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PROPAGATION OF THE MAMEY SAPOTE

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Abstract. **Mamey sapote, *Calocarpum sapota* (Jacq.) Merr. [syn. *Pouteria sapota* (Jacq.) H. E. Moore and Stearn], can be propagated true to type only by vegetative methods. Propagation by cuttings, air layers, and tissue culture has not been successful. Grafting and budding can be done successfully and are currently the most practical methods for vegetative propagation of the mamey sapote. Successful methods include approach grafting, veneer grafting, cleft grafting and shield budding. Careful attention must be given to grafting technique (sharp knives, accurate cuts), condition of scions and rootstocks, and environmental conditions. Mamey sapote seedlings are used for rootstocks. Seeds should be planted immediately after removal from the fruit because they lose viability rapidly. Timing of grafting is important; in Florida the best times are late October to early December and late March to early May. Grafting success is improved if scions are girdled 2-3 weeks before removal from the tree. Dormant scions can be forced into active growth by defoliation 8-10 days before removal from the tree.**

The mamey sapote, *Calocarpum sapota* (Jacq.) Merr. [Syn. *Pouteria sapota* (Jacq.) H.E. Moore and Stearn], has been known for a long time to the people of southern Mexico, Central America, a few islands of the West Indies, and southern Florida, although it is relatively little known elsewhere. The fruit does not reproduce true to type from seed, so growers and researchers have long been interested in vegetative reproduction of superior selections. Vegetative methods have given erratic results and often have been unsuccessful. Our objectives are to review the published work and the unpublished results of our personal observations, and to indicate the methods and environmental conditions which have given the best results in propagation of the mamey sapote.

Propagation Methods

Seed. Most of the mamey sapote trees in the world are grown from seed; however, seedling trees are highly variable and are likely to produce inferior fruit. Therefore, for efficient production of fruit of uniform quality, it is preferable to plant orchards of vegetatively propagated trees of superior selections than to plant seedlings (Almeyda and Martin, 1976; Campbell and Lara, 1982; Malo, 1970).

On the other hand, rootstock trees for grafting are always grown from seed because there is no other practical way to produce them (Almeyda, 1976; Almeyda and Martin, 1976; Phillips, Malo and Campbell, 1978). Fresh seeds germinate readily and produce plants suitable for grafting in 4-12 months. It is necessary to plant the seeds within 4-5 days after removal from the fruit because they lose viability in a short time, especially when they are dry. No good method of storing the seeds is known. Seeds can be germinated in a seedbed and later transplanted to containers in the nursery, or planted directly in containers. Plastic pots or plastic bags are used commonly in most nurseries.

Other species, such as canistel (Ogden and Campbell, 1980) and sapodilla (Gonzales and Favella, 1952), have been tested as rootstocks for mamey sapote, but the grafts were not compatible. Only the mamey sapote has been successful as a rootstock. Although we have found no published reports of its use, the green sapote, *Calocarpum viride* Pitt. [syn. *Pouteria viridis* (Pitt.) Cronquist], probably could be used as a rootstock because we have observed compatible grafts of green sapote on rootstocks of mamey sapote in Florida.

Cuttings or air layers. Several publications have reported investigations of propagation by stem cuttings (Almeyda and Martin, 1976; Quilanton-Carreon, 1979) and by air layering (Almeyda, 1976; Almeyda and Martin, 1976; Campbell, 1967; Malo, 1970). All of the authors agreed that these methods were not successful. A possible reason for this was reported by Ogden (1984), whose work on the morphology and anatomy of mamey sapote stems revealed the presence of fiber bands in the cortex. These bands could form a physical barrier to the formation of roots by differentiation of meristematic tissues in the vascular cambium.

Tissue culture. Research on tissue culture propagation of mamey sapote in several laboratories has not produced successful results. In experiments at the Univ. of Florida Tropical Research and Education Center, researchers found it very difficult to get callus formation from cultures of bud, stem, or leaf tissue. After callus formation was achieved, the researchers were not able to induce differentiation into embryos and plantlets (R. E. Litz, personal communication). Similar results were obtained in laboratories at Southern Illinois Univ., Univ. of Illinois and Univ. of Maryland (J. E. Preece, personal communication). None of this work was published.

Grafting and budding. Approach grafting is considered to be the oldest method of grafting and the most likely to be successful with woody plants. Many authors report it to be successful with mamey sapote (Cockshutt, 1991; Lazo Rodriguez, 1957 and 1965; Malo, 1970; Ogden, 1984; Phillips, Malo and Campbell, 1978; Rodriguez and Gurdian, 1986), although one report (Almeyda, 1976) indicated lack of success. Conventional approach grafting is not favored by nurserymen because it is time-consuming and inconvenient. Malo (1970) described a method used successfully in Thailand in which rootstock plants are grown in small lightweight containers (plastic bags with artificial media) and are easy to manipulate during the grafting process. Malo had successful results with this method in Florida.

Veneer grafting, long considered a good method for progagation of woody tropical species which are difficult to graft (Lynch and Nelson, 1956; Pennock, 1970), gives good success with mamey sapote under the proper

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physiological and environmental conditions (Almeyda, 1976; Campbell, 1967; Malo, 1970; Ogden, 1984; Phillips, Malo and Campbell, 1978; Quilantan-Carreon, 1979; Rodriguez and Gurdian, 1986). Seedling plants approximately 12 months of age are used as rootstocks.

Making very shallow veneer cuts distal to the fiber bands in the cortex of both scion and rootstock may increase the number of successful grafts (Ogden, 1984). Most nurserymen, however, achieve satisfactory results with cuts made in the conventional manner; that is, cuts exposing the vascular cambium of both scion and rootstock. Practical experience in Florida and elsewhere in Tropical America indicates that it is desirable to use a relatively long scion (3-5 inches) and a long veneer cut on both scion and rootstock. It is definitely not desirable, however, to use long scions in which a large part of the scion is left uncovered by the plastic grafting tape. Such grafts often fail, presumably from dehydration of the scion.

Sometimes growers wish to change their trees to different cultivars by topworking (Balerdi, 1991). This can be done readily by cutting back the main branches of trees in the field to stumps. If the branches are not too large in diameter, veneer grafts can be made directly on the stumps. If the branches are quite large, with thick bark, it generally is easier to let new shoots sprout from the stumps and put veneer grafts on the shoots.

Many years ago Lazo Rodriguez (1957 and 1965) reported success with cleft grafting of mamey sapote. He emphasized the importance of bleeding away the latex from the stems of scion and rootstock prior to grafting. One of the authors (SPL), working with Ogden (1984) and in his own commercial nursery, has found that cleft grafting can be done successfully with rootstocks and scions that are young and in a condition of active growth. Seedling plants about 4 months of age are used as rootstocks. He does not find that bleeding of latex is essential to success with this method, or with other grafting methods. This is supported by the experience of other nurserymen in Florida.

Although it is not used by most nurserymen for propagation of mamey sapote, shield budding is used with good success in the Zill High Performance Plants Nursery, Delray Beach, Fl, where large numbers of mamey sapote plants are produced. To get suitable scions with only one bud, it is necessary to find stems on which there are relatively long internodes. Buds of this kind frequently are dormant and need to be forced into active growth before removal from the stock tree. This can be done by defoliation of the branchlets 2-3 weeks before the grafting is to be done.

Marler (1991) reported the successful use of a "four-flap" method, which was originally developed for grafting of pecan. This method requires more hand operations than other successful methods, however, so it is not likely that commercial nurserymen will use it. Undoubtedly other methods of grafting could be developed for propagation of mamey sapote. The methods discussed here are the ones we have found to be in actual use at this time.

Factors Affecting Propagation Success

Environmental Factors. The mamey sapote grows best in the hot lowland tropics. It can be found in areas of well-distributed rainfall, but is best adapted to areas with distinct wet and dry seasons. It is not adapted to arid or desert regions. Ogden (1984) investigated the effect of environmental conditions on grafting success. She found two times of the year to be best for veneer grafting in Florida, late October to early December, and late March to early May. These periods correspond to the beginning and the end of the cool dry season of the year, a time of warm to hot days, cool nights, and relatively low atmospheric humidity. Nurserymen have also found these periods to be best for propagation of the mamey sapote in Florida.

These observations apply to Florida and to nearby places with a similar climate (Salcedo Gomez, 1986). In areas of different latitude or climate, the best times for grafting probably would be different. This can be determined only by experimentation in the specific region concerned.

Physiological Factors. Most of the published work on this aspect of mamey sapote propagation was done by Ogden (Ogden, 1984; Ogden, Campbell and Lara, 1984a and b). She found a natural accumulation of starch in the stems at the seasons in which grafting was most successful. In other experiments, girdling of the stems on the tree resulted in a similar accumulation of starch in the parts distal to the girdled area, indicating a way to facilitate grafting at times when environmental conditions were not favorable. The experience of researchers and nurserymen has confirmed the value of girdling scions 2-3 wk before removal. Scions with a large amount of stored carbohydrate may survive longer than scions with a small amount of carbohydrate, and thus have a better chance to form graft unions successfully.

Ogden (Ogden, 1984; Ogden, Campbell and Lara, 1984a and b) also investigated the factor of juvenility of the scions. When she compared grafting success of mature scions from fruiting branches of larger trees with juvenile scions from young seedling trees which had not yet produced fruit, the juvenile scions formed graft unions much more readily than the mature scions. The same effect was obtained by cutting back mature grafted trees to main branches a few inches above the graft unions and allowing new shoots to grow from the cut stumps. Scions taken from these "juvenile-like" shoots gave better grafting success than mature scions. This procedure is reminiscent of "stooling" techniques used with deciduous fruits like apples, and could be used to advantage with mamey sapote propagation.

The defoliation of branchlets on the tree to break dormancy and force buds into active growth illustrates another physiological factor in mamey sapote grafting. This method has been used for a long time to prepare scions of other species for grafting and it has been found to increase grafting success with mamey sapote in Florida.

Morphological and anatomical factors. Ogden (1984) and Salcedo Gomez (1986) have reported that the vascular cambium of mamey sapote stems is irregular and discontinuous, especially in the terminal portions of the stems where the internodes are very short (the kind of material used as scions for veneer grafting). This condition makes it difficult to match the cambium of the scion with that of the rootstock, and probably is an important factor in the difficulty of grafting.

Ogden (1984) also reported the presence of fiber bands in the cortex of mamey sapote stems, and suggested that they could be a physical barrier to the formation of roots of cuttings or air layers. It seems possible that the fiber bands could also interfere with the differentiation of meristematic tissues in the formation of graft unions.

An additional factor reported by Ogden (1984), which may cause problems in grafting, was the high content of silica in the cortical tissue of mamey sapote stems. She found this to be a physical problem in the preparation of stem sections for microscopic examination, the tissues tending to tear rather than to cut cleanly because of the hardness of the silica deposits. The silica caused microtome blades to become dull quickly and would have the same effect on the blades of grafting knives.

Nevertheless, although all of these factors contribute to the difficulty of grafting the mamey sapote, with proper techniques and good environmental conditions, this fruit can be grafted successfully. This is evidenced by the success of many nurserymen in Florida and elsewhere.

Summary

1. Mamey sapote cultivars can be propagated true to type only by vegetative methods.
2. Propagation by cuttings, air layers and tissue culture has not been successful.
3. Grafting and budding can be done successfully and are currently the most practical methods for vegetative propagation of the mamey sapote.
4. Successful methods include approach grafting, veneer grafting, cleft grafting and shield budding.
5. Careful attention must be given to grafting technique (sharp knives, accurate cuts), condition of scions and roootstocks, and environmental conditions.
6. Mamey sapote seedlings are used for rootstocks. Seeds should be planted immediately after removal from the fruit because they lose viability rapidly.
7. Timing of grafting is important. In Florida the best times are late October to early December and late March to early May.
8. Grafting success is improved if scions are girdled 2-3 weeks before removal from the tree.
9. Dormant scions can be forced into active growth by defoliation 8-10 days before removal from the tree.

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THE 'RUBY' MANGO

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Abstract. **'Ruby', a Florida mango [*Mangifera indica* (L.)] cultivar with promise for Tropical America, is described and discussed. *'Ruby' originated* as a seedling of unknown parentage from Miami, Florida. 'Ruby' fruit are small, averaging from 200-300 g. The fruit have brilliant color, with a yellow-orange ground color and a red or crimson blush. Eating quality is good with only a moderate occurrence of internal breakdown. 'Ruby' holds promise for Tropical America as a commercial export mango due to its consistent production, brilliant color and good internal quality in Florida. Significant drawbacks of this cultivar in Florida include the small size of the fruit, and the production of seedless fruit or nubbins.**

Florida can be characterized as a secondary center of diversity for mango cultivars (Campbell, 1992; Crane and Campbell, 1991; Young and Sauls, 1989). This is the result of a concentrated effort of mango germplasm introduction, evaluation and selection in Florida over the last century. Many of the cultivars developed in Florida have become commercially successful throughout the world due