

Descriptions of new varieties recently distributed from the Citrus Clonal Protection Program

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The Citrus Clonal Protection Program (CCPP) is operated through the Department of Plant Pathology and Microbiology at University of California (UC) Riverside and is funded in large part by The California Citrus Research Board (CRB). The CCPP processes citrus propagative material in two phases. First, during the quarantine phase, citrus budwood of potentially important commercial varieties is introduced from any citricultural area, germplasm or breeding program of the world under the authority of a permit which is issued to CCPP by the United States Department of Agriculture (USDA) Animal and Plant Health Inspection Service in cooperation with the California Department of Food and Agriculture (CDFA). While in quarantine at the Rubidoux Facility in Riverside (approximately 2.5-3 years), newly imported varieties are tested extensively and any detected pathogens (such as viruses and bacteria that cause the tristeza, exocortis, stubborn, or Huanglongbing (HLB) disease of citrus) are eliminated via therapy. The second phase includes the production of budwood source trees which are moved out of quarantine in Riverside and to the UC Lindcove Research and Extension Center (LREC) in Exeter, California, where the CCPP Protected Foundation (screenhouse) and Evaluation Blocks (field) are housed. Trees established in the Evaluation Blocks are evaluated for trueness to type by scientists, growers, and nurserymen and are accessible to the public during field and fruit testing days (aka “walkthroughs”). Trees established in the Protected Foundation Blocks are off limits to the public, they are regularly tested for a variety of pathogens and are registered with the CDFA as budwood source trees.

Over the past several years, many varieties have been through the rigorous “Variety Introduction-VI” disease testing and therapy program under quarantine at the CCPP. Varieties that successfully complete the VI process receive a unique VI identification number that permanently accompanies the budwood that is made available to growers, nurseries, researchers, and others. Little information about many of the CCPP VI varieties is accessible to the public, or may take a great deal of effort to find. As a result, the UCR-Citrus Variety Collection (CVC), USDA-National Clonal Germplasm Repository for Citrus and Dates (NCGRCD), and CCPP have compiled information on the 18 most recently distributed varieties.

Protected Foundation Block Budwood

“Protected Foundation Block Budwood” is budwood provided from CDFA registered CCPP citrus trees from the LREC screenhouses and is available from the University of California in accordance with the CDFA regulations for citrus registration and certification. Protected Foundation Block Budwood is produced by trees grown in pots and in ground under protective screen and is intended for individual nurseries or growers to produce their own registered budwood source trees or for the production of nursery increase blocks from which additional budwood may be harvested in accordance with CDFA (or other appropriate) regulations and used for the production of certified nursery stock. A signed “Waiver and Release” form must accompany all orders for Protected Foundation Block Budwood. The “Waiver and Release” form is available on the CCPP website (<http://www.ccpp.ucr.edu>).

SRA 337 or C54-4-4 Mandarin (VI 672): *First distribution of buds from the CCPP: September 2009*

‘C54-4-4’ was selected for introduction to California in 1997 by members of the California Citrus Nurserymen Society (CCNS) during a tour of the INRA-CIRAD Station de Recherches Agronomiques in San Giuliano, Corsica, associated with the Congress of the International Citrus Nurserymen’s Society. C54-4-4 is actually a product of California, being a cross of ‘Clementine’ X ‘Murcott’. The cross was actually made at the USDA Horticultural Research Laboratory in



‘C54-4-4’ mandarin: Citrus Variety Collection, Riverside, California, 16 Feb 2010. Photo by T. Siebert

Orlando, Florida, by Dr Phil Reece but the seeds were sent to Dr Joe Furr at the USDA Date and Citrus Station in Indio for testing and development. In 1963, budwood was sent from California to Texas for evaluation by Dr Heinz Wutscher, USDA, Weslaco. The characteristics of 'C54-4-4' under Texas conditions is presented in a paper in the Journal of the American Society for Horticultural Science, 103:124-127 (1978). Those results indicate that 'C54-4-4' is a late maturing mandarin with uniform exterior color with 20 % granulation. The fruit was large with an average of 22 seeds per fruit. Brix was intermediate in the varieties reported upon, but acid was among the lowest reported. Therefore, the brix/acid ratio was the second highest among the varieties evaluated. Yields were intermediate. This data was based upon harvest in January or February for the years 1969 – 1974. Dr Wutscher introduced this selection into Florida when he transferred to Orlando in 1975, and evaluated it in Florida conditions. In Florida, it proved susceptible to scab (a disease that we do not have in California). Dr Wutscher later made a scab-resistant selection of 'C54-4-4' that has recently been released by Florida Division of Plant Industry (DPI) as 'Furr' mandarin. Note that this is *not* the 'Furr' trifoliolate hybrid rootstock recently released by UC Riverside. In the 1980's, prior to making the scab-resistant selection, Dr Wutscher sent budwood of 'C54-4-4' to Corsica. This is the source of the recent introduction into California and hence does *not* represent the scab-resistant Florida selection 'Furr'.

Imperial Mandarin (VI 684): *First distribution of buds from the CCPP: January 2008*

'Imperial' is reported to have originated in Emu Plains, near Sydney, Australia, as a chance hybrid of 'Mediterranean' or 'Willowleaf' and another mandarin, possibly 'Emperor' in approximately 1890. 'Imperial' is one of Australia's most important and long-established mandarin selections. It is widely planted throughout existing mandarin-growing regions, with about 361,000 bearing and 26,000 non-bearing trees in 1999, mostly in Queensland. 'Imperial' is an extremely early maturing mandarin, equivalent in this regard to 'Owari' satsuma. Brix:acid ratio reaches 7:1 around mid-March in the earliest regions of Australia, with later regions reaching this ratio in early June. 'Imperial' can be harvested up to July or August in Australia, depending upon the region. Fruit quality is considered good with a good balance of sugar and acid and good internal color. The skin is thin and soft, and although adherent, it peels easily. Juice levels are at least 35 % and fruit are firm when peeled. Granulation is sometimes a problem because of the low juice content. There are usually 4 or less seeds per fruit in both solid and mixed plantings. The fruit is medium sized (or small in heavy crop years). The external color is yellow orange, but is more intense in regions where fall temperatures are cool. Fruit generally must be clipped from the tree rather than plucked. De-greening is necessary when fruit are harvested early and the post-harvest life is short at 2 - 4 weeks. 'Imperial' responds poorly to heat and cold treatments for pest disinfection, which makes it unsuitable for export (from Australia). 'Imperial' performs adequately on a variety of rootstocks, although incompatibilities have sometimes been noted on 'Carrizo' and 'Troyer'. 'Cleopatra' produces high quality fruit. 'Cleopatra' and 'Troyer' are the most commonly used rootstocks in Queensland, whereas 'Carrizo' is

more popular in southern areas. There is a tendency towards alternate bearing, which sometimes is managed by thinning. The tree's habit is vigorous and upright. Cross-pollinators may help with set, yield, and size. This variety is currently being evaluated by Toni Siebert and Tracy Kahn. This information was summarized from The Citrus Industry, 1967, I:516; and Saunt, 2000, 'Citrus Varieties of the World', pp 65-66. A downloadable factsheet developed by Australian Citrus Limited is available at <http://www.australiancitrusgrowers.com.au/aspdev/resources/documents/ImperialB.pdf>

Hickson Mandarin (VI 685): *First distribution of buds from the CCPP: June 2008*

'Hickson' is reported to have originated near the town of Roma, Queensland, Australia, as a sporting limb on 'Ellendale' tangor. 'Hickson' is similar in many respects to its 'Ellendale' progenitor. In Australia, it is a mid-season variety, maturing starting in late June, about 2 weeks earlier than 'Ellendale'. 'Hickson' is considered to hang better than 'Ellendale', with the harvest date extending through August. In August, it is usually slightly puffed but the juice content is satisfactory.



Hickson mandarin: Citrus Variety Collection, Riverside, California, 16 Feb 2010. Photo by T. Siebert

The general appearance of the tree is similar to 'Ellendale', although there are some differences in leaf shape. The fruit is similar in appearance to 'Ellendale' but the rind is not as smooth and it peels more easily. The fruit averages 6 cm X 5 cm, has a slight neck, and a smooth, yellowish-orange rind with some gloss. The orange-fleshed fruit is juicy with good flavor and has 12-15 seeds. 'Hickson' is resistant to brown spot and was initially considered a promising alternative to 'Ellendale'. However, 'Hickson' declines when propagated on rough lemon rootstock probably due to genetic or physiological reasons. It is also susceptible to a crotch rot associated with Phomopsis and in addition does not perform well on trifoliolate. For these reasons, it is no longer as popular in Australia. This variety is currently being evaluated by Toni Siebert and Tracy Kahn. Information summarized from: Jorgenson, 1972, Queensland Citrus Bulletin, 1972:23-24; Cox, 1975, NSW Dept of Agriculture, Bulletin H2.2.6; Broadbent et al, Proceedings, ISC,

1978:207-208; Forsyth et al, 1985, NSW Dept of Agriculture, Agfact H2.1.4.). A factsheet developed by Australian Citrus unlimited is available at <http://www.australiancitrusgrowers.com.au/aspdev/resources/documents/HicksonB.pdf>.

Sudachi Ichandarin (VI 693): *First distribution of buds from the CCPP: June 2007*

Thought to be a hybrid of a papeda and a mandarin, ‘Sudachi’ arose as a chance seedling in the Tokushima Prefecture of Japan, on Shikoku island, where it has traditionally been grown. When harvested young, ‘Sudachi’ is considered to have a distinctive fragrance that is different from ‘Yuzu’. The young fruits are used for cooking while still green, often being incorporated into vinegars or flavoring many different entrees, especially fish. The flavor is now also used in soft drinks and alcoholic beverages. Fruit of ‘Sudachi’ was formally evaluated by Ottillia Bier, Toni Siebert and Tracy Kahn in September and October of years 2003 to 2007 at Riverside, California. Significantly smaller than ‘Yuzu’, the average fruit size has a mean width of 3.8 cm and a height of 3.4 cm. The fruits have an oblate (spherical and flattened at both poles) shape, although some fruits can be round. ‘Sudachi’ has a mean weight per fruit of 27.2 grams. Color break was reached between the first and third week of September. The rind texture is slightly pebbly with a mean thickness of 1.9 mm. The number of seeds per fruit averages 9. The mean juice weight is 9.6 grams and the average juice content is 34.4%, which is fitting as ‘Sudachi’ is primarily used for juice. The juice weight and juice content increased during the sampling dates. The internal flesh color of ‘Sudachi’ in the green stage is light green to green-yellow. ‘Sudachi’ is slightly more acidic than ‘Yuzu’ with an average of 5% citric acid. ‘Sudachi’ trees tend to have a spreading habit of moderate vigor, but can be considered a small to medium



Sudachi ichandarin: Citrus Variety Collection, Riverside, California, 15 Nov 2002. Photo by D. Karp.

sized tree, as 26-years-old trees on Carrizo and C-35 citrange rootstocks are only approximately 8 feet tall, with no indications of rootstock-scion incompatibility. Thorns up to 5 mm in length are present in each leaf axil. Leaves are elliptical in shape, with a small winged petiole. The tree canopy has dense branching. (Kawada, K., and Kitagawa, H. “Storage of Sudachi (*Citrus sudachi* Hort. ex Shirai) in Japan”. Pro. Int. Soc. Citriculture, 1084-1085. 1992. Kawada, K., and Kitagawa, H. “Citriculture, Marketing are Different in Japan”. Fresh Citrus Fruits. Avi Publishing Company: Connecticut. 1986.)

Australian Finger Lime (VI 697): *First distribution of buds from the CCPP: June 2007*

The ‘Australian finger lime’, a citrus relative also known as *Microcitrus australasica*, is one of six different species of citrus considered to be native to Australia. This VI is one of 8 different accessions of *Microcitrus australasica* in the Citrus Variety Collection, and was imported from Sydney, Australia, in 1965. Depending on the type of rootstock used (The CVC has used several: Schaub rough lemon, Cleopatra mandarin,



Australian Finger Lime: Citrus Variety Collection, Riverside, California, 5 Dec 2008. Photo by D. Karp and T. Siebert.

C-35 citrange, Carrizo citrange, Calamondin, *Citrus macrophylla*), the ‘Australian finger lime’ can be a very small (about 5 feet on Schaub rough lemon) to large-sized tree. The leaves are tiny at approximately one-half inch long and the branches become very dense and spiny with about 1 thorn set in every leaf axil. New growth is purple in color and the one-quarter inch wide flowers are white and pink during the main flowering season of February to April. The finger limes are about three inches long and roughly the size of an average person’s index finger, but fruit from juvenile trees can be less than one inch long. The skin of the finger lime is usually a greenish black to very dark purple and thin, but durable. Once the fruit is cut open the tiny round juice vesicles will slowly seep out of the fruit without squeezing, and resemble what we like to call “citrus caviar”. The round vesicles are usually a clear-green, but can be very light pink. The juice is very tart, much like a Mexican lime. Although the tree produces fruit year round, the main fruiting season in California is November-December when the fruit falls off in your hand. Australian finger lime is reported to fetch approximately 40-50 dollars per pound. The fruits are technically edible, but this is not commonly done. Its most common use is as a garnish or flavor component in culinary creations.

Persian Lime SPB-7 (VI 708): *First distribution of buds from the CCPP: June 2007*

This selection of Persian-type lime is said to be free of the genetic disorder called wood pocket, which is found in many of the large-fruited acid limes. Wood pocket was formerly very common in Florida and caused extensive losses. The industry requested help from researchers and after screening more than 100,000 trees, 10 trees were identified that were apparently free of wood pocket, based upon their survival. The current selection (SPB-7) was entered into the program in



Persian lime: Citrus Variety Collection, Riverside, California, 3 Nov 2009. Photo by D. Karp and T. Siebert.

1954 as Li-38-1-1-X. This selection was apparently erroneously identified as being wood pocket positive and was dropped but later reinstated and never showed wood pocket symptoms. The current selection was entered into the Florida DPI foundation program about 1961 and was imported into California in the year 2000. The current screenhouse bud source descended from a tree planted in the Haines City Foundation Grove. Because of this budsource, the Florida Persian lime industry became virtually free of wood pocket by the early 1970s. (This information redacted from an email from Mike Kesinger, 06/25/2006) Trees of this selection have been planted at various places in California for evaluation as to the development of wood pocket. One of these locations is the Coachella Valley Agricultural Research Station in Thermal, CA. Since wood pocket develops more rapidly at high temperatures, the trees in Thermal should be the most susceptible to development of wood pocket. More information on these observations will be provided as it becomes available.

Lemonade (VI 734): First distribution of buds from the CCPP: September 2008

‘Lemonade’ is reported to be a sweet lemon hybrid of unknown parentage with a very pleasant taste, and can be readily but not easily peeled. The fruit is small-medium, and not very seedy. The trees are semi-dwarfed (on trifoliolate rootstock), but quite productive. The main crop matures in early spring in New Zealand, with much smaller summer crops also occurring. Unfortunately there is no commercial production in New Zealand, although it is a popular home garden tree. It is susceptible to citrus scab disease; however, in a drier climate this should be less of a problem. (This information redacted from an email from Andrew Harty via Peter Chaires, 12/07/2005) Although the budsource trees are derived from trees at the CCPP that tested negative for all known graft-transmissible diseases, trees of ‘Lemonade’ propagated in Riverside have shown a tendency to develop small brown to black lesions on the bark. The reason for these lesions is currently unknown. ‘Lemonade’ trees propagated at Riverside are not particularly vigorous but the relationships of this to the observed lesions is not known.



Lemonade: Citrus Variety Collection, Riverside, 3 Nov 2009. Photo by D. Karp and T. Siebert.

Early Release Budwood

“Early Release Budwood” is budwood provided from selected cultivars that have been recently out of quarantine and are maintained by the CCPP at the LREC Protected Foundation Blocks for the “Early Release” program. These cultivars are grown in pots under protective screen producing limited amounts of budwood. Therefore, supply of Early Release Budwood will be limited. A signed “Waiver and Release” form must accompany all orders for Early Release Budwood. The “Waiver and Release” form is available on the CCPP website (<http://www.ccpp.ucr.edu>).

Valentine Pummelo Hybrid (VI 597): First distribution of buds from the CCPP: September 2009

‘Valentine’ is the most promising of the seedy pigmented low-acid pummelo hybrids selected by Drs. Soost and Cameron in 1986 from a cross of ‘Siamese Sweet’ pummelo x



Valentine pummelo hybrid: Citrus Variety Collection laboratory, Riverside, California. Photo by O. J. Bier.

(‘Ruby’ blood orange x ‘Dancy’ mandarin). It received its name from former Staff Research Associate for the Citrus Variety Collection Ottilia ‘Toots’ Bier, who nicknamed it ‘Valentine’ not only because the fruit matures in mid-February near the Valentine’s Day holiday, but also because often when the fruit is cut lengthwise and turned upside down, the flesh of the fruit resembles a vibrant red heart. ‘Valentine’ fruits are round to somewhat pyriform (pear-shaped). The average fruit size is large with a mean width of 10.8 cm (4.25 inches) and a height (including the neck) of 11.0 cm (4.33 inches). The mean weight per fruit is 531.1 grams (18.7 ounces). Rind color is medium to dark yellow. The rind texture is moderately smooth with a mean thickness of 8.8 mm (0.35 inches). Fruit samples from Lindcove generally have a thicker rind than samples from Riverside. The number of seeds per fruit averages 27.6. However, the mean number of seeds per fruit among 36 different 10-fruit samples ranged from 2.6 seeds per fruit to 51 seeds per fruit. The mean juice weight is 201.8 grams (7.1 ounces) and the average juice content is 38.6%. The red flesh color of ‘Valentine’ can be somewhat variable in its distribution and intensity inside the fruit. Color formation first appears in mid-January and becomes more intense in early to mid February when the solids to acid ratio is an average of 16:1. Please see “‘Valentine’, A Recently Released Anthocyanin-pigmented Pummelo Hybrid Developed at UC Riverside” from *Topics in Subtropics*, 2009, 7(3): 2-4, for a more detailed description of this variety.

Xie Shan Satsuma (VI 621): *First distribution of buds from the CCPP: June 2007*

‘Xie Shan’ was originally imported from the Institute of Subtropical Crops of Zhejiang Academy in China in 1992. Dr. Fred Gmitter, University of Florida, who was responsible for the collection of this variety, reported Xie Shan to be “extremely early ripening in comparison to other Chinese satsumas”. In a California trial, Dr. Thomas Chao, UC Riverside, reported that ‘Xie Shan’ developed high brix levels somewhat earlier than other early Satsuma cultivars tested (‘Armstrong’, ‘Miyagawa’, and ‘Chinese S-9’). However, high acid levels kept the sugar/acid ratio within about the same range as the other cultivars. ‘Xie Shan’ and ‘Miyagawa’ were considered the earliest cultivars in this trial. Additionally, it

was reported that ‘Xie Shan’ was completely seedless, easy peeling, and had a unique taste and flavor. Projected harvest in the San Joaquin Valley was mid-September. (Information from *Topics in Subtropics*, 2005, 3(2): 3-5). This variety is currently being evaluated by Toni Siebert and Tracy Kahn.

China S-9 Satsuma (VI 636): *First distribution of buds from the CCPP: June 2007*

‘China S-9’ was part of the first of two different sets of several satsumas collected in the Hubei Province of China, by Dr. H. Huang, Auburn University, in 1995 and given to the CCPP for introduction and quarantine. Each selection in the first set was given the “S” signifier and a number, and was described in a letter from Bill Dozier, Auburn University, to the late Dave Gumpf on August 28, 1995. They were selected from fields in Hubei and Sichuan that had been devastated after a very bad freeze. Each selection was from branches on satsuma trees that had survived the freeze, and the three selection characteristics they looked for were cold hardiness, fruit quality and tree vigor. Huang rated the tree vigor and fruit quality of ‘China S-9’ as ‘acceptable’, and cold hardiness as ‘good’. The second set of satsumas were brought back by Dozier in either 1996 or 1998 after he visited these same areas of China where the freeze occurred. Preliminary observations by Thomas Chao at Santa Paula (see citation in previous description) suggested that ‘China S-9’ should mature early in the San Joaquin Valley (about the same time as ‘Miyagawa’ and ‘Xie Shan’). In addition, preliminary observations at LREC showed that ‘China S-9’ has a smoother peel than most other satsumas. This variety is currently being evaluated by Toni Siebert and Tracy Kahn.

Pehrson #3 Valencia Orange and Pehrson #4 Valencia Orange (VI 749 and VI 750): *First distribution of buds from the CCPP: September 2008*

These VI’s are two of a group of 8 Valencia clones selected by University of California Cooperative Extension Specialist Emeritus John Pehrson. These were included in a Valencia Strain Trial established at LREC. In a letter sent by John Pehrson on April 13, 2009, to the CVC, he described the



Xie Shan satsuma: Citrus Variety Collection, Riverside, California, 27 Nov 2007. Photo by T. Siebert.



China S-9 satsuma: Citrus Variety Collection, Riverside, California, 27 Nov 2007. Photo by T. Siebert.

complex history of the Valencia clones. The objective was to salvage propagative material from high production Valencia trees of good quality fruit because urban growth was shrinking Valencia acreage in Orange County, CA. Some of the strains were reported to be from the Smith Family Ranch and the Wagner Family Ranch in Placentia, CA, and the Gilman Grove, Fullerton, CA. Seedlings were grown from collected fruits and budded onto Troyer citrange. These were planted in cooperation with a grower in a Brea area oil lease that would not last another 15 years. The time frame was from the late 1950's to the mid 1960's for collection, growing and planting. Shortly after planting in Brea, Pehrson was moved from Orange County to Tulare County, so efforts were made to save these selections. With propagating material from the plot Pehrson had established with the grower in Brea, CA, Ed Nauer cleaned up 8 of the clones in Riverside, CA, and moved them into a Valencia strain trial at LREC in 1986 where they were compared with Campbell, Cutter, Frost, Olinda, and Chapman Valencias. The 8 Valencia clones were put through the VI index as VI's 747 to 754 with budwood taken directly from the nucellar block in November 2006. 'Pehrson Valencia #3' and 'Pehrson Valencia #4' were selected as being the most promising out of the 8 clones. 'Pehrson Valencia #3' was selected for having good peel color, minimal regreening, having a good yield, and is later maturing. 'Pehrson Valencia #4' was selected as having the highest cumulative yield and weight, and a good distribution of fruit size (information from M.L. Arpaia).

FairchildLS Mandarin (VI 762): *First distribution of buds from the CCPP: January 2010*

'FairchildLS' is an irradiated selection of 'Fairchild' mandarin developed at UC Riverside. The distinctive trait of 'FairchildLS' is that it is considered to be low seeded (2.4 seeds per fruit) despite any cross-pollination. 'FairchildLS' fruit are deeply oblate in shape with no neck. The fruit is medium sized for a mandarin (classed as Large by State of California standards) averaging 64 mm (2.5 in.) in diameter and 56 mm (2.2 in.) in height with a very smooth, deep orange rind color. The rind is relatively thin and at maturity is considered moderately easy to peel. The fruit interior has fine flesh texture with 10-11 segments. The fruit are juicy averaging 47% juice with an average weight of 110g. 'FairchildLS' matures in winter (late January) and holds its fruit quality characteristics through late March. Fruit from trees on Carrizo citrange rootstocks average 12.1-13.0% soluble solids and 0.85-1.17% acid in January increasing to 13.2-14.5% soluble solids with decreasing acid of 0.76-0.93% by mid-March at four trial locations. Fruit from trees on C-35 citrange rootstocks average 11.2-12.8% soluble solids and 0.94-1.23% acid in January increasing to 13.1-14.0% soluble solids with decreasing acid of 0.78-1.01% by mid-March. 'FairchildLS' averages 2.4 + 0.6 seeds per fruit in the presence of cross-pollination at all trial locations throughout California compared to 15-25 seeds per fruit for regular 'Fairchild'. Pollen of 'FairchildLS' has very low viability, therefore it has a very low likelihood of causing seeds in other citrus, particularly mandarins, when planted nearby. Fruit production for 'FairchildLS' begins in the third year after planting. Four-year-old trees averaged 62-88 lb, and five year old trees averaged 92-108 lbs. Alternate bearing can be a problem by years seven and eight (information from M.L. Roose and T.E. Williams). Patent and/or propagation



FairchildLS mandarin: *Photo by M. Roose.*

rights for Fairchild LS Mandarin are held by the Regents of the University of California. Budwood is available only to nurserymen who have a License Agreement for these cultivars.

Tango Mandarin (VI 765): *First distribution of buds from the CCPP: June 2007*

Tango is a patented (Plant Patent #17863) irradiated selection of W. Murcott mandarin developed at UC Riverside. Fruit of 'Tango' are similar to W. Murcott in all appearance, quality and production characteristics with the exception of seed numbers. 'Tango' fruit are deeply oblate in shape with no neck. The fruit is medium sized for a mandarin (classed as Large by State of California standards and size 28 by industry packing standards) averaging 59 mm (2.32 in.) in diameter and 48 mm (1.89 in.) in height with a very smooth, deep orange rind color. The rind is relatively thin and at maturity is easy to peel. The fruit interior has fine flesh texture with 9-10 segments and a semi-hollow axis of medium size at maturity. The fruit are juicy averaging slightly over 50% juice with an average weight of 90.6 g (3.2 oz.). 'Tango' matures in winter (late January) and holds its fruit quality characteristics through April into May. Production is excellent averaging 800-900 cartons/acre when planted at densities of 250-300 trees/acre. Fruit from trees on Carrizo and C-35 citrange rootstocks average 11.1-13.1% soluble solids and 0.97-1.19% acid in January increasing to 13.5-15.4% soluble solids with decreasing acid of 0.54-0.82%



Tango mandarin: *Citrus Variety Collection, Riverside, California, 21 Feb 2007. Photo by D. Karp.*

in April. 'Tango' averages 0.04 + 0.2 seeds per fruit in the presence of cross-pollination at seven trial locations throughout California compared to 11.6-22.6 seeds per fruit for W. Murcott. Pollen of 'Tango' has very low viability consequently it has a very low likelihood of causing seeds in other citrus, particularly mandarins, when planted nearby. Like 'W. Murcott', trees of 'Tango' have a tendency to overbear and therefore need to be regularly pruned to maintain good, but not excessive production and to maintain fruit size and prevent alternate bearing. Crop yields should be limited to about 150-170 lbs/tree (6-7 mandarin boxes) through a combination of pruning and, if needed, fruit thinning and should be harvested on time, not left on the trees as this can lead to alternate bearing (information from M.L. Roose and T.E. Williams). Patent and/or propagation rights for Tango Mandarin are held by the Regents of the University of California. Budwood is available only to nurserymen who have a License Agreement for these cultivars.

Primosole Mandarin (VI 777): *First distribution of buds from the CCPP: September 2009*

'Primosole' mandarin is a hybrid of 'Carvalhais' mandarin and 'Miho wase' Satsuma produced at the University of Catania, Sicily, in 1980. It is described as being seedless in isolation and matures very early (at the beginning of October in southern Italy or early April in Australia). Coastal Fruitgrowers Newsletter (Australia, August 2005) reported, upon release of 'Primosole' from quarantine, that it reached maturity about 10 days before Okitsu satsuma. Fruits are oblate in shape and average 150 grams in weight in southern Italy. The trees are said to be vigorous and productive with an open growth habit. They do not exhibit alternate bearing tendencies. The branches do not have spines, and the lanceolate (long, wider in the middle or lance-shaped) leaves tend to fold as if under water stress. According to an article published in Plant Disease, December 2001, pg. 1291, called "Extreme Susceptibility of Primosole Mandarin to Alternaria Fruit Rot in Italy", 'Primosole' is extremely susceptible to Alternaria fruit rot due to growth cracks at the stylar end (blossom end of fruit) and sensitivity to sunburn. Citrogold reports that this variety has orange rind color, a good to large fruit size, and a good to very good crop load. The peel separates easily. The flavor is said to be between satsuma and mandarin. The variety handles degreening well, stores well, handles cold sterilization well, and has a firm rind in comparison to satsumas. It tends to have a ricyness in the core of the fruit that lessens with tree age and characteristic leaf wilting. 'Primosole' is a self-incompatible variety, but will pollinize compatible varieties such as clementines. Cross pollination is managed by a buffer of 10 rows. It does not require a plant growth regulator to increase fruit set or size. It is very sensitive to strong winds and can defoliate under windy conditions. Swingle is reported to not be suitable as a rootstock for 'Primosole' mandarin, but it does well on C-35, Carrizo, and Troyer citranges. (Aznar and Fayos, *Citricos. Variedades y tecnicas de cultivo*. Mundi-Prensa Libros. 2006. pg 128)

Bitters C-22 Citrange (VI 792), Carpenter C-54 Citrange (VI 793), and Furr C-57 Citrange (VI 794): *First distribution of buds from the CCPP: September 2009*

According to the report provided by Claire Federici, Ricarda Kupper, and Mikeal Roose, "Bitters', 'Carpenter' and 'Furr' trifoliolate hybrids: Three New Citrus Rootstocks"

(information can be found at <http://plantbiology.ucr.edu/faculty/new%20citrus%20rootstocks%202009.pdf>), all three are hybrids of *Citrus sunki* and Swingle trifoliolate orange. John Carpenter and Joe Furr made all three hybrids as part of the USDA breeding program at Indio, CA. Professor W.P. Bitters tested the hybrids for Citrus Tristeza Virus tolerance in a trial established at the South Coast Research and Extension Center in Irvine, CA, in 1966 and 1968. All three hybrids showed good tolerance to the virus. Details about subsequent field trials, soils, management, and results compared to other varieties can be found at <http://plantbiology.ucr.edu/faculty/Summary-of-Active-Rootstock-Trials-5-09v5.pdf>

- 'Bitters' produces a small tree, with high yield per canopy volume. Young trees on this rootstock showed good tolerance to freezing. Fruit quality of late navels was good and granulation was no worse than fruit on 'Carrizo' or 'C-35'. It is tolerant to CTV, moderately tolerant of *Phytophthora parasitica*, not very tolerant of citrus nematode, and very tolerant of calcareous soil. It was reported that this rootstock is the best candidate in Texas to replace sour orange due to its tolerance of calcareous soil conditions.



Bitters C-22, Carpenter C-54, and Furr C-57 citrange rootstocks: *Photo by M. Roose.*

- 'Carpenter' produces medium to large trees, with good yield. Young trees on this rootstock showed moderate tolerance to freezing. Fruit quality of late navels was good and granulation was no worse than fruit on 'Carrizo' but was slightly worse than on 'C-35'. It is tolerant to CTV, moderately tolerant to *P. parasitica*, very tolerant of citrus nematode, and moderately tolerant of calcareous soil.

- 'Furr' produces medium to large trees, with good yield. Young trees on this rootstock showed good tolerance to freezing. Fruit quality of late navels was good and granulation was no worse than fruit on 'Carrizo' or 'C-35'. It is tolerant to CTV, very tolerant to *P. parasitica*, very tolerant of citrus nematode, and moderately tolerant of calcareous soil.

Please visit the Citrus Clonal Protection Program website at <http://www.ccpp.ucr.edu> for more information about how to obtain budwood of these varieties. Registered users of the online budwood ordering system may visit <http://ccpp.ucr.edu/budwood/budwood.php>. If you are not a registered user you can e-mail ccpp@ucr.edu with your name, address, e-mail, and phone number or call (951) 684 8580 and the CCPP will generate a username and password for you. After becoming a registered user of the budwood ordering system you will also receive announcements about future budwood distributions for other citrus varieties. ●