiment (maturity of wood) the intermittent mist operated throughout the day and night. Because of the heavy leaching of nutrients from the leaves, as indicated by their "bleached" appearance at the end of this experiment, the mist was kept completely off from 6 p.m. to 6 a.m. each day in subsequent experiments. The rooting mixture was one-half German peat and one-half horticultural grade perlite by volume.

The cuttings were all from stem tips about 8 cm or 3 inches long. The basal cut was made perpendicular to the stem axis, at the base of the node. A slight wound was made on 2 sides of the base of each cutting and, where appropriate, the base of the cutting dipped briefly into a solution of indole-butyric acid (IBA). Except where noted, all cutting material was made from a single tree of an unnamed Mexican type avocado growing on the main campus of the University of Florida (Fig. 1). The cold hardiness of the tree is attested by the fact it survived the 1957 freeze with virtually no damage and the 1962 freeze with less severe wood damage than mature 'Owari' satsumas growing in the near vicinity. The 'Brogden' avocado, in a warmer location, froze to the ground. It has not been determined whether this unnamed tree is a budded tree, but, in any event, it is over 30 years of age and has maintained its main trunk and scaffolds through the years.

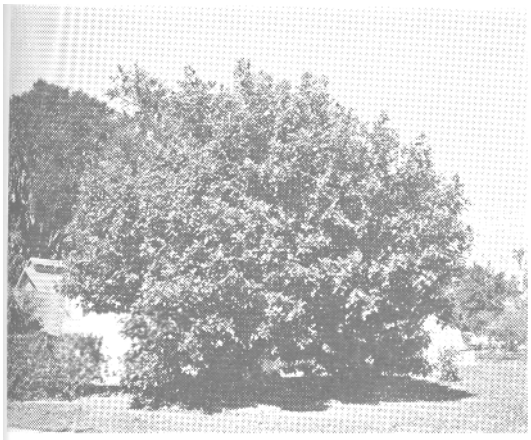

Figure 1.—Mexican type avocado tree used in the experiment.

Maturity of wood. One hundred cuttings each of 2 types, based on maturity of wood, were made in early September of 1963. All were treated with 2,000 ppm of IBA, and no bottom heat was used.

The 2 stages of maturity were termed *immature* and *young mature.* The immature wood type was made from actively elongating stem tips having some leaves that were not fully expanded. The young leaves of the Mexican type tree from which the cuttings were obtained did not often show the reddish-brown color typical of immature leaves of "Brogden" and many other varieties, but their stage of development was similar. The leaves were a light green. The stem color of the cutting varied from a reddish cast at the apex to a light green at the base. Most of the wood appeared to have a low chlorophyll content. The lenticels were reddish.

The young mature type had fully expanded leaves that were green. They did not have the hardened, dark green appearance of old mature leaves. The color of the stem was green from the apex to the base. The lenticels were brown and somewhat corky. The stem had ceased to elongate.

Despite their distinctly different appearance, these 2 types differed in age by only about 3 weeks.

Bottom heat and variety. Two different temperatures were maintained in the bottom half of the medium (Table 3) by using electric heating cables with thermostatic controls. One section without bottom heat was used as the control.

Sixty immature wood cuttings were made of 'Brogden' and of the unnamed Mexican type in early May of 1964 and treated with 2,000 ppm of IBA. Twenty cuttings from each source were inserted into each of the 2 sections with bottom heat and into the control section.

Concentration of IBA. In early May of 1964, 200 immature wood cuttings were made and 40 of each were briefly dipped into one of 4 concentrations of an ethanol solution of IBA (1000, 2000, 3000, 4000 ppm). An untreated control was included. Minimum bottom heat of 90°F was maintained.

RESULTS AND DISCUSSION

Maturity of wood. Cuttings made from immature stem tips rooted much sooner than slightly older, young mature tip cuttings; also, a much larger percentage of immature tip cuttings rooted than did the latter (Table 1). However, it took 5 months for an appreciable number of cuttings to root and it was 7 months before 90 percent had rooted.

At the end of 6 months, the leaves had a severely "bleached" appearance; nevertheless, all rooted cuttings survived transplanting and produced good vigorous plants without special care (Fig. 2).

Callus formation was heavy at the bases of both types of cuttings. Roots commonly grew both from the callus and from the etiolated area just above the callus (Fig. 3). There was no indication rooting was more common from the wounds made on each side of the stem than from immediately adjacent areas; however, some roots did arise there.

Despite the long time required for these cuttings to root, the method could be used commercially; even so, means of shortening the time required for rooting would be very

advantageous.

The successful rooting of one avocado selection does not mean that all varieties will root equally well or at all. In a subsequent experiment 'Brogden,' a relatively cold-hardy variety was compared with the hardy, unnamed Mexican type. When no bottom heat was used, 90 percent of the Mexican type and 40 percent of 'Brogden' rooted within 5 months (Table 2). Since the basal ends were well callused, the leaves were in good shape, and an increase in percentage of cuttings rooted was observed on each of the last 2 observation dates (Table 2), it is assumed a much larger number of these cuttings would have rooted if left in the cutting bed longer.

Table 1.--Influence of maturity of wood on rooting stem cuttings of an old unnamed Mexican type avocado.

	Months in rooting bed					
	2	4	5	6	7	8
	Percent rooted (cumulative)					
Immature Tips	0	4	47	84	92	96[1]
Young Mature Tips	0	0	1	10	13	16[2]

[1] Remainder rotted.

[2] Remainder included 23 percent callused but all leaves gone and 51 percent lost from rotting.

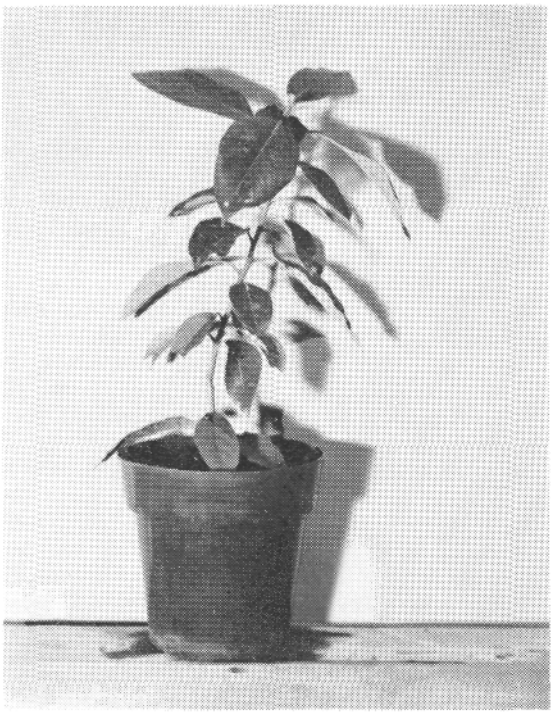

Figure 2.—Typical avocado plant produced from cuttings (about 6 months after potting).

Temperature of medium. Previous attempts to root avocados from cuttings have apparently not included any systematic work to determine the influence of bottom heat. Haas (6) rooted 'Zutano' cuttings within 6 months using a minimum bottom heat of 75°F. He noted that during the summer months the temperature of the medium was undoubtedly often much higher. He did not have differential temperature treatments. In general, bottom heat has increased rooting of plants. Armour (1) reported that citrus rooted slightly faster at 90° P than at 80 °F and much faster than with no bottom heat.

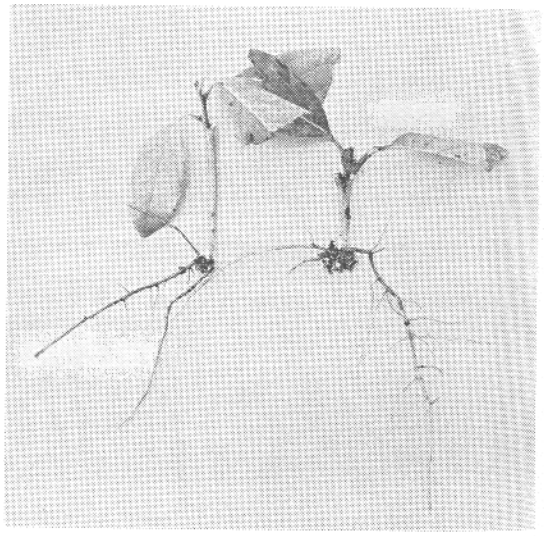

Figure 3.—Typical rooting obtained with avocado cuttings.

In this experiment bottom heat was detrimental. For both 'Brogden' and the unnamed Mexican type, the best rooting was obtained with no bottom heat, the next best was in the 80 °F section, and there was no rooting in the 90 °F section (Table 3).

This experiment had a weakness in that it was difficult to maintain a uniform bottom heat. There were times when the 90°F section registered as high as 100°F. The other 2 sections also fluctuated. This was noted early in the experiment and adjustments were made to the thermostatic controls to lessen these fluctuations. However, before this was corrected, a few cuttings had begun to deteriorate at the basal cut. These cuttings were removed, a fresh cut was made at the next higher node, and cuttings were again inserted into the medium.

Despite the difficulty in maintaining uniform bottom heat, it can be concluded from the data that media temperature is important and temperatures of 80°F and above are unfavorable to rooting.

Table 2.--Rooting of stem cuttings of 'Brogden' and a Mexican type avocado.

Variety	Months in rooting bed			
	1.5	4.0	4.5	5.0
	Percent rooted (cumulative)			
Brogden	0	15	15	40
Mexican type	0	55	75	90

[1]No bottom heat; all treated with 2,000 ppm IBA.

Table 3.--Influence of 3 different media temperatures on the rooting of 'Brogden' and an unnamed Mexican type avocado.[1]

	Brogden			Mexican type		
	CK	80°F	90°F	CK	80°F	90°F
Rooted	40%	15%	0%	90%	70%	0%
Callused	30	45	10	5	30	55
Rotted	30	40	90	5	0	45

[1]Total rooted in 5.0 months; all cuttings treated with 2,000 ppm IBA.

Table 4.--Influence of 4 concentrations of indolebutyric acid (IBA) on rooting stem cuttings of an old unnamed Mexican type avocado.[1]

	Months in rooting bed			
	1.5	4.0	4.5	5.0
	Percent rooted (cumulative)			
CK	0	0	0	0
1,000	0	2.5	7.5	7.5
2,000	0	2.5	7.5	10.0
3,000	0	0	2.5	2.5
4,000	0	0	0	2.5

[1]Minimum bottom heat of 90°F.

Concentration of IBA. No conclusions regarding the effectiveness of IBA in promoting root formation can be drawn from these data because a bottom heat temperature of 90°F was used. This temperature was so unfavorable that it masked any possible benefits from IBA. The 90°F temperature was selected because it had been found

beneficial in rooting citrus cuttings (1).

It was noted that cuttings callused well at all concentrations and in the control plots, but very little rooting occurred. The few that developed roots had all been treated with IBA; none of the untreated cuttings rooted.

SUMMARY AND CONCLUSIONS

1. A survey of literature indicates that stem cuttings of old clonal material, with a few exceptions, have been rooted only with special procedures that do not lend themselves to commercial propagation; however, the successful rooting of marcots or air layers of a wide range of varieties indicates avocado stems generally have the ability to form roots.
2. Immature stem tip cuttings from 2 sources, an unnamed Mexican type tree over 30 years old and a fruiting age 'Brogden' tree, were satisfactorily rooted under intermittent mist.
3. Immature tip cuttings rooted much better than those of slightly older cuttings of young mature tips. The difference in appearance of these 2 types of cuttings is described.
4. For both 'Brogden' and the unnamed Mexican type, the use of bottom heat was disadvantageous. Best rooting was obtained without bottom heat.
5. The results of IBA treatments were inconclusive because a 90°F bottom heat, which proved very deleterious, was used.

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