Table 1. Farm 1 hue values (h*).

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Day 1</th>
<th>Day 7</th>
<th>Day 11</th>
<th>Day 18</th>
</tr>
</thead>
<tbody>
<tr>
<td>NS-1</td>
<td>29.7</td>
<td>29.7a</td>
<td>31.2a</td>
<td>35.6a</td>
</tr>
<tr>
<td>NS-2</td>
<td>29.7</td>
<td>30.9a</td>
<td>32.5a</td>
<td>36.9a</td>
</tr>
<tr>
<td>Control</td>
<td>29.7</td>
<td>31.7b</td>
<td>34.0b</td>
<td>39.6b</td>
</tr>
<tr>
<td>NS</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
</tbody>
</table>

*p < 0.05, NS means not significantly different.

h* = hue angle (0° = red-purple, 90° = yellow, 180° = bluish-green, 270° = blue).

Table 2. Farm 2 hue values (h*).

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Day 1</th>
<th>Day 7</th>
<th>Day 11</th>
<th>Day 18</th>
</tr>
</thead>
<tbody>
<tr>
<td>NS-1</td>
<td>30.6</td>
<td>31.3a</td>
<td>33.6a</td>
<td>36.9a</td>
</tr>
<tr>
<td>NS-2</td>
<td>30.6</td>
<td>32.1a</td>
<td>33.9a</td>
<td>38.9b</td>
</tr>
<tr>
<td>Control</td>
<td>30.6</td>
<td>33.2b</td>
<td>36.0b</td>
<td>40.7c</td>
</tr>
<tr>
<td>NS</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
</tbody>
</table>

*p < 0.05, NS means not significantly different.

h* = hue angle (0° = red-purple, 90° = yellow, 180° = bluish-green, 270° = blue).

the ice was avoided. All fruit was transported to Orlando on the same day as harvest.

At the EcoScience lab in Orlando the fruit was de-stemmed and prepared for treatment. From the sample populations collected by farm, 30 fruit samples were selected at random for each treatment. Each treatment was repeated 3 times. As such, there were 90 total fruit per treatment for each farm. The treatments imposed were experimental Nature Seal 2000 #R3417-143-1 (NS-1), experimental Nature Seal 2000 #R417-139-1 (NS-2), and an uncoated control. All treatments were imposed on 9 June. Fruit were stored overnight at 16C and initial evaluations were done on 10 June. Color evaluation was done with the Minolta Chromameter 300 (Osaka, Japan). The LCh scale was used in order to facilitate interpretation and statistical analysis. Evaluations were made on days 1, 7, 11, and 18 following coating.

Results and Discussion

Upon coating, both Nature Seal formulations caused a decrease in hue angle values of lychee pericarps from Farms 1 and 2 (Tables 1 and 2). Chroma and lightness were not effected by either Nature Seal coating at the outset of the trial. Due to the initial difference in hue angle values, the treatment means for hue angle were significantly different on the first day of the trial. As such, the data were subjected to covariance analysis in order to allow for meaningful comparisons of treatment means.

The data indicate that there were significant differences between the two Nature Seal experimental coatings and the uncoated control. On the treatment lychees from both farms, the experimental formulations of Nature Seal had lower hue angles over time as compared with the uncoated control. Visually, however, none of the lychees were considered marketable with respect to color after day 11 due to pericarp browning across all treatments. The experimental Nature Seal formulations did reduce changes in hue angle, but not to the extent desired by producers wishing to maintain the fruit color at harvest for several weeks. While there is still promise for reducing the rate of pericarp browning in lychee with the use of polysaccharide coatings, further formulations development and field testing are required.

AN UPDATE ON GRAFTAGE METHODS FOR LYCHEE

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Additional index words. Rootstocks, cultivars, cambium, anatomy, Litchi chinensis.

Abstract. A resurgence of interest in growing lychee (Litchi chinensis Sonn.), both in Florida and other parts of the world, has created a need to learn grafting techniques developed in the past for this fruit tree. Rootstocks that are tolerant of less than optimum soil conditions must be used to establish varieties unable to grow well on their own roots as air layers, or from cuttings. Growers who are adept at grafting will be able to hasten the process of rootstock testing, essential for determining rootstock influence on yield and quality of lychee under South Florida conditions. This information will enable us to grow new varieties on our high pH soils.

Renewed interest in growing lychees in Florida has again brought attention to the importance of grafting newer cultivars onto rootstocks that have shown tolerance to the high calcium soils of South Florida. Although no research has been done on grafted trees on any rootstock, the major cultivars planted for fruit production, 'Brewster', 'Mauritius', and 'Bengal', are the most logical choice to test as rootstocks until other cultivars can be found. Currently, trees are grown either from airlayers or from rooted cuttings.

An example of a cultivar that does not thrive on its own root as an airlayer or rooted cutting is the famous lychee, 'Nom i ts'z', considered to be one of the best in China according to Groff (1921). It is being grafted onto rootstocks that have shown tolerance for high pH soils, both in South Florida and in Israel. Another cultivar that is being grafted onto 'Brewster', 'Mauritius', and 'Bengal' is the 'Emperor'. It has been a failure when attempts have been made to establish it as an air-layer on calcareous soils.

Methods used for grafting lychee have been inarching, chip and shield budding, and side veneer grafting. Some research was reported by Cobin (1948) on cleft grafting. Groff (1921) in his famous book, The Lychee and Lungan, describes cleft grafting as the main method the Chinese have used to top-work large lychee trees. Nelson (1954a; 1957) described graftage methods for lychee, using chip buds, shield buds,

dampered moss should be placed around the scion and secured with a plastic bag. Shade was recommended to prevent overheating inside the plastic bag during the period required for union between the scion and rootstock. These techniques of grafting proved successful, and I recommend that the present group of lychee enthusiasts try them.

I recently observed some interesting grafting procedures in Egypt, while on an assignment as an international volunteer advising on mango production. One very skilled propagator used a cleft graft on stems approximately 0.4 to 0.5 inches in diameter. A terminal scion was trimmed to a wedge, fitted into the slot on the stem, and wrapped with a plastic strip. The exposed part of the scion above the wrapped area was covered by a small plastic bag. A cone-shaped paper was placed over the plastic bag to protect the scion from the extreme heat that would occur inside the plastic bag from a “greenhouse” effect. The cone-cap and plastic bag were removed in 2 weeks. The plastic wrap was left in place for about 6 weeks to ensure that the scion was thoroughly united with the stock. The cone used as a cap over the scion should be of material that is waterproof if this is attempted in Florida—Egypt has less than 2 inches of rain per year in some areas, and almost no rain in most areas.

Figure 1. Grafted lychee trees, 9 months after grafting; (A) chip bud, (B) shield bud, (C) side veneer.

and side veneer grafts (Figs. 1 & 2). Cleft grafting was also recommended as sometimes advantageous. For best results,

Figure 2. (A) Scion and rootstock cut similar to the side veneer method. Scion has only one lateral bud at top. (B) Vinyl film wrap with opening at top for bud emergence.
I believe this cleft graft method should be attempted on lychee because this might allow a scion to have a greater chance of contacting active cambial cells. A more rapid growth of the scion is possible as there is very little competition if most of the leaves or sprouts are removed at the time the cleft is inserted into the stock. Cleft grafting is very successful on young avocado rootstocks and on ornamentals such as hibiscus and gardenia (Figs. 3 & 4).

The selection of graftwood is one of the most important considerations if lychee grafting is to be a success. I found that
the successful grafting of guava (Nelson, 1954b) was entirely
due to using scions of vigorous, more or less undifferentiated
tissue. The scions having these qualities of cell activity could
not be found on older trees unless drastic pruning was done
by topping approximately 1/3 of the tree selected as a scion
source. With adequate nutrition and water, vigorous shoots
were produced that provided scions that gave a high percentage
of success.

Lychee graftwood can be improved by a similar procedure
as was done to guava. Vigorous growth produces stems that
provide a larger diameter scion that is easier to cut to fit onto
the rootstock, hopefully providing more meristematic tissues.

Rootstocks grown from seeds should not be used because
of their variability. There is a good chance that many seedlings
would not have tolerance to alkaline soil, or they might
have other defects that could hinder the production of a uni
form and productive grafted lychee tree. Only clonal rootstocks
that have a known history of tolerance for calcareous soils
should be used.

Venning (1949) did the first anatomical study of lychee.
His research gave a rather discouraging picture of the poten
tial for successfully grafting lychee. He found that lychee
stems as small as 0.04 inches (1 mm) in diameter show all pri
mary tissue around the entire stem. No secondary tissues are
formed at this early growth period. However, when the stem
enlarges to 0.16 to 0.2 inches (4 or 5 mm) in diameter, the
 cambium is activated and is producing secondary tissues, but
only about half of the cambium is active around the stem at
any one growth period. When the stem reaches a diameter of
0.4 inches (1 cm), about 1/3 of the cambium is active during
a particular period of growth. This definitely presents a diffi
culty when a scion is placed on the rootstock, since there is no
external clue as to where the cambium activity is occurring.
Venning states that at certain growth periods, however, cambi
bial activity resumes movement around the stem. He suggests
that some grafting success is possible if the scion can be kept
from drying out during a period of cambial inactivity in the
area where the propagator may have placed the scion. The
question would be whether the cambial activity would resume
soon enough to reach the scion and provide cells that would
unite with the scion before it dies. High humidity under a
mist system could be used to keep the scion alive (Nelson,
1953a; 1954a).

Summary

We know that successful grafting has been accomplished
on lychee for many years by one technique or another. To in
crease the chances for successful grafting, efforts should be
made to obtain graftwood from trees that have been topped,
fertilized heavily, and have received all minor elements re
quired. Graftwood selection would most likely be available
several weeks following the fruit harvest. Trees will have re
ceived their heaviest fertilization as well as pruning. The
growth flushes will provide suitable scions on trees that have
been topped and hedged. Rootstocks should also be in a stage
of active growth.

The very active, recently organized lychee growers should
request some additional anatomical research to learn more
about cambial activity in the graftwood and rootstocks that
have been grown under the conditions I described, i.e., high
rates of fertilizer and forced growth flushes by severe pruning
of the graftwood source, and the use of very vigorous root
stocks.

The skill required to become a good propagator begins to
develop after grafting a few thousand trees and experiencing
both failure and success, while learning the art of grafting.

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CONFRONTING PLANT DIVERSITY WHEN PROPAGATING LITCHI CHINENSIS

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Additional index words. Airlayers, cross-pollination, rootstocks,
graftage, lychee.

Abstract. The Treehouse (Bokeelia, Fla.) has been involved in
the production of lychee (Litchi chinensis Sonn.) trees in par
allel with a wide range of citrus cultivars for over 18 years.

Many problems of the two bear a close resemblance. The ef
fects of parentage, limb and bud sports, virus and other caus
es on diversity has been well researched in citrus because of
its world-wide importance. The citrus investigations suggest
the path future research must take to resolve the problems en
countered in propagating the lychee. In addition, Groff's (1921)
work is relevant to modern problems with lychee propagation.
That we are dealing with a species of great genetic diversity,
manifesting severe graft incompatibilities, is quite apparent.
Having had to familiarize ourselves with many citrus disorders,
we can only come to one conclusion—that these incompatibil
ities of lychee are also indicative of graft-transmissible patho
gens. Thus, we view with alarm certain practices, used for