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The Inverted Root Graft: Applications for the Home Garden in Florida

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Experimentation began over 15 years ago with a grafting technique with potential for size control and precocity of fruiting in tropical fruit. This technique, termed the inverted root graft, was inspired by a similar technique used for lucuma (*Pouteria obovata*) in a large Chilean nursery. The inverted root graft technique inverts the rootstock, yielding a tree without a defined taproot and an enhanced feeder root system. The technique has been used in Florida on canistel, mamey sapote, sapodilla, jackfruit, mango, and avocado with varying degrees of success. Thus far the results have been best with canistel and mamey sapote. The resultant trees are anchored well in the ground, have profuse branching that lends well to size management, and begin to bear at an earlier age than conventionally propagated trees of the same species. The commercial viability of this technique will depend on the species used, due to survival rates of grafts and ease of management of the technique. Also, there is clear evidence of clonal specificity within species that will require further study. However, given the superior horticultural traits of these trees, there is significant potential for home garden usage in Florida.

The costs involved with the establishment of most tree fruit operations make early returns on the investment an important economic consideration for commercial fruit production. For home garden and estate agriculture with tropical fruit crops, it is equally important to provide for early fruiting and proper tree architecture. This will improve the experience with a given tropical fruit, leading to greater use and nursery tree sales. A specialized propagation technique was developed over the past 15 years to address the issue of early production and tree architecture on a wide range of tropical fruit. The technique was developed originally for use on canistel (*Pouteria campechiana*), but has also been used on mamey sapote (*Pouteria sapota*), sapodilla (*Manilkara zapota*), jackfruit (*Artocarpus heterophyllus*), mango (*Mangifera indica*), avocado (*Persea americana*), and South American sapote (*Quararibea cordata*). The objective of the current paper is to detail our experience with the inverted root graft as a useful technique for the propagation of tree fruit for the home garden in Florida.

Detail of method. The species grafted to date all exhibit hypogeal germination with cryptocotylar seedlings. Thus, the cotyledons remain enclosed within the seed, with the formation of a strong taproot and single shoot. Shoot expansion often lags behind the formation of the taproot by several days to even weeks.

Seeds were sown and allowed to produce a strong taproot of preferably 8 to 12 cm. As mentioned above, the emergence of the shoot often lagged for weeks behind the root formation. Germinated seeds lacking apical vegetative shoots were preferable. The germinated seed was removed from the soil and the apical shoot removed if present. Removal of the vegetative shoot must be complete to avoid re-sprouting. The seed with its exposed taproot was inverted and the taproot decapitated at a length of about 5 cm. The diameter of the taproot varied among species. Generally, the thicker the taproot, the easier it was to graft.

A cleft graft was used into the inverted taproot (Figs. 1–2). Scions of equal diameter with the taproot were selected for use. Straight taproots with minimal lateral branching were best for ease of grafting. Scions were used both with and without leaves, although our experience has shown the use of scions with leaves to yield superior success rates. The grafted plant (scion and inverted seed and taproot) was re-planted, leaving the graft union 1 cm above the soil surface. Scions with leaves were covered with a plastic bag and placed in a mist bed, whereas scions without leaves were covered with parafilm or similar material to retard water loss. Vegetative flushing of the scions occurred within 4 weeks of grafting in most cases.

Discussion and benefits of the inverted root graft. Following replanting of the grafted plant, fibrous root formation occurred. The fibrous root system in inverted root grafts was significantly greater than in conventionally grafted trees. A sometimes significant number of grafts in some of the tropical fruit species experimented with healed their grafts, but the inverted taproot formed few if any new roots. These trees languished and often died after several months. Success rates varied among the species grafted. Mango was the most difficult crop to graft, with percentage success rates from 10% to 20%. Jackfruit (50%), mamey sapote (60% to 70%), and particularly canistel (90%) were routinely successful. Resultant trees had more profuse branching

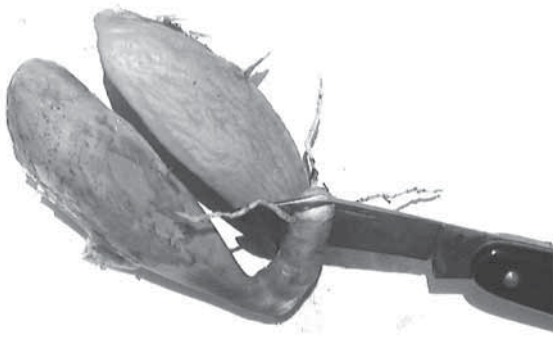

Fig. 1. Cleft cut on radical or inverted rootstock.

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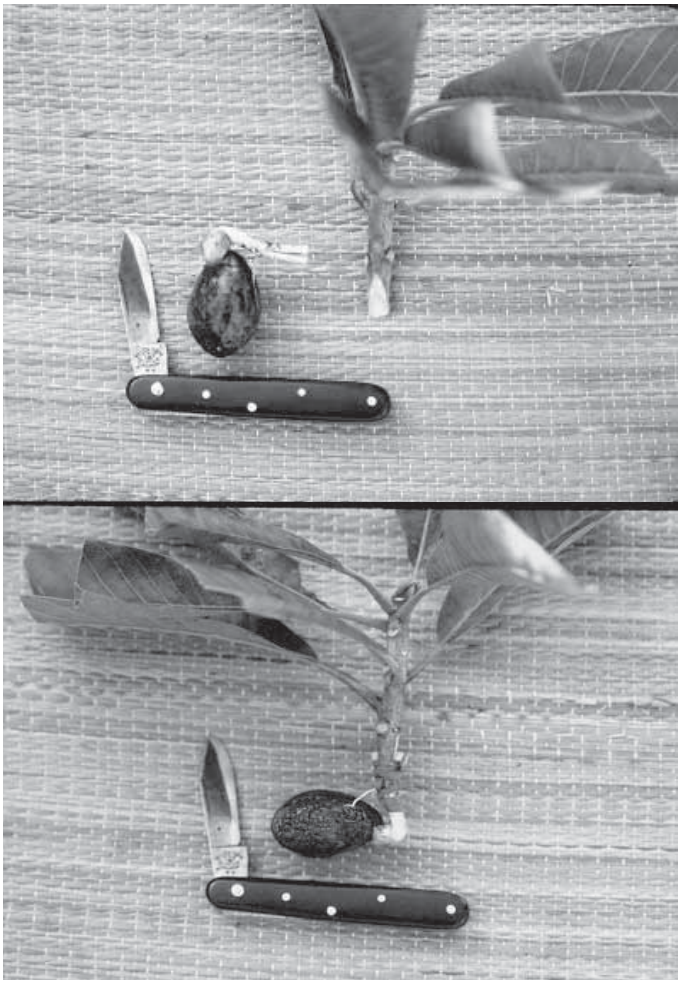

Fig. 2. Top: Prepared inverted rootstock and scion. Bottom: Completed inverted root graft.

and precocious flowering in canistel and mamey sapote, but not with jackfruit, nor South American sapote. Grafted trees were ready for field planting with canistel in less than 1 year and would often ripen their first fruit within 18 to 22 months from grafting. Canistel is by nature a precocious species, but the inverted root graft trees were 1 to 2 years ahead of conventionally grafted trees in their fruiting.

We have had over 10 years of field experience with these trees in South Florida. Canistel and mamey sapote trees are the most remarkable in their response, forming dense, fruitful trees of small stature with minimal pruning. Resultant trees are well anchored and show no tendency toward susceptibility to wind throwing. Fruit size is normal and there is no evidence of an influence on fruit quality. The size control may be an influence of the early fruiting, and this does open up the potential of using this method for size control in these two fruit. Avocado and jackfruit trees have grown well, but they have not been precocious in their fruiting and the trees are not dramatically distinct in their growth habits. South American sapote trees are reduced in their stature, but again have not shown any precocity of fruiting.

Conclusions

The economic and aesthetic benefits of this technique must be weighed against the cost for each species considered. The inverted root graft has shown the greatest potential in the Sapotaceae, and we are currently undergoing experimentation with other members of this family. After more than 10 years of experience with inverted root grafts in the field in South Florida, we feel that the inverted root graft deserves consideration as a propagation method on tropical fruit in South Florida.