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UNDERSTANDING CITRUS FRUIT GROWING

By
Dr. Murray Gaskins

Technical Reviewers
Dr. C. W. Campbell
William J. Wiltbank

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VITA
1600 Wilson Boulevard, Suite 500
Arlington, Virginia 22209 USA
Tel: 703/276-1800 . Fax: 703/243-1865

Internet: pr-info@vita.org

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PREFACE

This paper is one of a series published by Volunteers in Technical Assistance to provide an introduction to specific state-of-the-art technologies of interest to people in developing countries. The papers are intended to be used as guidelines to help people choose technologies that are suitable to their situations. They are not intended to provide construction or implementation details. People are urged to contact VITA or a similar organization for further information and technical assistance if they find that a particular technology seems to meet their needs.

The papers in the series were written, reviewed, and illustrated almost entirely by VITA Volunteer technical experts on a purely voluntary basis. Some 500 volunteers were involved in the production of the first 100 titles issued, contributing approximately 5,000 hours of their time. VITA staff included Leslie Gottschalk and Maria Giannuzzi as editors, Julie Berman handling typesetting and layout, and Margaret Crouch as project manager.

Dr. Murray Gaskins, the author of this paper, has been a VITA Volunteer for 10 years. He is an expert in crop physiology, tropical crops, and plant growth substances. Dr. Gaskins is a

plant physiologist with the U.S. Department of Agriculture in Gainesville, Florida, and has performed consultancies dealing with tropical crops for the USDA in Puerto Rico and various South American countries. The reviewers of the paper also have experience with tropical fruits. Dr. C.W. Campbell is a professor with the Tropical Research and Education Center of the University of Florida at Homestead. William J. Wiltbank is a professor with the Fruit Crops Department of the Institute of Food and Agricultural Sciences of the University of Florida at Gainesville.

VITA is a private, nonprofit organization that supports people working on technical problems in developing countries. VITA offers information and assistance aimed at helping individuals and groups to select and implement technologies appropriate to their situations. VITA maintains an international Inquiry Service, a specialized documentation center, and a computerized roster of volunteer technical consultants; manages long-term field projects; and publishes a variety of technical manuals and papers.

UNDERSTANDING CITRUS FRUIT GROWING

by VITA Volunteer Murray Gaskins

I. INTRODUCTION

Citrus fruits can be useful both as home-produced sources of very important nutrients, and as a valuable cash crop. Well-established trees grow satisfactorily in favorable environments even when given little care. However, in most environments young

trees die if neglected, and mature trees grow and produce well only when cultivated carefully. With proper management the trees grow and produce fruit indefinitely. Therefore, they should be treated as a lifetime investment deserving constant care.

APPLICATIONS

Citrus production on a small scale can be profitable for the small landowner, who may sell fruit in small quantities directly to neighboring consumers or in wholesale quantities to vendors who will resell to consumers. Initial investments made in plants, cultivating tools and labor will not be returned for several years, and the new fruit grower should be certain of the commitment to the enterprise before it is begun.

ORIGIN AND ADAPTATION

Citrus fruits originated in Asia and were dispersed early in small history. Cultivated forms are mentioned in records from many ancient cultures. The sweet orange is believed to have developed in southern China, but has been cultivated for centuries in many locations throughout the tropics and subtropics.

II. TECHNOLOGY

RESOURCES NEEDED

Horticultural production of citrus, perhaps combined with other fruit and vegetable crops, can be started on a land area of 1/2

hectare or less. Since the well-managed orchard becomes increasingly valuable as time passes, it is important to plan carefully at the beginning for possible expansion and improvement. In many areas security of the planting is important. Theft of fruit often is a very serious problem, and may be impossible to prevent if trees are planted in isolated places.

Source: J. Soule and F. P. Lawrence, How to Grow Your Own Citrus Trees, Circular 339 (Gainesville, Florida: Florida Cooperative Extension Service, University of Florida, 1973), p. 1.

LABOR NEEDED

Effective management of a small citrus planting, one hectare or less in size, may require a weekly average labor input of 5-15 hours, depending on skill of the people involved, availability of labor-saving equipment, terrain, and local pest problems. Often a small family can provide all the labor required. It is important to recognize, however, that the labor requirements depend on the season, and are concentrated in the summer rainy season.

COSTS AND RETURNS

Usually small horticultural efforts are best seen as family enterprises to which all can contribute and from which all can benefit. It is often not necessary to hire outside labor. Nevertheless, the cash investment is substantial before fruit trees become self-supporting. Major costs aside from the land include

cost of the trees and costs of fertilizer and pest control equipment and supplies. It is sometimes possible to grow vegetables or other crops by interplanting among the small trees, and generate income that will offset the cost of establishing the fruit tree planting. Actual costs and returns will vary significantly among locations, and can best be estimated by analyzing data collected locally. It is possible in some countries to obtain help in planning small farming businesses from the Ministry of Agriculture and from firms which sell fertilizers and other agricultural supplies. All available sources of information and assistance such as these should be located and used well in advance of actually beginning the work of planting fruit trees.

MAINTENANCE REQUIREMENTS

Citrus plants grow reasonably well in a variety of soils and weather conditions. Their limited ability to withstand subfreezing temperatures is well known. Very wet soils, dense shade, high winds and extreme drought also are particularly detrimental. However, the widespread occurrence of healthy citrus trees throughout much of the tropics and subtropics shows clearly that they are more flexible in adaptation than are many other fruit bearing species.

Climate

Citrus trees are best adapted to subtropical climates with clearly defined cool-dry and warm-wet seasons. The centers of commercial cultivation are found in such regions. However, tropical

areas can be satisfactory if proper types of fruit trees are selected. Most oranges and mandarins are suited only to altitudes well above sea level. Lemons, limes, grapefruit, and pomelos, on the other hand, can be grown satisfactorily in low-elevation moist tropical areas.

Tolerance of temperature extremes is affected by weather conditions preceding exposure. Dormant plants, "hardened" from exposure to cool, dry, winter weather conditions become capable of withstanding low temperatures which would kill or severely injure them if they were actively growing. Dormant orange trees (Citrus sinensis) often withstand freezing temperatures of about -4[degrees]C without injury. Areas where winter temperatures fall below this point should be considered marginal for growing oranges. Lime trees (C. aurantium) are considerably less hardy than oranges and may be injured by temperatures little below the freezing point. The lemon (C. limon) is intermediate in cold hardiness. Some of the tangerines withstand low temperatures better than oranges. In all cases, plants are better able to withstand temperature extremes, whether high or low, when they have been conditioned or hardened by weather that temporarily suppresses growth.

Citrus trees withstand high temperatures quite well if they are not deprived of water. However, high temperatures, particularly if accompanied by dry winds, increase water requirements. In locations where summers are very hot and dry, cultivation is practical only if the trees can be irrigated.

Soils

Citrus trees grow well in a variety of soils. They are not adapted to extremely wet soils, and should not be planted in areas where water accumulates on the surface. Heavy clay soils are not ideal, but may be acceptable if well drained. Many of the heavier soils of the tropics shrink and crack as they lose water in the dry season, and the cracks may injure tree roots. Such injury can be avoided if sufficient water is available to keep the soil moist throughout the dry season.

Sandy soils are satisfactory, provided trees are able to obtain sufficient water. Because small trees often suffer from lack of water in sandy soils, they may require irrigation. Mature trees develop deep root systems and, if properly fertilized, usually grow well in sandy soils without irrigation except where rainfall is very low or irregular.

CITRUS VARIETIES

Sweet oranges (e.g., Valencia, Pineapple, Navel), lemons, and

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Figure 1. Young Orange Tree

limes may be most suitable for cultivation because they are well known in most places. Locally named varieties of these are found in many markets and are readily recognized and accepted by consumers. It is generally best to study carefully the local varieties, and to use similar ones in new plantings. Unusual varieties which may be worth planting for home use, may be difficult to sell.

The performance of a new planting can be predicted with some assurance if propagated from local trees which perform well.

Often an experiment station or nursery can be found which can supply locally adapted varieties ready for planting. When this is not the case, trees can be propagated as described below.

PROPAGATION

Citrus fruit trees can be grown to maturity from seeds but such plants have several disadvantages. They are extremely slow to commence fruit production, they have an undesirable growth habit, and in some instances they produce fruits highly variable in quality and other characteristics. These and other disadvantages are avoided by use of "vegetatively" propagated plants. Such plants are produced by "budding" or "grafting" vegetative material (the scion) from a desirable variety to a suitable rootstock. The latter is a plant grown from a seed and is usually one to two years old when used for budding.

Figure 2. Collecting Branches Suitable for Budding

ucf2x5.gif (600x600)

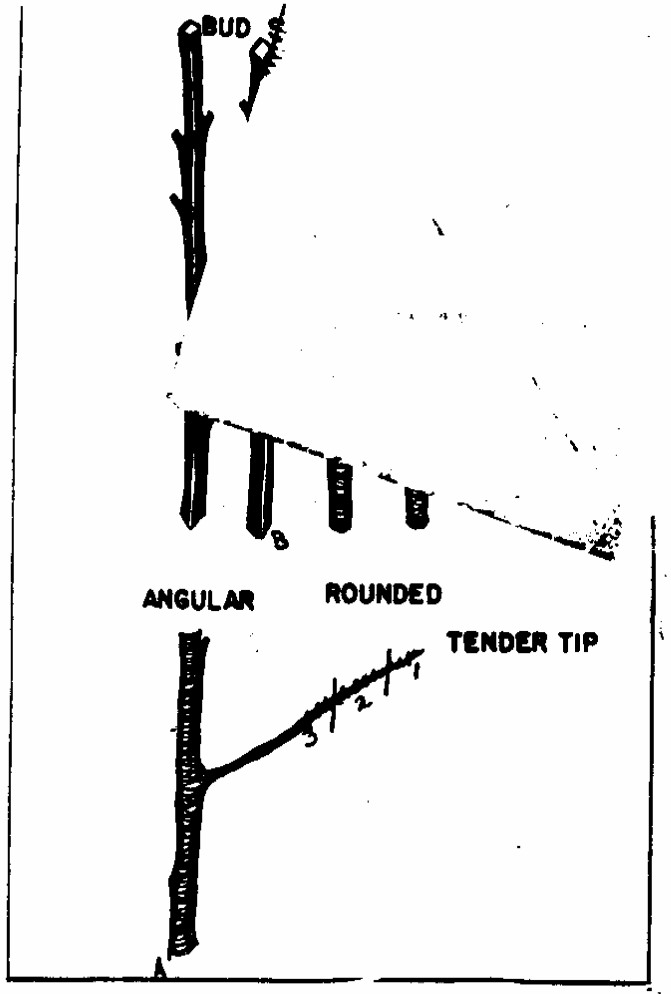

Figure 2. Collecting Branches Suitable for Budding

A. Wood of the second flush from the end of the branch is suitable for budding.

B. Budwood should be rounded with plump buds (right), not angular (left); leaves are trimmed to 1 centimeter stubs as budwood is cut from the tree.

Source: J. Soule and F.P. Lawrence, How To Grow Your Own Citrus Trees, Circular 339 (Gainesville, Florida: Florida Cooperative Extension Service, University of Florida, 1973), p. 5.

Another easy method of propagating citrus trees is by shield budding, in which the stock incision is made in the form of the letter "T." This operation is shown in Figure 3.

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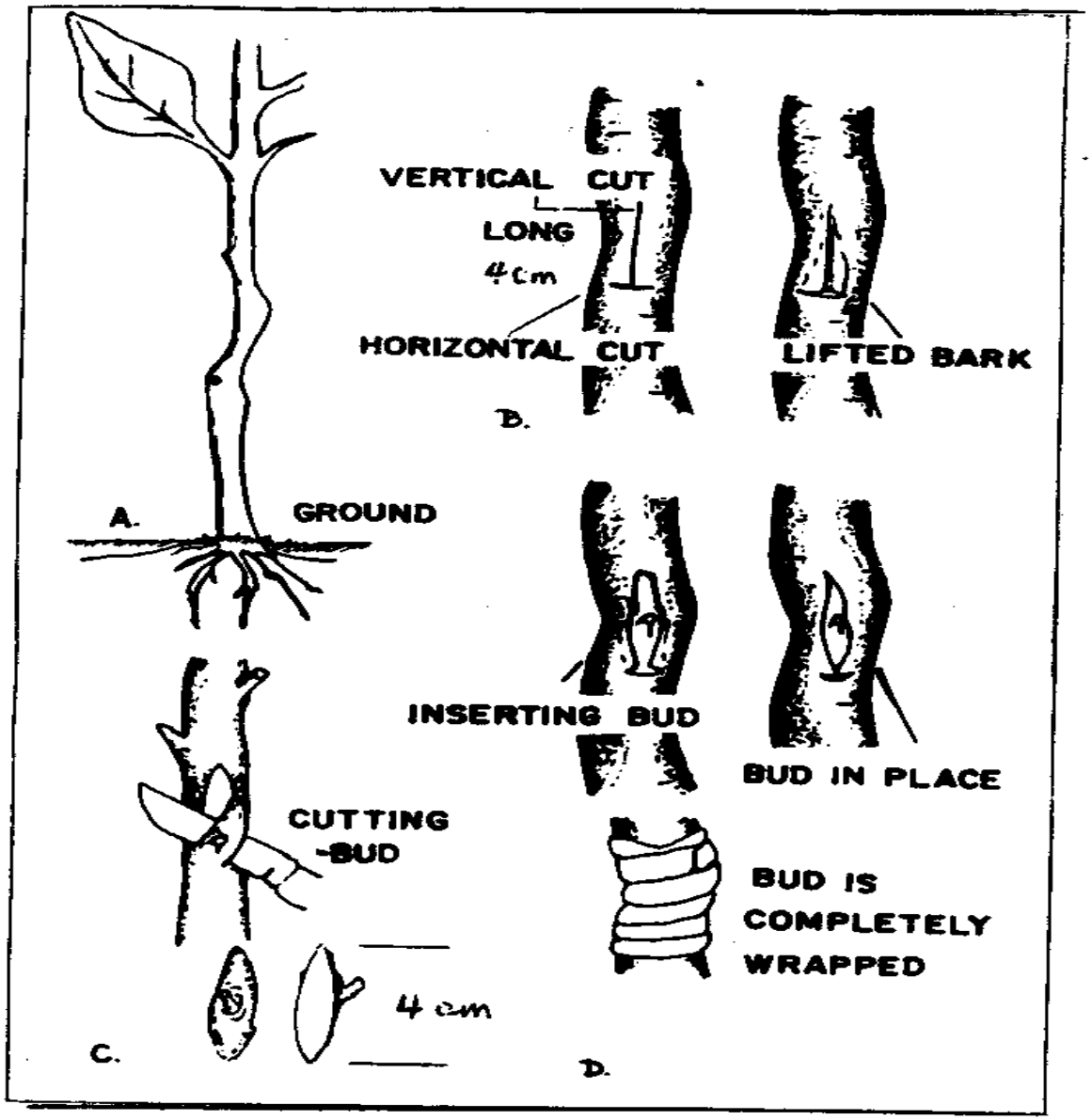

Figure 3. Steps in Shield Budding

Figure 3. Steps in Shield Budding

A. The stock is cleaned and trimmed-up to provide working room.
B. The incision is made on the stock and the bark flaps pried up.
C. The shield or bud is cut from the budwood. (Note that the underside is flat and the sliver of wood is left in place.
D. The shield is inserted and wrapped securely.

Source: J. Soule and F.P. Lawrence, How to Grow Your Own Citrus Trees, Circular 339 (Gainesville, Florida: Florida Cooperative Extension Service, University of Florida, 1973), p. 6.

Figure 4. Methods of Forcing a Bud to Sprout

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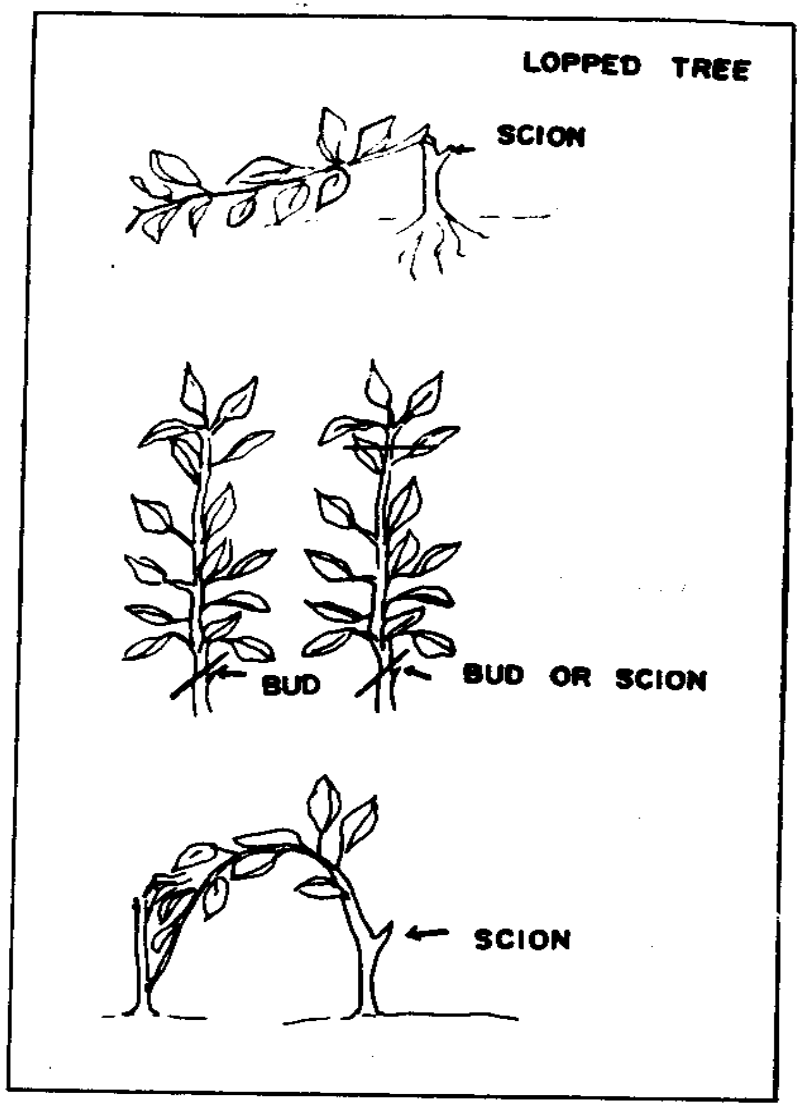

Figure 4. Methods of Forcing a Bud to Sprout

A. Lopping--The stock is cut part-way through and the top laid over.

B. Topping--The stock top is removed in one operation (left) or two (right).
C. Bending--the stock top is bent over and tied down.
(Note that the scion must be inserted much higher than is usual practice in Florida.

Source: J. Soule and F. P. Lawrence, How to Grow Your Own Citrus Trees, Circular 339 (Gainesville, Florida: Florida Cooperative Extension Service, University of Florida, 1973), p. 8.

Figure 5. Developing the Framework

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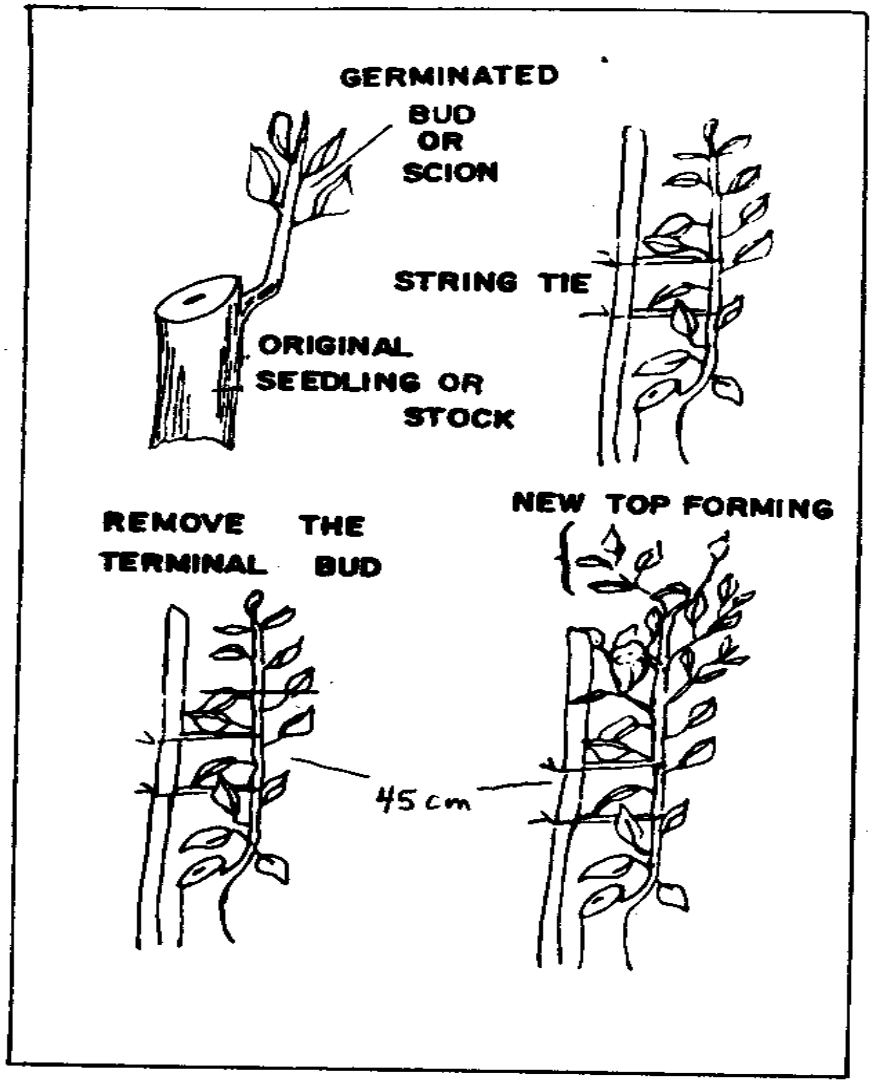

Figure 5. Developing the Framework

A. The stock is cut on a slant just above the scion.
B. The young tree is staked and tied with soft twine at

intervals of 15 to 45 centimeters.
C. The tree is headed at a height of 45 centimeters.
D. Four to six well-spaced branches are allowed to grow; all sprouts below these are removed as they appear.

Source: J. Soule and F.P. Lawrence, How to Grow Your Own Citrus Trees, Circular 339 (Gainesville, Florida: Florida Cooperative Extension Service, University of Florida, 1973), p. 9.

Success or failure in cultivation of fruit crops often depends on use of suitable rootstocks, because these determine the adaptation of the mature plants to different soils, their tolerance of certain diseases, and many other important characteristics. It is likely that if various rootstock plants are available, expert local advice about their selection may be available also. It is important to make use of local knowledge about matters such as this because it is difficult and expensive to correct mistakes after trees have been planted.

The varieties known as sour orange (C. aurantium), rough lemon (C. jambhiri), and Cleopatra orange (C. reshni) probably have been most used in the past. Each has its peculiar advantages and certain weaknesses. It is likely that if various rootstock plants are available, expert local advice about their use will be available also. This should be sought and used, since proper selection of a rootstock requires knowledge of local conditions.

The scion to be propagated should be known to grow and fruit well

locally. If fruit is to be sold local consumer preferences should be considered. Where citrus production is commercially important, great care is exercised to develop and maintain disease-free plants from which new trees can be propagated. Several virus diseases attack citrus, and when present in the scion these persist in the new plant. In the absence of propagating material known to be free of such diseases, the best procedure is to select scion material from mature trees which have grown well and fruited regularly for several years, and which show no deformed, mottled or small leaves, dead limbs, bark abnormalities, or other disease symptoms.

PLANTING

Citrus trees are usually grown in the nursery for one year after budding, and then transplanted to their permanent location. In the tropics trees are usually transplanted at the beginning of the rainy season. If they are given good care trees can be transplanted at any time, but trees moved at the beginning of the growing season, as summer rains begin, have a distinct advantage over those moved during the dry season or late in the rainy season after they have begun growth. Trees are usually planted at six to eight meter intervals in rows spaced eight to ten meters apart. Local customs vary considerably for a variety of reasons. Frequently annual crops or other tree crops such as coffee are grown among the immature citrus trees. This is advantageous for the farmer, and need not interfere appreciably with growth of the citrus trees if they are managed carefully. Intercropping increases efficiency of land use, and helps to defray costs of

bringing a citrus planting into production. It is important to promote growth of the young trees, however, and to avoid their neglect as other crops are cultivated.

In heavy and poorly drained soils where surface water may accumulate citrus trees may be planted so that they are elevated 5 to 10 centimeters above the surrounding area. On hillsides and on all well drained soils where flooding does not occur, the trees are planted so that in the field they will be at the same level as in the nursery row from which they were moved. Except in arid climates, the planting sites should not be excavated to form depressions. for the purpose of retaining water around the young trees. While it is desirable in some instances to maintain a basin around newly transplanted trees, so that irrigation water will be used efficiently, this should be done after the tree is planted as described above, by throwing up around the tree a low ring of soil to form a circle one to two meters in diameter.

FERTILIZING YOUNG TREES

Fertilizer recommendations should be obtained if possible from nearby experiment stations. These can serve as guides to indicate ratios of major nutrient elements, and help to avoid excessive use of those not needed. The mineral requirements of citrus trees are not unusual, and locally recommended fertilization schedules which support good growth of other evergreen plants can be used with confidence.

The fertilizer applied to commercially grown citrus trees on the deep sand soils of Florida in their first year after transplanting, would be equivalent to about 2 kilograms per tree of a 6-6-6 formula (N-[P.sub.2] [O.sub.5]-[K.sub.2] O). In the second year this would be increased to 4-5 kilograms per tree and in the third to 8-12 kilograms.

In all cases these quantities would be divided among four or-five applications. These high rates of fertilization are economically practical in Florida but would not be in many circumstances. At the opposite extreme, plantings are sometimes established without use of any mineral fertilizer. The most satisfactory approach to fertilization will be established by local conditions which determine availability, cost, response of the plants, and market demand for the fruit.

FERTILIZING FRUIT-BEARING TREES

It is common in commercial citrus production to regulate fertilization rates of mature trees in accordance with their estimated or actual fruit producing capability. This may not be known when citrus is a new or relatively unproven crop. In most instances, useful information can be obtained from local experiment stations. As noted above, when such information is not available, recommendations pertaining to other evergreen tree crops may be used as a general guide.

It is particularly important to determine soil characteristics

that affect the ability of plants to absorb needed mineral elements. Soils vary widely not only in content of various minerals but also in acidity, organic matter content, water holding capacity and other characteristics which affect nutrient absorption. The availability of certain minerals which may be used only in minute quantities may profoundly affect plant growth. A large, heavily bearing citrus tree may actually need in a year only a few grams of iron, the amount present in a small nail, but if this quantity is not absorbed, its growth will be severely impaired. This often occurs in the case of trees growing in alkaline (high pH) soils. Where trees are unable to obtain certain mineral elements from the soil, it becomes necessary to supply these by spraying the trees with solutions containing the needed minerals. In regions where this is necessary, local experiment stations usually can give advice about preparation and use of such sprays.

Nitrogen is the mineral element required in greatest quantity. The actual amount of elemental nitrogen (N) contained in 100 kilograms of citrus fruit is less than 500 grams, but trees growing in poor soil and producing this quantity of fruit might require 1 kilogram or more of N (about 5 kilograms of ammonium nitrate), applied as fertilizer each season. Other mineral elements are required in smaller quantities, but are of equal importance. It is wasteful and often entirely useless to apply fertilizers without knowledge of the local soil properties and plant performance. In many parts of the tropics liberal use of phosphate fertilizers is necessary to maintain satisfactory plant growth. Plants actually use only small quantities of phosphorus,

but their ability to extract it from some soils is limited and for this reason fertilizers containing large amounts of phosphorus-bearing minerals must be used.

PEST CONTROL

Citrus plants are attacked by a variety of insects and disease organisms. Aphids, mites, and scales are usually the most injurious insect pests. In some localities fungus diseases such as scab and melanose injure leaves and fruit of certain varieties. Fruit flies destroy enormous amounts of fruit. In the tropics, fruit-piercing moths and leaf-cutting ants can be very destructive. Pink disease and greasy spot are important diseases in both tropical and subtropical areas. Spray treatments can be used to control these and other disease and insect problems. Some of the spray materials are very dangerous to humans if used improperly, and it is imperative that these materials be used with great care, Guidelines provided by responsible local officials should be strictly observed.

Citrus plants that are well adapted to local conditions may produce fruit regularly without protection from pests. It may not be practical or necessary in all circumstances to maintain a pest control spray program. Usually when production is attempted on a commercial scale some control measures are well justified by the improvement in quality and quantity of marketable fruit produced. The full productive capability of carefully cultivated trees will not be achieved if pest control measures are neglected. Similarly, a good pest control program will not be highly

beneficial if other management elements are neglected.

HARVESTING AND MARKETING

It is often possible for a grower to establish and maintain a reputation for fruit of superior quality, for which buyers will readily pay premium prices. The additional costs of production resulting from pest control and other management efforts then may be offset not only by higher yields but by higher prices as well. The producer willing to invest the capital and personal effort required to produce high quality fruit should recognize and attempt to exploit this possibility. In many localities, seedling orange trees produce fruit which finds its way into the markets at very low prices for an extended period of time. It is important for the grower to select varieties which produce mature fruit while the market is not saturated with fruit of inferior quality from local seedling trees.

III. DESIGNING THE SYSTEM RIGHT FOR YOU

SCALE

Most of this discussion has assumed establishment of a small planting largely by an individual or a single family. Some experience with a small planting will yield answers to many questions which cannot be resolved fully in advance. Among such questions, that of optimum size is important. Some cost reduction is associated with larger scale, but a greater risk of failure may be present as well. The transition from a family

effort to one requiring frequent use of hired labor may radically change capital requirements. Such issues should be analyzed carefully in determining appropriate size.

PROBLEMS TO CONSIDER

The questions which follow will help identify problems which may arise, and which should be given careful thought in advance.

1. Is the land available of suitable quality for a citrus planting?

2. Will erosion control be difficult if fruit trees are planted?

3. Are the fertility characteristics of the soil sufficiently known?

4. Can a suitable fertilizer regime be relied upon to supply all mineral requirements of the plants?

5. Will the trees require irrigation?

6. If so, is sufficient water available for this purpose at reasonable cost?

7. Is the terrain suited for growing trees with irrigation?

8. Is sufficient capital available to purchase needed

equipment and supplies?

9. Is the owner able to invest the necessary management effort to make the venture a success?

10. Have supply sources been found for plants, fertilizers, pest control chemicals and other needed supplies?

11. Has information been assembled about available varieties, and has a decision been made about which to plant?

12. If plants must be propagated, has a suitable source of rootstock seeds and scion budwood been found?

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