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Hunt Institute was dedicated in 1961 as the Rachel McMasters Miller Hunt Botanical Library, an international center for bibliographical research and service in the interests of botany and horticulture, as well as a center for the study of all aspects of the history of the plant sciences. By 1971 the Library's activities had so diversified that the name was changed to Hunt Institute for Botanical Documentation. Growth in collections and research projects led to the establishment of four programmatic departments: Archives, Art, Bibliography and the Library.

FRUIT GROWING IN TROPICAL AMERICA

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PREFACE

The history of fruit growing in tropical America commenced with the second voyage of Columbus. Gonzalo Fernandez de Oviedo tells us (1526) that the first Spanish colonists brought oranges, grapes and other fruits to Hispaniola, while the great Cortés, in his fourth letter to the King, begs that no ship be allowed to sail ~~for Mexico~~ from Sevilla without bringing plants and seeds of those crops to which the Spaniards were accustomed in the Madre Patria but did not find in Mexico.

At the same time Oviedo, who was the first chronicler to write at length on the natural history of the American tropics, described many of the excellent fruits which had never before been seen by Europeans. Among these were the pineapple, the avocado, the anonas, the papaya and the guava, a galaxy sufficient to form the basis of a fruit economy, in marked contrast to the paucity of good fruits which Europeans found in more northern latitudes.

In spite of climatic conditions which, because of thw wide range in altitudes, made possible the cultivation of native fruits as well as many of those from the North, the development of fruit culture in tropical America has been slow. It was only toward the end of the last century that things began to happen. Commercial production of bananas came first. If measured in tons placed upon the market, fifty years ago the Gros Michel banana was one of the most important fruit varieties in the world.

It was not until 1900 that tropical fruits began to be propagated by grafting on a commercial scale. Preliminary work had been done

in the West Indies, based upon the selection of superior seedlings which originated locally, and the introduction of grafted mangos from the Old World. It should be remembered, however, that the aboriginal inhabitants of tropical America had improved many of their fruits through seed selection, thus raising the general level of the species to make the product of greater value to man. The pineapple is the best example of improvement through vegetative propagation, which was possible because superior forms were easily propagated suckers. The art of grafting does not seem to have been known to the early Americans.

The situation today is something like this: Commercial production of citrus fruits is increasing rapidly. Banana culture has spread into several new regions, and many more growers are involved than was the case half a century ago. Pineapple culture prospers in several countries. Avocados and mangos are beginning to be planted commercially, The pressing need for diversification is causing horticulturists to devote attention to fruits which have not yet been commercialised on an extensive scale. Home gardens are being enriched by the planting of little-known "minor" fruits, most of which have no commercial future, perhaps, but add to the pleasure of the tropical resident.

All this interest and activity draws attention to many problems. One of these is the local supply of good nursery stock. Throughout tropical America, nurseries producing vigorous, well-formed, accurately labelled plants are few and far between. In past years horticulturists depended largely upon imported stock. Little material of many fruits trees was available locally, and there was, to make things worse, a lack of confidence on the part of buyers.

This situation is changing, and one of the major purposes of this book is to assist nurserymen regarding the best methods of propagation, the choice of varieties of each fruit, and the exercise

of great care in labelling. As regards the more important commercial fruits, it must be remembered that new varieties come onto the market from time to time. This is especially true of fruits which are relatively new, so far as commercial cultivation is concerned. The planter should pay utmost attention to this subject before he lays out his orchard.

The selection of land for planting is a matter of great importance. Many tropical horticulturists do not realise the necessity of investigating texture, structure and depth of soil; drainage requirements; irrigation; and the need of fertilizers. These subjects are treated in this book; the tropical horticulturist is urged to give them the careful study they merit.

Pruning is often neglected, especially in the first few years when the tree must be properly formed. In other instances it is overdone, largely because insufficient experience has been accumulated through practice.

This book is based largely upon work done at Lancetilla Experiment Station and the Escuela Agricola Panamericana in Honduras, and work at the Subtropical Experiment Station of the University of Florida at Homestead and the several Plant Introduction Gardens of the U.S.Department of Agriculture in Florida. Lancetilla, which has the largest collection of tropical fruits in the Americas, so far as species are concerned, was fiunded in 1925 by the United Fruit Company. The Subtropical Experiment Station at Homestead has the largest collection of varieties of the avocado, mango and several other fruits. Other sources of information, many of them private growers whom we would like to thank individually did space permit, have been drawn upon heavily; and it should be added that material in this book on Temperate Zone fruits in the tropics - a subject to which serious attention has only been given during the past 25 years, has been accumulated mainly in

the highlands of Guatemala, El Salvador and Honduras.

Finally, we owe a special debt of gratitude to the following persons, who have reviewed chapters which they were particularly qualified to criticize:

(Here will follow a list)

INTRODUCTION

The Climates and Soils of Tropical America. Some notes on the management of tropical lands. Common cultural mistakes. The proper use of drainage and irrigation. Fertilizers and their use.

The propagation of Fruitbearing plants in the tropics: Seedage, cuttings; air-layers or marcottage; graftage.

THE FRUITS

1. The Citrus fruits - oranges, grapefruit, lemons and limes, some of the more useful hybrids.

2. The Banana and Plantain. The basic principles which the small grower needs to know. This is a very complexssubject and no attempt is made to enter into the highly technical problems of the great commercial producers.

3. The Pineapple. Same as for the banana.

4. The Avocado. Because of its growing importance and the lack of information in tropical America, this tree is dealth with in some detail.

5. The Mango. Remarks re the Avocado apply also to this fruit. In both cases the subject of <u>varieties</u> needs detailed treatment.

6. The Sapodilla and its Relatives

7. The Cherimoya and other Annonas

8. The Lychee and its Relatives - the longan, the rambutan, the pulasan and the mamoncillo

9. The Guava and other Myrtaceous Fruits

10. The Papaya and the Passifloras

11. The Nut Fruits - Macadamia, Pili, Cashew, Walnut, Pecan

12. The Fig, the Kaki or Oriental Persimmon, and the Loquat

13. Miscellaneous Tropical Fruits
The Mangosteen, the Durian, The Pejibaya and a dozen others

14. Temperate Zone Fruits in the Tropics
The apple, the peach, the plum and the peach. The small fruits - the grapes, strawberries, blackberries and raspberries.

The discussion of each fruit is in the following sequence:

Origin and History (briefly). Races (where they exist) and horticultural varieties. Cliamte and Soil. Propagation. Planting and Care. Principal Pests and Diseases.

EL MANGO

Con excepción de las naranjas y los plátanos, guineos o bananos, los paises tropicales del mundo entero no cuentan con una fruta mas importante, y en la opinión de millones de personas, mas deliciosa que el mango. Existen un sinnúmero de formas y variedades, algunas de las cuales han merecido para el mango el nombre de "Manzano de los trópicos", y el "Rey de las Frutas de la India". Hay formas y variedades multiplicadas por semilla que son de calidad inferior, como ocurre con las frutas de paises templados, por ejemplo el durazno, y la ciruela.

Los botánicos están de acuerdo que el mango tiene su origen en el este de la India, y en zonas adyacentes. Algunos opinan que mas de una sola especie botánica, la Mangifera indica, ha entrado en la formación de las razas de mango algo distintas que se cultivan hoy en día. Si eso es cierto es muy probable que el sinnúmero de variedades conocidas hoy en día en la India, ~~sean derivados~~ provengan de una especie silvestre, la Mangifera indica del Noroeste de la India; y las excelentes variedades que han llegado a las Américas y a otras partes desde las Islas Filipinas, e Indochina, o tienen ~~su origen~~ su origen en una forma geográfica de Mangifera indica, o en una combinación de Mangifera indica con otra especie. Como el gran De Candolle y otras autoridades opinan que el mango ha sido cultivado desde hace cuatro mil años por lo menos, el problema de su origen es parecido a aquel de muchos otros frutales, por ejemplo la palmera de dátiles, ~~la uva~~, y el banano. Lo seguro es, si los mangos cultivados actualmente en el mundo tropical tuvieron su origen en una sola especie de Mangifera silvestre, o en varias especies o si vinieron del este de la India y regiones adyacentes.

Clasificación

Debido a la existencia de unas mil variedades de mangos en la India, según el cálculo de varias autoridades, sin tomar en cuenta muchas en otras partes del mundo, un sistema natural de clasificación es difícil y hasta la fecha no ha recibido mucha atención de parte de los horticultores en general. Como se ha explicado en esta obra, un sistema artificial de clasificación tiene muy poca importancia para los pomólogos técnicos y aún para los prácticos. No les ayuda mucho clasificar los mangos en tres grupos: grandes, medianos y pequeños; ni según la forma de las frutas. Se recalca este punto aquí, pues la clasificación en grupos naturales de las frutas tropicales y las descripciones pomológicas de las variedades, merecen mucho mas estudio del que han recibido en años pasados. Felizmente la ciencia de la Pomología sistemática, viene año tras año recibiendo mas atención a manos de horticultores tropicales. El ingeniero agrónomo Héctor Huerta Studart Montenegro, publicó en 1956 un excelente Contribucao para o estudo pomológico do Abacateiro, Piracicaba, Brasil, y en 1957 el Indian Cousil of Agricultural Research, New Delhi, publicó "The Mango" lo que es sin duda alguna el mejor estudio pomológico del mango que ha salido a luz hasta la fecha. En esta obra maestra escrita por S. R. Cangolly, Ranjit Singh, S. L. Kayal y Daljit Singh, se describe y se presenta con ilustraciones a colores mas de 200 de las mejores variedades de la India.

En esta obra los autores dicen que es un caos completo la nomenclatura de las variedades injertados de mangos y que hasta ahora nó se ha logrado un sistema de clasificación que satisfaga los deseos de los pomologos. Dicen los mismos técnicos que la multiplicación vegetativa del mango, o sea por injerto de aproximación, se ha llevado a cabo solamente durante los últimos cuatro siglos

pues creen que la multiplicación vegetativa de los árboles frutales no fué conocida en la India antes del viaje de Vasco de Gama y la fundación de la colonia portuguesa de Goa, aunque consta en las escrituras muy antiguas en el idioma sánscrito que el conocimiento del injerto era condición indispensable para obtener un puesto como jardinero.

Ya que todavía nó es posible formar una clasificación de los mangos del mundo basada en caracteres naturales, lo más útil parece ser una clasificación en dos grupos grandes o sean: las variedades de la India, que en su gran mayoría son monoembriónicos; y los de las Filipinas de la Indochina y de otras partes del sudoeste de Asia que son poliembriónicos. En la América tropical se conoce este grupo como mangos Filipinos o de Manila, pues llegaron a este hemisferio como consecuencia del mucho tráfico que hubo en la época colonial entre Manila y Acapulco. El eminente horticultor Wester después de muchos estudios y averiguaciones llegó a la convicción que nó había llegado el mango a las islas Filipinas hasta 1600 o más tardar en 1650. Este dato es muy interesante,

Hasta cierto punto la situación actual es algo parecida a la del aguacate. Tenemos dos razas principales, y entre ellas híbridos que han sido formados naturalmente, o en algunos casos mediante los trabajos de los técnicos, quienes han tenido interés en combinar algunos cualidades de los mangos de la India con las de la raza llamada Filipina.

Y precisamente aquí es necesario entrar en una corta discusión respecto a las diferencias importantes entre estos dos grupos de mangos. Los árboles, por su tamaño, su aspecto general, su follaje y su resistencia a climas muy frescos, algo secos, o muy calientes son casi iguales - aunque cabe agregar que casi no hay clima demasiado caliente para el mango.

La gran mayoría de los mangos de la India, hablando de los que se multiplican por injerto, y por eso se consideran como los mejores, de lo contrario los horticultores no se habrían molestado en propagarlos con tanta laboriosidad, son monocotiledóneos. Una semilla monoembriónica es el resultado de la unión de las células sexuales, que pueden haber sido células del mismo árbol o el resultado de la polinización cruzada, o sea la fecundación de un óvulo del árbol madre con polen de otro árbol que por lo tanto es el padre. Además los mangos que son monoembriónicos y que tienen en su constitución factores hereditarios de diversa índole demuestran la tendencia típica de casi todos los frutales que han sido sometidos durante generaciones a la mano del hombre, siempre buscando su mejoramiento con fines con más y mejor fruta con cualidades deseadas. Así es cuando uno siembra semillas de mangos monocotiledóneos, en muy pocos casos puede esperar de los árboles provenientes de esas semillas frutas iguales a las de la madre. En la grandísima de las veces no van a ser tan buenas, pero hay excepciones como en el caso del mango Haden de Florida, proveniente de una semilla de Mulgoba, una de las mejores mangos del mundo, puede resultar una variedad que reúne cualidades excepcionales que dan a este árbol valor comercial o para la mesa.

Los mangos poliembriónicos que producen de sus semillas varias plantitas pues aunque el mango normalmente tiene solamente dos cotiledones como la mayoría de las plantas, en éstos se dividen en el estado embriónico a varias, de tres a cuatro hasta seis o aún más y cada una de éstas divisiones puede producir una plantita y resultar al fin en un árbol normal. Esta división de los cotiledones normales para formar varios embriones distintos, es el resultado del crecimiento de las células alrededor del óvulo las cuales muchísimas veces crecen a expensas de él hasta eliminarlo completamente. Como estas plantitas

que tienen su origen en los tejidos alrededor del óvulo y no en la fecundación de éste, son completamente vegetativos, son iguales en su origen genético a una púa o yema de las que se emplean en la multiplicación de un mango vegetativamente.

Los millares de mangos que se dicen de Manila que se ven en los mercados de México anualmente parecen de una sola variedad. Hay pequeñas variaciones en las frutas de esta raza debidas probablemente a esos casos raros cuando un óvulo fecundado logra resistir la intrusión de los tejidos del nucelo y resultar en un árbol con características de los mangos monoembriónicos, o sea la variación típica. En el caso de los mangos poliembriónicos es posible separar las plantitas que brotan de una sola semilla (seis, siete, etc.) y hacerlas crecer separadamente; solamente una de ellas proviene del óvulo fecundado y casi sin lugar a duda será diferente de las demás, pero nó hay manera de saberlo cuando están pequeñas sino hasta que den fruto y crezcan suficiente; las otras plantas, como se dijo antes, serán exactamente iguales como si hubiesen provenido de púas del árbol madre que se propagan vegetativamente.

Variedades

Como queda expuesto arriba, es imposible clasificar en pequeños grupos naturales todas las variedades importantes o interesantes de los mangos. Hay que confesar que una clasificación adecuada exacta todavía no ha sido perfeccionada para muchos otras frutas importantes.

Tomando en cuenta el gran número de variedades y la confusión de nombres respecto a muchos, y las limitaciones de una obra que la presente, se limitará abajo a algunos datos mas o menos detallados respecto a unas pocas variedades, algunas de la India y una o dos de otras partes las cuales por ser bien conocidas en el

mundo tropical y por tener méritos reconocidos, como su valor comercial o por ser deliciosas para la mesa, bien podrían entrar en esta lista.

Mulgoba. Parece que esta variedad tiene fama por ser una de las más perfumadas y delicadas frutas de la India, pues si no fuese así no hubiera sido despachada a los Estados Unidos, entre una pequeña remesa de árboles injertados que el horticultor inglés, J. Marshall Woodrow despachó a Washington en el año de 1889. Fué la única variedad de esa remesa que sobrevivió, y cuando dió su primera cosecha en 18__ dió un impulso al cultivo del mango en ese Estado, impulso que poco a poco se fué incrementando hasta alcanzar las proporciones actuales.

Mulgoba fué el primer mango mulitiplicado por injerto comercialmente en los Estados Unidos. Pero cuando los pequeños huertos comerciales entraron en producción, se veía que las cosechas eran pequeñas e irregulares. Por eso el Mulgoba perdió importancia comercial aunque la fruta es de buen tamaño, muy vistosa cuando recibe sol en el árbol, casi sin fibras en la masa, la cual nó es demasiado azucarada ni ácida y de un sabor aromático que tipifica el mango por excelencia. Es una lástima que esta variedad debido a su poca productividad y quizás también a su poca resistencia a la Anthracnosis, puede ser recomendada comercialmente para el trópico en general. El aficionado que puede plantar mangos en climas secos, haría muy bien en cultivar algunos arboles de Mulgoba para tener en casa esta golosina.

Haden. De unas semillas del mango Mulgoba traídas de India en 1889, y sembradas en Coconut Grove, al sur de Miami, Florida, Estados Unidos, resultó un árbol que produjo frutas excelentes - no muy parecidas a las de Mulgoba, pero con cualidades comerciales superiores, uno de esos ejemplos raros de la variación que existe cuando se siembran semillas de mangos monoembriónicos.

Haden que ha sido durante muchos años la variedad comercial mas

importante del Estado de Florida, Estados Unidos ha sido el primero de los mangos finos de origen asiático que ha sido propagado ampliamente en la América tropical. Antes de la aparición de Haden, había dos o tres variedades de mangos de la India conocidos en las Antillas, pero a los cuales nó se les había llevado a muchas partes de la America tropical. Haden para el mercado y aún para el huerto casero es un mango que tiene muchas cualidades excelentes. El arbol es hermoso, un adorno para cualquier patio o jardín, la fruta es grande, de forma ovalada, y al madurar adquiere una combinación bellísima de amarillo, verde y púrpura. La cáscara es gruesa, lo cual facilita su transporte y ayuda a que la fruta pueda guardarse por muchos días. La parte comestible, de color anaranjado es aromática, de un sabor riquísimo, y diferente que los mangos comunes que tiene mucha fibra, Haden casi no tiene. Puede cortarse en rebanadas y comerse con una cuchara como a un melón. Aunque en la opinión de muchos peritos en la materia hay mangos superiores a Haden en calidad para la mesa, en todas partes donde Haden es conocido, goza de un gran aprecio y popularidad.

Haden entra en producción a los ~~xxxtxx~~ tres o cuatro años y el árbol es muy productivo, aunque en Florida dicen que las cosechas disminuyen cuando el árbol ya tiene 12 o 15 años de edad. Esto no se ha observado en la América tropical, donde árboles injertados de 25 años o más todavía producen cosechas excelentes, con excepción de los años cuando las condiciones de clima son desfavorables, y los mangos en general no rinden buenas cosechas. En resumen puede decirse que Haden es el mango mas deseable y recomendable para muchos países tropicales americanos, donde los mangos de la India hasta ahora nó son bien conocidos ni hasta ahora han resultado muy productivos.

Pairi, (también deletreado Paheri y Pirie, y en las Antillas de habla inglesa conocido como Peters y Bombay) fué uno de los primeros

mangos finos de la India que llegaron al trópico americano. Pertence a un grupo de mangos cultivados en la región de Bombay, y por su masa sin fibra y su sabor riquísimo, dulce y aromatico, supera al Haden. Sin duda alguna es uno de los mejores mangos del mundo, pero en las Américas el árbol no ha resultado tan prolífico como era de desearse, con el resultado que comercialmente no ha sido un éxito. ~~Excepto esto~~ Naturalmente el hombre que se dedica al cultivo ~~comercial~~ comercial de mangos tiene que pensar en muchos factores, tal vez primero en la productividad del árbol, en la belleza y presentación de la fruta, en un tamaño deseable, en sus cualidades para el transporte, y en sus cualidades para su larga duración en buen estado. Después de estos factores comerciales que debe tener un buen mango, hay que tomar en consideración la calidad de la fruta. Esto es de lamentarse pero es la realidad.

Descripción Pomológica: Forma de ovada-reniforme a ovada-oblicua, de pico pronunciado; tamaño menos de mediano a mediano, peso de 7 a 10 onzas, largo de 3 a 3½ pulgadas, ancho de 2-7/8 a 3¼ pulgadas; base oblicuamente aplanada, sin cavidad; apex redondeado o de punta ancheada, con un pico prominente poco mas arriba del lado ventral de la fruta; superficie de lisa a ondulada, verde amarillosa en color, matado con escarlata en la base, pocos lunares, pequeños amarillo blancuzco; cáscara moderadamente gruesa; la masa de amarillo naranja, fruta firme pero jugosa, fina al tacto, libre de fibras, de aroma pronunciado, dulce, rico y especioso; semilla gruesa con fibras cortas, cerdosas sobre todo la superficie.

Amini. Entre los varios cientos de variedades de mangos de La India hay tantas diferencias en cuanto a tamaño, sabor, color, etc. como las hay entre los cientos de variedades de manzanos y peras de Europa y Estados Unidos. Y así como algunas personas prefieren esta o

aquella clase de pera o de manzana, en el mango algunas personas prefieren esta o aquella variedad. ~~de esta fruta.~~ Amini es uno de los mangos finos mas pequeños. pero es de un color bonito, amarillo con un lado rojizo, y de un perfume único, entre los mangos cultivados en la América tropical. El sabor nó es tan dulce como el del Haden o el de Pairi. Muchas personas lo prefieren a éstos y algunas consideran que el perfume y el sabor un poco ácido de Amini son muy agradables.

Amini tiene fama de ser uno de los mejores mangos de la India pero hay que anotar que esta reputación se refiere al Amini que fué introducido de Bangalore a ~~kax~~ Florida en 1901 y como se ha mencionado anteriormente hay mucha confusión respecto a los nombres vulgares de los mangos en la India, y cuando ~~kxk~~ se habla de Amini o de Alfonso o de cualquier otra variedad, hay que descripciones definitivas. Por eso la descripción pomológica del mango Amini tal cual se le conoce en la America tropical tiene importancia, y cabe agregar antes de citarla que el Amini conocido en esta parte del mundo ha resultado mucho mas productivo que la mayoría de los mangos finos de la India por ejemplo el Mulgoba y el Pairi. Por eso y por su excelente calidad, a lo menos en la opinión de muchas personas como se ha mencionado arriba Amini merece incluirse en ésta pequeña lista de mangos finos.

Descripción pomológica. Forma ovalada, comprimida lateralmente; tamaño de pequeño a mediano, peso de 6 a 8 onzas, largo de 3 a 3½ pulgadas, ancho de 2½ a 2¾ de pulgada, base oblicuamente aplanada, sin cavidad; apex redondeado, el nak prominente y a 5/16 de pulgada sobre la punta de la fruta; superficie lisa, color amarillo profundo tocado con escarlata opaco, particularmente alredor de la base, lunares numerosos, pequeños de color amarillo pálido; cáscara gruesa y firme; masa de color naranja brillante, fusible, muy jugosa, fuertemente

aromada y libre de fibras, y con un sabor dulce, raramente especioso; calidad excelente; semilla oblonga-oval, muy delgada, con solo unas cortas fibras en el borde ventral.

Sandersha. Las frutas de la zona templada, se clasifican popularmente en varias categorías, las finas para la mesa, otras para cocinar, otras para preparar en conservas, etc. Lo mismo debe ser con los mangos y por eso se incluye en esta corta lista de variedades, el Sandersha, que no ha gozado de la importancia que merece porque nó es una golosina. Para la elaboración de conservas y para usos culinarios en general, es casi único, y además es uno de los mangos de la India que entra en producción a temprana edad y casi todos los años da una cosecha buena.

Sandersha es un mango grande y sin fibra. Su color es amarillo anaranjado, su masa firme pero sin el aroma que daracteriza a Mulgoba y a Haden.

Este mango que fué introducido a la América tropical en los primeros años de este siglo, tuvo su origen en Bangalore, India, y es monoembriónico. Igual que el Amini y muchos otros mangos de la India, parece que hay variedades conocidas en la India bajo el nombre de Sandersha que nó son legítimos. Para evitar errores y confusiones de da a continuación la descripción pomológica de Sandersha:

Descripción Pomológica

Forma oblonga, afilada hacia el tallo y muy picuda en el apex; tamaño grande o extremadamente grande, peso de 18 a 32 onzas, largo de 6½ a 8 pulgadas, ancho de 3½ a 4¼ pulgadas; base estrecha, extendida; apex de punta ancheada, con el nak formando un pico prominente hacia el lado ventral; superficie lisa, de amarilla a oro en color, algunas veces tocado

al sol
/
de rojo en el lado expuesto, numerosos lunares, pequeños y de un amarillo grioso; la masa color naranja, carnosa, moderadamente jugosa, libre de fibras y subácida, de sabor ligeramente aromático; para postre es una calidad pasable, para conservas es excelente; semilla larga delgada, ligeramente curvada, con fibras solo a lo largo del lado ventral.

Julie. Hay un grupo de mangos todavía no muy bien estudiados cuyos árboles son de tamaño pequeño en comparación con la mayoría de los mangos. A este grupo, que parece ha venido a las Américas desde las Islas de la Reunión, en el Sud Pacífico, pertenece Julie, el cual es monoembriónico como la gran mayoría de los mangos de la India.

Julie difiere de la mayoría de los mangos, no solamente en el tamaño pequeño del árbol, sino también en su producción. Nunca dá cosechas grandes, pero insiste en florecer aunque sus primeras florescencias estén destruidas por la anthracnosis, un hongo que molesta mucho en épocas húmedas, y casi todos los años logra producir un número regular de frutas cuando otras variedades que hayan florecido solamente durante por una época corta han perdido sus esperanzan de fructificar.

Julie no es un mango vistoso. Es de regular tamaño, aplanado a los costados, de excelente sabor, muy dulce, con algo de fibra alrededor de la semilla pero mucho menos que los mangos comunes de semilla. Julie es mucho mas resistente al ataque de la mosca de la fruta que las otras variedades de mango comerciales.

En años recientes Julie ha llegado a ser quizá el más popular de los mangos finos en Jamaica, donde ha superado a Pairi o Bambay para huertos caseros.

El Grupo Filipino o de Manila

Estos mangos además de ser de excelente calidad son poliembriónicos y por lo tanto deben considerarse como algo muy distinto de los mangos de la India. Aunque existen algunas variedades de este grupo, como se

ha mencionado antes, los árboles provenientes de semilla en mas del 90% de los casos, producen frutas iguales en tamaño, color y calidad. La justificación para usar el injerto con estos mangos consiste en lograr una producción a una edad temprana, y evitar las pequeñas variaciones que resultan de polinización de una flor con otra en lugar del crecimiento de las plantitas que tienen su origen en los tejidos nucelares.

En las Islas Filipinas una variedad de esta raza o grupo, la Carabao es muy estimada y ha sido introducida y cultivada en otras partes del mundo. Hay unas pocas variedades, muy parecidas al Carabao cultivadas en las Filipinas. Del mismo grupo son algunos mangos de la Indochina, Java y otras regiones, por e jemplo el Aroemanis de Java y la Cambodiana cultivada en pequeña escala en Florida. Sigue una descripción pomológica de la variedad Cambodiana.

Descripción Pomológica

Forma de oblonda, comprimida lateralmente; tamaño de menos que mediano a mediano, peso de 8 a 10 onzas, largo de 3¾ a 4½ pulgadas, ancho de 2½ a 2¾ pulgadas; base redondeada, el tallo insertado al centro o ligeramente a un lado sin depresión; apex en punta, el nak solo un pequeño punto a media pulgada del apex; superficie lisa, de color verde amarillo fuerte, casi sin lunares; cáscara muy delgada y tierna; masa amarilla profundo, muy jugosa, libre de fibras y de un sabor aromático, suave, subácido; buena calidad; semilla eliítica oblongada, gruesa, con fibras cortas sobre el borde ventral.

Originada en Miami, Florida, de una semilla introducida en 1902 de Saigon, Cochinchina, por el Depto. de Agri. de los Estados Unidos (S.P.I. 8701). Una importación posterior de semillas de la misma región (S. P. I. 11645) ha dado nacimiento a otra variedad propagada por medio de injerto que se diferencia ligeramente de la aquí descrita. El árbol produce con

mas regularidad que la mayoría de las variedades de la India. Debe su nombre a Cambodia, una región de la Indochina francesa.

Chapter 5 The Mango

Widely popular as a dooryard tree in tropical America, the mango (Mangifera indica) is rarely grown there in commercial plantings. Its original home was in northeastern India and Burma, in the foothills of the Himalayas. From this area it was carried into the great Indian peninsula over 4000 years ago, and thence it went by sea to Malaya & Viet Nam, where some distinctive forms have developed in three millenia. Mangos occupy over half of all the land planted to orchards in India, and production there exceeds all the mangos grown elsewhere in the world. When the Portuguese settled at Goa in 1510, they made the acquaintance of this valuable fruit and adopted the name manga from the local Tamil man-kay. The English name is taken directly from the Spanish variant, mango, of the Portuguese name.

Early in the 17th century the mango was introduced from India into the Manila area of the Philippines, but much later it was realized that Malayan settlers in the southern Philippines around 1400 A.D. had introduced mangos from Viet Nam. Brazil received the mango from Goa before 1640, and some unusual types have developed there. From Brazil seeds were taken to Barbados in 1742, the first known introduction to the West Indies, and from the Philippines to Mexico about the same time. During the 19th century the mango reached Florida, Hawaii, Egypt, Palestine, and Queensland, all of which have commercial orchards, as well as spreading all over tropical America.

Climate and Soil

Mangos need warm temperatures during the growing season and are not successful where summers are cool. In Ceylon on the equator, altitudes from sea level up to 2000 ft. are satisfactory, whereas in Hawaii at 20° N latitude, an elevation of 1000 ft. is about the limit and production increases with decreasing altitude. No temperature is too hot — in India mangos thrive at 115° F.

Rainfall is important for its effect on fruiting rather than on tree growth. The trees endure long dry periods well on soils in which they can root deeply. Where rainfall is abundant and well distributed throughout the year, trees grow splendidly but bear

little or no fruit. For good flower production there must be a check in growth in late summer and early fall in order for blossom buds to be differentiated, and in the tropics only a dry period will provide this check. But even with abundant bloom, few fruits will set if blossoming occurs during a rainy season. Heavy fogs in the early morning are almost as unfavorable for fruit-setting as is rain. In both cases the bad effect is partly the result of decreased pollination and partly due to favorable conditions for fungi to attack flowers and fruit.

The mango is very tolerant as to soils, thriving on a wide range of soil types, even somewhat saline ones. High alkalinity is harmful and shallow soils are not suitable. Trees can endure flooding for several days, but only on deep, well-drained soils will growth and fruiting both be good. Too high a degree of fertility causes vegetative growth at the expense of fruitfulness.

Botanical Characters

The mango is a large, evergreen tree with rounded top. Branches are sturdy and wood tough, with good resistance to winds. Several flushes of growth are made each year, from 3 to 12 in. long, with the leaves of each flush spaced widely at the base and closely at the tip of each flush. Leaves are simple, alternate, leathery, from 6 to 12 in. long and 1 to 3 in. wide. Mature leaves are normally dark green, but young ones are some shade of pink, red, or bronze.

The inflorescence is a large, branching panicle, commonly borne at the tip of a twig. The whole exterior surface of a tree may be almost concealed by blooms. Panicles are from 6 to 24 in. long, averaging about 12 in. Individual flowers are small, about 1/4 in. broad, with 5 sepals and 5 petals, and only a single functional stamen. There are in each panicle some perfect flowers, with a tiny central pistil, and some male flowers with no pistil.

The fruit is a fleshy drupe, This flesh is quite sweet in most varieties, although a few are low in sugar, somewhat like a peach, varying in size from a few ounces to several pounds. Enclosing the large, flat seed is a thick, woody husk or "stone," from which fibers radiate out into the flesh. Varieties differ greatly in fruit size, shape, and color, and in the amount of fibers in the flesh. The seed may consist of a single embryo

(monoembryonic) or as many as 6 small embryos crowded together (polyembryonic). Where there is only one, it has usually resulted from fertilization; where there are several, they are commonly all of nucellar origin (see p.) and have crowded out the true embryo.

Races and Varieties

There seem to be grounds for dividing mango forms into 2 great groups: Indian and Indochinese. The former group has flourished in India and Ceylon for unknown centuries, while the latter has developed over a somewhat shorter period in Indo-China (Vietnam). These latter forms are sometimes called Philippine or Saigon types. The mangos found in Malaysia seem to be derived from both divisions. The characteristics of these two divisions are not exclusive, but combinations of characters are distinctive.

Indian division — fruit with either a resinous, turpentine taste or a rich, aromatic flavor which derives from terpenes; variable in shape, often much rounded at the apex, plump or somewhat flattened, but rarely long and pointed; skin color at maturity variable, from dark green through yellow to crimson or dark red, often yellow with a red blush; flesh full of fiber or (in cultivated varieties) nearly free of it.

Indochinese division — fruit never resinous, lacking the rich flavor of the best Indian types, blandly sub-acid in taste; shape always somewhat pointed, usually longer than broad, and somewhat flattened; skin color ranging from green to golden yellow, but with never more than a faint pink blush; flesh usually almost fiberless.

There are common seedling races of both divisions in tropical America. The West Indian race of Indian mangos is common in Cuba, Jamaica, Puerto Rico, Mexico, Florida, and Hawaii, while the Manga race is found mostly in Cuba and Florida. The fruits of both races are very fibrous. The Filipino race of Indochinese mangos is widely grown in Cuba and Mexico, and is highly esteemed because fiberless. All of these seedling races are polyembryonic and so reproduce very true to type.

Cultivated varieties have either been introduced as such from Asia (usually India) or have been selected in the Americas from seedling trees, usually from introduced varieties. Commercial varieties should be fiberless, colorful, of pleasing taste, and heavy bearing.

Few varieties rate high in all these characteristics. Those of Indian origin are likely to be low yielding while Indochinese types lack color. Recommended varieties for tropical America include Irwin, Haden, Kent, and Keitt for commercial orchards, and Carrie, Julie, and Manila for home planting. These are all productive, and the commercial varieties combine attractive appearance with good quality, while the home varieties rate low on color but high on quality.

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MANILA - fruit small, 8 to 12 oz., long and slender, skin greenish yellow to yellow, very thin, flesh fiberless, of very good quality. Season late May and June. Tree rather upright growing. As noted previously, the flavor of this Indochinese type is quite different from that of the other described varieties.

Propagation

Cultivated varieties are usually monoembryonic and their seedlings are very variable, so that vegetative methods of propagation must be used. Marcottage has been used occasionally, with a success differing with variety, but budding or grafting are the commonly used methods of multiplication.

Any vigorous seedling is satisfactory as a stock. The husk should be removed before the seed is planted, as this permits discarding diseased or insect-infested seeds as well as expediting germination. Seeds remain viable only a few weeks, hence they should be planted promptly after removal from the fruit. It is well to put them in peat moss or sawdust to germinate, and to plant the sprouted seeds in pots or in the nursery row.

Several types of grafting are in use. Veneer-grafting is very popular, using stocks 1 yr. old in containers or 2 yrs. old in field rows. Scions are the terminal 3 or 4 in. of twigs with the terminal bud swollen but not yet pushing out. This condition can be induced usually by removing the leaves, but leaving the petiole stubs, near the tip of the twig about 2 weeks before a scion is to be cut. Veneer-grafting can be done whenever stocks are in an active flush of growth. ~~and stocks should be in active growth when grafted~~. When the graft has united, after a few weeks, the top half of the stock should be cut off to stimulate growth of the scion; and after another month the stock is cut back to the graft union.

A form of veneer-grafting in which the scion consists only of a single bud is known as "chip-budding". Stocks are ready for use at 5 weeks, when the bark color has changed from red to green. Buds are cut like shield buds except that the chip is thickest at the base. Lateral buds are used and are induced to start swelling by removing the terminal and several subterminal buds about 10 days before grafting in the usual way for a veneer-graft. Several weeks later the stock is cut back to the union to force the scion bud into growth. Another form of grafting with a single-bud scion, the "modified chip-bud" method, is really a side-graft. The stocks are used at 2 or 3 weeks of age, while still red and succulent, and buds are pre-conditioned as above. The scion is a shield bud about 2 in. long and is inserted in a side cleft. About 10 days after grafting the stock is cut off just above the union. In both types of "chip budding", the graft is

wrapped with vinyl film to make a moisture-tight seal. Their advantage is the large number of scions which can be made from a limited supply of twigs, and the shorter time required from planting seeds to setting grafted trees in the orchard.

Approach-grafting, often incorrectly termed inarching, is the easiest method so far as technique is concerned, but one which often produces weak unions and which requires a good deal of labor compared to other methods. A potted seedling is supported close to a suitable twig of the scion variety, a shallow lateral cut a couple of inches long is made on both stock and scion, and the cut areas are placed together and bound firmly in place. In a couple of months the top of the seedling is cut back to the union, the scion twig is severed just below the union, and the potted graft is ready to put in the nursery.

Budding is sometimes used, with the customary shield-bud most common, although patch-budding was the type first used commercially. The method is very similar to that used for citrus fruits, but success is not easy and an experienced budder may have few mango buds unite. Seedlings stocks should be 1/4 to 1/2 in. thick, about 8 to 10 months old. Buds are taken from the next-to-last flush of growth, and may be pre-conditioned by cutting off their subtending leaves about 2 weeks beforehand. It is necessary, of course, that the bark should slip on the stocks. After the bud has united with the stock, the latter should be cut back as in veneer-grafting.

Topwork of established trees to change them into more desirable varieties may be done either by cleft- or veneer-grafting, preferably the latter. Young seedling trees, or unsatisfactory grafted trees, with trunks up to 6 in. diameter, may be veneer-grafted in spring on the trunk or at the base of the main limbs, using scions as described above. After the grafts have united well, the tops of the trees are gradually cut back to the union. With older trees, it is usually better to prune the top back in early winter to leave a foot or so of each main limb, and then to veneer-graft some of the sheets which develop in the spring as if they were young seedlings. Ordinarily they will be ready to graft in late spring or early summer.

However, on good soils little fertilization is needed, especially for bearing trees. For the first few years in the orchard, before a deep root system has developed, small applications of a balanced, mixed fertilizer may spur growth. If a bearing tree does not seem to have good green color in its leaves and makes abnormally short new flushes of growth, nitrogenous fertilizer should be given.

Planting and Care

Mango trees should be spaced widely enough apart that adjacent trees do not shade each other. Normally, only the buds at the tips of the branches produce flower clusters, and if these tips are heavily shaded, few flowers are formed. Varieties with trees of normal size should be spaced 30 to 45 ft. apart, the spacing being greater on deep than on shallow soils. Varieties of dwarfed habit may be planted more closely if not interplanted with larger trees. With wide spacings as above, the trees will not utilize much of the space of several years, and temporary crops may well be grown for a time. Bananas, papayas, limes, or vegetables may be interplanted, but always the space occupied by the intercrop must be restricted more each year, so that the mango trees never suffer competition. Planting is best done at the beginning of the rainy season, if there is one, or at the start of the normal growing season. Grafted trees in containers may be planted when they have completed 2 or more flushes of growth after grafting, and should not be in an active growth flush at the time of transplanting. If possible, trees in containers should be hardened before planting by gradually decreasing shade and water supply. (A heavy mulch of leaves or grass around newly planted trees is very helpful.)

Fertilization of mango trees may follow the program for oranges. Each year enough new vegetative growth must be made to produce flower buds for the following year and to provide leaf area sufficient to produce a good crop of fruits. Pruning is not practiced with mangos except to remove dead or injured branches, and sometimes to head back abnormally long leaders on young trees. Irrigation is especially important when the crop is setting in spring and during the latter half of fruit development when size increases rapidly if water is not limiting. The tree endures drought well on deep soils. During the first year after planting, before roots have gone deep, frequent watering will be needed if rainfall is sparse. Weed control may also follow that for oranges.

Flowering and Fruiting

Flower-bud differentiation normally takes place in terminal buds in autumn. In the subtropics the check in growth needed for this is provided by cold and drought at this time; in the tropics there must be a dry period in autumn for flower buds to develop. Shoots of the spring or summer flushes are much more abundant and much more likely to form flower buds

than shoots of an autumn flush. In the year of a heavy crop, fewer blossom-buds are differentiated in autumn than following a light crop.

The number of flowers borne on a mature mango tree is usually enormous. In a year of good bloom, a tree is likely to produce from 1000 to 2000 panicles, each with 1000 or more flowers, or a total of 1 to 2 million flowers. While the number varies in different varieties and seasons from 1 to 70%, in most of the well-known varieties about 25% of the flowers will be perfect, thus capable of setting a fruit. This still leaves from 200,000 to 500,000 flowers with the potential of becoming fruits; yet a crop of 500 fruits is considered unusually good. Less than 0.1% of the perfect flowers ever become mature fruits.

There are many factors which enter into this low permanent setting. Of course, if even 1% of perfect flowers became fruits, the weight of the crop might break down the tree. The real problem is not to achieve even a 0.1% set, but to avoid having only 1/10th or 1/100 th of this yield, as sometimes happens. One factor, about which the grower can do very little except to keep the tree as healthy as possible, is that a large proportion of the perfect flowers are not fully functional internally; they only appear functional. Another problem is pollination. Mango pistils only set fruit if they are pollinated, and often only a small percentage receive pollen. The flowers have only a single stamen which bears pollen and this requires insect help to transfer it from stamen to stigma. Hand pollination greatly increases final fruit set, but is entirely impractical when 100 flowers must be pollinated to obtain 1 fruit. Honey bees are usually good mango pollinators. However, mango pistils become ready for pollination before daylight but the stamens begin shedding pollen only about mid-morning, and stigmas may become dried before pollination occurs. Sometimes, also, thrips may destroy many perfect flowers. So the small number of fruits from the large number of flowers is not surprising. (Immediately after bloom there is usually a large number of tiny fruits that form the initial set, but most of these will fall off within the first month.)

Harvesting

Mangos which are picked immature ripen to very unsatisfactory flavor. For home use, there is no problem of knowing when fruits are properly mature. Most varieties

undergo a marked change in skin color from green to yellow, beginning at the end opposite the stem, as ripening begins. Fruits picked at this easily recognizable stage will ripen to their full potential flavor in 4 or 5 days as a rule, and picking every 3 days will assure that no fruits are left too long on the tree if each time all which show color change are taken. The commercial grower, who does not want the expense of repeatedly sending a picking crew through the orchard, need not wait for each fruit to show incipient ripening. After several fruits on a tree have ripened normally (and not prematurely because infested with larvae), he can safely pick all fruit from the same bloom as these first ripening ones. If there are fruits of different sizes from 2 or 3 bloom periods, those of each bloom must be handled separately.

While most varieties have a somewhat leathery skin, mangos are rather easily bruised if handled carelessly and bruised areas may become decayed as ripening progresses. As with avocados, mangos are usually picked from the ground with a long bamboo pole bearing a knife edge and a small canvas bag at the tip. Fruit stems should be cut off close to the fruit to avoid injury by them to other fruits. If picked at the first sign of color break, mangos can be put on a market a week distant; the more the color development, the shorter the time available to get the fruit to the consumer. When refrigerated trucks or ships are available, shipping fruit at 50° F keeps it in good market condition for 2 weeks. Fully ripe fruit can be held for 3 or 4 weeks at 32° F in good condition.

Mango Dermatitis

Belonging to the same family as poison-ivy (Rhus toxicodendron) and poison-wood (Metopium toxiferum), it is not surprising that juice from leaves but especially sap from the cut stems of green fruit should cause skin poisoning to some people. It is present only in the fruit peel, not in the flesh, and usually persons who are subject to mango dermatitis can safely eat fruit peeled by someone else. However, there are a few people who are allergic to mango flesh, as others cannot eat strawberries. Fortunately the great majority of people are unaffected in either way, but those sensitive to skin irritation should wear gloves while picking or handling fruits from which any sap drips.

Pest Control

Fungi

The only serious fungus disease of mangos is anthracnose, caused by Colletotrichum glocosporioides. This fungus attacks the blossoms, causing bloom blight, and the fruits, causing black-spot disease. A heavy bloom-blight infection prevents flowers from setting any fruit. If fruits are set and persist, infection by the anthracnose fungus cause black areas of decay in the flesh as they ripen. The critical period of fruit infection is when the fruits are very small, soon after they are first visible. The causal fungus is widely distributed, having a great many other hosts, so that only a spray program can control it. A series of spray applications must be made, at least 5 or 6, if weather during blooming and early fruit development is rainy or highly humid. The fungus is not able to infect blossoms or fruit if humidity is constantly low.

The first spray application should be made when panicles have pushed out for several inches but before any flowers open, and is intended to coat the sources of infectious spores. Two more sprays should be applied at weekly intervals. If the bloom is normal, it will be ended by another week, and the first fruit spray will be made as soon as tiny fruits are visible on the panicles. If new panicles prolong the blossoming period, the bloom sprays should be continued at weekly intervals until blooming is ended. After the first fruit spray, two further applications should be made at intervals of a month. Thereafter the fruit is very resistant to infection unless the skin is broken.

Copper sprays are very effective in control of this fungus, and have a long lasting effect, but they are slightly toxic to mango flowers. Fungicides such as zineb, maneb, and captan are also effective, but the residual effect is short. They are superior to copper sprays for the (and are not phytotoxic to mango) bloom blight, where applications must be made weekly because new flowers are opening each day; but only copper sprays are satisfactory for the monthly applications on fruits. Recommended spray mixtures for the bloom are 1½ lb. of maneb or zineb in 100 gal. of water plus a liquid spreader. For the post-bloom fruit sprays, a 6-6-100 Bordeaux mixture or, better, an equivalent neutral copper spray such as 4 lb. tribasic copper sulfate in 100 gal. of water. A spreader should be used also, to assure [illegible] of the skin of the mango.

Few varieties rate high in all of these characteristics. Those of Indian origin are likely to be low-yielding, while Indochinese types lack color. Many varieties of superb quality were introduced to Florida from India around 1900 — Mulgoba, Paheri (Deeta, Pirie), Alphonse, etc. — but because of scanty bearing they have almost disappeared there. They did, however, create a great interest in and enthusiasm for mango growing, and gave rise to seedlings from which presently grown varieties have been selected.

Recommended varieties for tropical America include Irwin, Haden, Kent, and Keitt for commercial orchards to give a sequence of maturing throughout the season, and Carrie, Julie, and Manila for home planting. These are all productive, and the commercial varieties combine attractive appearance with good quality, while the dooryard varieties rate low on color but high on quality. The season of maturity is that in Florida. All the commercial varieties ship well.

IRWIN — fruit of medium size, usually 10 to 14 oz., skin yellow with bright red blush, flesh fiberless, very good quality. Season June and early July. ~~Fruit ships well~~. Tree tends to be below average in size.

HADEN — fruit large, 14 to 24 oz., unusually beautiful with crimson blush over much of the yellow skin and purple bloom superimposed also. Quality is not very good, owing to short fibers in the flesh near the stone and a small amount of turpentine flavor. Yet the quality is good enough so that the size and color would make this the leading variety if it had better bearing habits. Season June and early July. Tree large. This arose as a seedling of Mulgoba about 1900, and gave the first basis for a mango industry in Florida.

KENT — fruit large, 20 to 28 oz., skin greenish-yellow with dark red cheek, flesh fiberless, very good quality. Season July and August. ~~Fruit ships well~~. Tree large.

KEITT — fruit like Kent in size, but with only a pink blush on the yellow skin, flesh nearly free of fiber and of very good quality. Season August and September. ~~Fruit ships well~~. Tree large, rather open.

CARRIE — fruit small, 8 to 12 oz., skin greenish-yellow, flesh fiberless with rich flavor, quality excellent. Season June and July. Tree rather dwarf with compact crown.

JULIE — fruit small, 8 to 12 oz., skin yellow with dull red blush over much of surface, flesh nearly fiberless, quality fairly good. Season rather long because of successive blooming. Tree dwarf. Because [illegible] resistant to fruitfly than most varieties. Remember

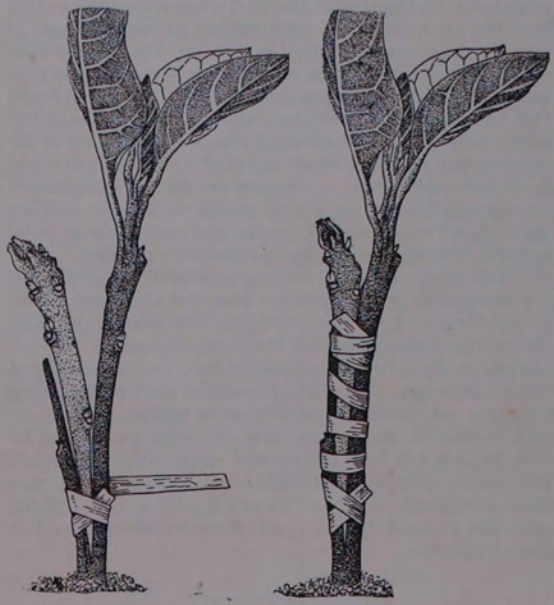
There are common seedling races of both divisions in tropical America. The West Indian race of Indian mangos is common in Cuba, Jamaica, Puerto Rico, Mexico, Florida, and Hawaii. It is characterized by tall, upright trees and small, beaked fruits with red cheeks. The Manga race, also Indian, is found in Cuba and Florida and has low, round-headed trees with small pear fruits either orange colored and very turpentine-flavored or light yellow with no turpentine. The fruits of both races are very fibrous. The Filipino race of Indochinese mangos is widely grown in Cuba and Mexico, and is highly esteemed because fiberless. All of these seedling races are polyembryonic and so reproduce quite uniformly by seeds.

Development of anthracnose in harvested fruits can be reduced by treating them with hot water before shipping to market. Usually the fungus penetrates the skin of very small fruits but remains inactive until ripening begins. The heat treatment does not kill the fungus but it slows greatly its rate of development with affecting the rate of fruit ripening. The treatment is especially valuable for fruit held at 50°F., since fruit ripening is much more delayed at this temperature than is fungus development in unheated fruit. Fruit must be immersed for 15 min. in water held between 123 and 124°F. A sufficiently large amount of water must be used, with ample heating facilities, so that the fruit does not lower the water temperature more than 1°F when immersed. A temperature of 126°F will injure the pod.

Insects

Fruitflies are among the most common and troublesome insect pests of mangos in tropical America. One reason for the popularity of Julie is that its pod is less readily penetrated by the ovipositor of female fruitflies than that of superior varieties. All of the other recommended varieties are very subject to infestation. The larvae pupate in the soil, and to prevent completion of the life cycle it is important to gather and destroy infested fruits before the larvae emerge and enter the soil. Daily collection of all dropped fruits and burial under 2ft. of soil of those infested with fruitfly larvae greatly decreases this pest. Other host fruits in the vicinity must also be destroyed if infested, in order for this program to be effective.

Scale insects and spider-mites are constantly present pests, and are likely to increase greatly in numbers following Bordeaux sprays. This is one advantage of using a neutral copper instead. Malathion at 2½ lbs. of 25% wettable powder in 100 gal. of water containing 0.7% actual content of summer oil such as Volck forms a good general scalecide and miticide



Side grafting the avocado. On the right, the graft is completed and tied with rubber grafting strip

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2. *Injerto de enchapado (Venee).*

Comenzó a gozar de gran prestigio en los últimos años, debido al buen éxito que tuvo en varios árboles frutales donde los métodos anteriores habían fracasado. Se logró un resultado positivo en el 80 al 90 por ciento de los árboles más difíciles de injertar: mango y guayabo.

Fig. 6.3. Injerto de enchapado o veneer.

Fig. 6.4. Injerto de lado.

3. *Injerto de lado.*

Es muy similar al injerto anterior. Su uso se limita principalmente a patrones muy tiernos como las puntitas de las ramas de los aguacates. En Florida se practica este injerto con fines comerciales en patrones tan tiernos que sus tallos todavía no son leñosos. Su principal ventaja consiste en la posibilidad de injertar plantitas de 6 a 8 semanas de edad en lugar de esperar igual número de meses, con lo que ahorra tiempo.

4. *Injerto de cuña.*

El empleo de este método se limita principalmente a la multiplicación de frutales de clima frio, como manzanos, ciruelos y duraznos. Es el más trabajoso de los cuatro injertos recomendados. La ventaja estriba en que se pueden injertar patrones bastante grandes.

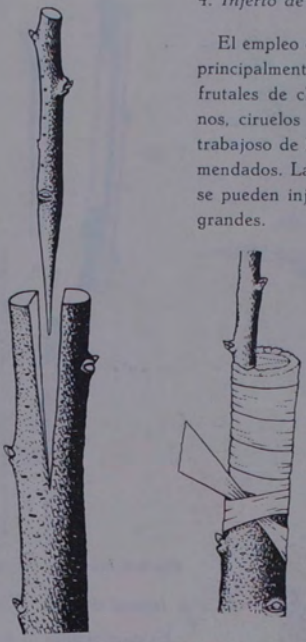


Fig. 6.5. Injerto de cuña.

6.2. PODA

La poda es una de las prácticas agrícolas que deben ser tratadas con la mayor discreción. Al igual que el injerto, es más un arte que una ciencia, sobre todo en los trópicos, donde ha sido objeto de poco estudio. En muchos horticultores existe aún la convicción de que es bueno para los árboles someterlos de vez en cuando a una poda general y rigurosa. En vez de esto, la poda debe perseguir objetivos que repercuten en el ciclo de vida de la planta, u otros que son de conveniencia humana. Debe prestarse la mayor atención al problema y pensar repetidas veces antes de tomar en mano la sierra o las tijeras de podar.

George B. Cellon of Miami, which was then "at the end of the line", was the first to propagate commercially mango and avocado varieties by grafting. He used the method known as shield budding, and he concentrated upon the Mulgoba mango and two avocado varieties which he had selected among the numerous seedlings growing in the Miami region—these were Trapp and Pollock. Cellon had moved south from his home in northern Florida. He was a true plantsman and a most picturesque character.

At about the same time, or a few years later, John B. Beach established a nursery at West Palm Beach, whence he sold budded trees of mangos and avocados. I recall that when I first visited him he was experimenting with a new method of grafting avocados something on the order of the herbaceous cleft, as we call, it today. This is the first time I remember seeing very young rootstocks used, a common practice today.

In the early years of the present century, the United States Department of Agriculture established a "Plant Introduction Garden" at Miami, a tiny tract of only seven acres or so which was destined to play a major role in the development of tropical horticulture. I believe P. H. Rolfs, for many years Dean of the College of Agriculture at the University of Florida, played an active part in this; and then, for some years, P. J. Wester was in charge. I recall Dean Rolfs telling me that he had found Wester at the Royal Palm Hotel in Miami, where he was head gardener, and had recognized in him those qualities of the true plantsman which peculiary fitted him for work at the new station. Wester later moved to the Philippines, where for years he was active in the work of plant introduction and propagation. He published many bulletins and papers, one of which, on the vegetative propagation of tropical fruits, is practically a classic, for he had succeeded in budding many species which had previously been grown only from seeds. Many of these species are still not commonly propagated by any other means.

Wester was succeeded by Edward Simmonds, who was for years assisted by Charles H. Steffani, recently retired as County Agent at Homestead. Simmonds had not been trained as a plantsman but he was born a plantsman. I remember his telling me how it happened that he got into the field of

horticulture. He was working in Washington, where he had come from his native country, England. He saw an advertise ment to the effect that a man was wanted for work in one of the greenhouses of the Department of Agriculture. He called upon George W. Oliver, one of the great plant propagators of his day. "Mr. Simmonds", asked Mr. Oliver, "do your know anything about greenhouse management?" "Not a thing", answered Simmonds, seeing his chances going up in smoke. "You're the very man I want", replied Oliver.

The little garden at Miami soon came under the direction of David Fairchild, who had taken over the Office of Foreign Seed and Plant Introduction of the Bureau of Plant Industry at Washington. Not only did material continue to arrive from abroad, but many new varieties of tropical fruits, some of which have retained importance to this day, were developed as local seedlings. Special attention was devoted to mangos from all parts of the tropical world. When I worked at this little station in 1915 and 1916 there were more than eighty varieties of grafted mangos under trial. Many of these were of fine quality but not very productive. I recall that day when an enthusiastic amateur (and they were rapidly increasing in number) came to the garden with a shoe box. He opened it, carefully unwrapped a handsome mango, and said proudly, "You see that? There are two more on the tree!"

For many years the "little garden on Brickell Avenue" carried on its pioneering in the field of tropical horticulture, and especially tropical fruits, until it was practically blown off the map by a hurricane, and in addition, with the growth of Miami, had become so valuable as real estate that a move was made to Buena Vista, north of town, then to Chapman Field, south of Coconut Grove, where the government turned over a large tract of land which had been an air base during the first world war. This site was more favorable from the standpoint of climate, and the work of plant introduction was carried on, recently under the guidance of Harold F. Loomis.

Long before the move from Brickell Avenue, another great figure came into the picture, that of William J. Krome, an engineer who had been instrumental in building the "overseas railroad" from Miami to Key West. Mr. Krome

took up a tract of land near the modern town of Homestead. Here he planted commercial orchards of citrus, mangos and avocados, and worked intensively and profitably on methods of propagation and culture. His untimely death left his activities in the hands of his widow, whose useful comments on mango culture appear in this issue of Ceiba and in those of his son William H. Krome, whose excellent paper on avocado culture also adorns our pages. If I am not mistaken, it was a piece of Mr. Krome's land which was turned over to the University of Florida for the establishment of the Subtropical Experiment Station.

In our last issue we presented a paper by Dr. Bruce Ledin, in which are set forth some of the findings at this station, where has been assembled through the years a remarkable collection of fruit varieties, now under the direction of Dr. George D. Ruehle. Numerous well-known scientists, including Herbert S. Welfe, now Professor of Horticulture at the University of Florida, obtained much of their early training here.

Perhaps especial mention should be made of this station's development of superior varieties of the common guava, a fruit which in its improved forms will become increasingly useful; and of the study which has been made of mangos. But there are many other things to the credit of the scientists who have devoted their time to investigating problems of tropical fruit culture at this place.

In more recent times, and in this connection we refer our readers to the excellent paper in this issue of Ceiba by S. John Lynch and Roy Nelson. The "South Campus" of the University of Miami has been the scene of a remarkable job in the development of the vegetative propagation of such recalcitrant subjects as the mango, the guava, and the lychee. The latter, it should be mentioned, was really "put on its feet" by the late Colonel W. R. Grove, working near Sarasota on the other side of the State. The lychee had long been known in Florida, but only in the form of scattered trees, a few of which had been introduced in the early years by Reasoner Brothers, others somewhat later, through Dr. Fairchild's office in Washington. Colonel Grove was a retired army officer, a lychee enthusiast who not only perfected the propagation of this tree through the use of plastics in air-layering, but also stimulated com-

mercial plantings to such an extent that Florida now has a Lychee Association devoted exclusively to the commercial production and marketing of this excellent fruit.

Many other men took part in the early development of tropical fruit growing in Florida. I call to mind at this moment Dean H. Harold Hume of the College of Agriculture, University of Florida, and Harold Mowry, Director of Experiment Stations; T. Ralph Robinson of the U. S. Department of Agriculture, who did valuable work on avocados and papayas, as well as citrus; the Dorn Brothers of Larkin, south of Miami, who were pioneers in the cultivation of avocados and mangos; and J. L. Hickson of Miami who had one of the early orchards. I mention all of these because they are among those whom I knew personally; others I have not omitted intentionally.

And now, to come nearer home, I should mention that the work done in Florida in the early days naturally was reflected in neighboring regions, of which I believe the most important were Cuba and Puerto Rico. In a recent and interesting booklet entitled "El Mango", H. A. Van Hermann, dean of tropical fruit specialists in Cuba, recounts that George B. Cellon in 1906 supplied Roland R. Conklin 100 Mulgoba mangos for planting near Habana; at about the same time others were sent to Mr. Runyon at Guanajay, and to the Isle of Pines. These plantings were doomed to failure because Mulgoba produced small and irregular crops, but the work of propagating and testing varieties at "Finca Mulgoba" was carried on by Mr. Van Hermann for many years. Slightly later than in Cuba, I believe, plantings of grafted mangos were made in Puerto Rico, and useful work in propagation and cultural practices was done at the Agricultural Experiment Station in Mayagüez by Hess and by Kinman.

So now I come back to my original question or a variation thereof: Just what bearing does all this have upon fruit growing in tropical America generally? We owe to workers in Florida, and to a less degree, those of other regions, much of our present knowledge regarding the propagation and care of tropical fruits in general. Captain Haden of Coconut Grove, Florida, produced the Haden mango, a seedling of Mulgoba, the most important grafted variety

Side grafting the avocado. On the right, the graft is completed and tied with rubber grafting strip

The tree will be ready for setting in the field in five to seven months from the time it is grafted. If these young trees are kept another year in the original gallon container, they become root-bound and are very unsatisfactory for planting in the field. Should it be desirable to hold the trees longer, they should be transferred to three — or five — gallon containers at the end of the first year.

Veneer grafting in the nursery is sometimes practiced if the young suculent reetstocks become too hard or too old for the side graft. These stocks can be of pencil size or even twice to three times that diameter. Where they have attained considerable size transfer should be made to larger

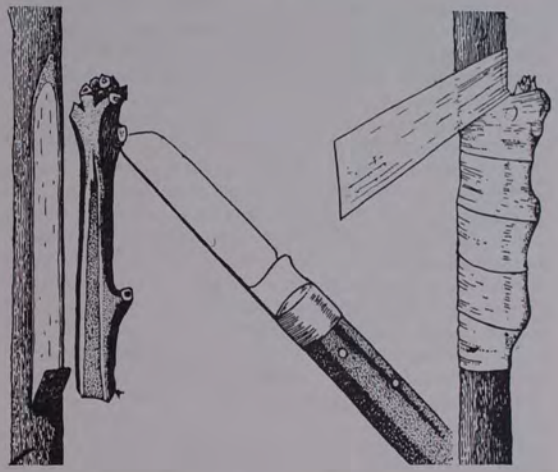
containers. The method is also used when top-working older avocado trees that have been topped to force sprouts of suitable tissue and diameter for grafting. The regular side-veneer is used with a scion two to three inches long, terminating in a healthy swelling terminal bud. It has been found that holding the scion in place and covering it completely with a strip of 0.0035-inch vinyl film, leaving the tip of the terminal bud exposed, allows the graft to remain moist and at the same time leaves an opening for the springing bud to emerge without unwrapping as quickly as in most grafting operations. Trees from this type of graft are ready to plant in the field from three to five months after grafting.

TOP-WORKING. Top-working avocados in Florida has not changed in general practice from the cleft-graft method described by Krome in 1916 (2). The work is still done during the cooler season of the year, November through March; as the warm season approaches, the percentage of "takes" decreases. This method is used to work over seedling trees that are found undesirable or to replace one variety with another. A ten year old avocado grove top-worked by cleft grafting will bear commercial crops within two years. The growth of top-worked trees is prodigious. Within two years the top will be 12 to 15 feet tall with a spread of the same size and will have a trunk diameter almost equal to that of the stock.

MANGO PROPAGATION

The successful budding and grafting of mangos in Florida within the last ten years has advanced rapidly with the demand for the newer varieties originating in this State. Several skilled nursery propagators and research workers have developed techniques that are used to grow thousands of trees each year.

The principal methods used are side-veneer grafting, chip and modified chip budding, and side grafting. The use of these techniques is determined chiefly by the diameter and age of the stock plant. Mango stocks are grafted in Florida from the growth period when the seedlings are still succulent, with a red or purple color, continuing through the successive growth stages until well-defined cambium has formed.



Details of veneer grafting the mango. On the left, scion ready for placing on the stock plant. Note the notch at the lower end of the cut on the stock, useful in holding the scion in place while wrapping proceeds. On the right, the graft has been wrapped with vinyl film, leaving only the tip exposed so that the terminal bud may break into growth.

Side-veneer grafting and chip budding are the two methods most in use at the present time. The technique of wrapping, budwood selection, and "springing" of the bud vary with the individual propagator, but standard procedures are gradually being established. The majority of trees grown in containers are grafted or budded when the stock has a stem in the "green" stage of maturity. This stage is reached in four to six weeks after the seedling has germinated and continues over a period of several months. The seedlings that are not grafted in the first green stage during the months of July, August and September are held over until the spring and early summer months. Graftage during the cold months is not advisable because growth of the scion is slow and the percentage of "takes" low.

Regardless of the particular method of graftage selected, disease and insect control on the stock and parent trees, season of year for the operation, and careful selection of scions for proper maturity are important to the success of the operation.

The choice between using terminal scions or lateral buds depends chiefly on the abundance of graftwood. The use of budding methods allows a greater number of trees to be produced when economy of graftwood is a factor. This is usually the case when the increase of a new variety is first attempted. Also, the particular technique with which the propagator is most proficient influences the choice of methods. Many prefer the terminal scion because springing is more rapid. Others use the budding method entirely because the scion length of the chip-bud requires a shorter cut and less wrapping material. Speed of the operation is also a factor which favors budding in comparison with the side-veneer graft. Springing the bud requires different procedures than are required with the terminal scion, but this can be successfully done by any of several methods used in Florida.

SIDE-VENEER GRAFTING. This technique was more exclusively practiced during the period when the Haden variety dominated the mango plantings. With the advent of newer varieties and the greater demand for trees, budding methods are now practiced almost as extensively as the side-veneer, if not tending toward more extensive use.

Side-veneer grafting may be started when the seedling stock has a defined cambium and has formed enough wood to have rigidity. The appearance of the bark will vary from a greenish-pink to a definite green color, and as further maturing occurs, the bark will appear grey with a corky condition noted on older trees where considerable bark sloughs off. The side-veneer graft is also used on large limbs or tree trunks in top-working.

The scion used is almost always a terminal stem two to three inches long. The degree to which the terminal bud is developed gives the best indication as to its suitability. An enlarged terminal that will "spring" in 10 to 14 days is ideal. Leaves are removed as the scions are taken from the parent tree. The scions are placed in damp peat or spaghnum moss until the grafting operation. The cut on the scion

Enlargement of the bud takes place as well as development of vascular tissues between the bud and stock. When it is determined, through experience, that conditions are right for springing of the bud, the seedling may be topped completely just above the bud or it may be lopped as done with citrus trees. This method may be considered rather clumsy nursery practice, that is, leaving the bud dormant for several weeks or even months; but it accomplishes the springing of a vigorous sprout in contrast to the rather slow growth derived from method N° 1. It will have to be determined which method will work best for the individual attempting it.

3. When is is fairly certain that union between scion and stock has taken place and the bud is advanced enough that is seems highly probable springing will take place in two to three weeks, the stock may be cut off completely just above the bud. However, it is generally considered safer to follow either method N° 1 or N° 2 because delay of springing may stunt the plant or, in some instances, kill it.

MODIFIED CHIP BUDDING. This method has also been reported previously (5, 6), but certain procedures have been improved in the sprouting of stocks and the springing of buds. The method is not in widespread use but should greater numbers of trees be needed, it will probably become more widely accepted. It does require grafting within a more limited time schedule, due to the fact that the young rootstock is in a "red" or "purple" stage of growth for only two to three weeks. This period can be extended under certain specialized environmental conditions such as shade or deep planting in the seedbed.

Sprout the seeds after removing the hull, in peat moss. If increase in diameter of stock is desired for easier manipulation in the grafting operation, it can be accomplished by planting the seed six to eight inches deep in peat moss. These seedlings, before leaves have developed to any great extent and the plant still receives the major part of its nutrients from the cotyledons, can be grafted or budded: (a) immediately and replaced in the peat moss and potted in one week, (b) as they are removed from the seedbed and potted, or (c) a few days after potting. By another workable procedure, seeds may be placed in peat moss to determine viability (5) and as soon as the radicle begins to protrude, potting of the germinating seed can be done. Graft-

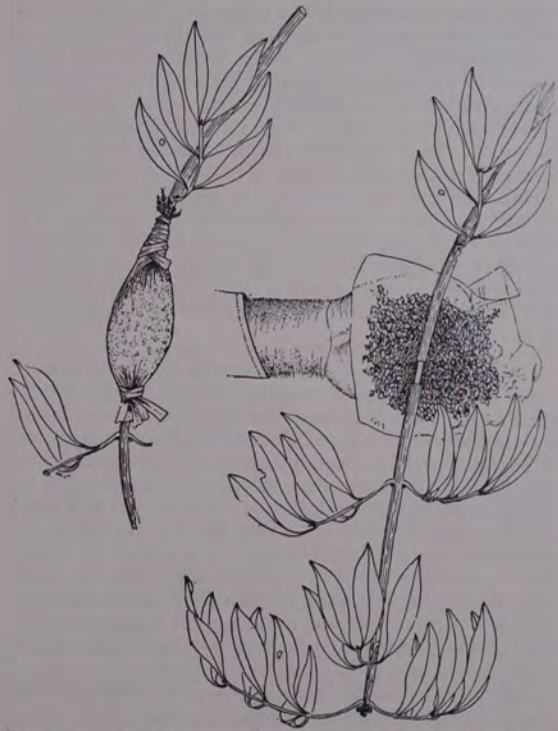
ing or budding can then be done as the seedlings reach the proper stage of development for the operation. This budding operation consists of making a slanting two-inch cut into the succulent seedling which extends diagonally downward and inward, reaching to almost the center of the stem. The bud is cut like the conventional chip bud except that the front of the shield just below the bud is cut so as to expose tissue in addition to that exposed on the opposite side. The wedge-like bud is then inserted into the slanting cut on the stock and wrapped with vinyl film, 0.0035-inch thickness, and of a suitable width and length.

The same procedures for graftwood selection and post budding care are recommended as for the chip bud.

TOP-WORKING. The need for top-working the less desiderable varieties of mangos has stressed the importance of reliable procedures whereby a quick top conversion is

Top-working the mango by means of veneer-grafting on large limbs which have been cut back for the purpose

the greater gas exchange, which makes more oxygen available for promoting root formation. There is a reduction of one-half to one-third the cost of film per air layer by using the lighter films. It has also been observed that the air layer should be removed from tree when three to five roots are visible through the film. If the roots are allowed to become too profuse and start to darken and lose their original fresh



Air layering the lychee. Dampened moss is placed around the girdled branchlet, then wrapped with Vinyl film to retain moisture

creamy-white color, there may be some slowness in the growing off of the air layered plant.

Considerable improvement has been made in growing lychee air layers by the use of a high humidity environment during the hardening-off process. This was discussed by Nelson (7, 10). The use of a timer to control alternate periods of fogging with periods where fogging was discontinued gave a better environment for potted air layers than where fogging was continuous. It also eliminated the water soaked soil or "water logging" which was one of the drawbacks of continuous fogging or mist. Under these conditions, dehydration of the immature plant in prevented and the stems and leaves which are normally removed may be retained, giving a larger plant and a more rapid increase of the root system. The flush of growth usually resulting when a plant is severely pruned back, is delayed under high humidity conditions until the time that the root system is better able to furnish the moisture requirements of the young leaves. The intermittent fogging system has given the best results, as stated above. Strainers to keep the fogging nozzle from becoming clogged, solonoid valves, and an electric timer capable of being set to short intervals are the integral parts of this system.

The timer used at the University of Miami may be set at any multiple of 12 seconds, on or off, during the sixty 12-second intervals comprising the 12 minutes used for one revolution of the clock. The settings best suited are determined by weather conditions such as temperature, wind and relative humidity where the plants are grown. As an example, in 1954, the settings were two minutes of fogging and four minutes without, during the first two weeks the plants were potted; then changing to two minutes of fogging and 10 minutes without for the third week, and the fourth week the fogging was discontinued. Much work needs to be done to determine the most advantageous fogging intervals, and it is fairly certain that these have to be correlated with local conditions.

Lychees have been grafted or inarched for over half a century (8); however, the methods used were rather crude and apparently a high percentage of "takes" did not result. At the present time, practically all lychee propaga-

tion in Florida is by air layers. As new varieties appear by introduction or are developed from native seedlings, their propagation in large numbers presupposes the use of graftage. As the lychee will be grown on a variety of soils in Florida, it may be necessary to use a specific rootstock produced either by air layers or cuttings. Lychee seedlings observed by the authors have proved to be very irregular in growth habits and vigor and would probably prove unsatisfactory as rootstocks.

We have tried several types of buds in propagating the Brewster variety, including shield budding, chip budding and side-veneer grafting. We have also used a slight modification of a veneer graft cut in a manner similar to that used in guava graftage (9). This type of scion cut has an advantage over the other methods in that the bud may be wrapped so that a slight opening is left at the top to allow emergence before the wrap is removed. The vinyl plastic film of 0.0035 inch thickness, cut in one-half inch strips, is used for wrapping the buds in a shingle-like manner. To force springing of the bud, the stock should be lopped over in the manner used in citrus budding. The lychee, being slower in growth habits, should not be lopped until one month after budding.

The selection of scions of proper maturity appears to be more important than the method used. They should be from vigorous flushes of terminal wood still retaining some green color and with prominent axillary buds. The lychee stem on the stock is very adaptable to shield budding, as the bark slips readily on rapidly growing stocks. Chip buds and side-veneer grafts also work very well. Lychee buds should be ready for field planting in nine to 18 months after propagation.

GUAVA PROPAGATION

The common guava has usually been propagated by seeds. These have a high viability, consequently, great guava thickets have developed in many regions. Seedlings of the common guava do not come true to type and hence there are great numbers of plants in existence producing fruits of poor quality. Two decades ago some better types of guavas came to the attention of horticulturists and need was seen for reliable asexual reproduction of this plant.

Very indifferent success was obtained with cleft grafting, side grafting, side-veneer grafting and budding, and even poorer results with both stem and root cuttings. With the advent of vinyl film wraps for air layers, Ruehle (14), in 1948, set forth the application of air layering to the guava and its success. Trees can be made ready for planting in the field by this method in four to five months. However, a rather generous portion of the parent tree must be used in taking off an adequate air layer. This method allows for the establishment of clones in moderate quantities, but where only a single parent tree is available, several years are required to produce a few thousand propagations.

Shortly after 1950, mist-type plant propagating frames found favor in the rooting of cuttings and the establishing of air layers (4, 7). Mist-type propagation was refined somewhat by the use of hydroponics in irrigating the cutting media (12). Kuperberg (3), using the hydroponic mist-type propagator, found that cuttings made from terminal succulent growth produced the greatest number of rooted cuttings, with a five-node length proving superior to the three-node length. The over-all percentage of cuttings to strike root in the experiment was less than six per cent. The highest amount to root was 18 per cent, where just the water mist was used and not the nutritional mist. Again, as with the air layering of guavas, a vast amount of propagating material must be available to produce several thousand plants of a clone starting with a single tree.

The theme running through literature on guava graftages has been a continual reiteration of failure. Work was started at the University of Miami Experimental Farm in the spring of 1950 in an attempt to devise or establish a method of guava graftage that would fit itself to commercial nursery practices. Nelson published, in 1954 (9), a method of graftage that has proved to give a high percentage of "takes" and the type of union which makes a fast developing desirable tree. The recommendations suggested are as follows:

Stocks: Seedlings of a vigorous variety of guava should be grown in seedbeds or three-inch clay pots and later transferred to N° 10 cans or to felt paper tubes of comparable size. If nursery plants are to be field grown, it is advisable to move them from containers to the field rather

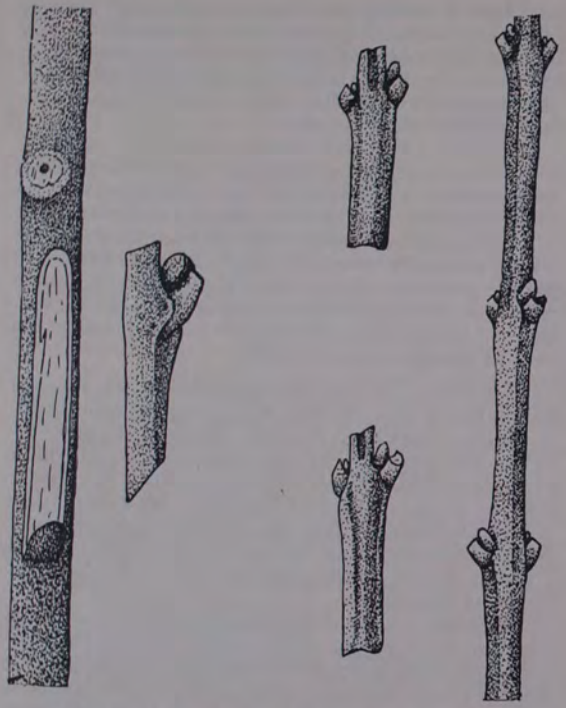
than from a seedbed, thus insuring more rapid recovery from transplanting. If possible, the better plan is to grow the plants in containers and thus eliminate root pruning and the problem of root suckers arising from the cut rootlets. The seedlings from the Red Indian variety of guava have furnished excellent rootstocks.

Guava seedlings grow rapidly when frequent watering and fertilizer applications have been made. The seedlings are considered to be of workable size when they are ¼ to ⅜ inch in diameter or about the size of a lead pencil, usually reaching this caliper in about six or seven months. It may be neccessary to spray the seedlings with a nutritional mixture containing copper, manganese, and zinc, before graftage is attempted, if these elements have not been adequately furnished by fertilizing. Insecticides for scale insects and leaf tiers are required at times.

Graftwood Selection: Scions are selected from terminal growth flushes when the stem is still green and quadrangular. Axillary buds should be well developed. In many instances both bud eyes (leaves are opposite in guava) will be of the proper development and this bud-stick with opposite eyes may then be split to form two scions. Usually at the time of budding, however, only one of the two bud eyes is of proper development, and the less desirable eye is trimmed off when the cut is made prior to placing it in contact on the cut of the stock.

In order to get a good supply of budwood from older parent trees, it has been found necessary to prune the latter back approximately one third in order to force sprouts that develop a large number of scions with desirable bud eyes. Younger parent plants produce growth flushes that are suitable for scions without this procedure. The forcing of this type of "juvenile" growth furnishes a larger diameter stick of budwood containing more scions than can be found normally on older parent trees.

Cutting the Stock: The cut on the stock for receiving the scion is made as in the chip bud or veneer method of grafting. The length of the cut will vary, depending on the length of the scion. The slice of tissue removed to expose the cambial region is made by cutting a notch at the lowest point where the scion is to be placed, slanting at approxi-



Veneer grafting the guava. Note the well-developed bud in the leaf axis.

mately 45° inward, and then moving the knife upward 1½ to 2 inches, and a downward cut made to the notch, thus removing a slice of bark and exposing the area of cambium. A properly made cut will not extend inward farther than the woody cylinder. However, it should be made certain that no bark remains on the cambial area where the scion is to be placed.

Cutting the Scion: Scions are usually cut into lengths of 1½ to 2 inches as they are removed from the parent plant. They are then stored in damp sphagnum moss until grafting is undertaken. Usually only one of the two opposite bud eyes is in the proper stage of development for use as a scion. The less desirable of the bud eyes is then removed by making a cut parallel with the surface of the scion and enough stem tissue is removed to expose the area of cambium. The scion, 1½ inches in length, will now have one bud eye which will be located on the upper ½ inch of the scion. There will be approximately ¼ inch of stem below the eye. In the event that both eyes should be of proper development on a scion, the cut can be made by simply splitting the stem, thus giving two suitable scions.

The graft is wrapped with a vinyl plastic strip ⅜ to ½ inch wide and of suitable length for the stock size used. It is wrapped in a manner that leaves a small opening at the top through which the bud emerges. After three weeks, the stock can either be lopped over as in citrus budding, or the top half of the stock can be removed. This will force more rapid springing of the bud. Staking and tying is done as with other nursery trees. After four to six weeks, the film is removed. The stub of the stock above the bud can be pruned back when the scion has attained four to six inches of growth. It should be painted with wax or some other suitable tree wound paint. Graftage on stocks from ¼ inch up to four inches, using the type of scion described, has been accomplished successfully.

Top-working guavas can be accomplished either by cleft grafting, by the Medora method for avocados (2), or by cutting back the stump, allowing shoots to spring, and grafting the shoots as described above. Tamburo (15) found that cleft grafting was much more successful in the spring than in the fall. His highest percentage of "takes" was from the chip budding method described by Nelson on sprouts, using succulent scions. As to the time consumed, he found that cleft grafting took about three times as long per stump as the chip budding. One of the problems still facing the grower in top-working guava trees is the tremendous number of suckers which persist in springing from adventitious

buds below the top-worked union. Probably this will always be a problem until a method of top-working is devised that brings the graft very close to the ground surface.

The preceding discussion of current methods of plant propagation in Florida is primarily a description of progress in the art of plant propagation. Most of the basic fundamentals of this section of plant culture were laid down centuries ago. As time progressed, refinement of the techniques of budding and grafting to approach nearer to 100 per cent success and to continually lower the costs in time and labor of the vegetative propagation of plants have made large acreages of standard quality fruit tree crops of the modern day a common occurence.

The methods in use today that produce a healthy plant rapidly and economically satisfy the needs of the average nurseryman. However, there is a growing awareness that more investigation is necessary regarding the processes of growth after the graft union. The formation of this union and the differentiation of adjacent tissues influenced by the type of cut and the stage of maturity of stocks and scions at the time of grafting is perhaps as important as the influence of the variety of rootstock itself.

We must be able to answer such questions as: "Does a budded mango tree grow as efficiently, produce fruit as well and carry on life processes for as many years as a tree in similar circumstances that was side-veneer grafted or one that was inarched?" Certain aspects of disease and mineral deficiency control are probably influenced by methods of vegetative propagation. These problems may, we hope, be answered in part at least, when current investigations are concluded at the University of Miami and at research stations elsewhere.

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ourselves little good with the present hodgepodge. Much more emphasis should be placed upon quality than has been evidenced in many recent plantings. You may say "Why not raise Mulgoba, Borsha and Paheri?" Scientists have removed the "bugs" from so many agricultural products, why can't they make Mulgoba bear lots of firm fruit, Borsha put on larger, cleaner crops and Paheri produce prettier fruit on sturdier trees? Well, so far they have not succeeded in making Haden behave and they have worked on that problem for a long time.

AVOCADO GROWING IN DADE COUNTY

Wm. H. Krome[1]

THE AREA IN FLORIDA in which avocados are grown commercially may be divided into two sections: Dade County, at the southern tip of the mainland; and the counties extending north from Dade as far as temperature minimums permit commercial cultivation (this limit runs roughly from Cape Cañaveral on the east coast to Tampa on the west coast). About four-fifths of the production is in the former section. My own grove operations are in Dade County, and my remarks are meant to apply only to that section.

Avocado groves in Dade County range in size from an acre or less to over 100 acres. Over 90% of the commercial plantings are of improved, budded varieties, the remainder being seedlings. There are from 70 to 85 trees per acre, as a rule; according to the Dade County Agent's office the average is 78 trees per acre. The plantings are for the most part solid avocados, but inter-planting with limes or other fruit trees is not uncommon. Many groves are operated by resident owners, but quite a few belong to non-residents, and most of these are cared for by professional caretaking organizations.

[1] A paper presented, March 8, 1954, at a hearing preliminary to adoption of a Federal Marketing Agreement for Avocados.

The avocado does not bear heavily when young, and it takes five to eight or more years to develop a grove to the point where it begins to pay its way. Thus a mature grove represents a sizeable investment. Figuring very roughly, I should say that at present price and wage scales the cost of bringing a grove into profitable production now would be in the neighborhood of $ 1200.00 an acre. Maintenance costs thereafter will vary, of course, with the amount of care given the grove, and with the efficiency of the caretaker. Proper care is likely to run about $ 300.00 an acre per year. As size and production of the trees increase, the costs may go higher. The best information I know of on this subject is found in a publication by the Dade County Agricultural Agent's Office entitled, "Costs and Returns on Avocados in Dade County, Florida, Seasons 1938-1950, incl.", with a supplementary table bringing some of the data through the season 1953. I suggest that it be referred to when detailed cost information is desired.

ACREAGE

The part of Dade County where avocados are raised commercially consists of a ridge of rocky land extending southwest from Miami to a point a few miles below Homestead. It is confined to land on which water does not stand for more than a few hours during maximum flood conditions, and is consequently relatively limited in extent. This type of land is in increasing demand for residential purposes, as the population of the Miami area grows. It is also regarded as the best land for limes and mangos. With this competition for land use, the amount available for avocados is being reduced, and incidentally the price of raw land and the taxes thereon, are increasing to such a point that areas close to towns and residential developments are already too expensive for agricultural use. The amount of land in avocado groves will doubtless increase; I might guess that it could eventually double its present extent, but expansion will certainly be limited by the factors I have mentioned. I present herewith the acreages of bearing avocados (including all over 3 years of age), as well as the production and crop value, in Dade County for the past several years, as recorded by the local County Agent's Office.

2.25 Kg; trébol híbrido, 1.15 Kg; y trébol ladino, 1.15 Kg.

Para suelos mal avenados: 1) alpiste (*Phalaris arundinacea*), 9.15 Kg; fleo, 4.5 Kg; trébol híbrido, 2.25 Kg; y trébol ladino, 1.15 Kg.

2) Alpiste, 9.15 Kg; y cuernecillo (*Lotus corniculatus*), 5.6 Kg.

Para suelos con sequías: fleo, 4.5 Kg; y cuernecillo, 5,6 Kg.

Las mezclas con trébol ladino deben limitarse a tierras que puedan cultivarse fácilmente, y que se hallen a una razonable distancia del granero, porque esta leguminosa requiere mucho cuidado para sobrevivir. Cuando las condiciones de la región son muy húmedas o muy secas para el trébol mencionado, se debe sembrar el cuernecillo. Se prefiere éste para tierras donde no puede repetirse la siembra con frecuencia por la escabrosidad del suelo, o porque están muy lejos del granero y se dificulta el cultivo adecuado. Para formar pastizales, se acomoda la variedad latifoliada y rastrera Empire, tipo Nueva York, mejor que las variedades europeas más altas y erectas.

Puesto que la extirpación de la hierba puede lograrse difícilmente a tiempo para una buena siembra en otoño, la primavera es la mejor estación para practicar la resiembra. En suelos con deficiente drenaje interno, y donde la erosión no es un peligro, todas las labores de cultivo y fertilización pueden completarse en el otoño, y la siembra efectuarse a principios de primavera cuando el suelo está esponjoso por la escarcha.

Una sembradora ciclón o de carretilla sirve bien para este objeto. La congelación y derretimiento alternados del suelo contribuyen a que se cubra bien la semilla. En los suelos con buen avenamiento se necesitan, antes de la siembra, una o más labores de cultivo, para romper la costra formada en el suelo en el invierno. La sembradora "culti-packer" o la de taladro para granos (que siembra por bandas) son los aperos más adecuados para este trabajo. Se recomienda la avena de primavera sembrada a razón de 0.87 Hl por Ha, y fertilizada con 135 kilos de abono 5-10-10 o su equivalente, como cosecha complementaria especialmente en tierras empinadas sujetas a la erosión. Es necesario remover esta avena a principios del verano, de preferencia por medio del pastoreo.

A menos que se lo cuide bien, un pastizal renovado volverá a su condición primitiva en pocos años. Deben cercarse los pastizales renovados y permitirse un ligero apacentamiento del ganado el primer año para dejar que se establezcan bien. Después de eso, el pastoreo rotativo, la fertilización anual con 445 Kg por Ha de abono 0-20-20 o su equivalente, y siegas periódicas para remover las malezas y hierbas de mal sabor para el ganado, contribuyen a dar máximos rendimientos. Los pastos bien atendidos no solamente rinden más, sino que la calidad o valor nutritivo del forraje se mejora, resultando una mayor producción del ganado. (Condensado de "Science for the Farmer").

El injerto de mangos y aguacates

por Mario Jalil R.*

Durante muchos años, el injerto de montura en mangos y el de escudete en aguacates, fueron los principales sistemas de multiplicación usados en la Escuela; luego las recomendaciones oportunas de S. John Lynch, Profesor de la Universidad de Miami, Florida, y de Bruce Ledin, Horticultor de la Estación Experimental de Homestead, Florida, nos iniciaron en el uso del injerto de "Veneer" o Enchapado, cuyo sistema, además de ser de fácil ejecución, ha dado excelentes resultados, los cuales han sido juzgados no sólo por su porcentaje alto de prendimiento, sino también por el rápido crecimiento y la perfecta unión del patrón y el huésped.

Tanto en mango como en aguacate, la altura a que debe injertarse dependerá del diámetro del patrón; sin embargo, al considerar el diámetro, se debe dar importancia a la altura a la que debe realizarse la operación, que es de 4 a 6 pulgadas.

Injerto del Mango. Para el caso del mango, el injerto puede ser hecho en patrones de media a una y media pulgada de diámetro, es decir, cuando ya tienen una zona de cambium definido y parte leñosa suficiente para mantener su rigidez. La apariencia de la corteza variará de un color rosado verdoso a un verde bien definido; más allá de este estado de maduración, la corteza presentará un color grisáceo. En cualquiera de estos estados, es factible realizar la operación con éxito. La púa (huésped) a usarse debe ser de una longitud de dos a tres pulgadas, con un diámetro de ⅜ a ½ pulgada, y con una yema terminal próxima a iniciar un nuevo crecimiento. Las hojas que van adheridas a la púa deben quitarse antes de hacer el injerto.

Una vez que el patrón y el huésped presenten las condiciones indicadas, debe empezarse por hacer el corte en el patrón, el que será más o menos de dos pulgadas de longitud y a una profundidad tal que no vaya a cortarse la parte leñosa del mismo, permitiendo únicamente separar la corteza de la madera; el pedazo de corteza será luego removido con un corte transversal hecho en forma de muesca que servirá a la vez para que la púa descanse sobre él como un punto de apoyo.

En la púa, el corte se hará en forma oblicua, empezando a corta distancia de la yema terminal y extendiéndose hasta el final de la púa; al lado opuesto del corte anterior, deberá hacerse un segundo corte en forma oblicua y de más o menos ⅜ de pulgada, a fin de permitir a la púa encajar adecuadamente en la muesca hecha en el patrón, de manera que la zona del cambium, tanto de la púa como del patrón, coincidan.

La operación final es el amarre, para el cual se está usando, con magníficos resultados, el material plástico conocido con el nombre de "Vinyl film" de un grosor de 0.0035 de pulgada. Al llevarse a cabo el amarre, sólo ¼ a ½ pulgada de la púa deberá dejarse al descubierto para facilitar el brote de la yema. Esto es muy importante.

Cuando la yema empieza a brotar, debe podarse una tercera parte del follaje del patrón para forzar la yema a crecer. Después de varias semanas, puede quitarse el amarre y el patrón cortarse gradualmente hasta llegar a la unión del injerto. Para evitar que el injerto se rompa en su punto de unión, se acostumbra usar tutores que también ayudan a darle dirección vertical, con el objeto de que cuando se haga el trasplante del árbol injertado, en su sitio definitivo, tenga la forma deseada.

Injerto del Aguacate. Al tratarse del aguacate, el injerto de enchapado se lleva a cabo lo mismo que el del mango.

El patrón estará listo para ser injertado cuando su diámetro, al igual que en el mango, alcance de ½ a 1½ pulgada.

La púa deberá tener yema terminal, próxima a romper en un nuevo crecimiento. En muchos casos, cuando no se dispone de suficiente material con yema terminal, se puede hacer uso de una yema lateral de la misma rama de donde se ha sacado la púa con yema terminal, debiendo tener en ambos casos la púa la longitud deseada, es decir, de dos a tres pulgadas. El amarre y la práctica que sigue al injerto serán iguales como en el caso del mango.

A) Púa lista para ser injertada en el patrón. B) Patrón con corte y muesca listo para recibir la púa. C) Patrón y púa en contacto. D) Patrón y púa amarrados en plástico. (Final del sistema de enchapado). (Dibujos del estudiante Fernando Salcedo) ■

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