

Lemon Rootstock Trials in Arizona – 2006-07¹

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Abstract

*In a rootstock evaluation trial planted in 1993, five rootstocks, 'Carrizo' citrange, *Citrus macrophylla*, 'Rough Lemon', Swingle citrumelo and *Citrus volkameriana* were selected for evaluation using 'Limoneira 8A Lisbon' as the scion. 1994-2006 yield and packout results indicate that trees on *C. macrophylla*, *C. volkameriana* and 'Rough Lemon' are superior to those on other rootstocks in both growth and yield. *C. macrophylla* does not consistently outperform *C. volkameriana*. 'Swingle' and Carrizo' are performing poorly.*

Introduction

There is no disputing the importance of citrus rootstocks to desert citrus production. The ideal citrus rootstock must be compatible with the scion, be adaptable to the appropriate soil and climactic factors and should also improve one or more of the following characteristics: pest and disease resistance, cold tolerance, precocity, internal and external fruit quality, yield and/or post-harvest quality. Ultimately, the value of a rootstock lies in its ability to improve production and/or quality of the fruit.

Climactic and edaphic characteristics of the desert citrus growing regions impose stress upon a citrus tree. Many times, rootstocks that are suitable for other areas are not suitable in the desert. Conversely, rootstocks that may be of limited value in other citrus growing areas might be more useful under desert conditions. It cannot be assumed that rootstocks will perform similarly across all climactic and edaphic conditions.

The first rootstock trial that we planted in 1993 was established to fill a large knowledge gap as to which were the appropriate lemon rootstocks for the Arizona industry. This trial includes rough lemon (*C. jambhiri*), a vigorous and formerly popular rootstock that is susceptible to *Phytophthora* root rot, and *C. macrophylla*, also popular, but susceptible to brown wood rot (*Coniophora eremophila*. and *Antrodia spp.*) and Macrophylla decline. Also included are *C. volkameriana*, a newly popular but untested rootstock, as well as 'Carrizo' citrange and 'Swingle' citrumelo as experimental rootstocks for the desert ('Carrizo' is commonly used as a rootstock for lemon in coastal California). 'Limoneira 8A Lisbon' lemon is the scion. Data collected from these trials has included tree growth, mineral nutrition, fruit quality, fruit size and total yield. Previous results from this trial have been reported in Wright and Peña (2006), Wright and Peña (2005), Wright and Peña (2004), Wright and Peña (2002), Wright and Peña (2001), Wright and Peña (2000), Wright *et al.* (1999), Wright (1998), Wright (1997), Wright (1996) and Wright (1995).

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Materials and Methods

This trial was established in March 1993 in Block 26 of the Yuma Mesa Agricultural Center, near Yuma, Arizona. The land was laser leveled and fumigated prior to planting. Trees were planted on a 10-m x 10-m spacing. Ten replicates of each of the 5 rootstocks were planted for a total of 50 trees. Experimental design is randomized complete block.

Irrigation is border flood, and normal cultural practices are used. Growth data, expressed as trunk diameter, was taken annually through 1997. Measurements were taken about 4 inches above the bud union. These locations were permanently marked with paint. Trunk diameters were taken annually in March, so as to quantify any differential growth rates that might have occurred. Leaves are collected annually in August for mineral analysis; however there have been no significant differences in leaf nutrient content.

Yield data is typically collected during the fall and winter. Trees were picked only once during the season, on 10-11-06. Prior to 1999-2000, about 30 lbs of fruit was sampled from each tree, and fruits were sized by hand and graded by observation. Since 1999-2000, the entire harvest from each tree has been passed through an automated electronic eye sorter (Autoline, Inc., Reedley, CA), which provides weight, color, exterior quality and size data for each fruit. There was no effect of rootstock on fruit color in 2006. Fruit packout data is reported on a percentage basis.

All data was analyzed using SPSS 8.0 for Windows (SPSS Inc., Chicago, Illinois).

Results

For 2006-07, trees on *Citrus macrophylla*, and *Citrus volkameriana* rootstocks had greater yields (ranging from 175 to 225% more) than those on 'Carrizo' citrange and 'Swingle' citrumelo (Figure 1). This continues a trend that has been apparent since the 1996-97 season. However, compared to the previous year, yields for trees on all the rootstocks tested dropped by more than 90%. We attribute this drop as a response to the high yields of the 2005-06 year. It is likely that tree carbohydrate levels were depleted after the 2005-06 year, and could not support a large fruit load for the 2006-07 season. Considering only the yield from the 2006-07 year, *C. macrophylla*, and *C. volkameriana* trees had the significantly greater yield, while trees on 'Rough lemon' and 'Carrizo' and 'Swingle' lagged (Figure 2). This year was the first year that 'Rough Lemon' yields were not similar to those of trees on *C. macrophylla*, and *C. volkameriana*.

Packout for the 10-11-06 harvest is shown in Figure 3. Trees on *C. macrophylla*, *C. volkameriana* and rough lemon had significantly more fruit of sizes 75 and 95, and significantly fewer fruit of sizes 140 and 165 than trees on the other two rootstocks tested.

For 2006-07, rootstock also affected fruit shape. Fruit of trees on 'Swingle' were significantly rounder than fruit of trees on *C. macrophylla*. Rootstock did not affect fruit color, or exterior quality (data not shown) .

Discussion and Conclusions

It is still apparent that all rootstocks other than *C. macrophylla*, *C. volkameriana* and 'Rough Lemon' are unsuitable as rootstocks for lemon in Arizona in high pH soils. Reduced vigor, late fruit sizing and ultimate small fruit size are characteristics that have not yet been overcome.

Differences between *C. volkameriana* and *C. macrophylla* had been becoming increasingly clear. From 1997-98 until 2003-04, yield of trees on *C. macrophylla* has equaled or surpassed the yield of trees on *C. volkameriana*. However, for the past three seasons, yields of trees on these two rootstocks were virtually the same. There is no clear trend as to which of these rootstocks produces earlier fruit, and overall fruit size appears to be similar. Arizona

packinghouse managers report that fruit of trees on *C. macrophylla* have a smoother peel, which leads to better overall fruit quality. Growers also report that *C. volkameriana* produces more water sprouts on the trunk than does *C. macrophylla*, and that trees on *C. volkameriana* show more transient nutrient deficiencies in the winter (winter yellows), than do trees on *C. macrophylla*. Perhaps an altered fertilizer regime with more fall micronutrient application would improve the yield of *C. volkameriana* trees. In light of the January 2007 freeze, it is also notable that some producers report that trees on *C. volkameriana* appear to be more cold hardy. It remains to be seen if yield for *C. macrophylla* will decline, and yield of *C. volkameriana* will surpass that of *C. macrophylla*.

After a slow start, 'Rough Lemon' has not had significantly different yield than *C. volkameriana* for the past seven years. 'Rough Lemon' has not typically produced as well as *C. macrophylla*, but for the first time in 2004-05, it had the greatest yield. This was not repeated in 2005-06 or in 2006-07. When there is more than one harvest per season, 'Rough lemon' continues to produce less early-season fruit compared to the other two vigorous rootstocks tested. 'Rough Lemon' is more difficult to grow in the nursery due to its greater susceptibility to *Phytophthora* root rot, so its availability is somewhat limited unless trees are special ordered on this rootstock.

Based on the results thus far, *C. macrophylla* appears to be a superior rootstock for lemons in Arizona; although the possibility exists that it may decline sooner than 'Rough Lemon' or *C. volkameriana*. The recent freeze event underscores the fact that it is probably not a good idea to plant all ones acreage on only one rootstock, thus either *C. volkameriana* or 'Rough Lemon' would be a good complementary rootstock as well.

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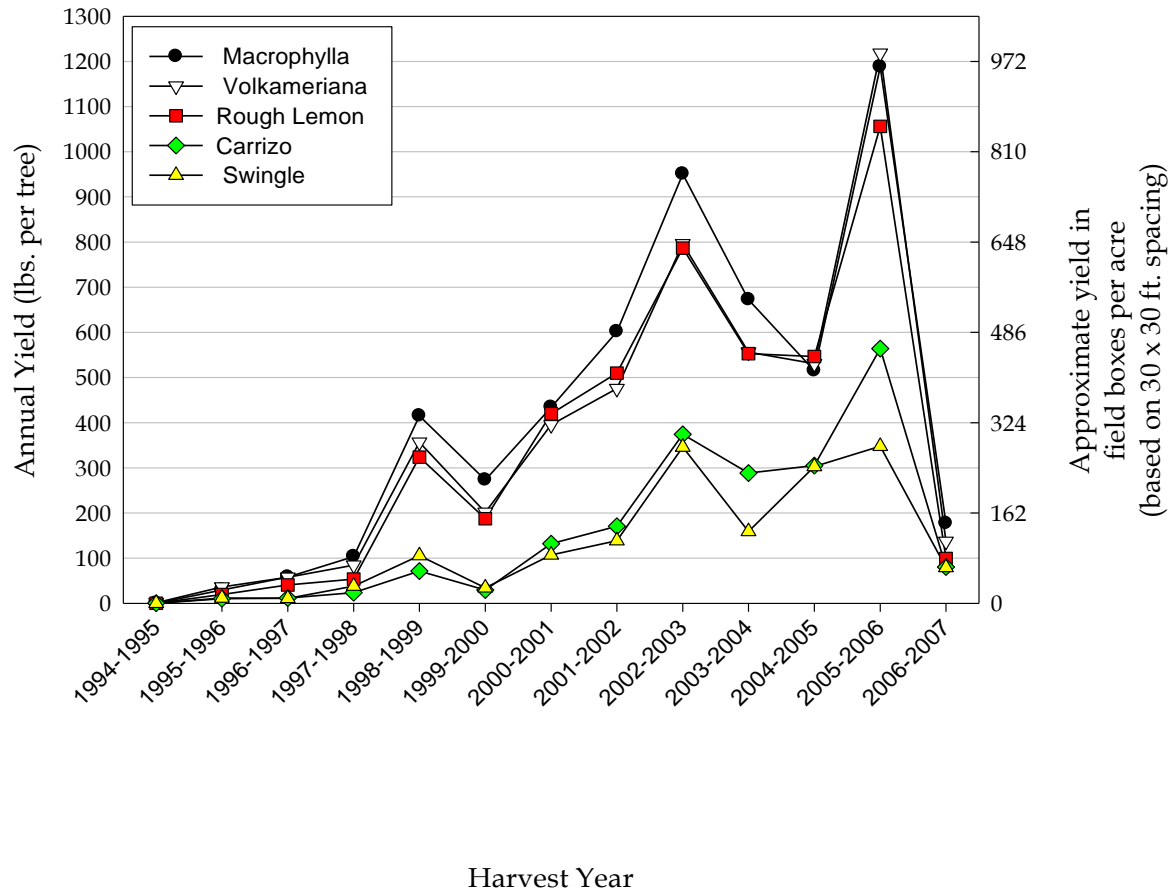


Figure 1. 1994 – 2006 ‘Limoneira 8A Lisbon’ lemon yields on five rootstocks.

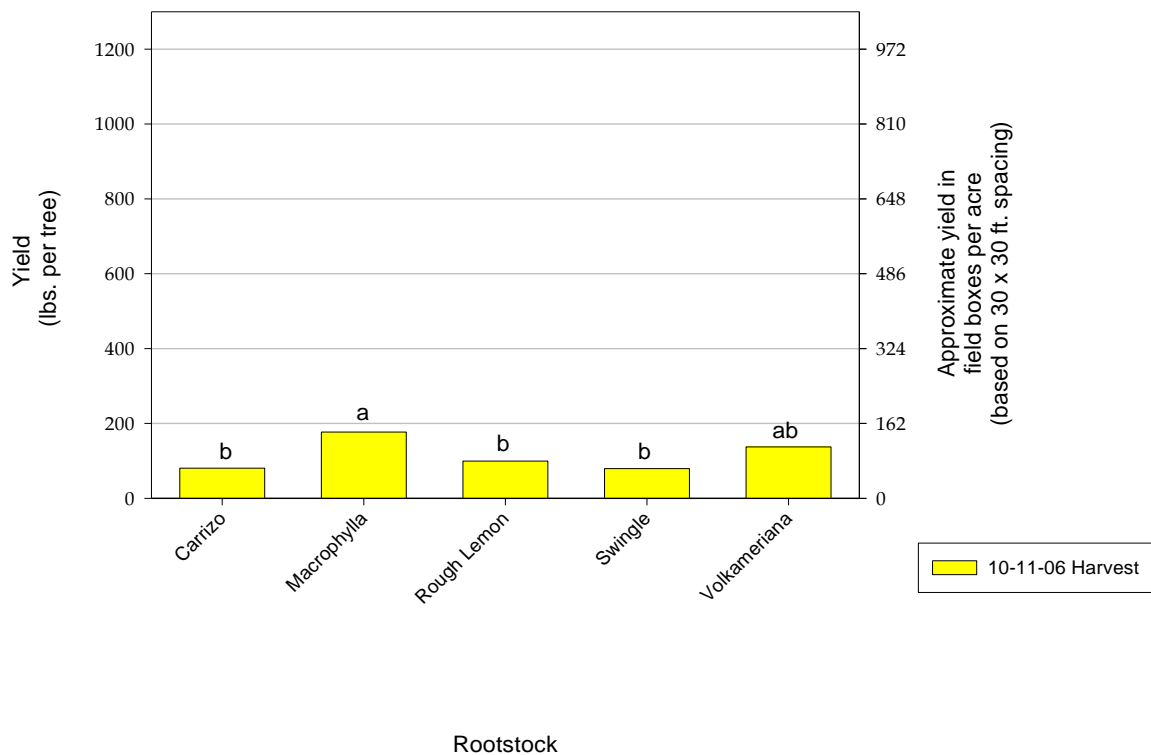


Figure 2. 2006-07 yield of 'Limoneira 8A Lisbon' lemon yields on five rootstocks. Means by Duncan's multiple range test, 5% level.

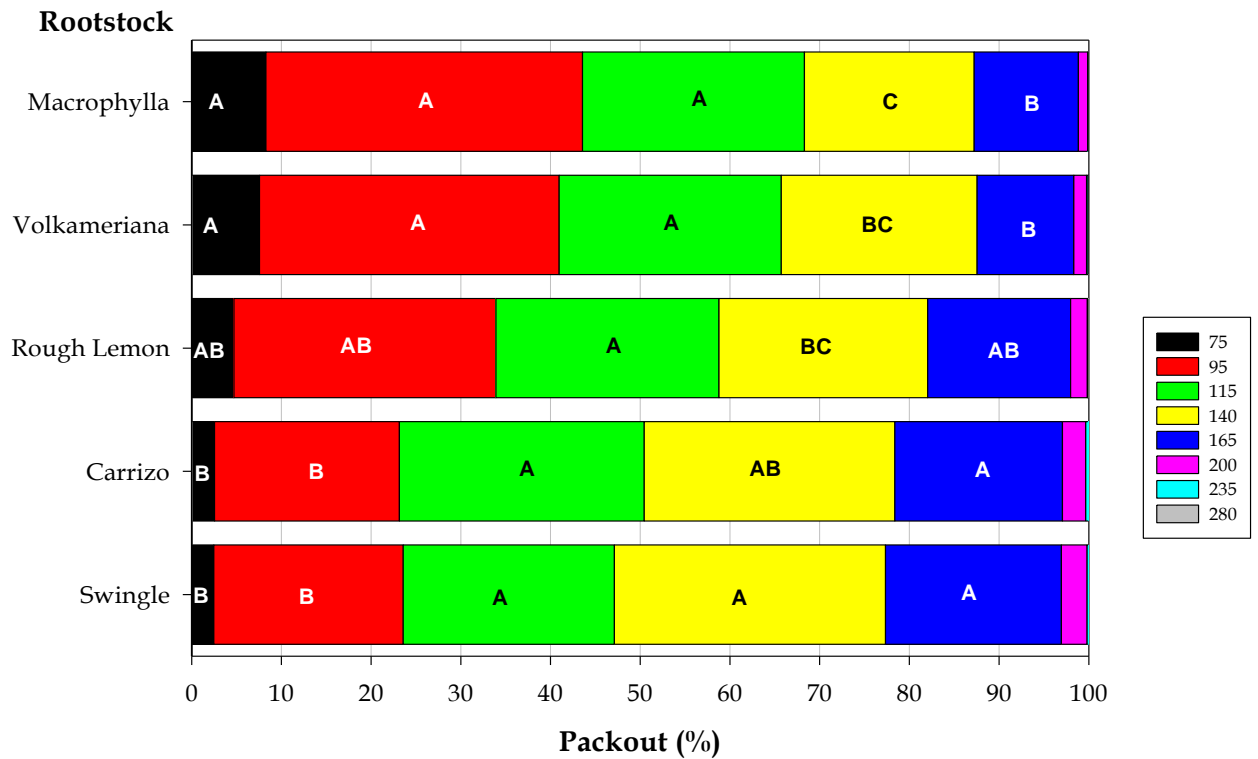


Figure 3. Packout of 'Limoneira 8A Lisbon' lemons on five rootstocks from the October 11, 2006 harvest. Means separation within fruit sizes by Duncan's multiple range test, 5% level. Bars of the same shade are significantly different if the letters within them are different. Bars of different shades cannot be compared.