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Citrus Rootstock Usage in the Indian River Region ¹

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Introduction

Sour Orange Rootstock and CTV

Potential Impact of Sour Orange Tree Loss on Grapefruit Production

Worldwide overproduction of grapefruit has greatly depressed prices, and the Indian River area is the worlds largest producer. The proportion of trees remaining on sour orange rootstock may be important in gauging the economic future for the Indian River citrus industry, especially for efforts to predict the duration of the current grapefruit oversupply. The rate of tree decline is also an important factor and grapefruit trees are less susceptible to infection with at least some CTV strains, displaying much slower infection rates than sweet oranges even where BCA is present. However, some researchers suspect that grapefruit and sweet orange express symptoms at a similar rate once they are infected.

Potential Impact of Swingle Decline on Grapefruit Production

In addition, grapefruit was widely planted on Swingle citrumelo rootstock in the 1980s and 1990s. Some of these plantings have become unproductive

where planted on soils with significant clay content or high calcium. Further losses from those groves may also influence future Indian River production.

Finally, while sour orange was a superior rootstock on all Indian River citrus soil types, no other rootstock has been proven as an excellent choice for grapefruit on high pH soils or those that contain substantial clay, making rootstock selection difficult where these soils are present. Two surveys were conducted to provide information on rootstock usage in the Indian River citrus growing region.

Surveys of Rootstock Usage

Survey of Rootstock Use Across All Indian River Citrus Varieties: 1998

Surveys were sent to numerous area citrus growers in June 1998 to assess the overall grove area planted with different rootstocks in the Indian River region, without regard to scion varieties. Respondents were also asked to identify any problems that they observed with the following rootstocks: sour orange, Cleopatra mandarin, Carrizo citrange, Swingle citrumelo, Smooth Flat Seville, and Sun Chu Sha mandarin.

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Survey of Rootstock Use in Indian River Grapefruit: 2000

Surveys were again sent to numerous area citrus growers in December 2000 to assess the overall area of grapefruit planted with different rootstocks in the Indian River region. Respondents were also asked to identify the percentage of grove area on sour orange and Swingle that experienced substantial decline in the preceding twelve months, and what proportion of decline appeared to result from CTV based on grower observation of field symptoms. These questions were asked to increase accuracy of economic projections about grapefruit production over the next ten years.

Rootstock Usage Summaries

Rootstock Usage Summary Across all Indian River Citrus Varieties from the 1998 Survey

Out of about 182,000 acres of Indian River citrus, 64,200 acres of production were represented by the survey respondents, accounting for 35 percent of Indian River citrus. Sour orange was the dominant rootstock with 48 percent of the reported grove area (see Table 1). Swingle, which has accounted for nearly 50 percent of the citrus trees propagated in Florida in the last ten years, accounted for 22 percent of reported area, while Carrizo was the third most numerous rootstock reported. Cleopatra mandarin has been used on a low percentage of plantings for many years, while Smooth Flat Seville has largely been used as a replacement for sour orange in fine-textured soils in recent years.

Rootstock Usage Summary for Indian River Grapefruit from the 2000 Survey

Out of about 83,000 acres of Indian River grapefruit, 44,000 acres of production were reported by the survey respondents, accounting for 53 percent of grapefruit grove area. Sour orange was again the dominant rootstock with 55 percent of the reported grove area (see Table 1). Swingle accounted for 27 percent of reported grove area, while Cleopatra was third, Carrizo fourth, and Smooth Flat Seville the fifth most numerous rootstock reported.

History of Individual Rootstock Usage and Rootstock Characteristics

Sour Orange

History of Use

According to Citrus Budwood Registration Bureau (2001) records, sour orange use for new tree propagations in Florida ranged from 19 to 52 percent in every year from 1953 to the 1986-87 season, representing a total of 22 million (31 percent) of the 65 million trees produced. During this period the percentage of grapefruit trees produced on sour orange was generally much higher than the average for all Florida citrus. In 1987-88 only 6 percent of trees were propagated on sour orange, and after that time, the proportion has declined to a negligible level. Overall, since 1987-88 only 1.4 million trees (2.4 percent) have been propagated on sour orange out of a total of 58 million reported. This tremendous decline occurred almost exclusively because of concern about sour orange susceptibility to CTV.

Advantages of Sour Orange

The fact that about 50 percent of Indian River citrus is still on sour orange reflects the nearly complete domination of sour orange in the region before 1987, since 43 percent of current Indian River grapefruit and 45 percent of all citrus grove area has been planted since 1987, when new plantings on sour orange essentially ceased. In addition to concerns about soil adaptation and general horticultural quality, some growers expressed doubt that other rootstocks provide several fruit quality advantages associated with sour orange. Sour orange rootstock is considered unsurpassed for maintaining fruit quality, and also is widely believed to provide superior postharvest handling qualities.

CTV and Sour Orange

Grapefruit was 46 percent and sweet orange 49 percent of all citrus grove area in the Indian River district in the 1999-2000 season (Florida Agricultural Statistics Service, 2001). The rate of CTV infection has been extensively studied in sweet oranges and generally shows an exponential increase

when infection rate exceeds 10 percent. It appears likely that sweet orange trees planted on sour orange will decline within a few years in most Indian River groves, since quick decline strains of CTV are widespread, BCA is present, and most groves on sour orange include trees with CTV decline symptoms. However, the rate of CTV infection and decline is much harder to predict in grapefruit. Infection rate of grapefruit with CTV remained linear throughout 11 years of study in Spain, even when infection exceeded 25 percent (Gottwald et al., 1996). With BCA and CTV present in the Dominican Republic, the rate of CTV infection was low in grapefruit, with maximum infection remaining below two years. This is especially interesting since initial infection was discovered two years before study completion and throughout this period a nearby orange block displayed a logarithmic increase in infection (Gottwald et al., 1998). There is some evidence that detection of CTV infection may be more difficult and variable in grapefruit than in sweet oranges and that infection rate may exceed detection.

Respondents in the Indian River survey indicated significant decline ranging from 1 to 70 percent of their grapefruit on sour orange in 2000, with a mean estimate of 8 percent, and almost all decline was attributed to CTV based on field symptoms. Of all Indian River grapefruit acreage planted on sour orange, 62 percent reported declines of 5 percent or less and only 11 percent of grove area reported decline of greater than 10 percent. This large range in response may reflect variation in initial infection with CTV quick decline strains, aphid populations, and possibly affects of stress on symptom development. Unfortunately, there are no published data on the rate of CTV symptom development after grapefruit trees on sour orange are infected. While some experts anticipate that grapefruit responds much like sweet orange, with severe symptoms expressed one to two years after infection, other virologists suspect that grapefruit harbor infection for many years until symptoms are triggered by additional stress. Anecdotal reports suggest that the severe 2001 spring drought may further accelerate tree loss from CTV.

If symptoms develop at the same rate as infection, but lag by several years, then the 8 percent decline reported by Indian River growers is greater

than the average annual infection rate observed in Spanish grapefruit without BCA present, but is within the range of observed annual increases (Gottwald et al., 1996). Environmental effects on flush development, aphid populations, CTV titer and the overlap of these factors can all influence the annual infection rate (Gottwald et al., 1997) resulting in fluctuations within the fundamental infection rate relationship. Alternatively, the reported decline rates may reflect more rapid infection for Indian River grapefruit resulting in part from introduction of BCA.

Better management decisions could be made with improved understanding of CTV spread and resultant decline in grapefruit. If decline from CTV does become exponential, as in sweet orange, accelerated loss of grapefruit groves may substantially influence profitability and overall grapefruit supply from the surviving groves.

Potential for CTV-Resistant Sour Orange?

It would be very risky to plant any new groves on sour orange at this time. When sour orange is included in newly planted rootstock trials, many trees develop CTV symptoms so quickly that trees remain stunted and never achieve commercial levels of production. In several research programs, scientists are working to confer CTV resistance that may permit safe use of sour orange as a rootstock. However, many years of trials will be necessary to use these trees with confidence, and there may be consumer reluctance to purchase fruit from groves where CTV-resistance is achieved using genetic transformation.

Swingle Citrumelo

History of Use

Swingle citrumelo began to be widely planted from the late 1980s, as a CTV-resistant, productive rootstock, yielding good fruit quality. It was used for only 8 percent of Florida citrus trees propagated from 1953-1987, but has been used for 48 percent of trees propagated since that time (Citrus Budwood Registration Bureau, 2001).

Advantages and Limitations

Swingle has proven well adapted to most of the better-drained citrus soils and is currently the most widely planted citrus rootstock in Florida. However, by the mid 1990s it was apparent that Swingle performs poorly on many soils with high pH, especially if they occur in soils characterized by chronic wetness and/or substantial clay content near the soil surface. These soils are commonplace in the Indian River area. Frequently, growers report that trees on Swingle initially grow well on these sites but begin to decline after five to seven years, with substantial losses in vigor and productivity. The 4.6 percent decline reported for trees on Swingle in the 2000 survey suggests that most of the Swingle plantings on problem soils were identified before this survey, but some growers reported decline in 50 percent of their Swingle acreage. On soils where Swingle is well adapted in the Indian River area, it remains one of the best choices for new plantings.

Carrizo Citrange

History of Use

Use of Carrizo as a rootstock has been as high as 52 percent of the annual total Florida nursery tree production (Citrus Budwood Registration Bureau, 2001), but has been declining in recent years. Nevertheless, the use of Carrizo accounts for about 24 percent of trees propagated since 1953.

Advantages and Limitations

Carrizo citrange is a popular rootstock for production of processing oranges in Florida and is replacing Troyer citrange as the dominant rootstock in California. Like Swingle, it is CTV resistant, but is quite susceptible to citrus blight in Florida. Trees on Carrizo are noted for early production and high yields, but somewhat lower juice soluble solids than in fruit from trees on sour orange or Swingle. These traits make Carrizo less popular for fresh fruit production, thus explaining its relatively minor importance as a rootstock for grapefruit in the Indian River area (3.7 percent). However, because processing oranges are also grown in the Indian River area, the overall use of Carrizo is higher (12.9 percent) across all citrus than its use for grapefruit.

Cleopatra Mandarin

History of Use

Cleopatra mandarin has been used for 4 to 22 percent of propagated trees annually between 1953-2000, averaging 10 percent for the entire period (Citrus Budwood Registration Bureau, 2001).

The use of Cleo in the Indian River for all citrus types, and grapefruit in particular, is similar to levels used statewide for production of nursery trees.

Advantages and Limitations

Trees on Cleopatra (typically called Cleo) rootstock have a reputation for producing good yields of high quality tangerines and tangelos. It is also considered an excellent rootstock for production of oranges and grapefruit marketed late in the normal maturity period for a given variety. However, orange and grapefruit trees on Cleo have low yields, produce small fruit, and reach mature bearing at a later age. Cleo is CTV-resistant, with high salinity tolerance, delayed development of citrus blight, tolerance to alkaline soils, and a tendency to develop foot and root rot. It also has the reputation of producing some of the longest-lived trees in the Indian River area.

Smooth Flat Seville

History of Use

Nursery tree production on Smooth Flat Seville (SFS) did not reach 1 percent of the state annual output until 1993, but from 1993-1999 it has been used for 7.3 percent of state nursery production (Citrus Budwood Registration Bureau, 2001).

Advantages and Limitations

SFS has some horticultural properties similar to those of sour orange, but is CTV-tolerant, and probably is a hybrid of pummelo and sour orange. In many cases, trees budded to this rootstock have comparable tree size, yield, and fruit size to those on sour orange, but juice quality is sometimes lower.

There are a few plantings established in the 1970s and 1980s in the Indian River area (made when the rootstock was called Australian sour) and they have performed well. In soils where trees on Swingle

are likely to decline, production managers generally report satisfaction with trees grown on SFS. It is likely that use of this rootstock will continue to grow in the short term, especially for grapefruit.

Unfortunately, there is a high degree of zygotic seedling production from SFS seed, making careful identification and elimination of off-type liners desirable in the nursery. Difficulty in identifying all off-type SFS seedlings will probably make plantings on SFS somewhat more variable than plantings on other rootstocks.

Volkamer and Rough Lemon

History of Use

Across all Florida citrus nursery production from 1953-1999, rough lemon and Volkamer lemon were used as rootstocks for 5.7 percent of the trees (Citrus Budwood Registration Bureau, 2001). A small number of Indian River growers reported use of lemon-type rootstocks. While overall use was less than 1 percent across all citrus varieties, several growers reported that 5 to 7 percent of their planted area was on lemon stocks.

Advantages and Limitations

Trees on these rootstocks are known for high and early yields, but lower juice quality, and high blight susceptibility. The Indian River area has focused on fresh fruit and high Brix processing fruit, thus, these rootstocks have much lower usage than the state average. It is likely that use in the Indian River is largely restricted to processing oranges since high yields of trees on lemon rootstocks typically result in high production of "pounds solids" (This is a term used in the citrus industry for total yield of sugar and other dissolved materials. Sale of Florida citrus for processing is often based on dollar value per pound solid, since higher "pounds solids", even if from large volumes of lower solids juice, will yield more frozen concentrated orange juice.).

Sun Chu Sha

Sun Chu Sha is a mandarin generally similar to Cleopatra in virtually all characteristics. Although represented by relatively few trees, plantings made on Sun Chu Sha in the last few years were reported to be performing satisfactorily in the Indian River area.

New Rootstock Development & Assessment

A wide range of new citrus rootstocks is being developed by both the University of Florida and the USDA-Horticultural Research Laboratory in Ft. Pierce, FL, and promising rootstocks from other areas are regularly brought to Florida for evaluation. Advanced selections are currently being tested against standard rootstocks in numerous trials around the state. It is likely that information from these trials will result in plantings of several new rootstocks on a commercial scale within five years. Broader plantings and longer experience with the "best" new rootstocks will inevitably identify problems and limitations for at least some of them, but it is likely that a few of the current advanced selections will prove attractive and will be used for a substantial proportion of Indian River citrus production in the next twenty years.

Table 1. Table 1. The percentage of grove acreage on individual rootstocks for the Indian River citrus region, reported for all citrus varieties in 1998 and grapefruit only in a 2000 survey. The percentage of grapefruit trees on sour orange and Swingle citrumelo reported by growers to significantly decline in the year 2000, as reported in a 2000 Dec. survey. Only rootstocks representing 1% or more of acreage are listed.

Rootstock	Grove area on indicated rootstock reported in 1998 survey for all citrus varieties (%)	Grove area on indicated rootstock as reported in 2000 survey for grapefruit (%)	Grove area declining in 2000 on indicated rootstock as reported in 2000 survey for grapefruit (%)
Sour Orange	48.3%	54.7%	7.9%
Swingle Citrumelo	22.0%	27.3%	4.6%
Carrizo Citrange	12.9%	3.7%	na
Cleopatra Mandarin	7.5%	8.5%	na
Smooth Flat Seville	3.0%	2.7%	na