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Citrus rootstocks: an evaluation for new and replant areas

Department of Agriculture, Western Australia
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CITRUS ROOTSTOCKS
— an evaluation for new and replant areas

By Officers of the W.A. Department of Agriculture.

Widespread decline of citrus orchards in Western Australia associated with Phytophthora root rot, citrus eelworm and other factors has prompted investigation of various citrus rootstocks. Trifoliata and Troyer citrange are most suitable for replant areas. Wider use of these and of other stocks such as sweet orange is advocated for new plantings.

The ideal citrus rootstock is vigorous, compatible with all scion varieties, resistant to disease, tolerant of a wide range of environments and has the ability to raise both the quantity and quality of fruit produced by the scion variety. No one citrus species or hybrid has all these requisites; all having virtues and vices.

In Eastern Australia, as in this State, citronelle, because of its early vigour and high degree of compatibility with all commercial citrus varieties, was the principal rootstock for many years. Nurserymen favoured citronelle because of its good nursery performance. Unfortunately this has not been in the interests of the industry, since trees on this rootstock tend to carry poor quality fruit.

Phytophthora Root Rot

In recent years the unthriftness and low productivity of many of the older citrus orchards in Western Australia has presented some orchardists with the problem of replanting or else abandonment. A major factor in this decline is the fungal organism *Phytophthora* which progressively destroys the feeder roots of susceptible varieties of citrus. Rootstocks vary greatly in their resistance to this fungus.

* Phytophthora citrophthora.
Citrus Eelworm

The vigour of the root system is also affected by the citrus eelworm† which attacks the feeder roots. Feeder roots of trees so infested show the soil adhering to the roots in clumps. This is due to the sticky substance secreted by the eelworms to protect the eggs. The eelworm may occur in tremendous numbers, so that their presence depletes the vigour of the tree.

Rootstocks which are susceptible to the citrus eelworm are also susceptible to the Phytophthora fungus.

Salt Uptake

Studies elsewhere and in Western Australia have shown that accumulation of salts derived from irrigation water can cause serious defoliation in citrus. These salts can gain entry to the plant either through the foliage or through the root system. In Western Australia, damage is most likely to occur by entry through the foliage and special irrigation techniques are necessary to minimise foliage uptake. Entry through the roots is, however, significant and is the only method of uptake relevant to this article.

Research has revealed that there are major differences between rootstocks in the ease with which salt is taken up by the roots. This is illustrated by the results of an experiment in which the four common rootstocks in Western Australia were irrigated with water of different salinities ranging from 0 up to 70 grains per gallon of common salt (sodium chloride). The uptake of chloride was evaluated by analysing the foliage of the scion variety. The results of this experiment are clearly shown in Graph No. 1.

Where water quality is good the ability of a rootstock to control salt uptake is not of great moment, but where irrigation water relatively high in salt is being utilised consideration of this factor in the choice of rootstocks is highly desirable.

Trials and Fruit Quality Tests

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rootstocks and selected scion varieties. These have been planted in experimental plots at Stoneville Research Station and on growers' properties from Bindoon in the north to Capel in the south.

The rootstocks included in the experiments are citronelle, sweet orange, troyer citrange, Cleopatra mandarin and trifoliata.

Fruits from these trials have been the subject of extensive quality tests to determine rind weight and thickness, percentage juice, sugar content and acidity. This has been done to clarify the influence of rootstock on fruit quality.

These trials have only been in existence for seven years and therefore field observations and experience elsewhere have been drawn on extensively in addition to local experimental results in the preparation of this article.

ROOTSTOCK CHARACTERISTICS

Citronelle

Citronelle (citrus limon) is an anomalous member of the lemon group. In the nursery citronelle seed produces vigorous, uniform and erect seedlings which rapidly reach a suitable size for budding.

In the orchard trees on this rootstock also make vigorous growth and are suited to a wide range of soil types. It is still probably our best rootstock for soils of almost pure sand. Roots of citronelle have the ability to control the uptake of common salt very well and the stock can be used where irrigation waters are slightly saline.

The most serious shortcoming of citronelle is its susceptibility to attack by the Phytophthora fungus and for this reason it is not suitable for a replanting programme.

Cropping of trees on Citronelle tends to decline comparatively early in their productive life and often becomes biennial. Fruit is inferior in quality, texture and in external appearance. It is inclined to be thick skinned and tests have shown it to be lacking in juice and in sugar.

It is known that trees on other stocks have the ability to produce better quality fruit and are more disease resistant and these facts should be borne in mind by growers when planting orchards.

Sweet Orange

All the commercial oranges with the exception of the seville or sour orange group are included under this heading.
Usually those of the so-called “common” orange varieties are preferred as stocks. In the nursery these stocks tend to branch early and to grow slowly but are compatible with all scion varieties. When planted out in the orchard trees on sweet orange make vigorous growth, eventually growing into very large, long-lived trees so that some allowance for eventual tree size should be made at planting. This rootstock is susceptible to Phytophthora root rot, though to a lesser degree than citronelle. Like citronelle, however, it is tolerant of a wide range of soils but has less ability to control salt uptake. To date trees on sweet orange have produced fruit superior in quality to that carried by trees on citronelle. Sweet orange is therefore a useful stock for deep loam or sandy loam soils.

**Trifoliata** (Poncirus trifoliata)

Trifoliata is related to, though not an actual member of the genus citrus. It has the peculiarity of being the only member of the citrus group to be deciduous in its habit of growth. This unusual feature is not transmitted to evergreen citrus varieties when trifoliata is used as a rootstock.

Trifoliata grows well in the nursery but is not as vigorous as citronelle. It often takes two years to reach a suitable size for budding. Unfortunately trifoliata is susceptible to the virus disease Exocortis or scaly butt. This virus can be carried by all the commercial citrus varieties without obvious symptoms or otherwise harmful effects. When it is transmitted to trifoliata stocks by way of scion wood from infected trees the resultant infected tree remains stunted and unproductive or occasionally dies within a few years. Therefore budwood known to be virus free must be used in the production of trees on trifoliata.

All the commonly grown commercial varieties of citrus fruits with the exception of Eureka lemon have been found to be compatible with trifoliata. These include Valencia, navel, all mandarins, Lisbon lemon and grapefruit.

Trifoliata has two highly valued characteristics. Firstly it exerts a beneficial influence on the quality of the fruit produced by the scion variety. Testing has shown that, locally, trees on this rootstock produce fruit which is superior to that carried by trees on all other rootstocks. Secondly it is rated as highly resistant or immune to the root rotting Phytophthora fungus and to eelworm attack. Due to this immunity it has, in recent years, been used extensively for replanting old orchards.

Trifoliata is reported elsewhere as being adaptable to most soils but in this State, although suited to slightly acid loams, it has been difficult to establish on light sands. It also shows a low tolerance to alkaline soils and its roots take up salt very readily. All local trials have shown it to be sensitive to shortages of trace elements when young. These deficiencies include manganese, zinc and copper, all of which can be rectified by foliage spraying so that they do not constitute a serious problem.

Field observations disclose that trifoliata has some drought resistance. Cropping commences early and young trees coming into bearing often suffer from over-production. Mature trees crop well and are less inclined to biennial bearing than are those on citronelle. However, they do not grow
as large as trees on Citronelle and consideration could be given to maintaining production per acre by adopting a slightly closer planting distance.

**Citranges**

The citranges are hybrids between sweet orange and trifoliata. They inherit most of the characteristics of the trifoliata parent and are therefore susceptible to scaly butt virus so that virus free budwood must be used. Two types of citrange, the Troyer and the Carizzo, are under trial in Western Australia.

No trees on this rootstock in Western Australia are more than seven years old, but, performance to date suggests that they are similar to trees on trifoliata in disease and eelworm resistance and in the ability to produce heavy regular crops of high quality fruit. They differ from trifoliata in that they make stronger growth and are more suitable to planting on sandy soils. Roots of the citranges also take up salt less readily than do those of trifoliata (see Graph 1) but are just as sensitive to low levels of trace elements.

The citranges appear to be suited to a wide range of soils and environments and since they produce high quality fruit could well be planted more extensively.

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**Conclusions**

To classify the suitability of the four principal rootstocks for various situations the following table has been drawn up, but it is emphasised that some of the information has been obtained from trees not more than seven years old.

<table>
<thead>
<tr>
<th>Characters</th>
<th>Citronelle</th>
<th>Sweet Orange</th>
<th>Troyer Citrange</th>
<th>Trifoliata</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resistance to Phytophthora and to citrus root eelworm</td>
<td>Not resistant</td>
<td>Slight resistance</td>
<td>Resistant</td>
<td>Highly resistant</td>
</tr>
<tr>
<td>Tolerance to scaly butt virus</td>
<td>Tolerant</td>
<td>Tolerant</td>
<td>Susceptible</td>
<td>Susceptible</td>
</tr>
<tr>
<td>Fruit Quality</td>
<td>Inferior</td>
<td>Quite good</td>
<td>Good</td>
<td>Excellent</td>
</tr>
<tr>
<td>Growth</td>
<td>Vigorous</td>
<td>Vigorous</td>
<td>Vigorous</td>
<td>Moderate</td>
</tr>
<tr>
<td>Salt uptake</td>
<td>Comparatively low</td>
<td>Moderate</td>
<td>Moderate</td>
<td>High</td>
</tr>
<tr>
<td>Trace element deficiencies</td>
<td>Not particularly prone</td>
<td>Not particularly prone</td>
<td>Susceptible</td>
<td>Susceptible</td>
</tr>
</tbody>
</table>
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