METHODS OF PROPAGATING THE ORANGE AND OTHER CITRUS FRUITS.

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GENERAL REMARKS.

The methods used in propagating citrus trees do not materially differ from those used in the propagation of other fruit trees. However, there are certain differences with which the prospective grower of citrus trees should be familiar, and it is therefore the intention of the writer to briefly describe the principal methods employed by citrus nurserymen and growers in Florida as a guide for those not already familiar with the industry.

One of the most difficult questions the prospective orange grower must decide is whether to use seedling or budded trees. Such conflicting opinions exist among orange growers in Florida regarding this question that to decide the best policy is confusing and somewhat difficult. The pros and cons of the question, however, can not be discussed here. Suffice it to say that the general tendency of intelligent and progressive growers is to use only trees budded with thoroughly tested and approved varieties. Practically all the advance that has been made in improving citrus fruits by propagating from selected seedlings, hybrids, sports, etc., which produce superior or peculiar fruits, depends entirely upon propagation by budding and grafting, as the characteristic features are commonly lost by seed propagation. However, many continue to use seedling trees, and there will probably always be some used.

SEEDLING TREES.

When seedling trees are to be used, the selection of seed becomes an important feature. Any and every orange seed should not be used. On the contrary, the greatest care should be exercised in selection. It is not an uncommon report that seeds of sweet oranges frequently produce sour oranges, and vice versa, but this is probably never true unless the seeds are the result of hybridization. It is well recognized by growers in Florida, California, and Italy that when seeds of a sweet orange are planted, trees bearing sweet fruit, of a fairly good character, almost invariably result. Orange trees, however, are generally grown in close proximity to lemons, limes, sour
oranges, pomelos, etc., and it is not to be wondered at if hybridization occasionally occurs. When hybridized with the sour orange, lemon, etc., the resulting seedlings may naturally be expected to produce sour, unmarketable fruit, or fruit with rough and unsightly skin. While seedlings of the sweet orange almost invariably produce sweet fruit similar to that produced by the parent, there is nevertheless considerable variation wholly aside from that resulting from crossing and hybridizing. This uncertainty as to fruits, especially the finer sorts, reproducing themselves true to seed is what renders budding and grafting desirable in the orange as in other fruit industries.

Where sweet seedlings, or in fact any kind of seedlings, are to be grown, the seeds should be taken from selected seedling trees known to produce good fruit and which are isolated from citrus trees of other varieties or species. Such selection would prevent the probability of obtaining seeds affected by crossing or hybridizing with other varieties, and make it reasonably sure that seedling trees producing good fruit would be obtained. Pomelos, lemons, limes, citrons, kumquats, and the various other species of citrus fruits are almost invariably produced true by the seed, as in the case of the orange, that is, pomelos produce pomelos, lemons produce lemons, etc. Like other fruit trees, however, the different varieties of the fruits named do not reproduce themselves true from the seed. Seedling pomelo, or grape-fruit, trees are quite common in Florida. The varieties, however, have not been so much improved as in the case of the orange, and as yet there is but little difference between the fruit of seedlings and that of the best named varieties. The principal varieties or subspecies of mandarin oranges cultivated in Florida, known as the China (commonly called Mandarin), Tangerine, King, and Satsuma, are not infrequently propagated by the seed, and with but slight variation they commonly reproduce true to the parent variety. However, they seldom average equal in flavor to the selected varieties, which must be budded, as they are not reproduced true by the seed. Seedlings of the China are said to show a tendency to form an elongation of the rind at the stem, which makes them awkward to pack. In all cases where seedlings are to be used the greatest care should be exercised to select seed from isolated trees known to uniformly produce good fruit.

THE SEED BED.

The seeds used for planting should in all cases be selected from fully grown, normal fruit taken from vigorous, healthy trees. In this case, as in others, it is important that the seed should be good in order to secure vigorous seedlings. The method of extracting the seeds from the fruit most commonly followed by nurserymen and those planting on an extensive scale is to cut the orange in half and squeeze the
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Seeds out into a receptacle. Sometimes the entire fruits are thrown into barrels and allowed to decay, after which the seeds are separated by washing in a coarse sieve, which allows the pulp to pass through. The seeds should be planted immediately, before they have had time to dry, but if this can not be done they may be preserved moist and in good condition for some time by packing in damp earth. If seeds dry out from necessity or by accident, the great majority of them can be induced to germinate by soaking in water for several days previous to planting.

Many different plans are followed in arranging the seed bed. If only a few seedlings are to be grown, the seeds may be planted in boxes about 8 inches or 1 foot deep and of any convenient size. The soil should be kept moist, but not wet. Mulching the soil with moss (the common Florida long moss) until the plants appear is said by some to be beneficial. If many seedlings are to be grown, it will probably be necessary to plant them in the open ground. In such cases the seeds are commonly sown in beds from 3 to 4 feet wide and about 2 feet apart. Sufficient room must be left between the beds so that the seedlings may be easily cultivated. The seeds are spread broadcast or are sown in drills, 1 or 2 inches being left between each seed. They are then covered with soil to a depth of about 1 inch. Some sow the seeds from one-half to 1 inch apart in rows about 1 foot apart.

After planting, the seed bed must be either mulched or covered with a shelter of some kind to protect the young seedlings from the sun when they first appear. The cover may be made of brush supported by a suitable frame, or of some thin cloth, like cheese cloth or burlap, such as is used in making fertilizer sacks. The practice of protecting the bed with some such cover is more commonly followed than mulching, and is apparently the preferable method. January is probably the best month for planting, although any time will do if care is taken to keep the seeds moist. If planted late in the spring, the dry season in April and May comes before they are thoroughly rooted and is liable to seriously injure them, so that watering may be required. Seeds planted in boxes usually appear in from ten to twenty days, but when planted in open beds they do not appear for about six weeks, although less time may elapse if the beds are artificially watered. The success of the seed bed depends very largely upon cultivation and fertilization.

Previous to planting, the soil should be fertilized with some non-heating manure, such as well-rotted stable manure or some of the commercial manures for vegetables. Heating manures, like blood and bone or cotton-seed meal, should be avoided, as they are liable to injure the young seedlings. The soil should be fertilized a second time when the plants are from 4 to 5 inches in height, and probably again a third time before they are removed to the nursery. Cultivation should be very thorough, as in the case of vegetables, no weeds being allowed to grow.
The seedlings may be left in the seed bed for a year or more, until they are about the size of a lead pencil at the collar and from 12 to 14 inches in height. Probably the best time to transplant to the nursery is in December or January, when the plants are thoroughly dormant. Usually transplanting can be done with safety at any time during the rainy season, but even then it is necessary that the soil should be thoroughly wetted, either naturally or artificially, several times shortly after planting, if the seedlings are to succeed well.

In digging the seedlings, carefully thrust a spade down perpendicularly near the plants and work it back and forth until the soil is loosened from the roots, after which the plants may be lifted out without injury. The roots and tops are then pruned preparatory to planting, the tap-root being cut off to about 8 or 10 inches in length and the tops pruned back a corresponding distance. A number of the seedlings may be taken in the hand and the roots and tops cut off with an ax to the desired length. As the seedlings are removed from the bed the roots should be placed in water or wrapped in damp moss or cloth to prevent them from drying out while they are being transferred to the nursery and planted. All small or weak seedlings should be discarded.

THE USE OF CUTTINGS.

Lemons, citrons, and limes are sometimes propagated by cuttings. Oranges and pomelos may also be propagated in this way, but as they do not root readily this method is seldom used with these fruits. As in other cases, the cuttings are taken from young wood, the twigs being cut into sections from 4 to 6 inches in length, and usually with a portion of one or two leaves remaining attached to the upper end. The base of the cutting is prepared by a smooth, slanting cut made with a sharp knife (a smoothly cut surface forms roots much more readily than a roughly cut surface in which the tissue is injured). Cuttings thus prepared may be planted in any convenient-sized box filled with sand. The basal end of the cutting is inserted in the soil, leaving about 1 inch of the upper end exposed. Wherever bottom heat can be secured, rooting is greatly facilitated. When the cuttings have sprouted and have attained a height of 8 inches to 1 foot, they may be transplanted to the nursery, as in the case of seedlings.

THE NURSERY.

The citrus nursery should be on well-drained soil and in a locality as thoroughly protected from frost as possible. Young trees are much more easily affected by frost than old ones. Wherever possible it is advantageous to have the nursery located on the south side of a considerable body of water, which serves to warm the atmosphere. The land should be thoroughly cultivated and all rubbish removed. The trees are usually planted in rows from 4 to 5 feet apart. The
tendency of nurserymen is to put the rows a considerable distance apart to facilitate budding and cultivation. The seedlings are planted from 14 to 15 inches apart in the rows. As it is much easier to cultivate straight rows than crooked ones, considerable care should be exercised in laying out the nursery (fig. 126). During the process of planting, the seedlings should be kept with their roots in water or wrapped in wet cloth to protect them against drying out. The holes in which the seedlings are to be planted are commonly made by thrusting a spade into the ground and pressing it back and forth until the soil is sufficiently spread. The seedling may then be put in place and the soil pressed firmly around it. The holes in which to set the seedlings may also be made by pressing a nurseryman’s dibble into the soil and crowding it back and forth until a space of the desired size is made. The roots may then be spread out and the soil pressed firmly around them. In planting great care should be exercised to get the soil packed firmly around the base of the root and not simply around the collar.

Wherever convenient, it is desirable to use water in planting. The soil must always be moist when seedlings are transplanted, and therefore transplanting should be done soon after a heavy rain, or else the ground should be artificially watered. This is very desirable, not only for the benefit to the plants, but if the soil is dry it is difficult to keep the holes open properly and prevent the dry, hot sand from falling in around the roots. Cuttings are transplanted in the same way as seedlings.
In the nursery, as in the seed bed, thorough cultivation and heavy fertilization insure success. In fertilizing, chemical manures especially prepared for vegetables should be used. About 2,000 pounds per acre of such fertilizer should be given annually in two or three applications. If two applications are to be made, one in February and one in July will probably give the best results. In case of three applications, February, June, and August will prove satisfactory periods.

The trees are allowed to remain in the nursery about two years before transplanting into the grove. The second spring after planting in the nursery they have usually attained sufficient size for budding. If it is intended to bud them, they should all be budded at this time, as it is desirable to insert the buds as soon as the trees have attained sufficient size, in order to throw all growth into the bud. If they are budded in the spring, the buds will have reached sufficient size by fall for the trees to be transplanted into the grove or put on the market, as may be preferred.

STOCKS.

The kind of stock used for budding has considerable influence on the health, vigor, and productiveness of the tree. As some stocks will not do well on certain soils and some varieties grow well only on certain stocks, it is desirable that the stock used for planting any given tract be carefully considered. The orange and pomelo, or grape fruit, are commonly budded on sweet-orange, sour-orange, lemon, or pomelo stock. If planting is to be done on rich, moist lowlands (low hammocks and flat woods) which are subject to foot rot, or mal-di-gomma, stock which is immune from this disease should be used. Sour-orange stock is the most resistant variety that has been found and usually gives the best results. Pomelo, or grape-fruit, stock is also quite resistant and is probably the best stock in foot-rot regions where the soil is droughty at certain seasons of the year. It is a more vigorous grower than the sour-orange and resists drought better. Foot rot is common also on some flat woods and high pine-land soils which are dry and well drained, and in such localities the pomelo is probably the best stock for general use.

In the case of high and dry lands not much subject to foot rot, sweet orange, lemon, and pomelo are probably the best stocks. On dry lands, sour stock, although much used, does not always give satisfaction. Lemon stock, particularly the Florida rough lemon, is a very excellent stock for dry, sterile lands, as it is a very vigorous grower, doing fairly well in soil where the sweet-orange would perish. It is so easily injured by cold, however, that it is safe only in southern localities. Pomelo is also a more vigorous grower than sweet orange and is probably a better stock for dry lands, but it is more tender and should be budded near the ground or its use limited to southern regions. In regions where foot rot is prevalent, sweet-orange stock and lemon stock
should never be used, as they are particularly subject to this disease. The lime, which is a very vigorous-growing stock, similar to the lemon, is used to some extent in southern Florida as a stock for the orange, and is said to be excellent for barren scrub land and rocky locations. The hardy trifoliate orange is used to a limited extent as a stock for the orange, but has not always given thoroughly satisfactory results.

Tangerine and China (Mandarin) do well on any of the stocks used for the common sweet orange, but as the grower usually desires to increase the size of these varieties it is probably preferable to bud them on rough-lemon stock. The Satsuma, which is a hardy variety, is very extensively budded on the hardy trifoliate orange, on which it is said to do well. It also gives good results on sweet-orange, which is probably the best stock to use in southern locations, but does not do well on sour-orange stock. Lemons are usually budded on rough-lemon, sour-orange, or sweet-orange stock, the rough-lemon being considered the most desirable, as it is the most vigorous grower. In places where foot rot abounds, sour-orange stock should be used.

In selecting stocks it is also important that the latitude and local climate be carefully considered. The various citrus species used as stocks for grafting or budding vary greatly in their resistance to cold. The following is a list of stocks commonly or sometimes used, and is arranged in order of hardiness, the hardiest being placed first: Trifoliate orange, sour-orange, bitter-sweet orange, sweet-orange, pomelo, rough-lemon (or lemon), lime, and citron. In localities where there is danger of severe freezes, no matter what stock is used, the point of union should be placed near or below the surface of the soil, so that the buds may be saved in case of freezes.

In regard to the effect of stock on the character of the fruit, it may be said that while some growers claim to have observed that the fruit is rendered coarser and thicker skinned by budding on vigorous, rapidly growing stocks, like the pomelo and the lemon, yet it is certain that the difference is very slight and in most cases hardly perceptible. In this connection all that needs to be considered is that stocks of this nature tend to produce rather larger fruits. While in some varieties this character is a disadvantage, it is, on the other hand, an advantage to have a vigorous stock, as in certain varieties this is necessary to insure fruitfulness. The varieties of the Navel orange are unfruitful on sweet or sour stock, but usually they are normally prolific if budded on rough-lemon.

**BUDDING.**

**WHEN TO BUD.**

The trees in the nursery should be budded when they have attained a size of from one-half to one inch in diameter. If the trees are grown for sale it is probably best to wait until they are three-fourths to one inch in diameter before budding. If the young trees
are grown for planting, it may be desirable to bud them rather sooner, in order to put them as soon as possible in their permanent places in the grove. If a tree is transplanted when still small, the greater portion of the roots and top is saved, and the shock in transplanting is therefore less. Budding can be done only when the tree is in a growing condition, so that the bark slips and separates easily from the wood. It is usually preferable to bud as early in the spring as possible. The nursery is commonly budded during March and April. It may be gone over again in May and those stocks which failed the first time rebudded. Budding may be done at any time during the summer, unless the trees are checked in growth by a severe drought, but it is usually not best to bud later than the first of July, as sufficient time should remain for the bud to push and mature the wood of the first growth before winter. If the budding can not be done by the time named, it is probably best to wait and put in dormant buds in October or November.

**SELECTION OF BUDS.**

Bud wood should always be selected from fairly well-matured wood of the current year’s growth. Round sticks (or as nearly round as possible) should be selected. The young growth of orange wood is at first angular, becoming rounder as the twig matures. The basal portions of the young branches, which are nearly or quite round (fig. 127, a), supply the best buds, with the exception of the first two or three, which are usually somewhat imperfect and should be discarded. Where it is difficult to secure well-rounded wood, angular wood which is not too soft (fig. 127, b) may be used. This, however, is not quite so satisfactory. Thorny bud wood should never be used when other wood can be obtained. Thorny trees are very undesirable, and a careful selection of thornless bud wood will soon result in thornless trees. The thorns have been bred out of many of the best citrus varieties, and if nurserymen would exercise proper care all the desirable varieties could soon be rendered thornless.

The bud wood should be cut while the wood is dormant, before the buds show any signs of pushing. That desired for spring budding should be cut the latter part of January. It is well to leave the wood on the tree as long as possible, and therefore the trees should be carefully observed during this period. When the first buds are observed to be swelling, all the bud wood desired should be cut immediately. After cutting, the leaves should be pruned off and the twigs cut into sections of the desired length. To preserve the bud wood until needed, the twigs should be tied up in convenient-sized
bundles, carefully labeled, and packed in old sawdust in a box of suitable size. The box should then be closed and buried in sheltered ground several inches below the surface. In this way bud wood can be preserved in good condition for from two to three months. Dampened sphagnum, or peat moss, may be used instead of sawdust, but in this case considerable care must be exercised to get the moss properly dried. It must be moist, but not wet, for if too wet the bud wood may mold. The same caution applies also to sawdust. In this case, the proper degree of moisture can be secured by taking the material from the interior of an old pile. Sawdust does not lose its moisture readily and is the best material for packing. Some simply bury the bud wood in the soil under shelter, digging down until the moist earth is reached.

MATERIALS.

Before beginning the operation of budding, material should be provided for wrapping the buds. For this purpose cotton cord, yarn, strips of waxed cloth, etc., are used. The last named has practically superseded all others in Florida, being more convenient and giving better results than any other wrapping material. The strips are made from strong muslin or calico. Before the cloth is torn into strips, it is folded into convenient size and dipped into a hot solution of wax made by melting together two parts of beeswax and one part of resin. Several formulas for making this wax are used, any one of which will probably answer. The method described is known from personal experience and observation to give good results. After saturating the cloth with the hot wax, all the superfluous wax should be removed before the cloth cools. To accomplish this quickly hang the piece of cloth, folded in convenient form before waxing, over a small, strong stick (fig. 128, a), which is held by an assistant. Then take two similar sticks of wood and holding them parallel on either side of the cloth (fig. 128, b), press them firmly together and pull downward, squeezing out the superfluous hot wax. The cloth should then be spread out until cool, after which it is ready to be torn into strips of the desired size, that is, one-fourth to one-half inch wide and from 10 to 12 inches long. The cloth may be torn into strips before it is taken into the field, or it may simply be torn into convenient-sized pieces and afterwards torn into strips in the field as desired for use. The latter is probably the most convenient way. Using waxed cloth for wrapping effectually excludes moisture, prevents the bud from drying out, and the work can be done more quickly than with string, as the strips cover more surface and do not require tying, the wax serving to hold the cloth firmly in place. It may therefore be recommended as far preferable to any other wrapping material.
Budding is a simple process, consisting in inserting a bud of a desired variety under the bark of the stock in such a way that the freshly cut inner bark of the bud comes in close contact with the layer of growing wood (cambium) of the stock. The bark is closed over the inserted bud and the stock wrapped with waxed cloth, as described, so that the bud is firmly pressed against the growing wood. If the operation is properly performed, the tissue of the bud and stock soon fuse together and the bud may be forced to grow.

In all varieties and stocks of citrus fruits the process of budding is practically the same, the method commonly employed being that known as shield, or eye, budding (fig. 129). The bud is inserted in the young stock near the ground. Previous to the severe freezes of the winter of 1894–95 the general practice was to insert the buds 12 to 18 inches above the ground, but since then the tendency is to bud as near the surface of the soil as possible, so that the trees may be readily banked with the earth above the bud to protect against injury from freezes. Most of the buds are now inserted from 2 to 6 inches above the soil. In sections where foot rot is abundant and sour-orange stock is used as a preventive measure the buds should be inserted from 12 to 18 inches above the soil, so that the sweet-orange wood will be above the influence of the disease.

All leaves and limbs which would hinder the proper wrapping of the buds should be cut away with a sharp budding knife. The use of sharp tools is the secret of success. A vertical cut about 1 ½ inches long is made at the point where the bud is to be inserted. At the base of this a horizontal cut is made, so that the two cuts present the appearance of an inverted T (⊥), as shown in fig. 130, a. The cuts should not be deep. The aim should be to merely cut through the bark, but no injury will result if the cuts are rather deeper. The lower edges of the bark are slightly raised with the end of the knife blade (fig. 130, b) to facilitate the insertion of the bud. This may also be accomplished by giving the knife an upward turn after making the horizontal cut. Now, take a stick of bud wood in the left hand and cut out a bud, as illustrated in fig. 129. Formerly the portion of the wood cut out with the bud was removed, but experience
has shown that this is entirely unnecessary. The upper end of the bud is inserted under the slightly raised ends of the bark (fig. 130, c) and gradually pushed upward until all portions of the cut face of the bud come in contact with the wood of the stock (fig. 130, d). If in proper condition for budding, the bark of the stock readily separates, allowing the bud to be pushed upward into position. The bud is now ready to wrap. Take a strip of the waxed cloth prepared as above, and beginning slightly below the horizontal cut wrap tightly around the stock over the bud in a spiral manner, each turn slightly overlapping the previous one. The wax holds the cloth in place and makes it possible to draw it very tight. When the vertical incision has been entirely covered, turn the end of the strip slightly downward over the wrapped portion, to which it adheres more firmly than it would to the bark, and no tying will be necessary (fig. 130, e).

It is better to wrap from below upward, as in this case each turn overlaps the other in the right direction to prevent water running down the stem from entering. Nurserymen usually wrap over the bud, covering it entirely. Some, following the practice commonly used in other fruits, leave the eye of the bud exposed. This, however, is more troublesome and does not succeed so well.

In some cases where bud wood of certain varieties is difficult to secure, it may be desired to use buds from the young angular wood (fig. 127, b). This may be used with good results if the stock to be budded is growing rapidly and is in a succulent condition. In this case the method of cutting and inserting the bud is slightly different from that already described. In cutting the buds the stick is turned slightly to one side, so that as the bud is cut off the eye lies on one side instead
of in the center of the bud (fig. 131, a, b, and c). It is only by cutting the bud in this way that the cut surface is made wide enough to hold the bud firmly in position. For inserting these buds an incision is made in the bark, as shown in fig. 130, a. The bark is slightly raised on one side with the point of the knife and the bud is slipped under in a lateral direction, the eye remaining in the vertical slit (fig. 131, d). The bud is then wrapped as shown in fig. 130, e.

UNWRAPPING THE BUDS.

In from ten to twelve days the buds will have united with the stock and may then be unwrapped. In early spring, when the weather is cool and the growth slow, the wrapping should be left on from fifteen to twenty days, while in the summer, when the weather is warm and the growth rapid, ten days is usually a sufficient length of time. However, it is impossible to say definitely how much time should elapse before the wrapping should be removed, as the wood of the stock should never be allowed to grow over the buds. It should not be removed until a light grayish line of new tissue can be seen forming around the edge of the incision made in inserting the bud. A little experience will enable one to tell at what stage it is safe to unwrap. Under ordinary conditions from twelve to fifteen days will give good results, but in very dry weather in the summer, when growth is slow, it may be necessary to leave the wrapping on for a longer time. Some ten days after budding an examination should be made of a number of the buds, and if they are found to be well healed on, the wrapping may be taken off, but if not, the wrapping should be replaced and allowed to remain some time longer. If the wraps are allowed to remain too long, the wood of the stock is liable to grow over the buds and greatly hinder their pushing.

FORCING THE BUDS.

In order to force the buds to push uniformly after they have healed on, it is necessary to severely check the growth of the stock. This is

![Fig. 131.—Shield budding with angular wood: a, cutting the bud; b, bud cut ready to insert; c, bud showing cut face; d, bud inserted, bark on right side only being raised.](image-url)
most commonly accomplished in nursery trees by lopping the tops, as it is called, which is usually done from three to five days after the wraps are removed from the buds. The lopping is usually done with pruning scissors, the knife edge being placed about 2 inches above the bud and the stock cut two-thirds through. The top is then bent over to one side and allowed to rest on the ground (fig. 132, a).

To provide for subsequent cultivation and attention it is necessary to use some definite plan of budding and lopping in the nursery. Two methods most commonly followed by Florida nurserymen are to lop the tops of two adjoining rows into the same center (fig. 133, a), keeping the alternate centers free for cultivation, or to lop the tops of alternate rows in different directions, one row in each center (fig. 133, b), and place them near the rows. By the latter method a cultivator may be run up one row and down the other, passing always in the direction in which the tops are inclined so that the branches will not interfere with the cultivator. Usually the old tops are allowed to remain attached until the buds have attained a height of from 12 to 18 inches, after which they may be cut off.

Some nurserymen have found that the buds make a larger growth if the old tops are allowed to remain attached through the summer and are cut off in September. If this practice is followed, two rows of trees should be lopped together. The tops thus form a dense shade or sort of mulch on the soil, keeping it moist and preventing the weeds from growing. In this case it is also desirable that the rows lopped together should be planted rather close (about 3 feet apart), for if this is not done the weeds will grow up among the tops, making it necessary to cut off the latter when the buds are 1 foot to 18 inches high in order to keep the weeds down.
In the case of vigorous-growing stocks, like the rough-lemon, it is said to be very desirable to leave the tops attached for some time.

When the old tops are removed, the portion remaining above the bud should be cut off smooth and close to the bud, so that it will soon heal over without forming an ugly scar (fig. 132, b). Some follow the practice of coating the freshly cut end with shellac, but others working on an extensive scale never do this. It is seldom that any noticeable benefit is derived from the practice.

**GROWTH OF THE BUDS.**

The attachment of the rapidly growing bud is at first very weak and it is necessary to strengthen it by tying to a stake (fig. 132, b). Some nurserymen practice cutting the stock rather high in lopping, and support the buds for a time by tying them to the remaining portion of the stock. The buds push much better, however, when the stocks are cut very close in lopping, so that it is hardly desirable to depend upon this method of supporting the buds, as in either case it is necessary later to supply the supporting stakes.

The development of the buds should be carefully watched during summer, and they should be pruned in such a way as to produce a top of the desired shape. In Florida, where a low tree is desired, it is necessary to nip the tops when they are 2 or 3 feet high to induce branching. The buds which push low down on the stock or bud should be rubbed off before they have grown to any size, as their growth detracts from the development of the bud.

The best time for transplanting orange or other citrus trees is probably during December, although they may be transplanted in January or February or during the rainy season. By December buds put in early in the spring have reached a convenient size for transplanting into the grove.

**DORMANT BUDDING.**

Putting in buds which are intended to remain dormant during the winter, or dormant budding, as it is called, is usually done in October or November. The process is exactly the same as described above, except that the tops are allowed to remain standing until the following spring. They are lopped in the usual manner the latter part of February, or just before the spring growth starts. The advantage of dormant budding is to secure the first spring growth in the bud, which is the largest growth of the year.

**SPRIG BUDDING.**

This is a form of budding frequently used on old stocks, where the bark is thick, in changing the variety or replacing a limb accidentally broken off. A scion about 4 inches long is selected (fig. 134, a), and the basal end sharpened by a slanting cut on one side, as shown in the
A curved oblique incision is made in the bark, the lower edge of which is slightly raised with the point of the knife, and the end of the scion inserted and pushed between the bark and wood in an oblique direction until the freshly cut surface of the scion comes in contact with the growing wood of the stock (fig. 134, b). The scion is held firmly in place by the bark of the stock, and the use of grafting wax or wrapping of any kind is said, therefore, to be unnecessary.

**Grafting.**

Grafting has not been extensively used in citrus culture in Florida, but as there is an increasing tendency to place the point of union between stock and graft, or bud, near or below the surface of the soil, this method will probably be more used in the future. There seems to be no good reason why it should not be adopted wherever desirable. Grafting should be done in January or February, while the trees are still in a dormant condition. The scions must be taken from thoroughly mature wood of the last season's growth. Round and thornless twigs should be selected if possible, although the somewhat angular wood may be used if thoroughly mature.

**Cleft Grafting.**

Cleft grafting, which is one of the simplest methods, may be used to advantage in place of budding in nursery trees where it is desired to place the point of union below the soil. A scion about 5 inches long is selected and the lower end sharpened to a wedge shape by two slanting cuts 1\(\frac{1}{2}\) inches long on opposite sides (fig. 135, a). The young stock to be grafted is cut or sawed off slightly below the surface of the soil and a cleft made in the stock (fig. 135, b). If the stock is larger than the scion, the latter must be inserted at the side, so that its cambium layer (the growing layer between the bark and the
wood) on one side will come in contact with that of the stock. After the scion has been pushed down into place, the stock should be wrapped with strips of waxed cloth, like those used in budding, one or more strips being put across the top of the stock to keep the sand out of the cleft until the graft starts to grow. The moist soil is then thrown up around the graft, leaving only the upper end exposed. The wrapping cloth will decay in a short time, but it is probably best to remove it soon after the grafts begin to grow.

**TONGUE, OR WHIP, GRAFTING.**

In grafting small stocks the tongue, or whip, graft (fig. 136) is generally used. If properly made, the tongue serves to hold the scion firmly in place and forms a good union. After the scion and stock are placed together, they are firmly wrapped around the point of union with strips of waxed cloth, as in the case of buds (fig. 130, e). The wrapping should be left on until the graft has started well, when it should be removed. By removing the soil somewhat around the collar the tongue graft may be used on small nursery trees to place the union below the surface.

**CROWN GRAFTING.**

When the tops of comparatively large trees (3 inches or more in diameter) are killed to the ground by freezing or in any other way which leaves the roots uninjured, they can be most quickly replaced by crown grafting. This method of grafting may be used to advantage on large limbs also. In crown grafting, as practiced in Florida, a scion about 5 inches in length is sharpened at the basal end by a long, slanting cut on one side (fig. 137, a). In crown grafting other fruits a slight shoulder is usually left on the scion, and this rests on the stock when the scion is inserted. When frozen or killed down, the stock to be grafted is sawed or cut off 2 or 3 inches below the surface of the soil, where the wood is fresh and living. With the aid of a knife blade the bark is then slightly loosened from the wood at one place and the scion is pressed in between the bark and wood, with the cut surface against the latter. The best places to insert the scions are in the concave portions of the trunk, as here, in order to allow their insertion (fig. 137, b), the bark can be pressed out without breaking. Several scions may be inserted on one trunk if desired. The bark, if unbroken, will hold the scion firmly against the wood and no wrapping will be required. If, however, it should
be necessary to split the bark to allow the insertion of the scion, it should be wrapped with string or waxed cloth to hold it firmly in position. Moist earth is then banked up over the stump until only the upper portion of the scion remains exposed. In using crown grafts above the soil, strips of waxed cloth or grafting wax must be used to prevent the scions from drying out.

**ROOT GRAFTING.**

Propagating citrus fruits by root grafting has never been thoroughly tested, so far as the writer is informed. In March, 1895, the writer was led to make several tests of this method, which, owing to the condition of some of the roots used, though not thoroughly satisfactory, yet strongly indicated that the method might frequently be used to advantage. About the first of April lateral roots, varying from one-half to three-fourths of an inch in diameter, were taken from sweet-orange trees and cut into sections about one foot in length, each having a fair quantity of fibrous roots remaining uninjured. These were immediately tongue grafted (fig. 136) with dormant sweet-orange scions obtained from California, and were then planted, the union being placed slightly below the soil. The majority of the grafts started growth promptly, but about one-half of these made very slow progress, the growth appearing unhealthy. The roots used were taken from trees about sixteen years old which had been frozen to the ground two months before, and this, it is thought, affected the results. While not recommending the general use of this method, the writer would suggest that the results obtained indicate that a bearing grafted tree may be secured in this way in far shorter time than by any method now practiced. The method would seem particularly promising where lemon, lime, or pomelo stocks, which root easily, are used.

All the methods of budding and grafting described may be greatly changed in detail. No attempt has been made to describe all variations, only those methods being given which have proved most satisfactory and which are most commonly used.

**INARCHING.**

Inarching consists of uniting limbs of the same or different trees by a process similar to budding. Several methods of inarching are used, but only the one in most common use will be described. The two
limbs to be inarched must be close together, in such a position that one may be easily bent over against the other. The operation is practicable only where one of the limbs is comparatively small—under 1 inch in diameter. The small limb is cut off by a slanting stroke in such a place that the cut surface faces the other limb when bent over against it at the point where the union is to be made (fig. 138, a). A vertical and a cross cut, like an inverted T (⊥), is made in the bark of the large limb or stock at the point where the two limbs touch (fig. 138, b). The end of the small limb is then pushed up into the slit (fig. 138, c), as in shield budding described elsewhere, and strips of waxed cloth are wound around the union to hold the limbs firmly in place. The wrapping should be allowed to remain for a month or more, till the limbs have become very firmly grown together. Inarching is frequently used in cases where trees are girdled by foot rot, wood lice, or white ants (Termites), or in any other way. In foot rot, young sour-orange stocks, which are immune from this disease, may be planted by the side of trees in the first stages of the malady and inarched into them 1/4 or 2 feet above the ground. In this way they may almost certainly be saved from the disease. If the bark of the diseased tree will not slip, a wedge-like union, similar to the cleft graft, should be tried, the incision in the stock being made with a chisel. In case of girdling by white ants or animals, sprouts from the roots may be inarched, or small trees may be planted by the side of the injured tree and inarched, as in the case of foot rot. Inarching is also frequently employed where it is desired to throw the strength of two or more sprouts into the development of one top, as in the case of numerous sprouts coming up around large frozen trunks. Limbs may be braced and strengthened by binding them together by means of inarching branches.

![Fig. 138.—Inarching: a, end of limb to be inarched, showing form of slanting cut; b, incision on stock, with bark raised preparatory to inserting end of limb; c, limb inserted, ready to wrap.](image-url)