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THE CHINCHONA VENEER-GRAFT METHOD OF PROPAGATING SUBTROPICAL FRUIT TREES

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Introduction

Subtropical fruits, such as the avocado and mango, may be propagated in a variety of ways, but none may be classed as entirely satisfactory from the standpoint of rapidity of manipulation and surety in giving a high percentage of successful unions between stock and scion under a variety of conditions. The success of two of the most common methods, shield-budding and side-grafting, depends greatly on the condition of the stock and the selected scion wood or buds. For example, in side-grafting avocados only soft, pencil-size seedlings may be used satisfactorily. Scion wood should be selected from well-matured terminal growth. Frequently scion wood is not in the proper condition when the stocks are in their prime for grafting. Older stocks that have passed their prime for budding or side-grafting can usually be propagated by inarching. This method, though fairly sure of success, is cumbersome and expensive.

The objective of the present investigation was to develop an easy method that would produce a high percentage of successful unions under a variety of conditions of stock and scion and at almost any time of the year. The cinchona veneer-graft has partly fulfilled this objective on the avocado, mango, lychee, jaboticaba, citrus, and many citrus relatives. A wide application appears possible, and it is hoped that the following brief description may lead to further experimentation and improvements.

Insofar as the authors know, the particular style of veneer graft described herein has never been used on fruit plants.* It has been used extensively in the grafting of cinchona in Central and South America. According to Popenoe (1), the technique was developed by Jorge M. Benitez, plant propagator of the Cinchona Experimental Plantations, Inc., at Finca El Naranjo, Chicacao, Guatemala.

Description of Method

By the cinchona veneer-graft method the stock is not cut off and the scion is applied somewhat as in inarching. A fairly long (approximately 3 inches) shallow cut is made in the bark, cutting down to (Fig. 1-B), but not into (Fig. 1-A), the wood. As shown in Fig. 1-B, a streak of wood is exposed along the center of the cut, while considerable area of bark tissue is exposed on the sides and ends of the cut. The removal of a shallow slice of bark exposes a wider expanse of the cambial region than is exposed by the deep cut

usually made into the woody portion of the stem in the ordinary veneer-graft and side-graft methods of propagation.

The scions used in this method should be approximately 4 inches in length. A long, slanting basal cut should begin 1 inch from the upper end of the scion and terminate on the opposite side in a feather edge (Fig. 1-C). Usually the diameter of the cut surface of the scion is made about the same or slightly less than that of the cut surface on the stock. In fitting the scion to the stock the feather edge of the scion extends almost to the lower edge of the stock cut (Fig. 1-D). Exact matching of the stock and scion appears unnecessary, as there is so much cambial region exposed on the stock cut that, unless the scion is usually wide or narrow, it is unlikely that a point of contact will fail to occur somewhere between the cambiums of the stock and of the scions. It is necessary, however, to have a smooth cut on both' the stock and scion, and these should be fitted together tightly. Frequently it may be necessary to cut a slice of stem off the under side of the apical end of the scion in order to fit together snugly the stock and scion. Callus formation takes place over the full length of the cut surfaces, but it has been noted that with avocados the point of firmest union usually occurs at the basal end of the scion.

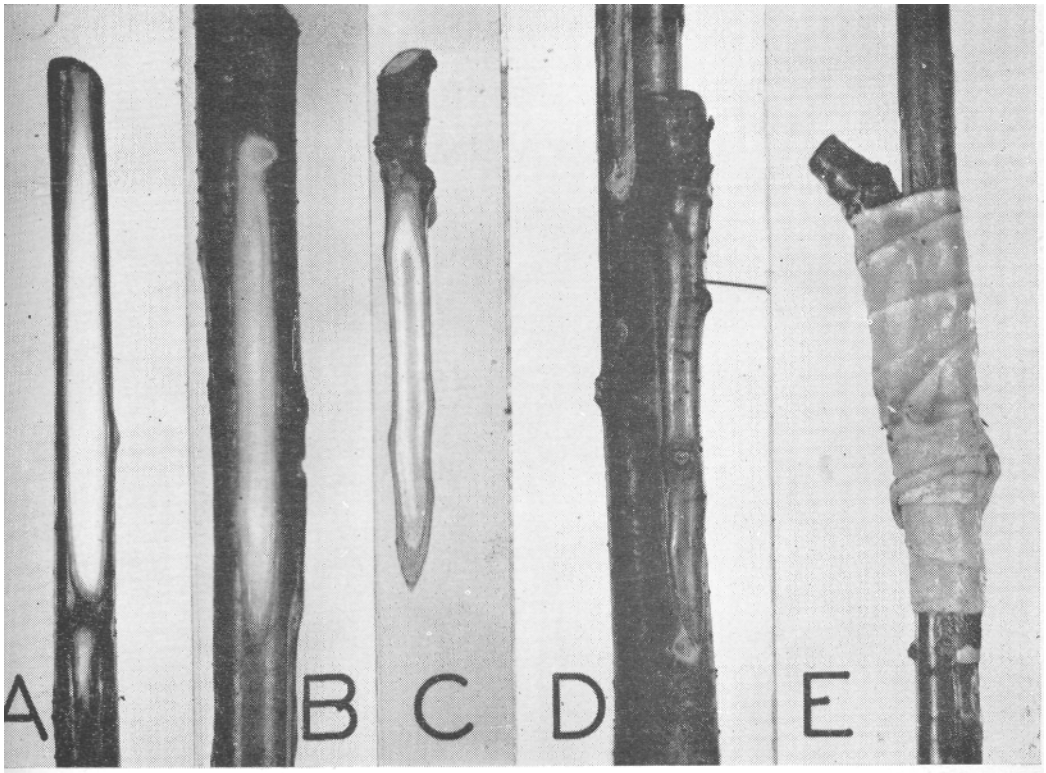

Fig. 1. Cinchona veneer-graft method used on the avocado. A, face view of stock showing the cut made too deep; B, face view of stock with cut properly made, showing shallow stock cut exposing only a narrow streak of wood along the center; C, face view of scion; D, scion fitted to stock (the pin was used only to hold the scion on for photographing); E, graft wrapped and coated with beeswax-paraffin wax.

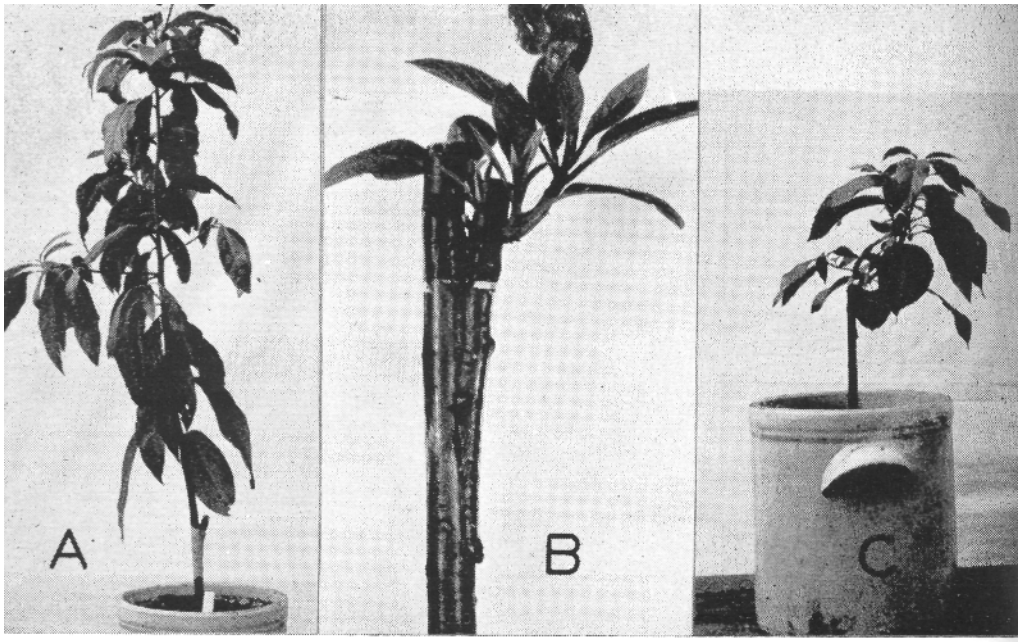

Fig. 2. Cinchona veneer-graft method used on the avocado. A, graft on 2-year-old seedling; B, Lula scion showing shoot growth from small buds in the bud-scar region between cycles of growth; C, new growth on Lula graft 2 months after grafting. The seedling top was cut back 1 month after grafting.

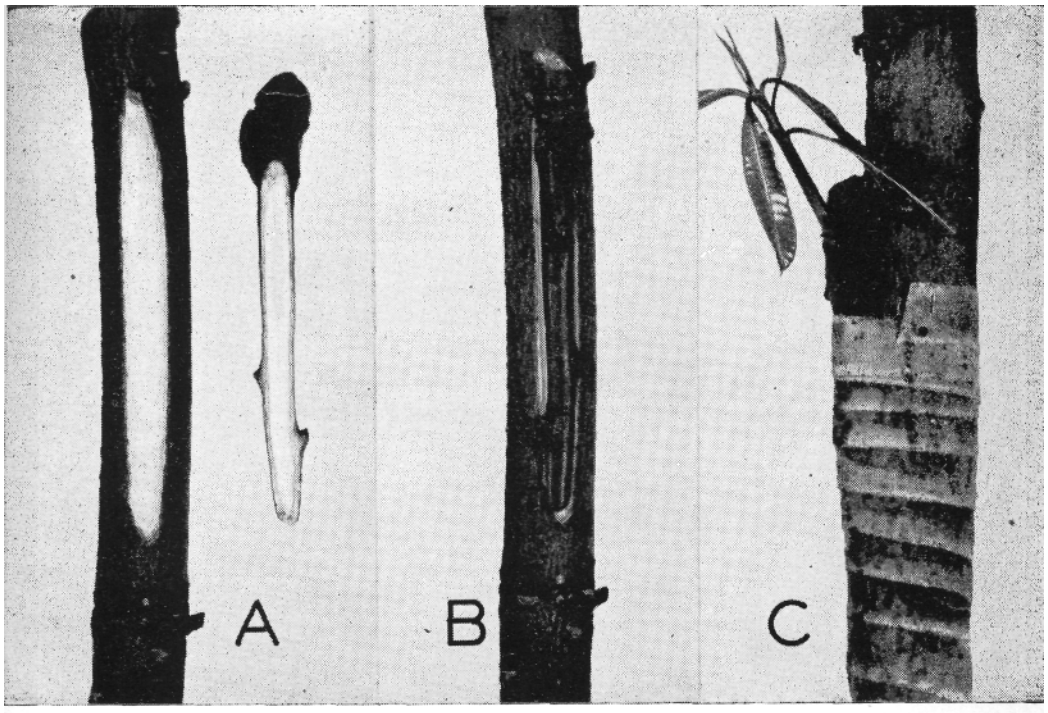

Fig. 3. Cinchona veneer-graft method used on the mango. A, face view of stock and scion cuts (only a very narrow streak of wood is exposed at center of stock cut); B, scion fitted to stock (due to wide expanse of bark on stock cut it was not necessary for scion to cover all of stock cut to get union of cambiums); C, Sandersha scion putting out new growth 1 month after grafting.

When the scion is fitted to the stock, the two are bound together by waxed cloth as shown in Figs. 1-E and 2-A. All of the scion is covered except about half an inch at the apical end. Some type of grafting compound is then applied around the top of the scion to prevent the entrance of water into the graft. In these experiments a semi-liquid grafting compound with a petroleum base was used satisfactorily during December, January, and February, but this compound appeared to cause some injury during March and April. Accordingly, a beeswax-paraffin wax was substituted.

TABLE 1. Successful unions obtained by using the cinchona veneer—graft method on avocado seedlings in various physiological conditions and at various ages

Date grafted	Variety of Stock	Age of Stock	Condition of Stock	Experimental Environment	Scion Variety	No. of Grafts	Successful Unions %
Jan. 6	Taylor sdlgs.	1 yr.	New growth at top, bark slipping	Pots in greenhouse	Lula	11	82.
Feb. 8	Misc. sdlgs.	2 yrs.	Dormant, bark not slipping	Pots in half-shade	Lula	17	100.
Feb. 28	Taylor sdlgs.	2 yrs.*	New growth at top, bark slipping	In ground in nursery	Taylor	18	61.
Mar. 1	Misc. sdlgs.	2 yrs.	Ditto	Pots in half-shade	Nabal	15	100.
Mar. 29	Misc. sdlgs.	2 yrs.†	Bark slipping	Pots in half-shade	Lula	27	82.
Mar. 29	Misc. sdlgs.	3 mos.	Soft wood, pencil size	Pots in half-shade	Lula	10	70.
Mar. 29	Misc. sdlgs.	4 mos.	Hard wood, pencil size	Pots in half-shade	Lula	9	78.

*Second growth on cut back seedlings
†Stumps of cut-back seedlings

Avocado Experiments

Results obtained in seven trials with the veneer-graft on avocado seedlings between January 6, 1945, and March 19, 1945, are given in table 1. This period represents both the winter and spring seasons, and the successful unions were numerous for the entire period. The percentage of "takes" varied from 61 to 100 and averaged around 80. Since the importance of not cutting into the wood in making the stock cut was not fully appreciated in some of the trials, it is believed that the knowledge gained from a study of these failures would make possible an even higher percentage of successful takes under comparable conditions.

As table 1 shows, a number of different types of seedling stocks were grafted. The one and two-year-old seedlings grafted as readily as the younger pencil-size material. The main difficulty in handling the younger material was in finding scion wood small enough. Most of the failures with these small stocks came from cutting the scion piece wider than the cut on the stock.

With the one and two-year-old stocks, the dormant plants with the bark not "slipping" grafted as successfully as those in a flush of new growth and with the bark "slipping." Second growth on cut-back seedlings, as well as old cut-back stumps, grafted quite readily.

The scion wood used in these trials was in most instances taken from wood one, two, or three growth cycles below the terminal flush of growth would be about one-half inch from the apex of the 3-inch scion piece (Fig. 1-C, D, and E). The excellent growth obtained from these small buds, which are axillary to bud scales rather than leaves, is illustrated in Fig; 2-B and C.

Types of scions other than the above have, however, given good results. Where healthy

buds occur in the leaf axils of the scion piece, they can be used successfully as the apical bud of the scion piece. In many cases, especially on the older wood, most of the leaf buds

Various types and stages of maturity of scion wood have not been investigated carefully. However, it was observed in the seven trials that well-matured wood appeared to give best results. Wood from the first, second, and third growth cycles below the terminal flush gave approximately the same results.

The type of scion used in most instances consisted of parts of the wood from two consecutive growth cycles. The scion piece was cut so that the narrow region of bud scale scars and small buds separating the two cycles have abscised and only the smaller scale buds remain.

As noted in the discussion on grafting compounds, it has been observed that the petroleum-base grafting compound appeared to kill some of the scions during the hot weather of April. It is suspected that, in addition to this heat factor, the scion wood itself was more susceptible to injury, perhaps because of the presence of an actively growing terminal flush of growth on the branches from which the scion wood was taken.

TABLE 2. Successful unions obtained by using the cinchona veneer—graft method on a number of subtropical fruit plants

Stock	Scion Variety	Date Grafted	No. of Grafts	Successful Unions %
Mango, misc. sdlgs.	Haden	Feb. 13	18	50.
Mango, misc. sdlgs.	Haden	Mar. 27	17	41.
Mango, misc. sdlgs.	Julie	Mar. 27	8	50.
Mango, misc. sdlgs.	Itamaraca	Apr. 2	8	75.
Mango, misc. sdlgs.	Cold-hardy sdlg.	Apr. 2	10	100.
Mango, misc. sdlgs.	Sandersha	Apr. 2	11	63.
Mango, misc. sdlgs.	Mulgoba	Apr. 2	3	33.
Mango, misc. sdlgs.	Saigon sdlg.	Apr. 20	46	44.
Mango, misc. sdlgs.	Julie	Apr. 20	15	80.
Jaboticaba, DeHaven sdlgs.	DeHaven sdlg.	Feb. 15	8	75.
Jaboticaba, DeHaven sdlgs.	DeHaven variety	Apr. 2	20	100.
Mountain lychee	Sweet Cliff	Apr. 2	10	40.
Lemon guava	Lemon guava	Mar. 19	30	0.
Loquat, misc. sdlgs.	Variegated loquat	Feb. 26	9	75.
White-sapote	White-sapote	Feb. 17	7	100.
Sweet orange sdlg.	Parson Brown orange	Feb. 21	15	87.
Sweet orange sdlg.	Parson Brown (shield buds)	Feb. 21	21	71.
Clausena lansium	Rough lemon	Mar. 26	10	70.
Clausena lansium	Sweet orange sdlg.	Mar. 26	8	25.
Murray Koenigii	Sweet orange sdlg.	Mar. 26	2	100.
Murraya paniculata	Sweet orange sdlg.	Mar. 26	7	14.
Atalantia ceylonica	Sweet orange sdlg.	Mar. 26	2	100.
Glycosmis pentaphylla	Sweet orange sdlg.	Mar. 26	2	0.
Aegle marmelos	Sweet orange sdlg.	Mar. 26	2	50.

Mango Experiments

The results obtained with the cinchona veneer-graft method on the mango are given in table 2. These grafts were made on 3-yearold seedlings obtained from a miscellaneous lot of seed. The grafts were inserted both in the main trunk, an inch or more in diameter, and in some of the lateral branches about half an inch in diameter. The small twigs of these plants had been frozen during cold weather in December, but by the beginning of these experiments in February the uninjured lower portions of the plant were beginning

new growth, and the bark over the entire tree was slipping.

The grafts were made in the same manner as with avocados. Scion wood of the terminal growth, when more or less mature, as well as wood from several growth cycles below, was found to graft satisfactorily. In April, terminal growth from which an inflorescence had abscised appeared to give the most rapid "takes." This was probably due to the fact that the terminal buds on these shoots were just about ready to break out into growth when the scion was taken from the tree.

Scions taken from growth older than the terminal flush, like those of the avocado scions, were composed of parts of two cycles of growth, the basal two inches from the older cycle and the half inch at the apex from the younger cycle. However, in the case of the mango, the cluster of buds near the scar region separating the two cycles of growth were leaf buds and not scale buds.

A typical mango graft is illustrated in Fig. 3. It is seen that the bark of the mango wood was much thicker Oían that of the avocado wood.

The percentage of successful takes with the mango was in general less than with the avocado but averaged well over fifty percent. With care and practice one should be able to improve on this record.

Experiments With Citrus and Citrus Relatives

With citrus a comparison was made in a single experiment between veneer-grafting and shield-budding, the latter method being the usual commercial practice. In this instance 87 percent of the veneers were successful as compared to 71 percent for the shield buds. Further observation on these grafts and buds showed that the veneers began growing much sooner than the shield buds. The grafts and buds were made on February 21, and on April 25 the average new growth on the veneers was 12.4 cm. per graft, while that on the shield buds was 1.2. It is suspected that the dry conditions prevailing during this period had more of an inhibiting influence on the growth of the buds than on the grafts. Accordingly, the veneergraft may well be used in preference to budding under such conditions as these. Since the veneer-graft does not require slipping bark, it is particularly useful in cases where the bark is tight.

In another research study at this station it was necessary to graft juvenile sweet orange seedlings onto a number of citrus relatives. As shown in table 2, this was done successfully by the veneer-graft method on **Clausena lansium, Murraya Koenigii, Atalantia ceylonica,** and **Aegle marmelos.** The "take" was poor on **Murraya paniculata and two** grafts on **Glycosmis pentaphylla** were unsuccessful.

Experiments With Other Subtropical Fruits

The data given in table 2 show that the veneer-graft method was successful in propagating the lychee, jaboticaba white-sapote, and the loquat. One hundred percent successful unions were obtained on the white-sapote and jaboticaba,

The common lemon guava which, according to Webber (2), is difficult to propagate,

failed to show a single successful union out of 30 grafts. The grafts were made on the main and lateral limbs of large mature trees.

Summary

Avocado and mango seedlings in various physiological conditions were grafted successfully by the cinchona veneer-graft method during winter and spring. Summer and fall grafting has not been tried but there is no reason to believe that this method can not be used successfully during those periods.

The orange, jaboticaba, loquat, and white-sapote were successfully grafted by the cinchona veneer method. Also orange scions were grafted onto a number of citrus relatives by this method.

The method was found to be unsuccessful in the grafting of the lemon guava.

Literature Cited

1. Popenoe, Wilson. Cinchona in Guatemala. Trop. Agric. 18 (4): 70-74. 1941.
2. Webber, H. J. The guava and its propagation. Calif. Avocado Soc. Yearbook 1944: 40-43. 1944.

Editor's Note—The usual veneer-graft has been used commercially for mango and loquat propagation for over 20 years by the Coral Reef Nursery, Homestead, Fla., with fairly high percentages of success.

* Since the preparation of this manuscript it has been learned that this method of grafting is being used successfully on the mango and other plants by Mr. David Sturrock at West Palm Beach, Florida.