California Cling Peach Advisory Board

2012 Annual Report

Project Titles: Regional Testing of New Cling Peach Selections

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2012 Summary

Unlike fresh market peach, the processing peach industry is based on fewer, well-tested cultivars since orchard or even cultivar breakdown earlier than 20 years represents a considerable economic loss. Consequently, the thorough testing in all major production regions and under the range of climates and environments anticipated in commercial production is prudent before cultivar release. Because cultivar validation typically requires up to 20 years of regional testing, it is too costly for private breeders and the responsibility falls to the University of California (UCD) which has developed the majority of currently important processing peach cultivars. While previous UCD breeding programs have typically released thoroughly tested cultivars primarily at the end of that breeding program (for example, *Carson, Corona, Andora, Carolyn* in the early 1940's; *Andross, Everts, Klampt, Bowen, Tufts* in the late 1960's; and *Dr. Davis* and *Ross* in the early 1980's), the current breeding program is attempting to accelerate the transfer of new varieties to industry while at the same time incorporating often novel traits (brown-rot resistance, uniform harvest, higher phytonutrient level, compact tree size, etc.) to meet changing industry needs. The Regional Testing program is an integral part of this process as it leverages grower and processor expertise in both evaluating performance as well as facilitating commercialization of this new germplasm. Currently, a total of 20 selections planted at 80 sites and comprising over 5,500 trees have been established in regional test sites. The 2nd generation cultivars *Goodwin* and *Lilleland* had been released to address needs in the *Dixon-Andross* and *Halford* seasons. Advanced UCD 3rd generation selections in the *Ceres-Carson, Dixon-Andross* and *Starn-Corona* seasons and incorporating novel disease resistance and production traits are now being prepared for release to the California processing peach industry. A number of promising 4th generation breeding selections further combining new traits with adaptation California's changing production needs, are in advanced stages of regional testing.

Regional Testing of New Cling Peach Selections: 2012

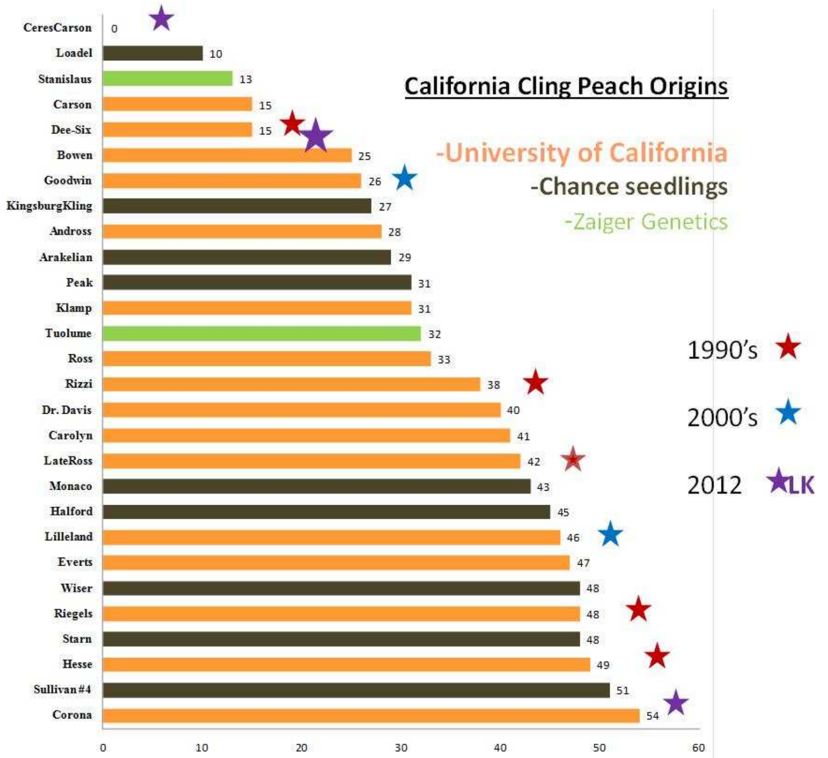


Fig. 1. Relative harvest times and origins of commercially important California processing peaches. (Current releases represent the 3rd generation (violet stars) of new cultivars released by UCD.

Unlike fresh market peach, where numerous new cultivars are being introduced and the average cultivar commercial life expectancy is often less than 10 years, the processing peach industry is based on fewer, well-established cultivars. This is because of the higher productivity required from these cultivars, the need to have cultivars fully compatible with food processing, and the longer orchard life-expectancy of 20 years or more. Because of the high orchard investments, cultivar breakdown earlier than 20 years can represent a significant economic loss for the grower. Consequently, the thorough testing in all major production regions and under the range of climates and environments anticipated in commercial production is prudent before cultivar release for commercial planting. Because such cultivar validation typically requires 10 or more years of regional testing, it is often too costly for private breeders and the responsibility falls to the University of California (UCD) which has developed the majority of currently important processing peach cultivars (**Figure 1**). An early goal of the current UCD peach breeding program has been the replacement of problem varieties, particularly in the *Dixon-Andross* and *Halford-Starn* maturity and, to a lesser extent, season-extension particularly earlier than *Loadel*. A more recent objective has been the development of cultivars allowing lower inputs, particularly labor and agrochemicals, yet fully compatible with grower and processor requirements. Three advanced UCD selections, *UltraEarly #1, ExtraEarly #1,* and *ExtraLate #1*, are currently being prepared for patenting and release and will be the primary focus of this report. The report will concentrate on the characterization and assessment of these selections, and to a lesser degree, a description of not-yet fully tested but promising 4th generation selections ripening within the same periods.

Table 1. Fruit characteristics of UCD processing peaches selections along with standard cultivars representing different harvest seasons. [Advanced selections being prepared for patenting and release are highlighted in yellow while promising 4th generation selections within the same harvest season are highlighted in tan. Advanced selections are designated based on industry harvest season followed by a unique identification number]. [Results are the averages of 3 years (2010-12) data from trees which were heavily flower thinned so that fruit development was not resource limited and thus represents its maximum genetic potential.]

Selection	Ripe	Brix	pH	TA	Brix/TA	Firmness	Fruit Weight	Pit Weight	Color a*
UltaEarly#1	11-Jul	12.3	3.883	0.5625	22.20	7.75	284.5	4.3	17.22
Loadel	15-Jul	9.9	3.845	0.554	17.74	7.05	183.7	5.2	5.65
Carson	20-Jul	10.45	4.041	0.563	18.29	6.7	219.5	4.3	4.97

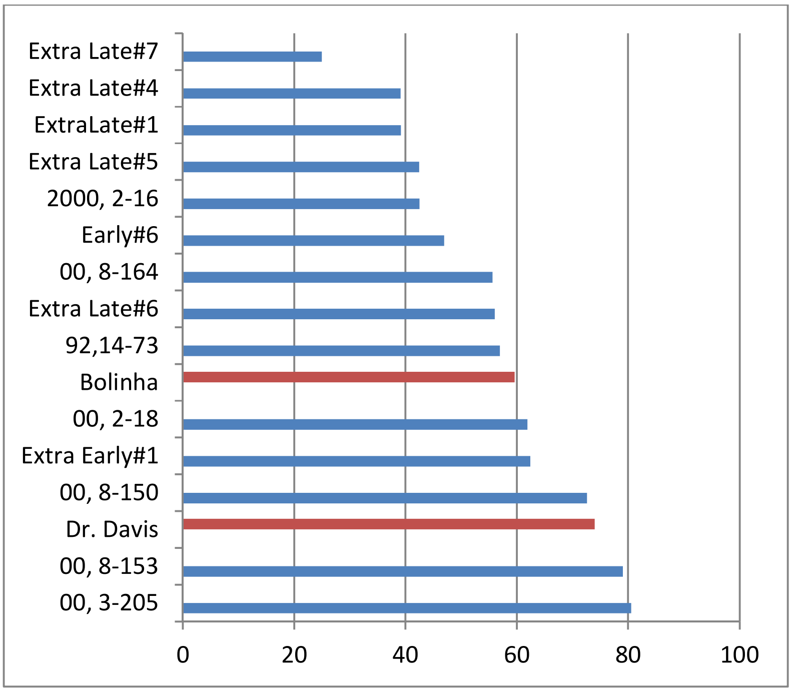
Carson	20-Jul	10.45	4.041	0.563	18.29	6.7	219.5	4.3	4.97
Dixon	27-Jul	12.85	4.058	0.4015	32.03	5	226.4	4.8	6.07
ExtraEarly#1	27-Jul	12.9	3.984	0.4865	26.52	6.4	332.7	8.1	6.98
Early#6	29-Jul	10.75	3.805	0.558	19.28	7	237.9	8.9	5.03
Compact#2	27-Jul	10.9	3.818	0.604	18.03	4.75	307.2	5.8	11.42
Early#4	30-Jul	12.3	3.954	0.4415	27.86	5.6	195.4	4.6	7.05
Goodwin	31-Jul	12.35	3.852	0.5165	24.04	8.6	236.2	5.8	9.07
Early#5	2-Aug	11.9	3.773	0.566	21.02	9.15	235.7	5.2	11.99
Andross	2-Aug	12.65	4.087	0.414	30.56	7	332.2	6.4	6.87
Ross	7-Aug	12.3	3.822	0.5115	23.96	9.5	236.0	6.8	5.27
Late Ross	22-Aug	13.7	3.852	0.4915	30.59	7.85	167.5	5.4	9.33

Halford	27-Aug	13.85	3.966	0.5925	24.61	9.05	275.7	6.7	7.12
Lilliland	28-Aug	12.65	3.723	0.567	23.50	7.75	296.5	4.3	6.08
UCD91-16-154	28-Aug	11.8	3.883	0.502	23.51	7.4	260.3		11.93
Everts	29-Aug	12.55	3.904	0.5015	26.15	6.5	226.5	6.2	8.30
Riegels	30-Aug	14.05	3.831	0.5535	25.38	7.1	227.0	6.7	8.03
ExtraLate#2	6-Sep	12.15	3.98	0.5205	23.38	7.5	240.2	4.9	14.36
ExtraLate#4	6-Sep	14.3	3.722	0.878	16.29	10.25	237.7	5.9	15.67
Hesse	7-Sep	12.15	3.976	0.5085	24.26	6.75	243.7	5.8	9.42
ExtraLate#1	7-Sep	14.7	3.791	0.579	26.07	8.3	259.5	6.1	6.29
Compact#3x	8-Sep	15.95	3.794	0.687	23.32	8.65	241.7	5.1	17.19
ExtraLate#7	8-Sep	14.45	3.703	0.6975	20.80	11.15	175.8	4.5	15.38
ExtraLate#6	8-Sep	13.45	3.792	0.7205	18.68	10.1	181.2	5.2	14.33
ExtraLate#5	9-Sep	14.3	3.636	0.893	16.34	12.35	203.7	5.0	15.22

Chart 1. Fruit brown-rot resistance ratings (average of 2009 -11 data) for selected advanced UCD selections along with cultivar standards for different harvest seasons. [Fruit brown rot resistance screening (Bostock lab) was not funded in 2012. *Extra-Late#1 was not* analyzed during these years though earlier evaluations rated resistance as comparable to *Carson*].

Selection	Average Brown-Rot Severity	STD
UltraEarly#1	1.20	1.48
Carson	13.19	6.10
ExtraEarly#1	3.11	2.89
Early#4	3.14	2.53
Early#5	6.39	6.19
Early#6	4.24	4.43
Goodwin	5.83	4.98
Ross	21.28	7.01

Chart 2. Resistance to *Monilinia* flower blight results from 2012 controlled inoculation study with Jim Adaskaveg, UCR. *Ultra-Early#1* analysis was not included in 2012, however, previous resistance scorings were comparable to *Early#6*.



Ultra-Early#1

Fig. 1. *Ultra-Early#1*: lineage (top), left image shows 2012 fruit at 10d passed tree-ripe stage while remainder 2010 images are from tree-ripe harvest. Note the tendency for irregular fruit shape and some beaking at fruit tip.

[UCD breeding designation D,62-193]. *Ultra-Early#1* is derived from a combination of Brazilian (*Conserva485*) and Eastern European (*NJC5102893*) peach germplasm from the Rutgers University breeding program of Dr. Fred Hough which was terminated in the late 1980's. The initial New Jersey selection expressed unusual sections of stem necrosis which we determined to be genetic rather than disease in origin. A series of clonal-source selections since the 1990's (based on the noninfectious-bud-failure elimination strategies developed in almond) has eliminated all trace of this condition in UCD and regional trial trees. *Ultra-Early#1* combines very good size and cropping potential with a very early maturity of approximately 8-12 d before *Loadel*. Despite its early maturity, this selection demonstrates exceptional compensatory-sizing capacity (i.e. the ability to aggressively size fruit when more resources become available as would occur when the crop is over- thinned or early fruit loss from weather, disease, etc.

The aggressive fruit sizing compensates by making remaining fruit and so yield appreciably larger; more data presented in 2012 annual Variety Development report).

> *[Early UCD breeding efforts utilizing traditional California processing peach germplasm found that fruit cropping potential decreased dramatically for selections maturing before Loadel, contributing to a general perception that yield potential this early in the season was constrained by insufficient heat units. Several of the diverse origin clingstone peach breeding parents from the Rutgers University program demonstrated that good fruit size, Brix and productivity could be achieved in this Ultra-Early season with appropriate initial germplasm and subsequent genetic selection.]*

Ultra-Early#1 is also distinguished by a high level of fruit flesh firmness and fruit brown-rot resistance (Chart 1) and has become an important breeding parent within the UCD program for these objectives as well as earliness. Fruit maintain integrity and quality for 10 days or more after tree-ripe (*Long-Keeper* trait) allowing delayed or once-over harvest. Fruit are similar in size and general shape to *Carson* but with firmness comparable to *Loadel.* As shown in the images, fruit can be somewhat irregular in shape which limits their value for processing as fruit halves. Fruit also have a more pronounced orange-gold color compared to the yellow to yellow-gold color of *Loadel* and *Carson*. The high Brix, Brix/TA ratio (over 20), good firmness and deeper color may make them suitable for slicing and well suited for dicing (which is often a major use of fruit in this very early season). Skin, like flesh color, is gold to orange-gold with only slight blush. Fruit show low levels of flesh bruising even when overripe. No red pigmentation is observable in the skin or pit though some slight pink in flesh can occur in very overripe (> 14 days) fruit. Fruit flesh develops full colors precociously before the skin and so allows some early pick and still make color grade. [While *Ultra-Early#1* has demonstrated consistently good levels of resistance to *Monilinia* fruit rot (both in lab inoculations in field conditions) resistance is considerably enhanced when fruit epidermis is still green to color break. This would allow even greater field resistance in this very early maturity season which is more prone to early summer rains). Fruit-tip beaking of 2 cm or greater may be present after warm springs. Some split-pits and early fruit-drop have been observed with up to 8% splits observed in 2010. Most grower test sites (including an organic orchard) are in the lower San Joaquin Valley near the now closed Kingsburg DelMonte cannery because of its capacity begin peach processing in this early-season. Additional test plantings are present in the Sacramento Valley as some of the more northern canneries are interested in a very early peach which can be grown and processed organically. (The early processing time is required to avoid later contamination with nonorganic produce. The good productivity, firmness, Brix/TA ratio color and disease resistance of *Ultra-Early#1* may make it particularly well suited for this use). Release of *Ultra-Early#1* is expected to be slightly delayed relative to other releases owing to the joint development history of this material with Rutgers University.

Two other UCD selections *Ultra-Early#2* and *Ultra-Early#3* are also being tested to bridge the gap between *Ultra-Early#1 and Loadel.* A multiyear/multi-site evaluation of fruit quality and productivity for these more traditional 2nd generation breeding material indicates that they may not be up to commercial standards. *Ceres-Carson*, however, could be used to fill the *Ultra-Early#1- Loadel* harvest gap if needed.

Extra-Early#1

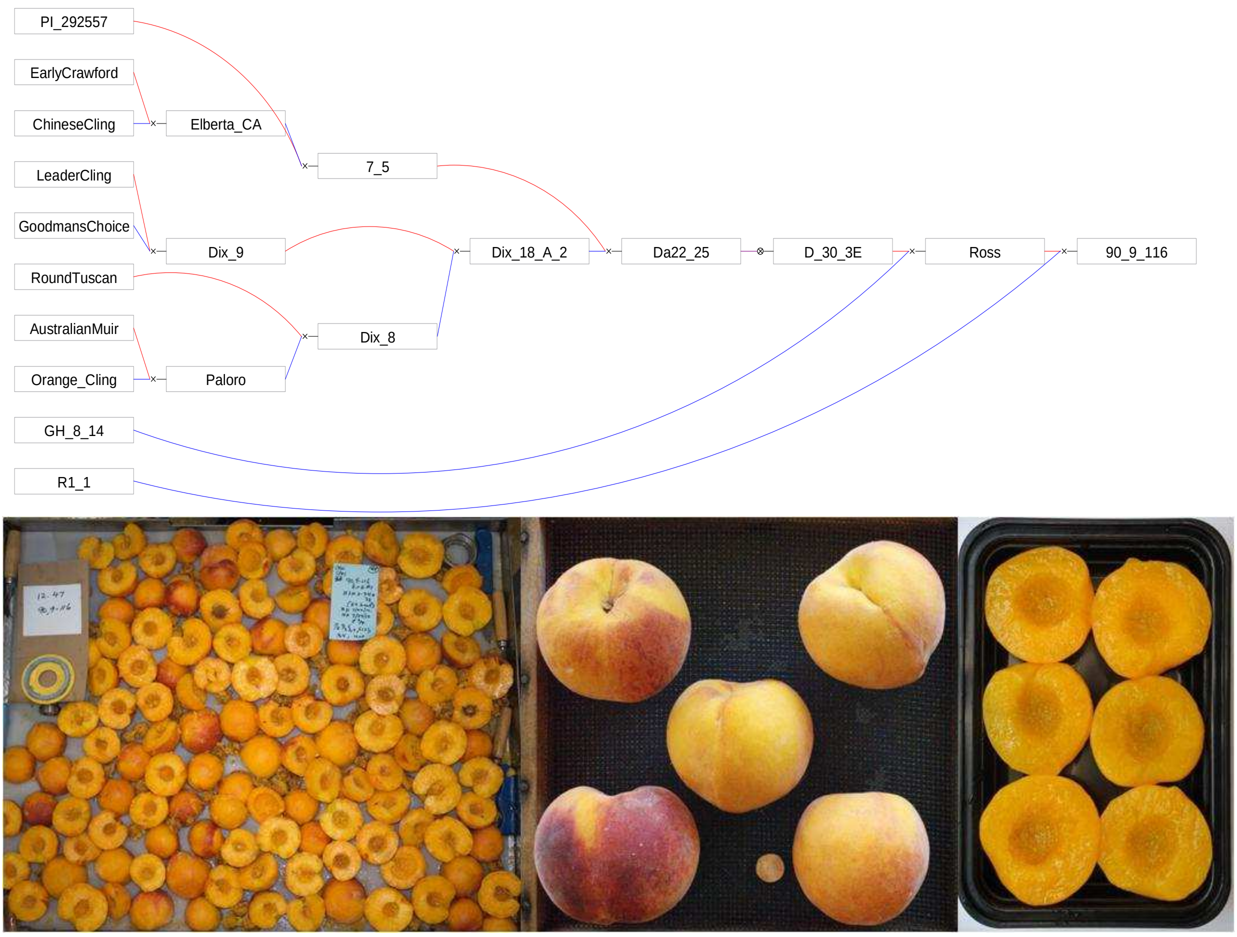


Fig. 2. *Extra-Early#1*: lineage (top), left image shows 2012 fruit at 10d passed tree-ripe stage while remainder 2010 images are from tree-ripe harvest.

[UCD breeding designation 90,9-116]. Fruit ripens between *Carson* and *Goodwin* (approximately the same time as the old *Dixon* variety) but because it maintains good fruit integrity on the tree following the full-ripe stage, can be harvested to *Andross* season. Fruit weight under conditions of heavy flower thinning is among the largest of the *Extra-Early* and *Early* selections tested (Table 1, more results in Variety Development annual report). This indicates an aggressive compensatory-sizing (very similar to *Andross*) which should facilitate consistently high grower yields. Fruit Brix (averaging 12.9) is also amongst the highest for these maturity seasons) and Brix/TA ratio is above the desired level of 20. *Extra-Early#1* has consistently shown good levels of fruit brown rot resistance (Chart 1) and is being used as a parent for this trait. Fruit are generally symmetrical; though occasionally show some cheek asymmetry similar to *Goodwin* with which it shares some lineage. Flesh color is golden-yellow, also similar to *Goodwin* and also occasionally showing traces of green on shoulders. Flesh shows good firmness as well as low bruising/browning potential. Skin is yellow-gold with up to 80% showing stippled red blush. Fruit drop, split pits, and pit fragments were low in 2006-20011 evaluations with some drop at KAC plantings in 2009 & 2010. Fruit are similar in size and shape to the *Dixon* cultivar but without the red-pit staining and excessive pit fragments associated with *Dixon*. Some slight pink discoloration of in pit cavities was observed in some overripe 2008, 2009 & 2010 samples but was lost in cooking. Early 2004 KAC test plantings of this selection included a few atypical trees which ripened 4-5 days after most trees in the selection, suggesting that some variability in maturity time may be present. Subsequent test plantings, including all grower test plantings, were propagated from individual Foundation trees established at FPS in virus-free isolation blocks. No deviations from fruit ripening time were observed in either FPS or propagated trees suggesting that off-types were the result of propagation error.

Early #6

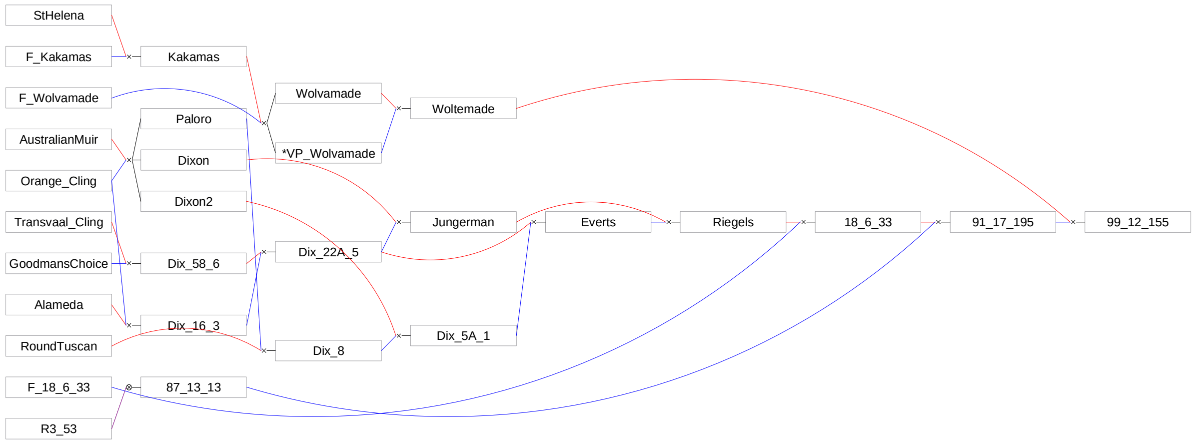


Fig.3. *Early#6* lineage (top), left image shows heavily thinned 2012 fruit while right image shows standard thinned-tree; both harvested at tree ripe stage.

[UCD breeding designation 99,12-155]. *Early #6* is an advanced fourth-generation selection derived from South African germplasm combining the long-keeper potential of *Late#4* with a more traditional golden-yellow flesh color, and a maturity time within the crucial *Dixon-Andross* season . This selection has consistently shown superior fruit color as well as harvest- and post- harvest firmness and cropping potential over a multi-year test period. Fruit maintain integrity and quality 10 days or more after tree-ripe (*Long-Keeper* trait) allowing delayed or once-over harvest. Good levels of fruit brown rot resistance have also been achieved both in the lab (Chart 1) and field, as well as moderate levels of resistance to Monilinia flower blight (Chart 2). Fruit is medium large, uniformly round and firm even when overripe. Fruit show no red blush on the skin and, more importantly, no red stain development in the fruit pit-cavity even up to two weeks beyond the full-ripe date. Pit-cavity is medium to large and somewhat ragged. Fruit weight following heavy thinning was moderately large (238g) being similar to *Ross* but significantly smaller than *ExtraEarly-1*. This suggests it may be at a compensatory-sizing yield disadvantage relative to *ExtraEarly-1* when trees are over thinned (or early crop loss from frost, disease, etc.). However, because *Early-6* harvest between *ExtraEarly-1* and *Andross* it may complement these varieties.

Extra- Late#1

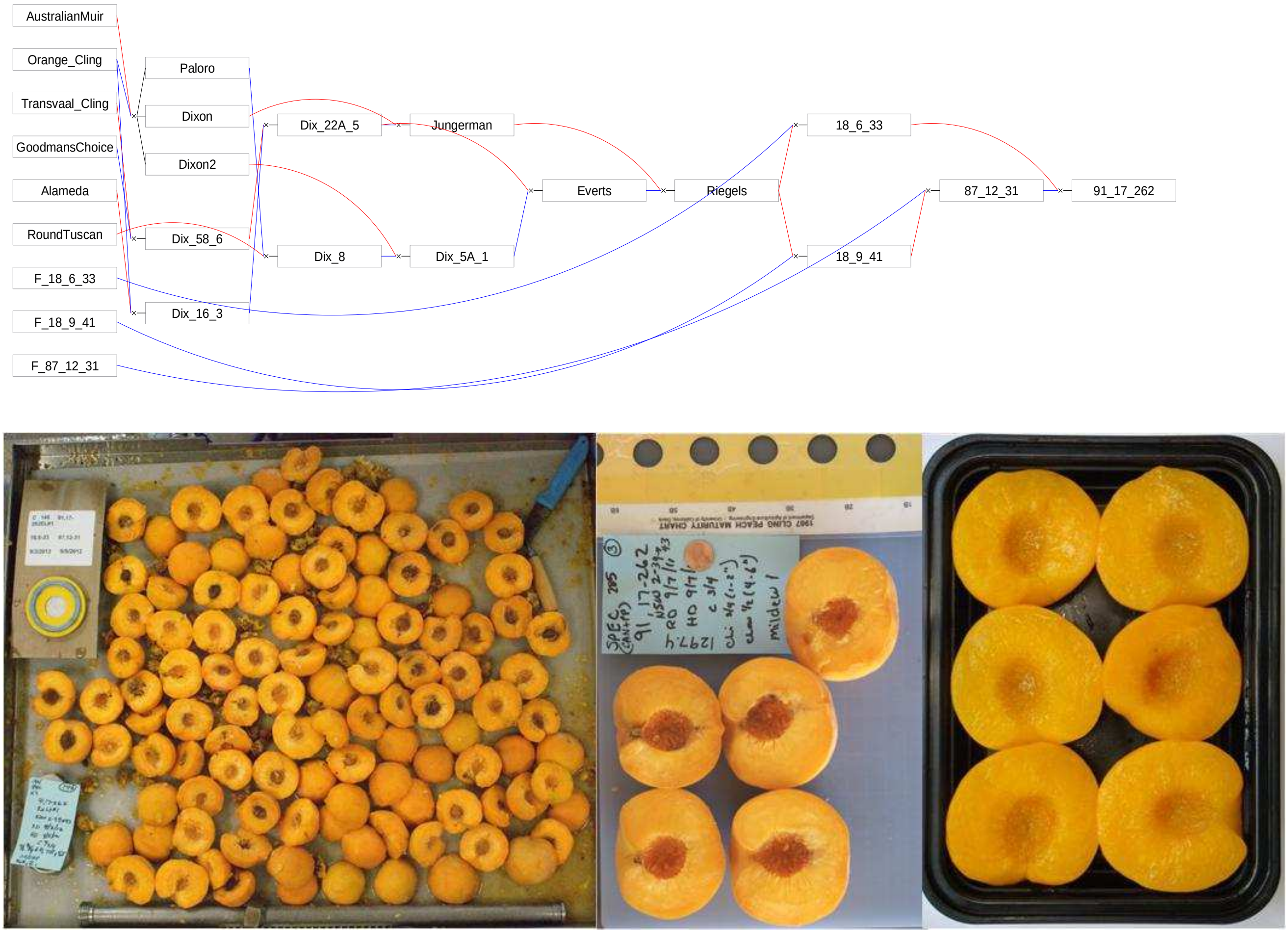


Fig. 4. *Extra- Late#1* lineage (top), left image shows 2012 fruit at 5d passed tree-ripe stage while remainder show tree-ripe fruit from 2012 harvest and from canned 2010 samples.

[[UCD breeding designation 91,17-262]. Fruit ripen in the targeted *Starn-Corona* season. Fruit are medium to large in size with a moderately small pit contributing to improve processing case-yield. Flesh color is uniform yellow-gold to orange-gold with associated higher levels pro-vitamin A and antioxidant compounds. In some years flesh color can approach that of *Hesse*. Skin color is a uniform yellow-gold, also without red pigmentation. Fruit are firm with an average 3 year value 8.3 lbs. (Table 1). *Extra-Late#1* consistently maintained better flesh firmness and texture than the adjacent *Halford* and *Corona* in regional test-plantings. Pit cavities are generally free from split pits and fragments. Fruit flesh show low bruising potential but some bruised fruit and flesh browning was observed in overripe 2009 and 2011 samples. Some fruit drop as well as field brown- rot fruit were observed in 2008, 2009 and 2011. Unlike 4th-generation *Extra-Late#4-7* selections, *Extra-Late#1* shows only moderate levels of the *long-keeper* post-ripening fruit integrity trait and fruit brown-rot resistance (comparable to *Halford)* but relatively high levels *Monilinia* flower blight resistance (Chart 2).

Compact#2 and Compact#3.

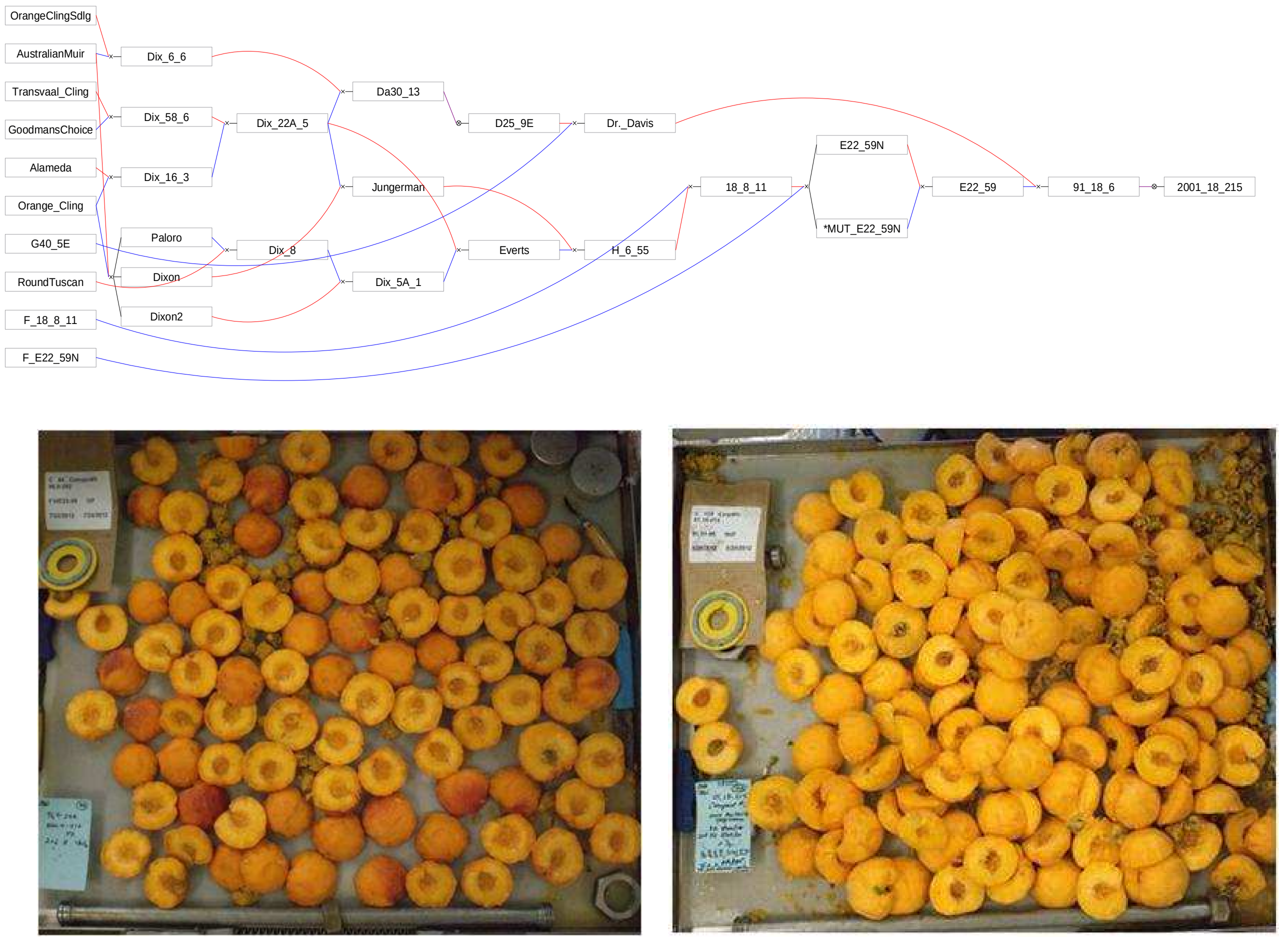


Fig. 5. ***Compact#2* and *Compact#3***: lineage of Compact#3 (top) { *Compact#2* is self of E22-59}. Left image shows 2012 *Compact#2* at 5d passed tree ripe stage; right image shows 2012*Compact#3* fruit at 10d passed tree-ripe stage. Trees were from test plots that were unpruned and unthinned.

[UCD breeding designations 99,6-292 and 2001,18-215]. The trees are productive and compact, being approximately 1/2 to 2/3 standard height (see 2010-11 Annual Reports for detailed data on tree architecture). Thus, while expressing high levels of fruit quality, on-tree holding ability, and disease resistance, will require novel management strategies to be commercially viable. *Compact#2* fruit ripen with *Dixon* and will hold on the tree until *Andross* time. Fruit are medium size, of very good quality with a good (on-tree) holding ability allowing a 1 to 2 week delay in harvest if necessary. Fruit can be only moderately firm but with high Brix, low bruising and moderate resistance to fruit brown rot. Fruit flesh is uniform gold to yellow-gold and is usually free of red pigmentation even when overripe (some pink observed in pit cavities in 2008, all of which cooked-out with processing). Skin is yellow-gold with up to 40% red blush. Trees are productive with relatively little blind wood and low preharvest drop making them amenable to mechanical harvest. Some flesh bruising/browning was observed in overripe 2009-11 fruit and ~6% splits observed in 2010-11.

Compact#3 tree is productive and compact, being approximately 2/3 standard height. Fruit are of very good quality with a good (on-tree) holding ability allowing in one to two week delay in harvest if necessary. Fruit ripen with *Monaco* to *Halford* but will hold on the tree until *Corona*. Fruit flesh and skin is uniform yellow and free of red pigmentation. The fruit pit cavity is free of red-staining, though over-ripe fruit will often show a slight brown pit- imprinting, which after canning can appear as a slight pink imprinting in the pit. Trees are very productive with relatively little blind wood, low fruit brown rot and bruising, making them amenable to mechanical harvest.

Extra Lates#4-7

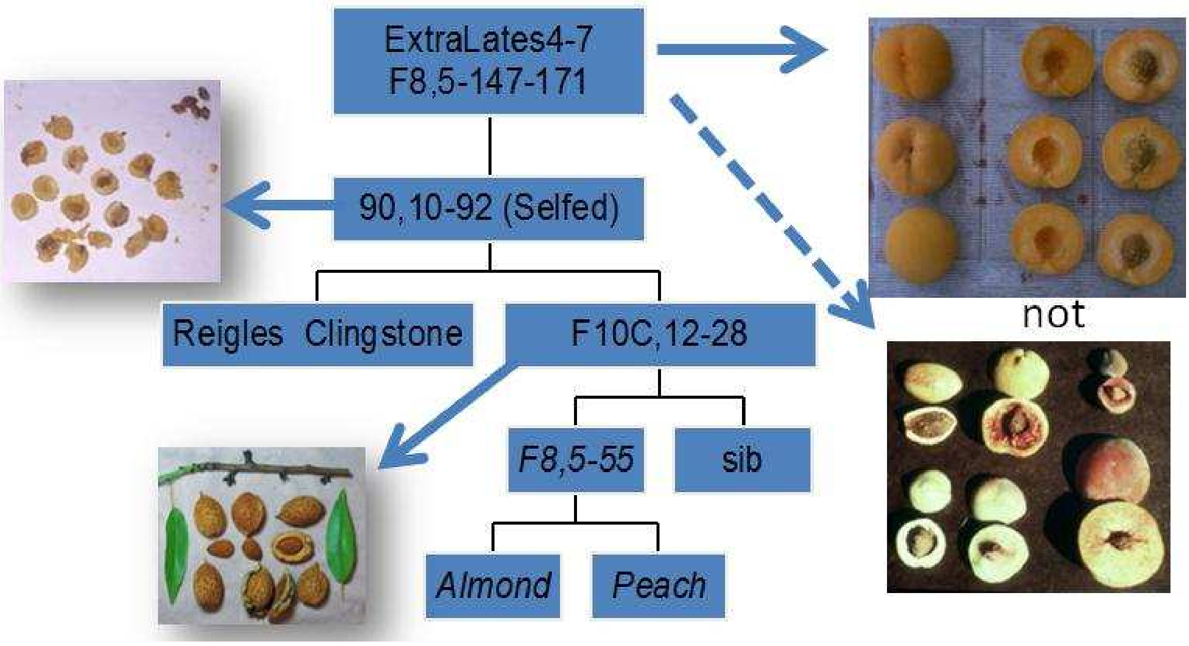


Fig. 6. Lineage (top) showing recent derivation from almond (arrows identify fruit types). Processed samples (2010) show, from left, *Extra Late#4, ExtraLate#6* and *ExtraLate#7* fruit harvested at 10d passed tree-ripe stage.

[UCD breeding designation F8,5-147,-156,-166 &-171]. While combining high levels of fruit quality and disease resistance and exceptional levels of on-tree post-ripe holding ability (Long-Keeper trait), these selections represent a highly experimental 'whole-genome' approach to cultivar development and so may at some point exhibit unanticipated problems. Response to-date from long-term regional grower testing, however, has been positive with no significant problems reported. Other atypical aspects of these breeding selections are a flowering time is approximately 4 days earlier than even *Ross,* and trees which tend to be productive with minimum thinning. Selection *Extra-Late-6* has displayed evidence of resistance to the plum pox virus (sharka disease) in tests with collaborators in Spain. Fruit ripen in the targeted *Starn-Corona* season. Fruit are of good quality with a good (on-tree, *Long Keeper*) holding of 4 weeks or more, allowing delayed or once-over harvest if desired. Fruit also displayed good cold storage potential (8 plus weeks) relative to traditional cultivars. Fruit is uniform and symmetrical, has high soluble-solids, is medium in size and with a small, clean pit cavity (Table 1). Fruit flesh is firm and easily pitted, but occasionally maintains a greenish tinge when processed which can give the canned fruit a more orange hue though not as dark as the South African variety *Kakamas.* Fruit color is yellow-gold with no red pigmentation in the pit-cavity, flesh or skin. Pit cavity is medium large and somewhat ragged. Middle mesocarp flesh is particularly firm which is maintained post-ripe and postharvest. Some fruit drop observed in the field in 2007, 2009 and 2011. FPS virus-free foundation stock has been developed for *Extra Late#4, ExtraLate#6* and *ExtraLate#7* to provide clean foundation stock to California nurseries if released. *ExtraLate#5* stock was found to be infected with Prunus necrotic ringspot virus and has not yet been decided as to whether to make the effort to attempt to clean it.

Table 2. Regional Trial Grower Sites. A total of 20 selections planted at 80 sites and comprising over 5,500 trees have been established in regional test sites. *(Data is from early 2012 with some test-plantings having since been removed when orchards were removed because of loss of processor contracts, orchard pull-out program, etc.).*

Seq.	Selection	Grower	No. of Trees	City
1	UltraEarly#1	Bob Quatrin	100	Kingsburg
1	UltraEarly#1	Jim Jackson	50	Kingsburg?
1	UltraEarly#1	Wolfskill	2	Winters
1	UltraEarly#2/	Wolfskill	1	Winters
1	UltraEarly#2/3?	Bob Quatrin	50	Kingsburg
1	UltraEarly#3	Bob Quatrin	50	Kingsburg
1	UltraEarly#3	Jim Jackson	50	Kingsburg
1	UltraEarly#3	Kearney Ag. Center	100	Parlier
1	UltraEarly#3	Wolfskill	2	Winters
2	ExtraEarly#1	Jim Jackson	50	Kingsburg
2	ExtraEarly#1	Kearney Ag. Center	100	Parlier
2	ExtraEarly#1	Paul Rai	50	Yuba City
2	ExtraEarly#2	Kearney Ag. Center	20	Parlier
2	ExtraEarly#2	Paul Rai	50	Yuba City
3	Early#4	Richard McPherrin	80	Yuba City
3	Early#5	Kearney Ag. Center	5	Parlier
3	Early#5	Richard McPherrin	80	Yuba City
4	Late#2	Sarb & Kuldip Atwal	50	Olivehurst
4	Late#2	Kearney Ag. Center	5	Parlier
4	Late#2	Wolfskill	10	Winters
4	Late#2	Richard McPherrin	50	Yuba City
5	ExtraLate#1	Kearney Ag. Center	100	Parlier
5	ExtraLate#1	Wolfskill	7	Winters
5	ExtraLate#1	Pat McCay	50	Davis
5	ExtraLate#2	Parminder Sarwat	30	Ballico
5	ExtraLate#2	Mike Nolan	30	Marysville
5	ExtraLate#2	Sarb & Kuldip Atwal	50	Olivehurst
5	ExtraLate#2	Wolfskill	4	Winters
5	ExtraLate#2	Richard McPherrin	50	Yuba City
5	ExtraLate#4	Gus Obertier	70	Waterford
5	ExtraLate#4	Wolfskill	2	Winters
5	ExtraLate#5	Gus Obertier	70	Waterford
5	ExtraLate#5	Wolfskill	2	Winters
5	ExtraLate#6	Gus Obertier	70	Waterford
5	ExtraLate#6	Wolfskill	2	Winters
5	ExtraLate#7	Wolfskill	2	Winters
5	ExtraLate#7	Gus Obertier	70	Waterford
6	Compact#1	Kearney Ag. Center	15	Parlier
6	Compact#1	Wolfskill	2	Winters
6	Compact#2	Wolfskill	4	Winters
6	Compact#3	Davis	1	Winters

Regional Trial Grower Sites. (continued from previous page)

Year	Selection	Grower	No. of Trees	City
2009	Compact#2,	Pete Martini	101	Escalon
2009	Compact#2,	Sarb Johl	100	Live Oaks
2009	Compact#3	Gary Schnitzler	96	Kingsburg
2009	Compact#3	Runjit Davit	103	Live Oaks
2009	Compact#3	Paul J. Van Konynenburg	100	Modesto
2009	ExtraEarly#1	Harvinder Kullar	119	Ballico
2009	ExtraEarly#1	Wil Sohal	45	Sacramento
2009	ExtraEarly#1	Sean Carberry	55	Yuba City
2009	ExtraLate#4	Paul J. Van Konynenburg	100	Modesto
2009	ExtraLate#4	Gus Obertier	130	Waterford
2009	ExtraLate#4	Sarb Johl	50	Live Oaks
2009	ExtraLate#4	Mohinder Ghag	24	Live Oaks
2009	ExtraLate#5	Mohinder Ghag	104	Live Oaks
2009	ExtraLate#5	Paul J. Van Konynenburg	100	Modesto
2009	ExtraLate#6	Mohinder Ghag	113	Live Oaks
2009	ExtraLate#6	Paul J. Van Konynenburg	100	Modesto
2009	ExtraLate#7	Mohinder Ghag	114	Live Oaks
2009	ExtraLate#7	Paul J. Van Konynenburg	100	Modesto
2009	Late#4	Lou Boer	51	Ceres
2009	Late#4	Runjit Davit	98	Live Oaks
2009	Late#4	Gus Obertier	55	Waterford
2010	Early#6	Rajinder Chohan	315	Yuba City
2010	ExtraEarly#1	Rajinder Chohan	315	Yuba City
2010	ExtraLate#4	Eric Spycher	78	Ballico
2010	ExtraLate#5	Eric Spycher	78	Ballico
2010	ExtraLate#6	Eric Spycher	78	Ballico
2010	ExtraLate#7	Rajinder Chohan	315	Yuba City
2010	Late#4	Norman Kline	22	Riverbank
2010	Late#4	Eric Spycher	186	Ballico
2010	ExtraLate#4	Norman Kline	206	Riverbank
2010	ExtraLate#5	Norman Kline	226	Riverbank
2010	ExtraLate#6	Norman Kline	270	Riverbank
2010	ExtraLate#5	Marjorie Bishop	22	Modesto
2010	ExtraLate#6	Marjorie Bishop	7	Modesto
2010	Late#4	Marjorie Bishop	74	Modesto
2011	Early#6	Satinder Davit	25	Live Oaks?
2011	Late#4	Pete Martini	xxx	Escalon
2011	Early#6	UC	300	UCD
2011	Late#4	xxx	300	xxx

Recent Publications

1. Gradziel. T.M. 2011. Almond origin and domestication. In J. Janick (ed.) Horticultural Reviews. 38:23-82.

2. Hamby, K. L.W. Gao, B. Lampinen, T. Gradziel and F. Zalom. 2011. , Hull Split Date and Shell Seal in Relation to Navel Orangeworm (Lepidoptera: Pyralidae) Infestation of Almonds. Hort. Entom.: 104-965-969.

3. Socias i Company , R., J.M. Alonso, O. Kodad and T.M. Gradziel. 2011. Almonds. In: M.L. Badenes and D.H. Byrne (eds.), Fruit Breeding, Handbook of Plant Breeding 8. Springer N.Y. pg. 697-728.

4. Gradziel. T.M. 2012. Classical genetics and traditional breeding. In: A. G. Abbott & C. Kole (eds.). Genetics, Genoics and Breeding of Stone Fruits. Science Publishers, Inc., Plymouth. pg. 1-50.

5. Riaz Ahmad, Dan E. Parfitt, Joseph Fass, Ebenezer Ogundiwin, Amit Dhingra, Thomas M. Gradziel, Dawei Lin, Nikhil A. Joshi, Pedro J. Martinez-Garcia, Carlos H. Crisosto. 2012. Whole genome sequencing of peach (Prunus persica L.) for SNP identification and selection. BMC Genomics 2011, 12:569 doi:10.1186/1471-2164-12-569

6. Martínez-García P., Peace C., Parfitt D., Ogundiwin E., Fresnedo-Ramírez J., Dandekar A., Gradziel T., Crisosto C. (2012) Influence of year and genetic factors on chilling injury susceptibility in peach (Prunus persica (L.) Batsch). Euphytica (Online first): 1-14. DOI: 10.1007/s10681-011-0572-1

7. Frett, T., K. Kasic, J. Clark, D. Byrne, T. Gradziel and C. Crisosto. In-press. Standardized phenotyping for fruit quality in peach [Prunus persica (L.) Batsch]. HortScience.

8. Prabhu Dhanapal, Pedro J Martínez-García, Thomas M Gradziel, and Carlos H Crisosto. 2012. First genetic linkage map of chilling injury susceptibility in peach (Prunus persica (L.) Batsch) fruit with SSR and SNP markers. Journal of Plant Science & Molecular Breeding Pg1-

9. Shiran, B. Sorkheh, K., V. Rouhi, T. M. Gradziel, B. K. Epperson, P. Martinez-Gomez. (in press). Molecular characterization of Iranian almond cultivars and related wild species using amplified fragment-length polymorphisms (AFLPs). Zaragoza (Spain), 16-20 September. Acta Horticulture, (in press).

10. Granell, A., Pons, C., Martí, C., Forment, J., Royo, C., Gradziel, T.M., Peace, C.P., Ogundiwin, E. and Crisosto, C.H. (xxx). Genomic approaches – innovative tools to improve quality of fresh cut produce. Acta Hort. 746:203-212

11. Ogundiwin, E.A., Peace, C.P., Gradziel, T. M., Dandekar, A.M., Bliss, F.A., and Crisosto C.H. (2007). Molecular genetic dissection of chilling injury in peach fruit. Acta Horticulturae 738:633-638.

12. C.P. Peace, A.M. Callahan, E.A. Ogundiwin, D. Potter, T. M. Gradziel, F.A. Bliss, and C.H. Crisosto (2007). Endopolygalacturonase variation in Prunus. Acta Horticulturae 738:639-646.

13. Martínez-García Pedro J, Jonathan Fresnedo-Ramírez, Dan E Parfitt, Thomas M Gradziel, Carlos H Crisosto. 2012. Effect prediction of identified SNPs linked to fruit quality and chilling injury in peach [Prunus persica (L.) Batsch]. Plant molecular biology. 11/2012

14. Ebenezer A Ogundiwin, Cameron P Peace, Thomas M Gradziel, Dan E Parfitt, Fredrick A Bliss, Carlos H Crisosto. A fruit quality gene map of Prunus. BMC genomics. 12/2009; 10:587.

15. Gradziel, T.M. 2012. Almond. In: J. Janick and M. Faust, (Eds.) Origin and Dissemination of Prunus Crops.