

CITRUS PROPAGATION & ROOTSTOCKS

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In response to various questions from overseas, we have tracked down some answers that are of general interest to our readers. These have been published in past issues of *ECHO Development Notes*. This technical note reprints those in their entirety. It also adds a couple of helpful tables that were provided by the Holm Citrus Nursery concerning characteristics of citrus rootstock and varieties of citrus.

WHAT VARIETIES OF CITRUS WILL GROW TRUE FROM SEED?

Jerry Larson with Double Harvest in Haiti asked us what varieties of citrus might come true from seed. I checked with Dr. Carl Campbell at the University of Florida Extension research center. Carl has given me many in-depth, insightful answers to tropical fruit questions sent by several of our readers. He said that a great number of citrus trees would come true from seed. There is a way that you can tell by examining a few seeds from the tree. Peel off the outer and inner seed coat. If the seed is polyembryonic, i.e. has many embryos, it will come true. I asked what it would look like if it were polyembryonic. Carl said that the various embryos would be convoluted upon each other. If it is mono-embryonic there will be one embryo with two distinct cotyledons. Almost any sweet orange will come true from seed, as well as key limes, grapefruit, tangerine and tangelo. Two varieties that will not come true from seed are temple and pomelo.

What are the advantages and disadvantages of growing citrus from seed when that is possible? One obvious advantage is that it is much less labor intensive to simply sow citrus seeds and eliminate the grafting step. Another advantage is that the seedling will most likely be free from viruses that sometimes get into the budwood that is used for grafting large numbers of trees. I asked Carl about reports that non-grafted citrus trees live longer, up to twice as long, as grafted trees. He said that this can be true, depending on the number and kinds of disease organisms that may be present in the budwood. If one uses certified disease-free budwood, and if there are no microorganisms present that we don't even know to look for yet, then there should be no difference in the longevity of the trees.

One advantage to grafting is that one can combine the best traits of the above ground part of the tree with the best adapted rootstock for the particular soils and conditions of the area. A seedling will tend to grow upright, tending toward a single trunk, and becoming quite thorny. A grafted tree will be more highly branched. The seedling tree will not fruit for 6-7 years, contrasted to the 3-4 years for a grafted tree. The earlier fruiting of the grafted tree is partly responsible for the more highly branched form of growth. Apparently the weight of the fruit after about 3 years bends the branches and causes new buds to begin growing; resulting in a more highly branched tree.

But not all of the reasons for the differences between seedling and grafted trees are known.

If you live in an area where citrus is not a major crop but would like to introduce it, you might consider trying some of the polyembryonic seeds. If you are more adventuresome, in a few years also plant some accepted rootstock varieties for grafting using budwood from the new trees you have introduced. If you prefer to start with a Florida variety rather than a good local variety, and want only a few seeds, we can at times provide them. If you want larger amounts, we have located a supplier, Lawrence Reed at Holm Citrus Seed Co., who routinely ships overseas. Seed currently sells for \$30 per pound plus airfreight. He can provide phytosanitary certificates if you so request and include your full address and phone number. I asked about the danger of introducing a new disease. He said this does not appear to be a problem with citrus seed. There has never been an instance where a citrus disease has been proven to have been introduced by seed. They are sending me a one-page guide to help select seed for rootstock. I will send you a photocopy upon request. If you have money on deposit with us, we will be glad to place orders for you.

I asked Dr. Campbell to proofread the above. He added that in some of the polyembryonic citrus, some of the embryos are of gametic origin and therefore do not come true. The percentage varies by species and variety.

SUGGESTIONS FOR PURCHASE OF CITRUS SEEDS

Carl Berg, a Peace Corps volunteer in Ecuador, inquired about citrus rootstock and how best to introduce assorted varieties of citrus into his part of the country. I phoned Mr. Reed at Holmes Citrus Nursery for help.

There are five rootstocks that he recommends for anyone, anywhere (though he sells 18). These five are sour orange, 'Carrizo' citrange, 'Swingle', Cleopatra' mandarin and *Poncirus trifoliata*. If there is no danger of freeze or frost, he would add to the list the following: *Citrus macrophylla* (for extremely warm climate, but poor fruit quality), 'Rangpur' lime, 'Palestine' lime, 'Milam' and volkameriana. We also sent Carl budwood of superior varieties to bud onto wild citrus. These will be used to bud the new rootstock when it is ready.

The prices per quart range from \$30 to \$125, so most of ECHO's collaborators would be unable to try more than perhaps one variety. I asked if he would be willing to prepare an assortment in smaller packets. He agreed to the following. You can send him \$40 for an assortment of the first 5 mentioned above, all ten mentioned above, an assortment of citrus that will come true from seed, or any combination of these. He will arrange packet size to make the bill come out to \$40. We agreed to allow him some flexibility, as he would not have time for precise measurements, etc. You will receive approximately 1.5 pounds of seed. I would recommend that you add about \$20 for airmail postage, as citrus seeds begin to lose viability within a couple weeks after removal from refrigerated storage. Alternatively, you may know someone in the States that is about to visit you. The seeds could be sent to them via UPS. Mr. Holmes is doing this as a favor to help your work and does not assume responsibility for delivery by international mail systems. Send your order, mentioning the ECHO package arrangement, to Mr. Chuck Reed, Reed Brothers' Citrus, P.O. Box 1863, Dundee, FL 33838 (Phone 813/439-1916).

I also asked about susceptibility to *Phytophthora* root rot. He said that rough lemon is one of the worst rootstocks in regions where *Phytophthora* is a problem. It once was the primary rootstock in Florida, but has been totally replaced. All citrus trees are susceptible to *Phytophthora* root rot to some degree. If a workman injures a root and the organism is in the soil, it can enter and damage the tree. It can then kill after a few months or just reduce production. Some trees in a row may become infected and others not. Budwood is not infected.

ANSWERS TO SOME QUESTIONS ON CITRUS

Two of our readers asked some interesting questions about citrus. We called Larry Reed at Holm Citrus nursery who has so often been helpful. The questions and answers are of general interest, so I repeat them here.

Q. (From William Boykin in Zambia). "The navels, valencias and hamlins do not have the sweet flavors we had hoped. Is there anything we can do, or might it be the rootstock? We budded onto cape lemon."

A. The cape lemon rootstock is your major problem. Lemon rootstocks produce big quantities of fruit, but the quality is always poor. Lemon rootstock is for commercial juice production where they want to emphasize quantity. They then mix with smaller amounts of other juices to get the right taste. An advantage of the lemon stock is rapid growth, it being more vigorous than other stock. However, this also results in poor taste. Climate can also cause inferior taste. It would help if the climate were cooler. I would suggest budding onto either Carizzo or sour orange. They may not allow sour orange into the country because it is so susceptible to Tristeza. For example, Brazil's citrus industry was wiped out some years ago by tristeza. But it depends a lot on how virulent is the strain in your country. It is so good that I would take the risk and not worry too much about tristeza. My third choice would be Cleopatra mandarin. The disadvantage with it is foot rot. This worldwide problem is caused when workers injure the root while cultivating. It is most susceptible during the first 5 years. The safest thing would be to use a combination of rootstocks. Then it will be unlikely that you will be wiped out.

If you wish to plant some true-to-type seeds I would recommend two varieties: ridge pineapple or what is called "old sweet seedling." By the way, any true-to-type seedling [plant grown from seed that will give fruit like the parent tree] is susceptible to foot rot.

Q. (From Peter van Lonkhuyzen in Haiti). I have used budwood from some three-year-old trees that are not bearing fruit yet. Someone told me that by using such young trees my grafted trees will start bearing late and never will give good yields. Is this true?

A. A grafted tree will normally start bearing some fruit within a year. The fact that the parent trees you used were not bearing at three years suggests that they were seedlings. If so, you will have to wait about as long as if you had planted the seed.

There is one way you can get some quick budwood. Take budwood from a mature bearing tree and graft onto a rootstock in your area. As soon as this has grown to produce some branches, you can use this to bud other trees. They call this "first generation budwood." However, the second generation of trees should not be used for budding until they have started bearing.

Q. What rootstock should I use that is resistant to both drought and tristeza?

A. Sour orange is drought resistant, but if you want tristeza resistance also I would recommend Carizzo. Of course, even that is only drought resistant to a point. True-to-type seedlings will never tolerate drought as well as the normal rootstocks. I might also mention that a rooted cutting from any variety of citrus will have about half the normal life expectancy of a grafted citrus, due to susceptibility to a range of root diseases.

Q. How is it possible that in some places they have Washington naval trees without thorns while somewhere else the same variety has thorns?

A. There can be some differences in thorniness within a variety. In the one location they must have budded from trees that did not have thorns. You will still have some thorns of course. Alternatively, the thorny ones could be seedlings, as they tend to have more thorns.

Table 1. SOME REACTIONS OF ROOTSTOCKS TO DISEASES, NEMATODES, AND COLD.								
Rootstock Variety	Tristeza	Xyloporosis	Exocortis	Footrot	Blight	Burrowing Nematode	Citrus Nematode	Cold
Rough lemon	T	T	T	S	HS	S	S	S
Sour orange	HS	T	T	T	S**	S	S	T
Cleopatra mandarin	T	T	T	S	S**	S	S	T
Sweet orange	T	T	T	HS	S**	S	S	T
Trifoliata orange	T	T	HS	T	S	S	T	T
Rusk citrange	T	T	S	S	S	S	S	S
Carrizo citrange*	T	T	S	T	S	T	S	S
Estes Rough lemon	T	T	T	S	HS	T	S	S
Milam	T	T	T	HS	S**	T	S	S
Ridge Pineapple orange	T	T	T	HS	S**	T	S	T
Rangpur lime	T	S	S	S	S	S	S	S
Sweet lime	T	S	S	S	?	S	S	S
Citrus macrophylla	HS	S	T	T	S	S	S	S
Smooth flat Seville	S	T	T	T	S	S	S	T
Rangpur x Troyer	T	S	S	T	S	S	S	S
Swingle	T	T	T	T	?	S	T	T
Volkamer lemon	T	T	T	T	S	S	S	S

*Psorosis virus is transmitted through Carrizo citrange seed. Use seed from tested psorosis free sources only.

**Less susceptible than all others.