'TDE2' Mandarin Hybrid - Shasta Gold™

M.L. Roose and T.E. Williams
Department of Botany and Plant Sciences
University of California, Riverside

'TDE2' (patented by the University of California under the 'TDE2' name) is a late maturing mandarin hybrid that combines large fruit size, attractive deep orange rind color, rich fruit flavor and the virtual absence of seeds even in mixed plantings. No other mandarin currently available combines this set of characteristics. It may be successful in a marketing window that currently has few low-seeded cultivars. The pedigree of 'TDE2' is (Temple tangor x 4n Dancy mandarin) x Encore mandarin. The female parent was tetraploid. The variety is triploid. It will be marketed under the trademarked name Shasta Gold.

Fruit Characteristics: 'TDE2' fruit are oblate (moderately flat) in shape, with little or no neck. The fruit base (stem end) is slightly concave while the apex (blossom end) is truncate with a slight depression and a small (4 mm, 1/8-1/4 in.), occasionally open stylar scar. The average fruit size is large for a mandarin (classed as Mammoth by California state standards) with a mean width of 75mm (2.95 in.) and a height of 59 mm (2.32 in.), giving a height to width aspect ratio of 0.78, and a mean weight per fruit of 185 grams (6.5 oz., heavy for the fruit size). Rind color is deep orange for fruit harvested in Riverside in mid-February, with similar values for fruit from the San Joaquin Valley, Ventura and north San Diego County. The rind texture is variable, depending on tree age and crop. For older trees with a moderate to heavy crop, rind texture is smooth to slightly pitted, with depressed oil glands. The rind of fruit from trees with very light crops is often excessively rough or bumpy. The rind is fairly easy to peel when fruit are mature, but can be more adherent early in the season. The fruit is juicy averaging 49% juice content. Flesh is deep orange in color with a moderately fine texture.

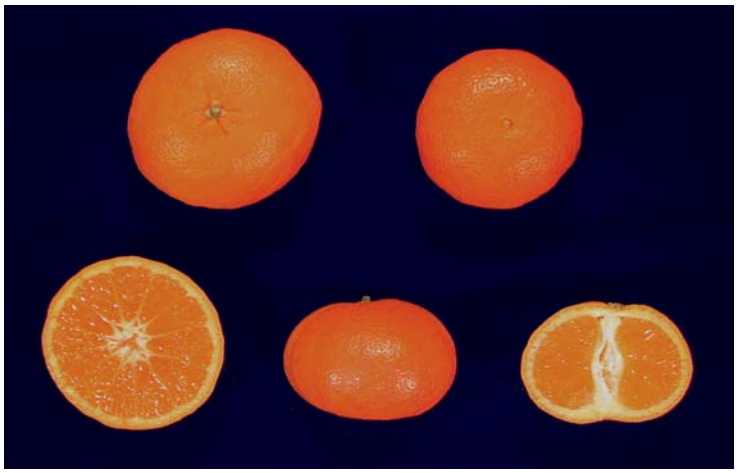

Figure 1: Fruit of 'TDE2' from Riverside

Figure 2: 'TDE2' tree on Carrizo citrange at Riverside

Tree Characteristics: Tree shape (Figure 2) is approximately spheroid, rather similar to that of orange trees. Leaves are on the large size for a mandarin with leaf shape more orange than mandarin-like. Canopy density is very good and many fruit are born inside the canopy, which serves to limit sunburn and help maintain the very distinct rind color. Fruit exposed to excessive sun will lose significant color on the exposed surface. Overall trees are vigorous, more so than most mandarins. In comparison with most old-line citrus cultivars, trees of 'TDE2' are fairly thorny, with normal branches having medium length (15 mm, 1/2 in) thorns at about 50% of the nodes, and watersprouts having long (31 mm, 1.2 in) thorns at about 73% of nodes. Thorniness will probably decrease as the cultivar ages. To reduce thorniness, budwood should be selected from thornless, upper canopy branches.

Rootstocks and Tree Performance: Several different rootstocks were used in 'TDE2' evaluations including Carrizo citrange, C-35 citrange, Schaub rough lemon, Volkamer lemon (*C. volkameriana*), and trees topworked on Valencia orange on Troyer citrange rootstock. Overall trees performed well on all rootstocks with no indications of rootstock-scion incompatibility although trial trees are still relatively young. Tree vigor varies greatly by location. At southern desert locations (Coachella Valley) canopy volumes of 7-year-old trees averaged 41.1 and 28.8 m^3 (1451 and 1017 ft^3) in two separate trials. In contrast, at the cooler Santa Paula and Ojai (Ventura County) locations, 7-year-old trees averaged 6.3 and 6.1 m^3 (222 and 215 ft^3). Canopy volumes were greater for topworked trees in north San Diego County. Trees have performed best in locations with more moderate climates such as the coastal and inland valleys of southern California and the San Joaquin Valley. The topworked trees tested were quite vigorous being larger overall than trees on all other rootstocks at the same age. In the desert locations trees on Volkamer lemon were considerably larger than those on Carrizo citrange or C-35 citrange. Trees on Schaub rough lemon were larger than those trees on Carrizo citrange or C-35 citrange at the cooler trial locations. Tree spacing in field plantings will depend on vigor of the rootstock. For Carrizo citrange rootstocks, a recommended tree density would be 150 (15' x 20') to 200 (11'x20') trees per acre. Higher densities are possible but

will require more frequent pruning or hedging. In comparison with Carrizo, C-35 rootstock reduces the final size of sweet orange trees, but it is not yet known if it will have a similar effect on 'TDE2' trees. Care of young trees should be similar to that used for other mandarins or oranges. Flowering occurs from early April into May at all locations except the desert where it is earlier. The normal flowering overlaps with many mandarin varieties including Clementinas. It is not known whether 'TDE2' trees require cross-pollination for fruit set because all experimental trees were grown in mixed plantings. Therefore, we do not recommend establishing large plantings without provision for cross-pollination. Trees should be grown with pollinizer cultivars such as Minneola, Valencia orange, or other unrelated mandarins that produce viable pollen until the requirement for cross-pollination is better understood. Trees that were screened to exclude bees during flowering produced very few fruit for two consecutive years, but it is possible that 'TDE2' is self-fertile but requires pollination for fruit set. Pollen viability is low (about 10%), suggesting that 'TDE2' will have little effect on seediness of Clementines or other cultivars, but direct experimental evidence to confirm this is not yet available. Optimal pruning practices have not yet been developed, but in many locations trees will perform well with relatively little pruning. If fruit set is very heavy, then trees should be pruned to reduce the crop in order to reduce future alternate bearing. The trees have not been noted as particularly susceptible to any diseases and, based on a freeze in 1999, appear only slightly more cold hardy than oranges of similar age.

Yields: Yield evaluations of 'TDE2' indicate that alternate bearing is common in this cultivar, as in most mandarins, although at some trial sites the off year crops are reasonably good. Crops were rated on scale ranging from 0 (no crop) to 5 (very heavy crop); a crop rating of 2.5 is considered to be commercially acceptable yield while a crop rating of 5 cannot be sustained over many years by most mandarins. Using this scale data indicate that topworked trees at Valley Center showed the highest and most consistent crops, ranging between 3 and 4.5 over the 4 years studied. It is not clear whether the more consistent yields at this location are due to tree propagation method, management, or location. Crops at Ojai were also good, being 2.5 or greater in all years. At Santa Paula, crop ratings indicated alternate bearing, with average values of 2.17, 3.67, 1.17, and 3.50 from 1998-99 to 2001-2002 respectively. Trees planted at Thermal in 1994 showed similar behavior, but with lower values of 1.83, 0.50, 2.40, and 1.40, while those planted in 1996 had crops of 0, 0, 2.87, and 1.5. Overall, performance of the trees in the southern desert indicates that 'TDE2' may not bear well enough for commercial use in desert areas. Trees tend to flower profusely at desert locations, but fruit set and fruitlet retention are not always good.

Fruit Maturity: An important determinant of maturity date for citrus fruit is the solids:acid ratio. The estimated dates on which fruit reached an 8:1 solids:acid ratio were December 6 for the southern deserts, January 2 for Ojai, February 20 for Valley Center (north San Diego County) and March 5 for Santa Paula. In California, state standards specify a solids:acid ratio of at least 6.5 for tangerines and mandarins. The 8:1 ratio is used for oranges. We believe that 'TDE2' should not be marketed until fruit reach a solids:acid ratio of at least 10:1. Taste panel evaluations support this recommendation. This would delay maturity by about 3 weeks compared with the dates above and would result in a much better tasting and easier to peel fruit. 'TDE2' holds especially well on the tree for an extended period. They maintain their marketable fruit qualities well into May at most locations. Fruit from trees on Volkamer lemon and Schaub rough lemon generally have slightly lower solids and acid than those from trees on Carrizo citrange, C-35 citrange, or Rich 16-6 trifoliate orange, but this effect is less noticeable than with oranges and does not preclude the use of Volk or Schaub as a rootstock with trees used for fresh fruit marketing.

Fruit Storage: Limited data indicate that fruit of 'TDE2' store very well after harvest. Trial fruit taken from a late-February harvest at Valley Center which were run over the packline at the University of California Lindcove Research and Extension Center and waxed were evaluated by a taste panel prior to and after storage at three different temperatures, 11 days at 68^{o} F (20.5^{o} C), 12 days at 37^{o} F (3.4^{o} C) followed by 7 days at 55^{o} F (13.3^{o}C), or 12 days at 41^{o} F (5.6^{o} C) followed by 7 days at 55^{o} F (13.3^{o}C). These samples would represent peak maturity fruit of 'TDE2'. Fruit quality ratings were good for all traits before storage, and were little changed or improved (peelability) by both cold storage treatments. Storage at a continuous 68^{o} F (20.5^{o} C) reduced the scores for visual appeal and peelability. Waxed fruit were similar to unwaxed fruit for nearly all traits in all temperature regimes.

'TDE2' is being released along with two sister siblings, 'TDE3' and 'TDE4'. In comparison with its siblings, fruit of 'TDE2' is similar in size, shape and rind texture to that of 'TDE4' but has a less deep orange rind color, while it is larger and flatter than 'TDE3' and without a neck and with less rind color. Fruit of 'TDE2' mature later than 'TDE3' at all locations and holds on the tree past maturity much longer. In comparison with 'TDE4', both mature at approximately the same time (somewhat location dependent) but 'TDE2' holds longer past maturity than 'TDE4' (both hold quite well). 'TDE2' has a slightly less fine flesh texture and is slightly less juicy than 'TDE3' but is juicier and more finely textured than 'TDE4'. 'TDE2' peels easier than 'TDE3' and similar to 'TDE4'. All three varieties are heavy for their size. Overall 'TDE2' has yielded about the same as 'TDE3' and 'TDE4', but few yield trials included all three cultivars. Alternate bearing habits are similar for all three varieties.

For more information contact:

Dr. Mikeal Roose
Department of Botany and Plant Sciences
University of California
Riverside, CA 92521
Tel: (909) 787-4137
Fax: (909) 787-4437
Email: roose@citrus.ucr.edu