



# ASLP Citrus Factsheet

Australia-Pakistan Agriculture Sector Linkages Program



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## Citrus Rootstocks for Pakistan

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### Introduction

Rootstocks are used to overcome disease issues and challenging soil characteristics, and to enhance fruit quality and production. Rootstocks are selected based on:

- scion variety
- soil type
- water and soil salinity
- irrigation method
- disease pressure
- tree vigour
- desired fruit quality (i.e. time of fruit maturity, sugar and acid levels)

It is often difficult to select a rootstock that perfectly matches your situation. Rootstocks are often chosen by considering the most important attribute or limiting factor.

Rootstocks such as sweet orange, rough lemon and sour orange were used extensively around the world in the early 1900s. However these rootstocks were susceptible to citrus nematode, *Phytophthora* root and collar rots, and *Citrus tristeza virus* (CTV). In the mid-1900s, CTV killed many citrus trees on sour orange rootstock throughout the world; the affected countries overcame CTV and other disease problems by replanting on modern rootstocks such as *Citrus trifoliata* (trifoliata), citrange types (Troyer, Carrizo, Benton) and Cleopatra.

Modern rootstocks, such as trifoliata, have shallower root systems than the older types. These shallower rooted rootstocks require more frequent irrigations than the deep rooted varieties. The adoption of modern rootstocks occurred in conjunction with increasing popularity of modern and efficient irrigation methods, such as drip and sprinkler systems. Furrow irrigation is not as efficient as drip or sprinkler, but is much better than full flood irrigation. Trees can be irrigated weekly with furrow irrigation to satisfy modern rootstock needs.

## Rootstocks for Pakistan

Rough lemon rootstock is commonly used for Kinnow mandarin in the Punjab region. The majority of growers flood irrigate on a fortnightly basis and the high vigour of the rough lemon rootstocks are able to exploit the soil moisture under these saturated conditions. Trifoliata rootstocks are best suited to the clay loam soils of Punjab because their shallow roots (30-40cm) are able to use the higher soil oxygen levels found near the soil surface. Citrange is less suited to heavier soil types because their deep roots (50-60cm) suffocate for lack of oxygen at depth in clay soils. Citrange types are better suited to sandy well drained soils; trifoliata may also be used on sandy soils but trees must be irrigated more frequently than trees on citrange rootstocks.

Sour Orange is a commonly used rootstock for blood orange varieties in the KP region. The majority of growers use this rootstock because it enhances fruit quality. However, since 2010 trees on sour orange are developing symptoms of CTV infection and the industry will need to rapidly change to CTV resistant rootstocks or suffer tree death across the region. Both citrange and trifoliata rootstocks have some tolerance to CTV. Citrange would be a suitable rootstock in KP for use in well-drained sandy soils whilst trifoliata or other rootstocks might be suited to heavier soils.

## Rootstock incompatibility

Not all rootstocks are compatible with all scion varieties. Rootstock incompatibility is often characterised by an overgrowth of the rootstock where it is joined to the scion.

Incompatibility between the scion and rootstock can kill young trees or it can take 10 to 15 years for trees to decline.



**Figure 1: Benching (overgrowth) of the rootstock where it was grafted to the scion is caused by rootstock incompatibility. This caused the death of this tree.**

**Table 1. Summary of common citrus rootstocks - advantages and disadvantages**

Stock	Characteristics	Requirements	Major risk factors
<i>C. trifoliata</i>	Highly resistant to <i>Phytophthora</i> , <i>Citrus tristeza virus</i> (CTV) and citrus nematode. Intolerant of <i>Citrus exocortis viroid</i> (CEV) and <i>Citrus tatterleaf virus</i> (CTLV). Cold hardy. Shallow depth of rooting but develops high fibrous root density. Tree size small to medium. Generally highly fruitful. Fruit quality very good.	CEV and CTLV free budwood. Will grow on wide range of soils, but prefers loams. Intolerant of highly acid and lime soils. Poor drought tolerance.	Incompatible with Eureka lemon and acidless oranges. Compatibility with some minor varieties unknown. Despite accumulating high levels of chloride in leaf tissue does not exhibit obvious toxicity symptoms. Prone to 'sudden death'.
Carrizo & Troyer citranges	Resistant to <i>Phytophthora</i> ; tolerant to CTV. Infection by CEV results in reduced tree size, but no butt scaling; intolerant of CTLV. Cold hardy. Mycorrhizal dependent. Intermediate depth of rooting; main lateral and fibrous root development may be poor in young trees. Medium to large trees, usually very productive with good fruit quality.	CEV and CTLV free budwood. Adapted to wide range of soil types, except highly calcareous soils.	Incompatible with Eureka lemon. Very prone to micronutrient deficiencies, especially on calcareous soils. Compatibility with some minor varieties unknown. Prone to 'sudden death'.
Swingle citrumelo	<i>Phytophthora</i> and tristeza tolerant; nematode resistant; intolerant of CEV and CTLV. Drought tolerant. More salt tolerant than other <i>C. trifoliata</i> hybrids. Good fruit quality.	CEV and CTLV free budwood. Not suited to clay or highly calcareous soils.	Sensitive to overwatering. Incompatible with Eureka lemon and some orange and mandarin cultivars. Overgrows orange varieties. Fruit more prone to creasing.
Cleopatra mandarin	Moderately susceptible to <i>Phytophthora</i> root and collar rots. Tolerant to CTV and CEV. Susceptible to citrus and burrowing nematodes. Intermediate depth of rooting; intensive fibrous root development. Slow growing in nursery, mature trees large. Early production poor, satisfactory in mature trees. Good fruit quality but small fruit size with some cultivars.	Performs well on both heavy and light soils; best suited to loams. Lime and salinity tolerant.	Tendency to small fruit size. Good drainage and precautions against root rot essential. Slow to come into bearing.
Rough lemon (citronelle)	Susceptible to <i>Phytophthora</i> root and collar rots, and citrus nematode. Tolerant to CTV and CEV. Mycorrhizal dependent. Extensive lateral and vertical root development. Highly drought tolerant. Produces large trees. Yields are high, of good fruit size, but poor quality. Promotes early maturity.	Best on deep virgin sandy soils.	Does not tolerate poorly drained soils. Tendency to accumulate excessive chloride leading to leaf drop. Unsuitable for some mandarins e.g. Satsuma and Ellendale tangor.
Sweet orange	Very susceptible to <i>Phytophthora</i> root and collar rots; susceptible to citrus nematode. Tolerant to CTV and CEV. Mycorrhizal dependent. Intermediate depth of rooting. On well-drained soils in inland areas produces large trees. High yielding with good fruit quality.	Best on deep sandy soils. Sensitive to dry conditions but tolerates calcareous soils.	Does not tolerate excessive soil moisture.
Benton citrange	Resistant to <i>Phytophthora</i> root and collar rots. Compatible with Eureka lemon. With Eureka produces trees of intermediate size and good cropping efficiency.	CEV and CTLV free budwood. Not suitable for calcareous soils.	Limited experience. Tolerance to nematodes unknown.

Table 2. Average effect of rootstock on citrus fruit quality

Quality characteristic	Rootstock					
	<i>C. trifoliata</i>	Carrizo & Troyer citrange	Swingle citrumelo	Cleopatra mandarin	Rough lemon	Sweet orange
Fruit size	medium-large	medium	medium-large	small-medium	large	medium
Rind thickness	thin	thin	thin	thin	thick	medium
Rind texture	smooth	smooth	smooth	medium	coarse	medium
Maturity	mid-late	mid	mid	mid	early	mid
Juice content	high	high	high	medium	low-medium	medium
TSS	high	high	high	medium	low	medium
Acidity	high	medium-high	medium	medium	low	Medium

Table 3. Relative tolerance of citrus rootstocks to disease, citrus nematode, salinity and lime

Rootstock	Phytophthora	CTV	Citrus nematode	Salinity	Lime
<i>C. trifoliata</i>	1	1	1	5	5
Carrizo Citrange	2	1	3	3	4
Troyer Citrange	2	1	3	3	4
Swingle citrumelo	2	1	1	2	4
Benton Citrange	2	1	?	4	4
Cleopatra mandarin	3	1	4	1	1
Rough lemon	4	2	4	4	3
Sweet orange	5	2	4	3	2

1 = best of rootstocks listed; 5 = worst of rootstocks listed

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