

SELECTED ARTICLES

A NEW METHOD IN MANGO PROPAGATION*

EVERGREEN fruit trees, like the mango, citrus, chico, and avocado, are generally propagated by inarching and marcotting in warm countries, as it is believed that both budding and veneer grafting are not successful in the tropics. The reason is mainly based upon the fact that in cold countries one can easily utilize dormant buds which can be revived by placing them upon a functioning root stock, while in warm territories it is difficult for the budwood to harden and also the scion or buds used easily dry up with excessive heat before they become firmly established in the process of union with the tissue of the root stock. Both inarching and marcotting, besides being tedious, cannot be expected to produce a large number of vigorous young plants at one time. The resulting offspring, besides being too large to be moved thus exposing them to the danger of withering, are always weak and look old. Various methods of twig grafting have been claimed to be more satisfactory. One method is to use the whip grafted scion with a free bottom end nourished by water in tube, or inserted into moist soil. This method undoubtedly keeps the bud alive during a period long enough to perfect the union, but it requires too much labor. "Etiolation layering" is sometimes recommended to secure a large number of vigorous young plants in the tropics, but it is not always successful when the soil and temperature are not ideal. Under this circumstance, a new device for side-grafting in which immature wood is used is proposed by Ichizo Nakamura of Takao, Formosa. This device works very satisfactorily under tropical conditions in multiplying mango plants in a very speedy way. This new finding is described in the following paragraphs.

THEORETICAL STARTING POINT

In temperate countries where both budding and grafting are practised the scion species used are mostly deciduous and the buds are dormant when cut, as those on immature wood are hard to revive. In tropical countries, in the case of the mango, the development of the bud does not require a long period of dormancy, and soft wood buds can be used for grafting purposes. Moreover, the healing of the wound is much easier when the plant is active in midsummer up to early fall when the temperature is high and the regenerative power is strong. In early spring the temperature is not high

* By Tyozaburo Tanaka of Taihoku Imperial University in *The Philippine Journal of Agriculture*, Vol. 10, 1st quarter, 1939, No. 1.

and the plant is more dormant than in summer and this gives a different effect to the plant. The root stock to be worked is also larger and more vigorous with the advance of the season and it is easy to force the bud to start strong growth. This supports the theory that spring is not the proper season when to practise grafting in the tropics, since the physiological and morphological conditions of the stock plant are, in summer rather than in spring, far more conducive to make the wound heal faster; force the inserted bud to grow easier, and complete the elongation of the shoot faster. It does not require an entire season to expect a full wood growth, as the growing season is long and the temperature favors a rapid elongation. Another important difference is the evaporation power. Ordinary scions used in the temperate countries in spring are dormant and keep a considerable length of time without losing their power of regeneration as the physiological activity is slow. Scions used in the tropics, on the other hand, are always active and ready to function even during winter, and are ever subject to lose water by transpiration and respiration. Under this condition, the scion must be properly protected against loss of water, and the budwood must be waterproof as far as possible. To answer this requirement, budwoods must have neither foliage nor petiole, and the leaf scar should be water-tight with complete cork formation after the natural abscission of the petiole. This can be attained by removing the leaf blade at the middle of the petiole, before the scion is cut, and by waiting a week or so, the remaining petiole falls down with the formation of an abscission cork layer. Such wood is ready to be used as a scion. Without doing this, and if the leaves are removed at the time when the scion is cut, the cut surface of the petiole is likely to form a danger point, from which water may evaporate very quickly. Such scion will wither very rapidly and will not survive at all when used. Defoliation and healing of the leaf scar will unquestionably prevent the loss of water by the bud. Not only that. They accelerate the subsequent development of the bud into a sprout. The pre-curing of bud by defoliation renders the scion ready to start bud growth when used. This point is well explained in Mr. Nakamura's method and the factors which cause the failure of grafting in the tropics are wisely avoided and more logical processes substituted.

METHOD OF GRAFTING

In Mr. Nakamura's method, terminal or lateral buds, in an intermittent rest period between two cyclic growths, are to be used. If the terminal bud is wanted, several leaves from the top are removed, and the scion with two or three leaf scars is to be cut after the abscission of the petiole. The lower portion of the same stick can be used again, after two weeks or so, in the meantime waiting for the terminal cut to heal completely. After removing the leaf blade and the remaining petiole, the top part with several leaf scars, can be used as before for the scion. This time, the axillary buds in the uppermost position are to be developed. In a similar way, the still lower part of the same stick is available. It is better to remove all leaves of the entire shoot at the beginning, if several scions are to be obtained from the same shoot.

The scion is inserted into the notch made on one side of the immature but fully developed root stock, while the bark is still green. Two- or three-year-old stocks with brown barks are also available but they are not so good as the green ones. Still larger stocks over two centimeters in diameter should be cut back when worked on with young sprouts. When the stock is old and top working is desired, the entire trunk is cut down in early spring at a point 15 to 18 cm. from the ground. From several adventitious sprouts arising near the cut surface, one or two opposite strong shoots may be saved, and such vigorous shoots are used when they grow big enough to work on. It does not matter how big the stock is, but the part to work on must not be fully mature and dormant. When working on young plants, the stock is cut at a point 5 to 10 cm. from the ground, leaving two or three leaves, which are left untouched when the scion is inserted.

THE ROOT STOCK

The most economic and speedy way is to use one-year-old root stock, and operate in mid-summer of the same year. The mango fruits chosen to supply seed for stock, must be large enough in size, if the plant is a seedling type, and it must represent a good early strain. It is not necessary to use the seeds of big varieties, like the Carabao or Golek, because all seedling types supply good stock plant for these standard mangoes. If the Carabao mango seedling is used as the root stock of the White Golek, the scion will always outgrow the stock, but the stock of the seedling type of the mango will grow just as big as the scion or will slightly outgrow it, whenever the Carabao or White Golek is worked on to it. The seeds are planted in pots or in the ground 60 cm. apart, after removing the shell. The planting soil must be well prepared and rich in organic matter. After sowing the seeds, it is desirable to have a thin sand dressing on the surface. Upon germination of the seeds, they must be tested to show only a single plant from each seed, and smaller poly-embryonic secondary sprouts must be scraped off while they are young. The seedlings should be well fertilized to allow them to attain their maximum height and girth. In starting the work, the bigger seedlings are to be worked on first, the smaller ones next. The cutting back of the top of the stock must not be carried down too far away from the parts having closer leaf stand. In top-working old seedlings, the best results may be obtained when the plant is rather large, having at least a diameter of 12 to 15 cm. That transplanting may be made easier the seed should be planted in a longitudinally halved pot.

OPERATION AND TYING

The bottom of the scion must be cut very sharply to make an acute wedge but one side must be cut along the cambial layer as far as possible, so that both sides are not symmetrical. The cut surface must be very smooth, allowing a single draw of the knife to make an even plane. The stock is then notched by cutting it down diagonally, and the knife must be drawn straight down to make the oblique cut very sharp and even. The side to be incised must be as straight as possible. Curves should be avoided. It is preferable to work on the eastern side, as the afternoon sun may injure the graft when

it is done on the western side. The wood tissue should not be cut too deep into and the incision must not be too far away from the cambial layer. The scion wedge to be well placed must be inserted in air-tight contact with the incision surface. The tongue-like portion of the bark must not be broader than the stock notch, even if the scion is thicker than the stock. In other words, the cambial plain of the former must be completely concealed within the incision of the stock. All precaution must be taken to make the scion wound perfectly covered by the cut surface of the stock. The air-tightness of the contact surface would decide whether the union is successful or not. A long exposure of the cut surface of the scion must be strictly avoided. Therefore, the scion ready to be used must be kept, during the operation, in a tall box to prevent its cut surface drying up. The best kind of knife to use in mango grafting is one having a blade of stainless steel and sharpened on one side only. By using such a knife, oxidation of the cut surface can be prevented. The sharp edge of the knife must be straight so as not to cause any curvature on the cut surface. The best type of tying material is ordinary cotton string tape commonly used in the shop, which is composed of several thread lines pasted flat in one narrow strip. The tape must be wound close and tight so as to exclude air. Such tape will be removed one or two months after the taking of the scion when it will have increased in volume. Waxed cloth tape generally used in budding is not satisfactory, as it prevents the quick swelling of the scion in action.

TREATMENT AFTER THE OPERATION

No cover is necessary to protect the graft even in strong sunshine. After two weeks, the uppermost bud of the scion begins to swell. If it looks difficult to judge whether the graft was successful or not, observe at night with the use of a flashlight. The surviving scion looks lustrous and turgid. After the third week, the bud starts its initial growth. The internal activity of the living graft can be easily detected with the frequent visit of ants, seeking the sugary secretion of the new growth. At this time, the top of the root stock may also show new growth. These stock shoots must be shaved off with care as soon as they start to elongate. When the new growth of the scion develops and reaches a length of 30 cm. or so, the remaining top portion of the stock must be sawed off carefully at a point 5 to 8 mm. above the union.

If the scion did not take, the same stock can be worked again at the opposite side a little below the original incision.

Since no cover is used in the present method, precaution must be taken not to leave any wound of the scion in contact with the air. The success of the graft is therefore dependent upon the skill of the operator. Covering the grafted portion with soil helps injurious fungi or bacteria to the wound.

DISCUSSION

Mr. Nakamura's side working method of the mango is a good example of "soft wood grafting" which is generally believed unsuccessful in the tropics as well as in the colder countries. He found that the failure lies principally

in the adequate condition of the scion, and the lack of proper attention to safeguard its activity. The immature bud does not develop in most of the temperate species, except in a few, like the apple, plum, and the cherry. With most of the tropical species, however, it is easier to make such immature bud start growth, provided the forcing is done effectively. This can be attained by pre-curing the bud through defoliation and putting it into a vigorously growing stock during the active growing season, not in the spring-time when the bud is semi-dormant. The strong seedling cut in summer or early fall can easily stimulate the inserted bud to growth, after a certain period of curing caused by the natural drop of the petiole which, in turn, is forced by the removal of the blade. At the same time the scion is almost water-proof as the petiole scar is already well coated with cork tissue thus preventing evaporation. All these factors favor the rapid healing of the union and the easy development of the new bud. At the end of the fall, an already well developed nursery plant can be secured, and a large number of similar plants will then be available as a good supply of the budwood can be had at intervals of approximately two weeks, as stated in the preceding paragraphs. The entire grafting work is complete at the end of the year the seeding of the stock plant is started and the resulting young plants are ready to be transplanted in the next spring. In this way standard varieties, like the Carabao and the White Golek, can be obtained in a large number within a very short time. This gives an opportunity to mango planters to raise more plants of the desirable variety with less expense and labor. This fact also suggests the possibility of the mango trees being planted on a large scale as a plantation crop, since the demand for fresh fruits has increased after the invention of preparing the frozen mango meat for use in ice-cream manufacture. The canning of the mango meat is also a great possibility in tropical countries. Fruits of such varieties like the Carabao and the White Golek can be picked green before the mango fruit fly, *Chaetodacus dorsalis* Hendel has a chance to attack them. They can then be satisfactorily transported and marketed before they get over-ripe. It is hoped that the present paper may be of help in the future development of the mango industry in the Far East.