The fact that tetracycline antibiotics suppressed the development of lethal yellowing whereas penicillin was ineffective greatly supports the hypothesis that this disease is caused by a mycoplasma-like organism. The visualization of mycoplasma-like bodies in diseased plant tissue through the electron microscope does not necessitate their playing any etiologic role. However, the presence of these bodies along with positive tetracycline and negative penicillin chemotherapy provides the strongest possible evidence for a mycoplasma-like pathogen in the absence of cultural confirmation.

It was interesting to note that the terramycin-citric acid formulation was not effective. The pH of this solution was 2.0 as opposed to a pH of 4.0 in the tartaric acid formulation. It is possible that at this pH and citric acid concentration (40,000 ppm) the solution was toxic to the coconut tissue and the antibiotic was not translocated. A two gram dose of terramycin (tartaric acid formulation) injected in one liter of water was found to be readily translocated into coconut foliage in a previous test (3). In that test, levels of 3 ppm were obtained 3 days after injection. These levels fell off rapidly and no antibiotic was detectable after two weeks.

The terramycin soil drenches were ineffective, even though applied in doses 10 and 20 times greater than those injected directly into the palm trunks. However, it is expected that terramycin would be rapidly hydrolyzed in alkaline soil such as is present in the test area. In any case, there was no apparent uptake of antibiotic from the soil.

It is evident that the highly concentrated terramycin-tartaric acid formulation of 2 g/0.2 L (= 10⁵ ppm) was readily mobilized in the plant since it was just as effective as the 2 g/L treatment. This is important in that it reduced the time required for injecting one tree from one hour down to 15 minutes. Any conceivable large scale treatment program would naturally require a rapid means of treating individual trees with a suitable formulation of antibiotic solution.

### Literature Cited


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**JACARANDA PROPAGATION BY CLEFT GRAFTING**

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Bradenton

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Coral Gables

**Abstract.** A preliminary investigation conducted during 1971-72 dealing with jacaranda vegetative propagation clearly showed that cleft grafting produces a smoother union than side grafting and indicates that best results are obtained when the operation is performed between November and March. During 1972-73, the study was expanded to determine the effect of the age of the scion on the success of cleft grafting; to verify the best months for grafting; and to determine the anatomical aspects of callus formation and subsequent initiation of cambial activity. Detailed description of the grafting technique is summarized both verbally and pictorially.

The jacaranda, native of Tropical America is a popular ornamental tree in Florida due to its "fern-like" foliage and profusion of blue trumpet-shaped flowers.

Jacarandas may be propagated from seeds, cuttings, or by grafting. For a number of years, side-veneer grafting has been a popular means of propagating these trees. Unfortunately this type
of grafting frequently results in a poor union of stock and scion and produces a young tree with a crooked trunk.

The purpose of this paper is to present the basic technique involved in a two-year study of the propagation of jacarandas by cleft grafting.

**Results and Discussion**

**1971-72.**

Investigations conducted during 1971-72 showed the superiority of cleft grafting to side-veneer grafting for the propagation of jacaranda. Although the data summarized in Table 1 is limited, it indicates that the best time for cleft grafting jacarandas appears to be from approximately November to March. The scions used in this initial investigation were obtained from three trees of the Sky Blue variety growing in the Bradenton area. The seedling rootstocks were two years old at the time of grafting. The designation of scions as firsts, seconds, and thirds refers to the distance from the distal to the proximal end of the graft stick, the youngest being designated as firsts and the oldest as thirds. During the months of July through March of 1971-72, no records were kept as to the type or age of scions used but the mixed scions of January, February and March ranged in percentage of takes from 61 to 99. In April the scions were separated as firsts, seconds and thirds. The seconds and thirds were superior to the firsts with respect to the percentage of takes. The smaller percentage of takes with younger scion was attributed to the immaturity of the tissues of the scions which resulted in their failure to unite with those of the rootstocks. The same basic grafting technique was used in the 1971-72 preliminary investigation as is described in detail below for the 1972-73 studies.

**1972-73.**

In order to determine the best time of year for cleft grafting jacaranda and to determine the effect of maturity of scions on the percentage of successful grafts, the 1972-73 grafts were made from October through March and included scions of four gradations of maturity.

Rootstocks used for grafting had been grown from seeds planted in flats containing a mixture of 6 parts Stern's potting soil; 2 parts of Florida peat; 1 part hardwood shavings; 1 part cutting sand plus a small amount of iron and manganese. After 3 months, the seedlings were transplanted into pint pots in the same type mixture as above and allowed to remain there for 6 months before being transplanted into 1 gallon containers. Chlor-dane was added to the potting soil in the gallon containers prior to transplanting the young seedling plants as a control for fire ants. Subsequently these plants, in 1 gallon containers, were transferred into the open where they remained until grafted.

<table>
<thead>
<tr>
<th>Month</th>
<th>No. grafted grafts</th>
<th>Type scion</th>
<th>Firsts %</th>
<th>Seconds %</th>
<th>Thirds %</th>
<th>Mixture %</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No. takes</td>
<td>No. takes</td>
<td>No. takes</td>
<td>No. takes</td>
<td>No. takes</td>
<td>No. takes</td>
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<tr>
<td>July</td>
<td>1400</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>1400</td>
</tr>
<tr>
<td>Aug.</td>
<td>None</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Sept.</td>
<td>None</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Oct.</td>
<td>Few</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Nov.</td>
<td>Few</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Dec.</td>
<td>40-50</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Jan.</td>
<td>330</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>330</td>
</tr>
<tr>
<td>Feb.</td>
<td>170</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>170</td>
</tr>
<tr>
<td>March</td>
<td>9</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>9</td>
</tr>
<tr>
<td>April</td>
<td>40</td>
<td>16</td>
<td>56</td>
<td>16</td>
<td>75</td>
<td>8</td>
</tr>
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</table>
At the time of grafting the seedling rootstocks were two years old with stems measuring approximately ½ inch in diameter. The tops of the seedling rootstocks were removed to within about 6 inches above the soil level. A vertical cut, measuring approximately 2 inches in depth was made in the rootstock with a sharp grafting knife.

The terminal portion of young branches of the Sky Blue variety were used as scions. The leaves were removed with clippers leaving a short stub of petiole beneath each of the axillary buds. The terminal portion of each branch was cut into 4 sections each of which included 2 or 3 nodes. The youngest or most distal section was designated as a first, the next as a second, the next as a third and the most proximal or older portion as a fourth. The firsts measured approximately % inch in diameter at their basal ends, the seconds and thirds approximately ⅛ inches and the fourth ⅛ inches.

The base of each scion was cut to form a long, sloping wedge making a single cut on each side with a sharp knife. The cuts were started parallel to a pair of axillary buds so that following insertion, the buds would be located level with the cut end of the stock (Fig. 1). The scions were carefully trimmed to fit snugly throughout the entire length of the cut in the rootstock thus bringing the cambia of rootstock and scion into direct contact throughout the length of the sloping wedge. Following insertion, the graft was wrapped from bottom to top with a % inch strip of 8 mm. gauge plastic (Fig. 2). Particular care was taken in wrapping the top of the graft to be certain that the wrap was tight and waterproof (Fig. 3). The grafted plants were left initially in the seed house where the maximum average daily temperature ranged from 88-97°F and the minimum from 51-61°F.

The data in Table 2 show the jacaranda can be successfully cleft grafted from October through March. The percentage of takes for firsts was slightly less than for seconds, thirds and fourths in grafts made in December and March of 1972-73 which substantiates the preliminary observation made in 1971-72. Although the percentage of takes for fourths was excellent, their use is not recommended as the larger stocks and scions are too difficult to prepare due to the hardness of the wood.

Figure 4 shows a first, second and third three weeks after grafting. The graft on the left is a first which has failed to take, whereas, the second and third show marked vegetative development.
from the axillary buds of the scions. Figure 5 includes a mixture of grafted plants seven weeks after grafting at which time they had reached a height of 25 to 30 inches and the firsts were in bloom. The grafted plants were transplanted to 3 gallon plastic containers two months after grafting. Five months after grafting, approximately 60 percent of the successful grafts had attained a marketable height of 3½ to 4 feet. The remaining 40 percent reached this size seven to ten months after grafting (Fig. 6).

Within five to twelve months from grafting the unions were relatively smooth and ultimately became so smooth that the point of union in some instances could be ascertained chiefly as a difference in bark color of rootstock and scion (Fig. 7).

To minimize the tendency of the trunks to become somewhat crooked, the young grafted trees should be staked and tied once below and once above the graft union.

Cleft grafting was also tried on three year old rootstock measuring % to 1 inch in diameter and using larger scions. In some instances, it was necessary to insert a wedge to keep these clefts open. As was the case in the use of older scions described

![Fig. 3. Jacaranda wrap completed.](image)

![Fig. 4. Cleft grafted jacarandas three weeks after grafting. Left, a first which failed to take; center, a second; right, a third.](image)

Table 2. Cleft grafting of jacaranda - 1972-73.

<table>
<thead>
<tr>
<th>Month</th>
<th>No. grafted grafts</th>
<th>No. takes</th>
<th>Firsts</th>
<th>Type scion</th>
<th>Seconds</th>
<th>Thirds</th>
<th>Fourths</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>%</td>
<td></td>
<td></td>
<td>%</td>
<td>%</td>
<td>%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>No. takes</td>
<td></td>
<td></td>
<td>No. takes</td>
<td></td>
<td>No. takes</td>
</tr>
<tr>
<td>Oct.</td>
<td>10</td>
<td>10</td>
<td>70</td>
<td></td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Nov.</td>
<td>10</td>
<td>10</td>
<td>100</td>
<td></td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Dec.</td>
<td>104</td>
<td>43</td>
<td>86</td>
<td>28</td>
<td>93</td>
<td>24</td>
<td>100</td>
</tr>
<tr>
<td>Jan.</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Feb.</td>
<td>116</td>
<td>43</td>
<td>100</td>
<td>37</td>
<td>100</td>
<td>24</td>
<td>100</td>
</tr>
<tr>
<td>March</td>
<td>104</td>
<td>44</td>
<td>77</td>
<td>44</td>
<td>91</td>
<td>15</td>
<td>100</td>
</tr>
</tbody>
</table>
above, the hardness of the older wood would seem to limit the usefulness of cleft grafting with older rootstocks.

**Histology of Cleft Graft Unions.**

The histological work was limited but the observations are believed to merit presentation. An expansive production of cambial-like layers within the callus between the wood of the stock and scion was observed. Sass (1) reported the development of "recurved cambial extensions" into the callus of apple grafts in association with poorly matched grafts. The cambial-like layers in jacaranda are apparently of common occurrence in cleft grafts; are not necessarily associated with poorly matched grafts; and apparently do not prevent the successful union of stock and scion as the grafts used in these histological studies were selected at random from grafted seconds in which the scions were developing well vegetatively.

The cylinders of the grafts for study were removed approximately ¼ inch below the cut surface of the stock. Collections were made 16, 23, 32, 39, 45 and 53 days after grafting. The specimens were fixed in FAA; imbedded in paraffin-plastic; sectioned at 14-19 micra with a rotary microtome and stained with iron hematoxylin. Despite soaking the exposed surface of the imbedded specimens for several days in a 50% solution of glycerin and water, the xylem or wood remained hard resulting in poor sectioning in which the wood and bark frequently separated in the region of the vascular cambium.
Examination of the stained slides showed that complete cushions of callus had developed between the stock and scion within 16 days after grafting which is comparable to the observations in hibiscus made by Sharples and Gunnery (2). Cambial-like layers were developing within the callus with more extensive development adjacent to the scion than adjacent to the stock by the 16th day (Fig. 8A). After 23 days, some unions showed a vascular cambium bridge or are uniting the cambia of stock and scion (Fig. 8B). This section also showed tiered cambial-like tissue developing in the callus internal to the cambial bridge. The opposite side of the same union (Fig. 8C) showed no development of a cambial bridge, instead the cambia of both stock and scion had recurved into the callus cushion. Figure 8D shows a union 53 days after grafting in which the stock and scion were not perfectly aligned but the cambia of stock and scion ultimately united as a cambial bridge despite the somewhat poor alignment. The extensive proliferation of cells by the cambial-like layers of stock and scion appear in some sections to have crushed the entrapped callus tissue. The presence of vessels in tissues produced from these cambial-like layers leaves no doubt but that they produce xylem tissues behind them. The type of tissue produced ahead by the cambial-like layers could not be identified with certainty.

The exact origin of the cambial-like layers is not clear. The recurving of the vascular cambium of the stock and scion certainly could and probably does contribute to their initiation near the surfaces of the unions. Figure 8A would seem to indicate that deeper within the callus the cut surface of the wood of stock or scion may contribute to their development. Their origin in isolated areas within the callus cannot be attributed to either of the above sources. The possibility should not be overlooked that these cambium-like layers may result, at least in part, from proliferation of existing cambia located above or below the sections studied.

Fig. 8. Union of stock and scion in cleft grafts of jacaranda. A. 16 days after grafting, note apparent proliferation of xylem cells to cambial-like layer. B. 23 days after grafting, vascular cambial bridge completed. C. Opposite side of same union as in B, showing recurving of vascular cambium into callus. D. 53 days after grafting, vascular cambial bridge completed despite poor alignment of stock and scion. SC=scion; ST=stock; CA=callus; CB=cambial bridge; CL=cambial-like layer; VC=vascular cambium.
A more extensive study of sectioned material and an extensive survey of existing literature on graft unions might reveal additional information pertaining to this peculiar phenomenon and its effect on graft unions.

THE ECONOMICS OF MUNICIPAL STREET TREES

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Abstract. Street trees struggle against encroaching pavement, utility lines and conduits. Loss of prevalent “forest giants”, e.g. elms and maples, makes tree programs of many municipalities appear short-sighted and uneconomic. Much of public spending goes for maintenance and removal, up to 87.6% on elms alone in some areas. Maples amount to 73.5% of trees being planted and over 70% of tree removals other than elms. Despite the higher initial price, more dwarf flowering trees should be planted in future municipal tree programs to reduce the 50% of existing trees that are maples. A transition from forest giants to other species shows more trees maintained with less cost to the utilities and to the community. Total municipal tree expenditures appear significantly affected by the number of street trees, “tree removals” and median income per capita.