Field Evaluation of Almond Varieties

Project No.: 17-Hort2-Lampinen

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Objectives: The objective is to evaluate new almond varieties and selections in replicated trials at three locations in the almond growing areas of California.

Interpretive Summary:
The next generation Regional Almond Variety Trials were planted in the winter of 2014 in Butte, Stanislaus and Madera counties. Rows of Nonpareil were alternated with 29 varieties and/or selections at all 3 sites. Trees at the Butte, Stanislaus and Madera trial were planted on Krymsk 86, Nemaguard and Hansen 536 rootstocks respectively (with the exceptions listed at the bottom of Table 5). Unlike the previous generation Regional Almond Variety Trials, there are four replications of each of the varieties and selections at each of the three sites in the 2014 trials. Bloom overlap of pollenizers with Nonpareil was generally good at all the sites with the exception of UCD 3-40. Yields at the three trials were higher than the previous generation Regional Almond Variety Trials likely due at least in part to higher planting densities. Main kernel defects observed in 2016 were doubles, twins, naval orange worm damage, blanks and severe shrivel.

Materials and methods:

Regional Almond Variety Trials Planted in 2014

The next generation almond variety trials were planted in the winter of 2014 in Butte (Chico State University), Stanislaus (Salida School District Site), and Madera (Chowchilla grower site) counties. The varieties and selections planted are listed in Table 1. The first 30 items are common to all 3 sites and a few different items added at individual sites are listed at the bottom of Table 1. Trees at the Butte, Stanislaus and Madera trial were planted on Krymsk 86, Nemaguard and Hansen 536 rootstocks respectively (with the exceptions listed at the bottom of Table 1). Trees were planted at a spacing of 18' x 22' at the Butte site (110 trees/acre), 16' x 21' at the Stanislaus site (130 trees/acre) and 12' x 21' at the Madera site (173 trees/acre). These densities are significantly higher than the previous generation RAVTs where planting densities for the Butte, San Joaquin and Kern trials were 64, 75 and 86 trees per acre respectively. Of the items planted in the main trials, fourteen are either partially or fully self-fertile (Table 1).

Bloom, hullsplit, canopy light interception and yield data collection were initiated in 2016. Bloom data were collected approximately every three days and recorded as onset of bloom, full bloom, and the end of petalfall. Hullsplit was recorded from the beginning of the first non-blank splits to completion of hullsplit.

Results and discussion:

General observations for each site

Butte. The winter of 2016-2017 was very wet in Butte County with roughly 40.3 inches of rain measured in Chico. This is 13.8 inches greater than the Chico long term average. The spring 2017 growing season experienced 7.7 inches of rainfall in February, 3.1 inches in March, 3.4 inches in April, and 0.8 inches in May. These wet in-season conditions likely increased disease pressure at this site.

Varieties with noticeable twig dieback (cause unknown) occurring mostly on low and interior canopy shaded twigs included UCD 8-27, Winters, Supareil, UCD 1-232, Self-Fruitful P13.019, and Y 117-86-03. Some varieties also had more hull rot at harvest than others, these included Folsom, UCD 3-40, Supareil, UCD 8-160, Eddie, UCD 1-232, UCD 8-201, and Capitola. Finally, bacterial spot symptoms continue to be documented and were observed on UCD 18-20, UCD 1-271, Booth, Self-Fruitful P13.019, and Self-Fruitful P16.013, with a slight case on Aldrich in 2017.

With only three shakes in the 2017 harvest, many varieties were not shaken at 100% hull split. They continued to dry for prolonged periods and had poor nut removal as a result. With unsatisfactory nut removal and very high mummy counts on many varieties (see Table 7), we hope this can be improved with four harvests planned in 2018.

Despite a very wet May, spring foliar diseases in the Butte trial were not widespread. As in 2018, water stress during long post-shake dry down periods flared extensive spider mite infestation, as well as yellowing and leaf drop on some varieties. After harvest, tree losses were recorded, with notable band canker symptoms and resulting tree loss in the Sterling variety. Other varieties were affected to a lesser degree. Almond leaf scorch symptoms were observed on the Self-fruitful P16.013 and Booth varieties. In 2018, almond leaf scorch was confirmed on Self Fruitful P16.013 and UCD 1-271 by Dr. Lindsey Burbank at USDA-ARS in Parlier.

Bloom conditions were wet and cold at the Butte RAVT in 2019. The February rainfall total at the nearby Durham CIMIS station was 11.3 inches, compared to the 4.4-inch historic average. Heavy rainfall in late February and early March prevented orchard access while many varieties were reaching full bloom and prevented bloom density ratings. At both the Butte and Stanislaus sites, bee hours were far fewer than the Madera site. Despite wet and cold bloom conditions, blast development on flowers and leaves at the Butte location was not severe. Minor blast type symptoms were observed on UCD 1-271, Bennett, and Booth. *Botrytis* gray mold was most commonly present in samples sent to Dr. Themis Michailides at the Kearney Ag Center, with a minor presence of *Pseudomonas* bacterial blast on the three sampled varieties. Blast

symptoms were very minor at the Butte RVT in 2018 and 2019 compared to 2017 when severe blast was observed in several varieties.

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Stanislaus. Trees in the Stanislaus RAVT have grown about average for trees on Nemaguard rootstock, although there have been some problems. In 2015 (second leaf), many trees in the trial exhibited signs of Verticillium wilt, and to a lesser degree in 2016. In 2016, a significant portion of the field suffered drift injury from an errant, aerial application of glyphosate and glyphosonate to an adjacent field. This herbicide drift occurred during bloom and appeared to have affected 3rd-leaf nut set / retention throughout much of the field. Trees appear to have recovered and no long-term deleterious effects are expected. Beginning in 2016 and continuing through 2017, over 15% of the Nonpareil trees have had moderate to severe signs of band canker (*Botryosphaeria* spp.). Approximately 100 Nonpareil trees will be replaced. Relatively few of the test variety trees showed obvious band canker symptoms although Y121-42-99, Sterling and Kester on Hansen rootstock appear to have been disproportionately affected.

There were several varieties or selections with significant hull rot in 2018 (selection 1-232, selection 8-201, selection 1-272, Supareil and selection 3-40). Winters and selection 1-271 had significant incidence of scab. Varieties or selections with significant band canker included selection Y121-42-99, Sterling, selection Y116-161-99, Kester on Hansen, and Nonpareil. Selection Y121-42-99 had an unknown malady that resulted in leaf spotting resembling bacterial spot and defoliationbut no pathogens were detected. Selection Y117-91-03 had many dead nutlets and still had black mummy nutlets from the previous year.

Bloom conditions were wet and cold at the Butte RAVT in 2019. The February rainfall total at the nearby Durham CIMIS station was 11.3 inches, compared to the 4.4-inch historic average. Heavy rainfall in late February and early March prevented orchard access while many varieties were reaching full bloom and prevented bloom density ratings. At both the Butte and Stanislaus sites, bee hours were far fewer than the Madera site. Despite wet and cold bloom conditions, blast development on flowers and leaves at the Butte location was not severe. Minor blast type symptoms were observed on UCD 1-271, Bennett, and Booth. *Botrytis* gray mold was most commonly present in samples sent to Dr. Themis Michailides at the Kearney Ag Center, with a minor presence of *Pseudomonas* bacterial blast on the three sampled varieties. Blast symptoms were very minor at the Butte RVT in 2018 and 2019 compared to 2017 when severe blast was observed in several varieties.

Madera. A number of trees at the Madera site have died. The majority of deaths have been in two sections with infiltration issues in blocks three and four (see areas with missing trees in Fig. 4). The rest have been scattered throughout the site, mostly of undetermined causes, although a few Nonpareil and Wood Colony deaths have been due to bark damage. Remaining missing trees will be replaced by next spring.

As for diseases, in the spring many trees showed shot-hole like symptoms. However, samples were not tested to confirm this. Additionally, many varieties were suffering from cankers. All Y121-42-99 trees in block one had cankers on lower limbs leading to lower limb death and a few trees also had trunk cankers. Multiple Jenette trees also had cankers in blocks one and two, however this variety was not affected as badly. In late July branch samples were sent to the Trouillas Laboratory at Kearney Research and Extension Center. The lab only found saphrophytic fungi present so the cause of the cankers is unknown. Other varieties suffered from occasional branch cankers, but not at a high enough frequency to be noted.

A number of trees at the Madera site have died. The majority of deaths have been in two sections with infiltration issues in blocks three and four. The rest have been scattered throughout the site, mostly of undetermined causes, although a few Nonpareil and Wood Colony deaths have been due to bark damage. In 2018, there was significant frost damage on 3 dates during bloom. There was also significant hull rot damage. In addition, many varieties were shaken much earlier than desired.

In 2019, bloom in the Madera trial was hit by flower blast. Samples showed a combination of *Pseudomonas syringae* and *Botrytis cinerea*. Winters, Y117-86-03, UCD 18-20, Jenette, Folsom, Bennett, Capitola, Y121-42-99, Eddie and Nonpareil were affected, and UCD 1-271, Supareil, Durango, Aldrich, Wood Colony, UCD 7-159 were strongly affected. Hull rot was severe in many varieties and selections with UCD1-232, Eddie, Nonpareil, Sterling and Folsom most affected.

Bloom, Hullsplit, Yield and Quality

2016

Bloom was very compact at all 3 sites in 2016 (Fig. 1). Overlap with Nonpareil was good for everything except UCD 3-40 which was quite early at all sites. Bee flying hours during Nonpareil bloom for 2016 are shown in Table 2.

Midday canopy photosynthetically active radiation interception (PAR) was collected using the mobile platform light bar in June 2016. PAR interception varied from 20 to 43 percent at the Butte trial, 23 to 36 percent at the Stanislaus trial and 23 to 61 percent at the Madera trial. The level of PAR interception at the Madera site is among the highest we have seen for an almond orchard this age. This is partly due to the high tree density (173 trees/acre) and vigorous Hansen peach x almond rootstock.

Completion of hullsplit ranged from August 3 to September 6 at the Butte trial. At the Stanislaus trial it ranged from July 15 to August 22. At the Madera trial it ranged from July 21 to August 17.

Yields at the Butte and Stanislaus sites ranged from about 100 to 800 kernel pounds per acre which is about normal for a 3rd leaf orchard but those at the Madera site were among the highest we have seen for a 3 year old orchard (up to 2000 kernel pounds per acre). The yields for the 2014 trials versus those for previous generation trials is shown in Fig. 3. The yields for the 2014 Butte and Stanislaus trials were greater than those for the 1993 trials at a similar age but the Madera yields were significantly higher (and slightly higher than those from the McFarland trial). Figure 6 shows the relationship between midday canopy photosynthetically active radiation interception and yield by site. Although there is a relationship at each site, the overall relationship is quite different for each site. This is likely due to a combination of planting density variability, management differences and weather related issues. Note that yields at Butte site were higher than those at the Stanislaus site despite the higher planting density at Stanislaus. This is likely due to the previously noted issues with disease as well as herbicide damage at the Stanislaus site.

The relative number of mummies left on the tree after shaking were estimated at the Madera trial in 2016 (Table 6). Although this may give some estimation of relative ease of shaking, it should be noted that many varieties were harvested together for convenience. Therefore, some varieties or selections were likely harvested before or after their ideal harvest timing so these results should be considered with that in mind.

The main kernel defects observed in 2016 were double kernels, twin kernels, naval orange worm damage, and severe shrivel (Table 17). A double kernel results when both ovules develop within the nut resulting in two kernels within the nut, each with a separate seed coat or pellicle. A twin kernel result when two embyros develop within a single pellicle. Defects are listed if they have equal to or greater than 6% incidence.

2017

In 2017 bloom was much more protracted (right side of Fig. 1), due to extended periods of rain and clouds at all 3 sites. Bee flying hours during Nonpareil bloom are shown in Table 2. Bloom overlap with Nonpareil was again good for all pollenizers except UCD 3-40 (Fig. 1).

Hullsplit at the Madera site started earlier and was completed significantly earlier than at either of the other sites in 2017 (Fig. 3). In general, the patterns at all 3 sites in 2017 was quite similar to the patterns observed in 2016 (Fig. 3).

The number of mummies left on the trees after harvest were rated at all three sites in 2017 and results are shown in Table 16. Again it is important to remember that all varieties and selections were likely not shaken at their ideal development stage due to large number of items in these trials.

The main kernel defects observed in 2017 were similar to those observed in 2016 including double kernels, twin kernels, naval orange worm damage, and severe shrivel (Table 18). Defects are listed if they have equal to or greater than 6% incidence.

2018

Butte- In 2018 the Butte RAVT was challenged by both extensive freeze damage and low bee hive activity as well as low frame density of hives.

Stanislaus- In 2018 bloom at the Stanislaus trial was much more protracted (left hand side of Fig. 2), due to extended periods of rain and clouds. Varieties with significant hull rot included UCD 1-232, UCD 8-201, UCD 1-271, Supareil and UCD 3-40. Varieties with significant scab included Winters and UCD 1-271. Varieties with significant band canker included Y121-42-99, Sterling, Y116-161-99, Kester/Hansen, and Nonpareil.

Madera- A number of trees at the Madera site have died. The majority of deaths have been in two sections with infiltration issues in blocks three and four. The rest have been scattered throughout the site, mostly of undetermined causes, although a few Nonpareil and Wood Colony deaths have been due to bark damage. In 2018, there was significant frost damage on 3 dates during bloom. There was also significant hull rot damage. In addition, many varieties were shaken much earlier than desired.

2019

Butte- Collection of bloom data at the Butte site in 2019 was difficult due to protracted rains making it difficult to enter the site. The red shaded areas on the right side of Fig. 2 show the periods where the orchard was inaccessible. Bloom overalap was generally good in 2019. Hullsplit ranged from July 16 to Sept. 9 on various varieties (bottom of Fig. 4). Yield ranged from 870 to 3002 kernel pounds per acre with Nonpareil being second highest at 2999 kernel pounds per acre (Table 4). Cumulative yields for the Butte site ranged from 2472 to 8376 kernel pounds per acre with Nonpareil being the top yielding variety (Table 3). Photosynthetically active radiation (PAR) interception ranged from 40.8 to 78.8 % (Table 5). None of the varieties or selections reached the 50 kernel pounds per acre per 1% PAR intercepted that our best orchards can produce (Table 6).

Stanislaus- Bloom overlap was generally good and was slightly earlier at the Stanislaus site compared to the Butte site in 2019 (middle right side of Fig. 2). Hullsplit ranged from July 13 to Sept. 2 with Nonpareil and Eddie being earliest (Fig. 4). Yields in 2019 ranged from 964 to 2630 kernel pounds per acre with Nonpareil being in the bottom half of yields (Table 8). PAR interception ranged from 40.4 to 65.6% (Table 9) and several selections produced near our optimal level of 50 kernel pounds per acre (Table 10).

Madera- Bloom ranged from February 1 to March 22 with overlap generally good except for UCD 3-40 and UCD 8-27 which were quite early (Fig. 2). Hullsplit at the Madera site was quite protracted in 2019 and ranged from July 10 to September 30. 462 to 3521 kernel pounds per acre with Nonpareil landing just above the middle of all yields (Table 12). Madera continues to have the highest cumulative yields but also the most variable ranging from 1923 to 10278 kernel pounds per acre. This variability is likely due to drainage issues and hullrot. PAR interception ranged from 59.7 to 91.2% which is higher than any of the other sites. However, yield per unit PAR intercepted 16.2 to 43.6% with no varieties or selections reaching our optimum of 50 kernel pounds per 1% PAR intercepted (Table 14).

Average cumulative for all three sites averaged is shown in Table 15. It ranged from 3392 to 7095 kernel pounds per acre. UCD18-20 which is the top yielding selection or variety overall also has a large number of doubles every year so this may be problematic (Table 18-20).

Tree architecture

We are working on methodology to assess tree architecture. For details about our current strategies see Tom Gradziel's report on the Almond Breeding Program report (Fig. . We plan to discuss this at the Almond Workgroup meeting this coming December. We have the Mule light bar photos from all years allowing us to go back and assess canopy structure from the beginning of the study once we decide on the best options for rating this.

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Table 1. Varieties and selections planted at the next generation regional almond variety trials. Items 1-29 are planted at all 3 sites while additional material planted at individual sites is listed at the end. Trees at the Butte, Stanislaus and Madera sites were planted on Krymsk 86, Nemaguard and Hansen 536 rootstock respectively (exceptions are noted at bottom of table).

	Variety or selection	Source
1	Eddie	Bright's
2	Capitola	Burchell
3	Supareil	Burchell
4	~~Self-fruitful P16.013~~	~~Burchell~~
5	~~Self-fruitful P13.019~~	~~Burchell~~
6	Booth	Burchell
7	Sterling	Burchel
8	Bennett	Duarte
9	Nonpareil	Fowler
10	Durango	Fowler
11	Jenette	Fowler
12	Aldrich	Fowler
13	Marcona	Spain
14	Winters	UCD
15	Sweetheart	UCD
16	Kester (2-19e)*	UCD
17	UCD3-40	UCD
18	UCD18-20	UCD
19	UCD1-16	UCD
20	UCD8-160	UCD
21	UCD8-27	UCD
22	UCD1-271	UCD
23	UCD1-232	UCD
24	UCD7-159	UCD
25	UCD8-201	UCD
26	Y121-42-99	USDA
27	Y117-86-03	USDA
28	Y116-161-99**	USDA
29	Y117-91-03	USDA
30	Folsom	Wilson
31	Wood Colony on Krymsk 86 (Butte site only)	
32	Wood Colony on Nemaguard (Madera site only- planted one year later after Lone Star was removed)	

*Kester was planted at all three sites on the usual rootstock for the site. In addition at the Butte and Stanislaus sites it was also planted in the replicated trial on Hansen 536 rootstock

**Y116-161-99 was planted only in two reps outside of the main trial at the Butte site. Self-fruitful P16.013 and Self-fruitful P13.019 were eliminated from data collection in 2019 since they have been dropped by the nursery that developed them.

Table 2. Bee flying hours during Nonpareil bloom by site for 2016 and 2017. Bee flying hours were calculated as daylight hours with air temperature greater than or equal to 55°F, windspeed less than or equal to 15mph, and no precipitation.

Site	2016	2017
Butte	80	119
Stanislaus	101	104
Madera	83	127

Table 3. Cumulative yield for Butte County from 2016-2020.

Butte

#reps	Variety	Cumulative yield(kernel lbs/ac)										
4	Nonpareil	8376	a									
4	Booth	7736	a	b								
4	UCD18-20	7666	a	b								
4	Jenette	6855		b	c							
4	Y117-91-03	6638		b	c	d						
4	Aldrich	6636		b	c	d						
4	Durango	6188			c	d	e					
4	Winters	6168			c	d	e					
4	UCD8-160	6127			c	d	e					
4	UCD8-201	5933			c	d	e	f				
4	Y116-161-99	5833			c	d	e	f				
4	Folsom	5785			c	d	e	f	g			
4	Kester	5662			c	d	e	f	g	h		
4	Capitola	5611			c	d	e	f	g	h		
4	Y117-86-03	5503				d	e	f	g	h		
4	Bennett	5391				d	e	f	g	h	i	
4	Wood Colony	5338				d	e	f	g	h	i	
4	Eddie	5314				d	e	f	g	h	i	
4	UCD1-232	5281				d	e	f	g	h	i	
4	Kester/Hansen	5217					e	f	g	h	i	
4	UCD8-27	5079					e	f	g	h	i	j
4	UCD1-16	4835					e	f	g	h	i	j
4	Sterling	4732						f	g	h	i	j
4	UCD7-159	4464							g	h	i	j
4	UCD3-40	4396								h	i	j
4	Sweetheart	4128									i	j
4	Supareil	3810										j
4	UCD1-271	2472										k

Table 4. 2019 yield for Butte County.

	#reps	Variety	2019 yield (kernel lbs/ac)							
Butte	4	Winters	3002	a						
	4	Nonpareil	2999	a						
	4	UCD3-40	2816	a	b					
	4	Booth	2613	a	b	c				
	4	Jenette	2505	a	b	c	d			
	4	Capitola	2461		b	c	d	e		
	4	UCD18-20	2368		b	c	d	e	f	
	4	UCD7-159	2114			c	d	e	f	g
	4	Durango	2086				d	e	f	g
	4	Supareil	2071				d	e	f	g
	4	Aldrich	2024				d	e	f	g
	4	Folsom	2016				d	e	f	g
	4	Kester	2006				d	e	f	g
	4	Wood Colony	1989				d	e	f	g
	4	Bennett	1958				d	e	f	g
	3	UCD1-16	1947					e	f	g
	4	Y117-91-03	1878						f	g
	4	Y117-86-03	1846						f	g
	4	UCD8-201	1842						f	g
	4	Sterling	1828						f	g
	4	UCD1-232	1819						f	g
	4	Y116-161-99	1811						f	g
	4	UCD8-160	1808						f	g
	4	Sweetheart	1801						f	g
	4	UCD8-27	1790							g
	4	Kester/Hansen	1785							g
	4	Eddie	1748							g
	4	UCD1-271	870							h

Table 5. 2019 canopy PAR interception for Butte County.

	#reps	Variety	PAR interception (%)											
Butte	4	Capitola	78.8	a										
	4	Nonpareil	68.4	a	b									
	4	Supareil	67.6	a	b	c								
	4	Folsom	65.7	a	b	c	d							
	4	Y117-91-03	65.4	a	b	c	d							
	4	Sweetheart	64.7	a	b	c	d							
	4	Kester	64.3	a	b	c	d							
	4	Booth	63.6		b	c	d							
	4	UCD18-20	63.3		b	c	d	e						
	4	Kester/Hansen	62.6		b	c	d	e	f					
	4	Sterling	61.9		b	c	d	e	f					
	4	Durango	60.5		b	c	d	e	f	g				
	4	Winters	60.2		b	c	d	e	f	g	h			
	3	UCD3-40	58.6		b	c	d	e	f	g	h			
	4	UCD1-16	58.2		b	c	d	e	f	g	h	i		
	4	Y117-86-03	58.2		b	c	d	e	f	g	h	i		
	4	Eddie	57.3			c	d	e	f	g	h	i		
	4	UCD8-27	57.3			c	d	e	f	g	h	i		
	4	UCD7-159	56.9				d	e	f	g	h	i		
	4	Aldrich	56.0				d	e	f	g	h	i		
	4	UCD1-232	53.1					e	f	g	h	i	j	
	4	UCD8-201	52.7						f	g	h	i	j	
	4	Bennett	51.7							g	h	i	j	
	4	Y116-161-99	51.7							g	h	i	j	
	4	Jenette	50.1								h	i	j	
	4	Wood Colony	48.1									i	j	k
	4	UCD1-271	44.0										j	k
	4	UCD8-160	40.8											k

Table 6. 2019 yield per unit PAR intercepted for Butte County.

	#reps	Variety	Yield/PAR							
Butte	4	Jenette	43.6	a						
	3	UCD3-40	41.1	a	b					
	4	Nonpareil	40.4	a	b	c				
	4	UCD8-160	37.4	a	b	c	d			
	4	Wood Colony	37.3	a	b	c	d			
	4	Booth	36.5	a	b	c	d	e		
	4	UCD7-159	34.9	a	b	c	d	e	f	
	4	UCD18-20	33.5		b	c	d	e	f	
	4	Y116-161-99	32.6		b	c	d	e	f	g
	4	Winters	32.1		b	c	d	e	f	g
	4	UCD1-232	31.4			c	d	e	f	g
	4	Aldrich	31.1			c	d	e	f	g
	4	UCD8-201	30.4				d	e	f	g
	4	Durango	30.3				d	e	f	g
	3	UCD1-16	29.7				d	e	f	g
	4	Capitola	29.6				d	e	f	g
	4	Bennett	28.7				d	e	f	g
	4	Folsom	28.5				d	e	f	g
	4	Kester	27.8				d	e	f	g
	4	Y117-86-03	27.7				d	e	f	g
	4	Eddie	27.2					e	f	g
	4	Sterling	27.1					e	f	g
	4	Kester/Hansen	27.0					e	f	g
	4	UCD8-27	26.8					e	f	g
	4	Supareil	26.1						f	g
	4	Y117-91-03	25.5						f	g
	4	Sweetheart	24.4							g
	4	UCD1-271	16.2							h

Table 7. Cumulative yield for Stanislaus County from 2016-2020

Stanislaus

#reps	Variety	Cumulative yield (kernel lbs/ac)									
3	Kester/Hansen	7287	a								
4	UCD18-20	6722	a	b							
3	Y117-91-03	6419	a	b	c						
4	UCD8-160	6280	a	b	c	d					
3	Kester	5612		b	c	d	e	f			
4	Y116-161-99	5608		b	c	d	e	f			
4	Bennett	5570		b	c	d	e	f			
4	UCD7-159	5483		b	c	d	e	f	g		
4	Y121-42-99	5476		b	c	d	e	f	g		
4	Booth	5402			c	d	e	f	g		
4	Y117-86-03	5247			c	d	e	f	g	h	
4	Winters	5216			c	d	e	f	g	h	
4	Aldrich	5064				d	e	f	g	h	i
3	Sterling	5062				d	e	f	g	h	i
3	Durango	5046				d	e	f	g	h	i
4	Capitola	5034				d	e	f	g	h	i
4	Nonpareil	4999					e	f	g	h	i
4	UCD8-201	4900					e	f	g	h	i
4	UCD1-232	4773					e	f	g	h	i
4	UCD1-271	4562					e	f	g	h	i
4	Folsom	4411						f	g	h	i
4	Eddie	4385						f	g	h	i
4	Jenette	4296						f	g	h	i
4	Sweetheart	4281						f	g	h	i
4	UCD1-16	4228							g	h	i
3	Supareil	4047								h	i
4	UCD3-40	3856									i
4	UCD8-27	3748									i

Table 8. 2019 yield for Stanislaus County.

Stanislaus

#reps	Variety	2019 yield (kernel lbs/ac)										
4	Kester/Hansen	2630	a									
4	UCD18-20	2121		b								
4	UCD8-160	1992		b	c							
4	Supareil	1968		b	c	d						
4	UCD7-159	1780		b	c	d	e					
3	Y117-91-03	1763		b	c	d	e	f				
4	Y116-161-99	1739		b	c	d	e	f	g			
4	UCD8-201	1660			c	d	e	f	g	h		
4	UCD1-232	1646			c	d	e	f	g	h		
4	UCD1-271	1630			c	d	e	f	g	h		
4	Kester	1618			c	d	e	f	g	h		
4	Folsom	1573			c	d	e	f	g	h		
4	Sweetheart	1554				d	e	f	g	h		
4	Booth	1498					e	f	g	h	i	
4	Durango	1495					e	f	g	h	i	
4	Aldrich	1480					e	f	g	h	i	
4	Y117-86-03	1465					e	f	g	h	i	
4	Sterling	1447					e	f	g	h	i	
4	Bennett	1442					e	f	g	h	i	
4	Nonpareil	1377					e	f	g	h	i	
4	Y121-42-99	1356					e	f	g	h	i	j
4	UCD3-40	1341					e	f	g	h	i	j
4	Winters	1341					e	f	g	h	i	j
4	Jenette	1322						f	g	h	i	j
4	UCD1-16	1295							g	h	i	j
4	Capitola	1284								h	i	j
4	UCD8-27	1062									i	j
4	Eddie	964										j

Table 9. 2019 canopy PAR interception for Stanislaus County.

Stanislaus

#reps	Variety	PAR interception (%)								
4	Kester/Hansen	65.6	a							
4	Sweetheart	61.8	a	b						
4	Supareil	60.2	a	b	c					
4	Y117-91-03	59.6	a	b	c					
4	Booth	56.8	a	b	c	d				
4	Eddie	55.4	a	b	c	d	e			
4	Capitola	54.7	a	b	c	d	e	f		
4	UCD3-40	54.5	a	b	c	d	e	f	g	
4	UCD18-20	51.6		b	c	d	e	f	g	h i
4	Sterling	51.5		b	c	d	e	f	g	h i
4	UCD8-27	51.3		b	c	d	e	f	g	h i
4	Kester	50.0			c	d	e	f	g	h i
4	UCD1-271	49.8			c	d	e	f	g	h i
4	Bennett	49.5			c	d	e	f	g	h i
4	Folsom	49.5			c	d	e	f	g	h i
4	Durango	47.4				d	e	f	g	h i
4	UCD1-232	46.3				d	e	f	g	h i
4	Aldrich	45.7				d	e	f	g	h i
4	Jenette	45.6				d	e	f	g	h i
4	UCD1-16	44.9					e	f	g	h i
4	Nonpareil	44.7					e	f	g	h i
4	UCD7-159	44.4					e	f	g	h i
4	Y121-42-99	43.4						f	g	h i
4	Y117-86-03	43.4						f	g	h i
4	Y116-161-99	42.8						f	g	h i
4	UCD8-201	42.6							g	h i
4	Winters	41.9								h i
4	UCD8-160	40.4								i

Table 10. Yield per unit PAR intercepted for Stanislaus County.

Stanislaus

#reps	Variety	Yield/PAR							
4	Y116-161-99	57.0	a						
4	UCD8-160	49.4	a	b					
4	Nonpareil	48.6	a	b					
4	Y121-42-99	44.1		b	c				
3	Y117-91-03	42.1		b	c	d			
4	UCD18-20	41.6		b	c	d			
4	Kester/Hansen	40.6		b	c	d			
4	UCD7-159	40.1		b	c	d	e		
4	UCD8-201	39.0		b	c	d	e	f	
4	Winters	36.4		b	c	d	e	f	g
4	UCD1-232	36.2		b	c	d	e	f	g
4	Y117-86-03	33.9			c	d	e	f	g h
4	Folsom	33.7			c	d	e	f	g h
4	UCD1-271	32.8			c	d	e	f	g h
4	Supareil	32.6			c	d	e	f	g h
4	Aldrich	32.5			c	d	e	f	g h
4	Kester	32.4			c	d	e	f	g h
4	Durango	31.6			c	d	e	f	g h
4	Sterling	29.2				d	e	f	g h
4	UCD1-16	29.1				d	e	f	g h
4	Jenette	29.1				d	e	f	g h
4	Bennett	28.7				d	e	f	g h
4	Booth	26.4					e	f	g h
4	Sweetheart	25.2						f	g h
4	Eddie	25.0						f	g h
4	UCD3-40	24.9							g h
4	Capitola	23.4							g h
4	UCD8-27	20.6							h

Table 11. Cumulative yield for Madera County from 2016-2020

	#reps	Variety	Cumulative yield (kernel lbs/ac)							
Madera	3	Y116-161-99	10278	a						
	4	UCD18-20	9566	a	b					
	4	Y117-86-03	9180	a	b	c				
	4	Kester	8497	a	b	c	d			
	4	Y117-91-03	8465	a	b	c	d			
	4	Nonpareil	8442	a	b	c	d			
	4	Jenette	8107	a	b	c	d			
	4	Capitola	8020	a	b	c	d			
	1	Y121-42-99	7946	a	b	c	d			
	4	Booth	7776		b	c	d			
	4	Bennett	7568		b	c	d	e		
	4	Sweetheart	7468		b	c	d	e		
	4	Eddie	7409		b	c	d	e		
	4	UCD8-201	7395		b	c	d	e		
	4	Winters	7295		b	c	d	e		
	4	UCD8-160	7201		b	c	d	e		
	4	UCD1-16	7132		b	c	d	e		
	4	Folsom	6974			c	d	e		
	4	Aldrich	6863			c	d	e		
	4	Sterling	6764			c	d	e		
	4	Durango	6218				d	e		
	4	UCD8-27	6072				d	e		
	4	Supareil	6069				d	e		
	4	UCD7-159	6036				d	e		
	3	UCD1-232	5035					e	f	
	1	Wood Colony	3262						f	g
	3	UCD1-271	3176						f	g
	3	UCD3-40	1923							g

Table 12. 2019 yield for Madera County.

	#reps	Variety	2019 yield (kernel lbs/ac)					
Madera	4	Winters	3521	a				
	4	Capitola	2925	a	b			
	4	Sweetheart	2833	a	b			
	4	UCD1-16	2741	a	b			
	4	Y116-161-99	2716	a	b	c		
	4	Folsom	2668	a	b	c		
	4	Booth	2536	a	b	c		
	4	Supareil	2468	a	b	c	d	
	4	Kester	2467	a	b	c	d	
	4	UCD18-20	2434	a	b	c	d	
	4	Nonpareil	2429	a	b	c	d	
	4	UCD7-159	2306	a	b	c	d	e
	4	Sterling	2285	a	b	c	d	e
	4	UCD8-160	2280	a	b	c	d	e
	4	Jenette	2200		b	c	d	e
	4	Y117-91-03	2124		b	c	d	e
	4	Wood Colony	2088		b	c	d	e
	1	Y121-42-99	1981		b	c	d	e
	4	Y117-86-03	1896		b	c	d	e
	3	UCD1-232	1890		b	c	d	e
	4	UCD8-27	1846		b	c	d	e
	4	Eddie	1824		b	c	d	e
	4	Aldrich	1819		b	c	d	e
	4	UCD8-201	1770		b	c	d	e
	4	Durango	1406			c	d	e f
	4	Bennett	1021					e f
	4	UCD3-40	507					f
	3	UCD1-271	462					f

Table 13. 2019 canopy PAR interception for Madera County.

Madera

#reps	Variety	PAR interception (%)										
4	Folsom	91.2	a									
4	Capitola	89.2	a	b								
4	Booth	89.1	a	b								
4	Supareil	88.1	a	b	c							
4	Sterling	87.6	a	b	c	d						
4	Nonpareil	87.0	a	b	c	d	e					
4	Eddie	83.8	a	b	c	d	e	f				
1	Y121-42-99	82.9	a	b	c	d	e	f	g			
4	UCD1-271	81.4	a	b	c	d	e	f	g	h		
4	Aldrich	78.6	a	b	c	d	e	f	g	h	i	
4	Sweetheart	78.5	a	b	c	d	e	f	g	h	i	
4	Kester	78.1	a	b	c	d	e	f	g	h	i	
4	UCD3-40	76.9	a	b	c	d	e	f	g	h	i	
4	Durango	76.7	a	b	c	d	e	f	g	h	i	
4	UCD8-27	74.2		b	c	d	e	f	g	h	i	j
4	UCD7-159	72.3			c	d	e	f	g	h	i	j
4	Bennett	72.0				d	e	f	g	h	i	j
4	Winters	71.2					e	f	g	h	i	j
4	UCD1-232	70.9						f	g	h	i	j
4	Y116-161-99	70.2						f	g	h	i	j
4	UCD1-16	68.8						f	g	h	i	j
4	UCD18-20	68.3						f	g	h	i	j
4	Y117-91-03	67.7						f	g	h	i	j
4	Jenette	67.0							g	h	i	j
4	Wood Colony	66.6								h	i	j
4	Y117-86-03	65.1									i	j
4	UCD8-201	64.0									i	j
4	UCD8-160	59.7										j

Table 14. 2019 yield per unit PAR intercepted for Madera County.

	#reps	Variety	Yield/PAR							
Madera	4	Winters	50.2	a						
	4	UCD1-16	40.7	a	b					
	4	Y116-161-99	40.5	a	b					
	4	UCD8-160	39.2	a	b	c				
	4	Sweetheart	37.0	a	b	c	d			
	4	UCD18-20	36.5	a	b	c	d			
	4	Jenette	33.4	a	b	c	d	e		
	4	Capitola	32.9	a	b	c	d	e		
	4	UCD7-159	32.6	a	b	c	d	e		
	4	Wood Colony	32.6	a	b	c	d	e		
	4	Y117-91-03	31.7	a	b	c	d	e		
	4	Kester	31.6	a	b	c	d	e		
	4	UCD8-201	29.6	a	b	c	d	e		
	4	Y117-86-03	29.5	a	b	c	d	e		
	4	Folsom	29.1	a	b	c	d	e		
	4	Supareil	28.1		b	c	d	e		
	4	Booth	27.9		b	c	d	e		
	3	UCD1-232	27.5		b	c	d	e	f	
	4	Sterling	26.1		b	c	d	e	f	g
	3	Nonpareil	25.5		b	c	d	e	f	g
	4	UCD8-27	24.7		b	c	d	e	f	g
	1	Y121-42-99	23.9		b	c	d	e	f	g
	4	Aldrich	22.9		b	c	d	e	f	g
	4	Eddie	22.1		b	c	d	e	f	g
	4	Durango	18.6			c	d	e	f	g
	4	Bennett	14.4					e	f	g
	4	UCD3-40	6.8						f	g
	3	UCD1-271	5.7							g

Table 15. Average cumulative yield for all 3 sites combined for 2016-2019.

Variety	Cumulative yield (kernel lbs/ac)
UCD18-20	7985
Nonpareil	7272
Y116-161-99	7240
Y117-91-03	7174
Kester/Hansen	7000
Booth	6971
Y121-42-99	6711
Y117-86-03	6643
UCD8-160	6536
Jenette	6419
Winters	6226
Capitola	6221
Aldrich	6188
Bennett	6177
UCD8-201	6076
Durango	5817
Folsom	5723
Eddie	5703
Kester	5637
Sterling	5519
UCD1-16	5398
UCD7-159	5328
Sweetheart	5293
UCD1-232	5030
UCD8-27	4966
Supareil	4642
UCD1-271	3403
UCD3-40	3392

Table 16. Relative number of mummies left on tree after shaking at the Madera trial in 2016. Ratings categories are described below. Although this might give some idea about relative ease of shaking, it is likely confused by the fact that not all varieties or selections were shaken at their ideal time. Varieties and selections are rated from least mummies at top to most at bottom. Wood Colony was planted in place of Lonestar at the Madera trial and is one year younger and was not harvested.

Variety or selection	Relative mummy count rating
UCD1-16	1
Y116-161-99	1
Y117-91-03	1
Y121-42-99	1
Eddie	1
Y117-86-03	2
Jenette	2
Aldrich	2
Self-fr P13.019	2
UCD8-27	2
Self-fr P16.013	2
Capitola	2
UCD1-232	3
Supareil	3
Durango	3
Marcona	3
Bennett	3
Booth	3
UCD3-40	3
Nonpareil	3
Sweetheart	4
UCD8-160	4
Winters	5
2-19E	5
UCD1-271	5
UCD8-201	5
Sterling	5
Folsom	5
UCD7-159	5
Wood Colony	one year behind

Rating categories
1 = < 20/tree
2 = 20-49
3 = 50-99
4 = 100-199
5 = > 200

Table 17. Relative number of mummies left on tree after shaking at the Butte, Stanislaus, and Madera trials in 2017. Although this might give some idea about relative ease of shaking, it is likely complicated by the fact that not all varieties or selections were shaken at their ideal time, and the presence of hull rot at the Madera site. Ease of knocking was rated with the following scale after shaking and before poling: 1=fewer than 20 mummies per tree, 2=20-50 mummies, 3=50-100, 4=100-200, 5=200-500, 6= over 500.

	Butte County	Stanislaus County	Madera County
Folsom	1	2	4
Y121-42-99	2	5	4
Eddie	2	1	2
Y116-161-99	2	3	1
Aldrich	2	1	3
P16.013	2	1	4
Supareil	2	1	2
3-40	2	2	3
Nonpareil	2	1	4
Capitola	2	2	2
Bennett	3	2	3
Y117-91-03	3	3	2
Y117-86-03	3	3	1
Booth	3	3	4
Wood Colony	3	-	1
Durango	4	1	3
Winters	4	2	3
1-16	4	2	3
18-20	4	1	2
Jenette	4	3	3
P13.019	4	2	4
8-27	4	3	2
Sweetheart	4	6	3
Sterling	4	5	5
Kester / Hansen	4	5	4
1-232	5	3	4
Kester	5	5	-
7-159	5	5	5
8-160	5	1	3
8-201	5	3	4
1-271	6	6	4

Table 18. Main kernel defects for 2016 harvest. Items are listed if they had 6% or more of kernels exhibiting the defect.

	Trial					
Varieties with defect	**Butte**	**(%)**	**Stanislaus**	**(%)**	**Madera**	**(%)**
Double kernels	UCD 18-20	15	Booth	22	UCD8-201	25
(both ovules in ovary developed)	UCD 8-201	14	UCD 18-20	21	Y121-42-99	20
	Booth	12	UCD 8-201	17	Booth	16
	Self-Fru P16.013	10	P16-013	14	UCD1-232	7
	UCD 1-232	10	Y121-42-99	10	Y117-86-03	7
	Jenette	8	P13-019	8	UCD18-20	6
	UCD 8-27	7	Capitola	6	UCD8-27	6
	UCD 1-16	6				
	UCD 8-160	6				
Twin kernels	UCD 3-40	27	Jenette	21	UCD8-201	18
(two kernels within the same pellicle)	Sweetheart	20	UCD 8-27	19	Kester	12
	Jenette	19	UCD 3-40	16	Jenette	12
	UCD 8-201	17	Sweetheart	12	Sweetheart	6
	UCD 8-27	13	Folsom	11	Wood Colony	6
	UCD 8-160	11	P16-013	11		
	Nonpareil	11	UCD 8-160	10		
	Kester	8	UCD 8-201	10		
	Bennett	8	Booth	9		
	UCD 7-159	8	Kester/Hanser	9		
	Kester/Hansen	7	Capitola	9		
	Eddie	7	Kester	9		
	UCD 1-232	7	Supareil	7		
	Y-117-91-03	6	Aldrich	7		
			Nonpareil	7		
			Durango	7		
			UCD 1-232	7		
			UCD 7-159	7		
Naval orange worm damage	(none)		Booth	14	(none)	
			Y116-161-99	8		
			Eddie	7		
Blank kernels	UCD 1-232	10	Folsom	13	(none)	
			Booth	11		
			UCD 1-232	11		
			UCD 8-27	9		
			UCD 7-159	7		
Severe shrivel	Capitola	12	Capitola	24	Folsom	14
	Folsom	12	UCD 7-159	23	Wood Colony	8
	Self Fru P13.019	11	Folsom	19	Eddie	7
	Supareil	8	UCD 8-201	18	Booth	6
	Y-117-91-03	8	Y117-86-03	17	UCD8-27	6
	Bennett	7	Jenette	16	Y117-91-03	6
	Y117-86-03	7	UCD 8-160	16		
	UCD 1-271	7	UCD 8-27	15		
	Self-Fru P16.013	6	Bennett	11		
	Sweetheart	6	Booth	11		
	UCD 8-201	6	Sweetheart	11		
			UCD 1-232	11		
			Supareil	10		
			P16-013	9		
			Sterling	8		
			UCD 1-271	8		
			UCD 18-20	8		
			Durango	7		
			P13-019	7		
			Y117-91-03	7		
			UCD 1-16	7		
			Kester	7		
			UCD 3-40	6		

Table 18. Main kernel defects for 2017 harvest. Items are listed if they had 6% or more of kernels exhibiting the defect.

	Trial					
Varieties with defect	**Butte**	**(%)**	**Stanislaus**	**(%)**	**Madera**	**(%)**
6% or more double kernels	UCD 18-20	41	UCD 18-20	22	UCD 8-201	36
	Self-fru P16.013	37	UCD 8-201	18	Booth	22
	Booth	30	Booth	16	UCD 18-20	20
	UCD 8-201	26	Y121-42-99	16	UCD 8-27	18
	Wood Colony	24	Self-fru P16.013	15	Self-fru P16.013	13
	UCD 8-27	21	UCD 8-27	15	UCD 1-16	8
	UCD 8-160	20	Self-fru P16.013	14	Durango	7
	UCD 1-232	19	UCD 1-16	11	UCD 1-232	7
	Self-fru p13.019	19	Jenette	8		
	UCD 1-16	18	Durango	7		
	Jenette	14	Y117-91-03	6		
	Durango	13				
	Aldrich	9				
	Winters	9				
	Folsom	8				
	Kester	7				
	Bennett	7				
6% or more twin kernels (two kernels within the same pellicle)	UCD 8-27	18	UCD 3-40	14	UCD 3-40	28
	UCD 3-40	12	UCD 8-27	11	Jenette	9
	Sweetheart	10	Jenette	9	UCD 8-27	8
	Nonpareil	9	UCD 8-201	8	UCD 8-201	7
	UCD 1-232	7	UCD 8-160	7	2-19E	7
	UCD 8-160	7	Self-fru P16.013	7	UCD 7-159	6
	Booth	6				
	Jenette	6				
	UCD 8-201	6				
6% or more navel orange worm damage	UCD 8-27	6	UCD 8-27	8	UCD 1-271	14
					UCD 8-27	11
					UCD 8-201	8
					Supareil	7
					Bennett	7
					UCD 3-40	7
6% or more blank kernels	Self-fru P16.013	16	(none)		(none)	
	Booth	14				
	Y121-42-99	12				
	UCD 18-20	9				
	Jenette	6				
6% or more severe shrivel	Folsom	21	Jenette	10	Folsom	10
	Y117-86-03	17	UCD 8-201	8	Jenette	9
	Eddie	16	Y117-86-03	6	UCD 8-201	8
	Self-fru P16.013	14			Self-fru P13.019	7
	UCD 8-201	13			Wood Colony	7
	Capitola	13			Supareil	6
	UCD 8-27	12			UCD 8-27	6
	Y117-91-03	11				
	UCD 3-40	10				
	Y116-161-99	9				
	Self-fru p13.019	8				
	Sweetheart	8				
	UCD 1-232	8				
	UCD 8-160	8				
	UCD 1-16	8				
	Jenette	7				
	Supareil	6				
	UCD 18-20	6				

Table 19. Main kernel defects for 2018 harvest. Items are listed if they had 6% or more of kernels exhibiting the defect.

	Trial					
Varieties with defect	Butte	(%)	Stanislaus	(%)	Madera	(%)
double kernels	UCD 8-201	67	UCD 8-201	39	UCD8-201	44
	UCD18-20	56	UCD 18-20	23	UCD18-20	42
	Booth	37	Booth	19	Booth	29
	Wood Colony	28	UCD 8-27	18	UCD8-27	24
	Y117-86-03	24	UCD 1-16	7.5	Y117-86-03	23
	UCD 8-27	23	Aldrich	7.5	Y121-42-99	18
	Y121-42-99	18	UCD 1-232	7	Self-fr P16.013	17
	SF P16.013	18	P16-013	6.5	Capitola	14
	UCD 1-16	15	Y121-42-99	6	Aldrich	13
	Capitola	14			UCD1-16	12
	Nonpareil	13			Durango	12
	UCD 8-160	12			Winters	11
	Folsom	11			Folsom	11
	UCD1-232	11			UCD3-40	11
	Aldrich	11			UCD1-232	10
	Y117-91-03	8			Bennett	9
	Winters	7			UCD8-160	7
	Durango	6			Supareil	7
	Jenette	6			Jenette	7
twin kernels	Sweetheart	12	UCD 3-40	12	Sweetheart	18
(two kernels within the	UCD 8-27	11	Sweetheart	8	UCD8-27	12
same pellicle)	Booth	6	UCD 8-27	6	UCD8-201	9
	UCD 3-40	6			Jenette	7
	Jenette	6			2-19E	6
					Self-fr P16.013	6
blank kernels	Booth	17	Booth	8	Booth	15
	Jenette	9			UCD1-16	12
	Y121-42-99	8			Y121-42-99	8
	Wood Colony	7			UCD8-27	7
	UCD 8-27	6			Self-fr P16.013	7
					UCD18-20	6
					Capitola	6
shrivel	Lone Star	10			Jenette	11
	Jenette	9			UCD8-160	8
	UCD 8-27	9			UCD8-201	8
	Y116-161-99	8			UCD8-27	7
	UCD 8-201	8			Supareil	6
	Sweetheart	7				
	Y117-86-03	7				
	UCD1-232	6				
stain/discolor	UCD 1-271	20			UCD1-271	39
	Y116-161-99	16			Sweetheart	23
	Eddie	7			Winters	20
	Supareil	7			Supareil	14
	Sweetheart	6			Sterling	11
					UCD3-40	10
					Capitola	8
					Eddie	8
					Self-fr P13.019	7
					UCD1-232	6
					UCD1-16	6
mold	Eddie	24			UCD3-40	16
	UCD 1-271	13			UCD1-271	10
	Y117-91-03	9			Winters	8
	UCD1-232	9			Eddie	7
	SFP13.019	8			Self-fr P13.019	6
	Nonpareil	7			UCD1-16	6
	Folsom	6			Supareil	6
gum	UCD 3-40	13				
	UCD1-232	13				
	Durango	8				
	Folsom	7				

Table 20. Main kernel defects for 2019 harvest. Items are listed if they had 6% or more of kernels exhibiting the defect.

	Trial					
Varieties with defect	Butte	(%)	Stanislaus	(%)	Madera	(%)
6% or more double kernels	UCD18-20	29	UCD 18-20	20	UCD 18-20	19
	UCD 8-201	18	UCD 1-16	13	UCD 8-27	15
	Wood Colony	18	UCD 8-201	13	UCD 8-201	13
	SF P16.013	15	UCD 8-27	12	Booth	10
	Durango	13	Capitola	6	P16.013	8
	Aldrich	9.7				
	UCD 8-27	9.7				
	Booth	9.3				
	UCD 1-16	8.7				
	UCD 8-160	8.3				
	UCD 3-40	8.3				
	SF P13.019	7				
6% or more twin kernels	Nonpareil	15	UCD 3-40	14	UCD 3-40	17
(two kernels within the same pellicle)	Folsom	13	Sweetheart	13	UCD 8-27	13
	UCD 3-40	13	UCD 8-27	11	Jennette	7
	Sweetheart	12	Folsom	9	UCD 8-201	7
	UCD 8-27	12	UCD 1-232	7		
	Jenette	12	P16.013	7		
	UCD 7-159	9.7				
	UCD 8-201	6				
6% or more chipped/broken	SF P16.013	16	P16.013	8	P16.013	8
	SF P13.019	11	P13.019	6		
	UCD18-20	7.7				
6% or more crease	Y117-86-03	15	Sterling	8	UCD 8-160	15
	UCD 8-160	13	Jenette	6	Sterling	10
	Sterling	12	Durango	6	Sweetheart	8
	Capitola	11			Jennette	8
	Jenette	9.7			Capitola	7
	Folsom	8.7			UCD 1-232	6
	UCD1-232	7.7			Folsom	6
	Wood Colony	7.3				
	Durango	7				
	Eddie	6.3				
6% or more shrivel	UCD 8-201	7.3			Folsom	8
	Capitola	7				
	Y117-86-03	6.3				
6% or more stain/discolor	Capitola	6.3	UCD 1-271	11	UCD 3-40	50
			Shasta	7	UCD 1-271	30
					UCD 1-232	24
					Eddie	21
					UCD 8-160	17
					Supareil	9
					P16.013	9
					Sweetheart	8
					Y116-161-99	8
					UCD 18-20	7
					P13.019	7
					UCD 8-201	6
6% or more mold			UCD 1-271	8	Eddie	11
			Eddie	7	Nonpareil	9
					UCD 1-271	8
6% or more navel orange worm damage	UCD 8-27	6.3		0		0

Fig. 1. Bloom data for 2016 (left) and 2017 (right) by site and variety or selection.

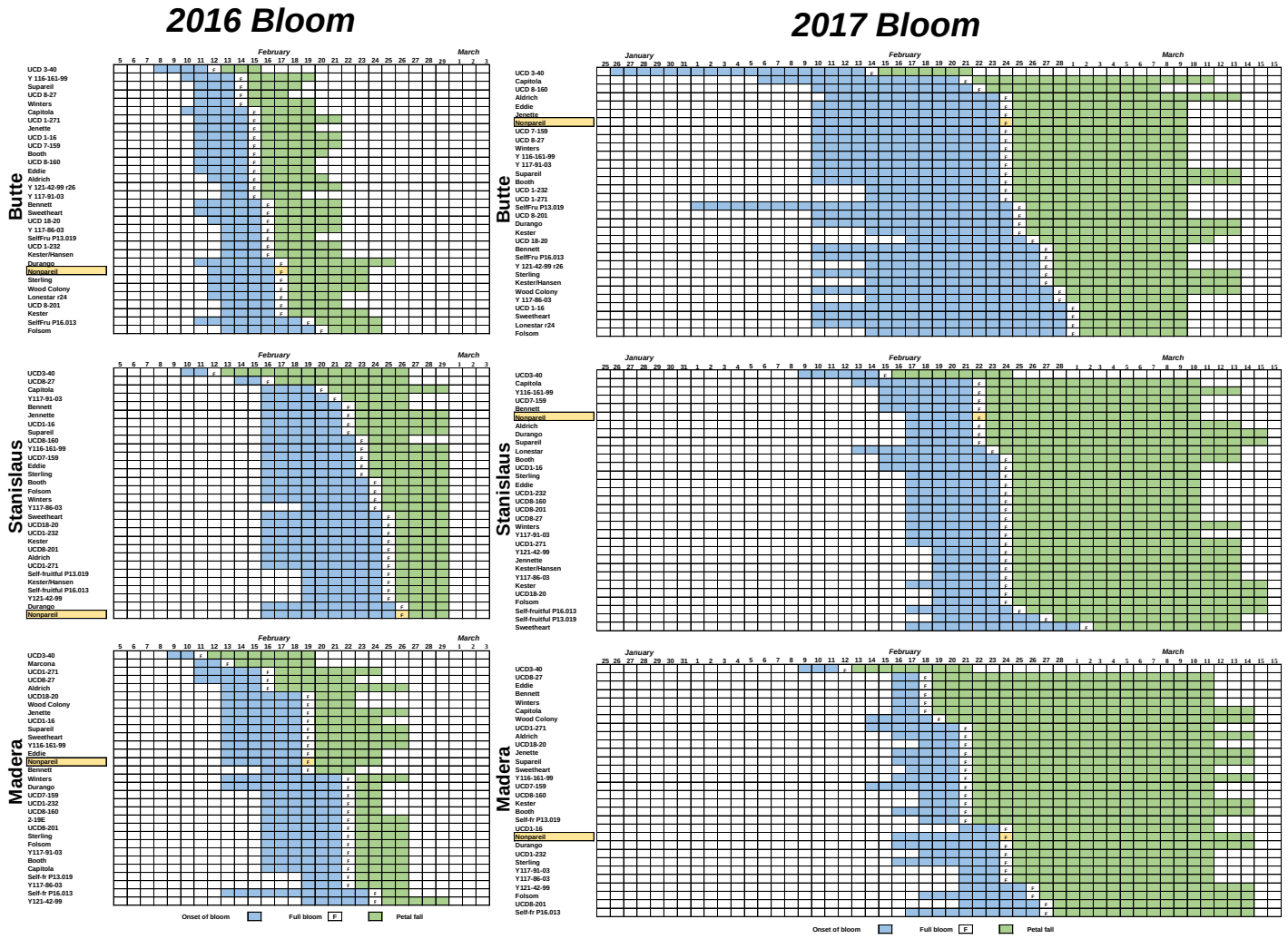


Fig. 2. Bloom data for 2018 (left) and 2019 (right) by site and variety or selection. Pink area on 2019 bloom chart for Butte indicates time when orchard was inaccessible due to muddy conditions.

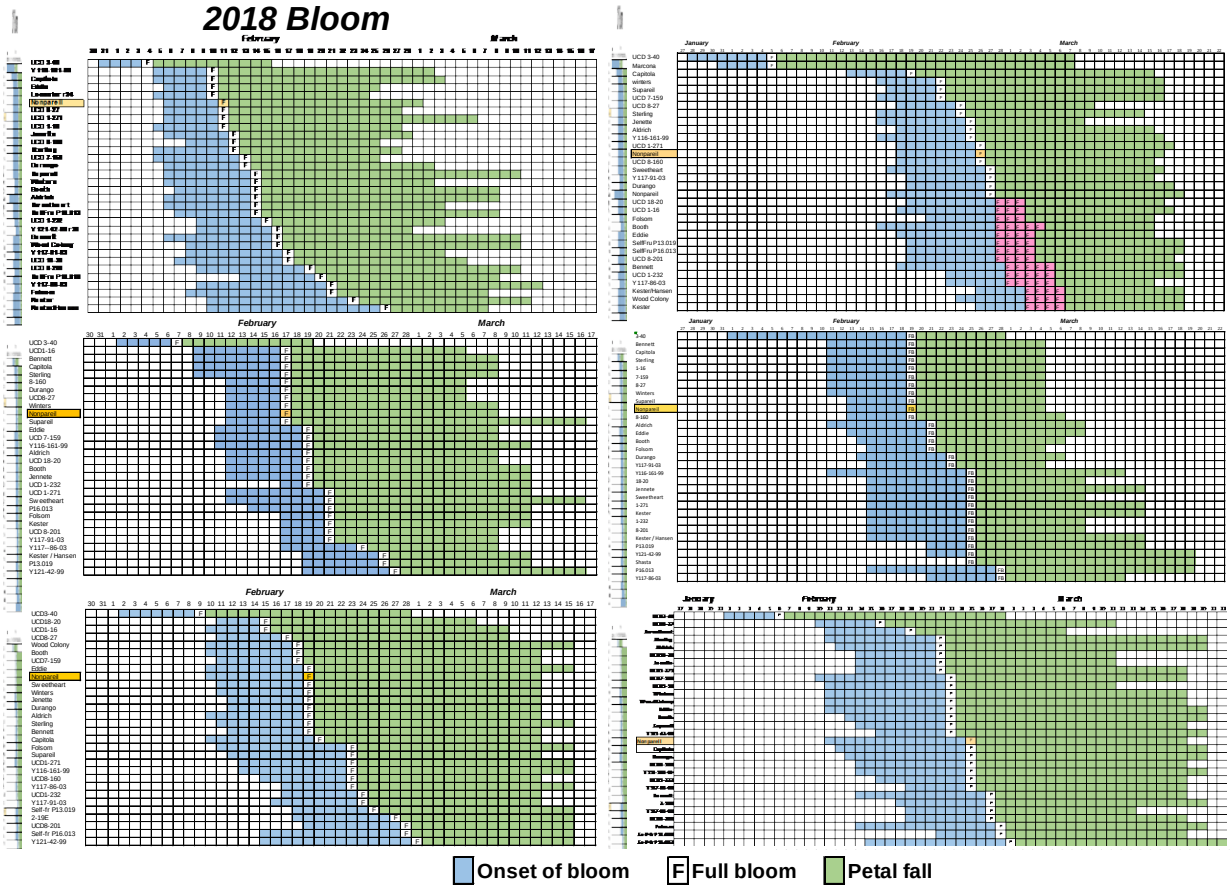


Fig. 3. Hullsplit by site, variety and selection for 2016 (top) and 2017 (bottom).

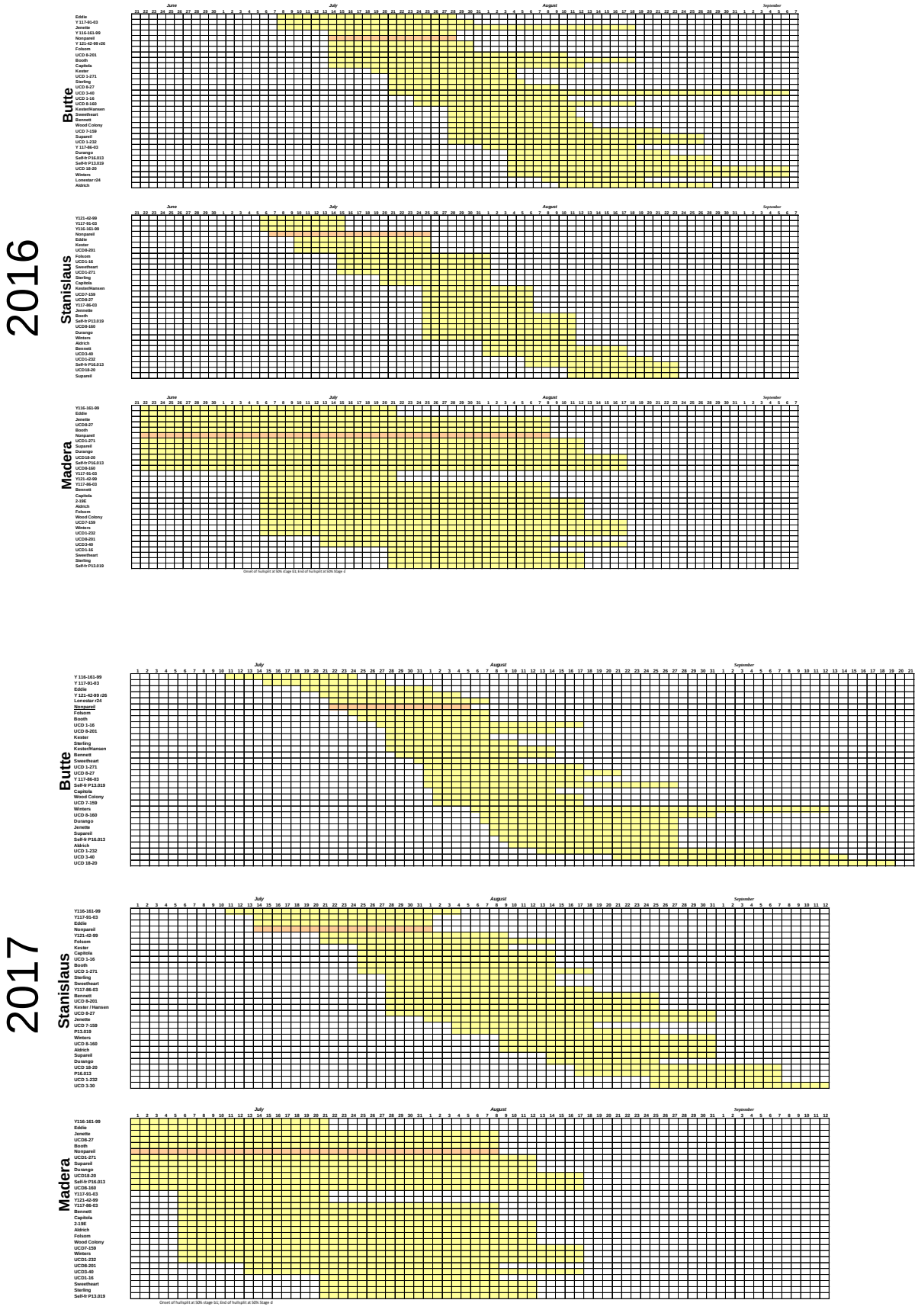
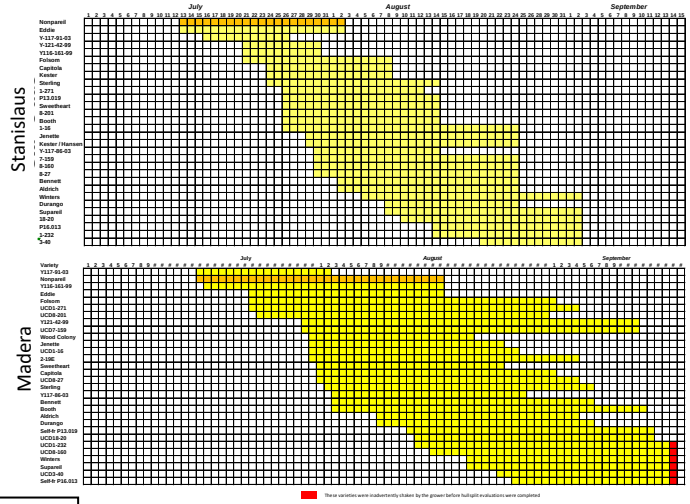


Fig. 4. Hullsplit by site, variety and selection for 2018 (top) and 2019 (bottom).

2018



2019

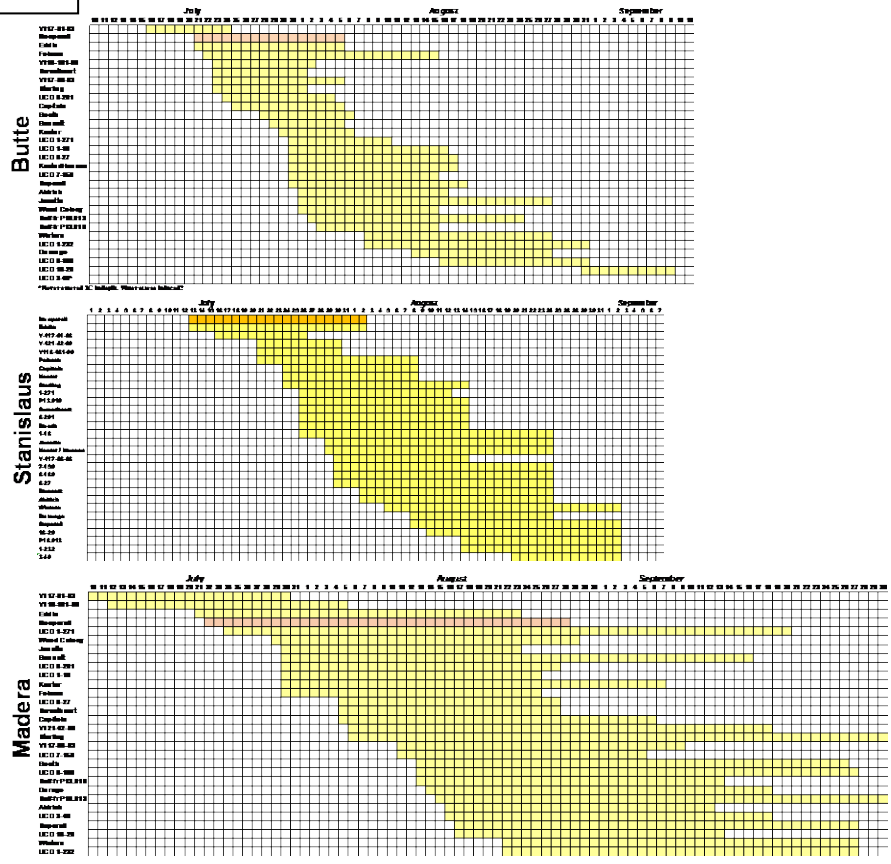


Fig. 5. Average yield for all varieties, selections and Nonpareil sources by orchard age for the 1993 Butte (64 trees per acre), Delta (75 trees per acre) and Kern (86 trees per acre) Regional Almond Variety Trials as well as the McFarland Variety Trial that was planted in 2004 at a density of 121 trees per acre. Data for the 2014 trials is shown on the left. Madera, Butte new and Stanislaus trials have tree densities of 110, 130 and 173 trees per acre respectively.

Site	Trees per acre	2016 (kernel lb/ac)	2017 (kernel lb/ac)	2018 (kernel lb/ac)	2019 (kernel lb/ac)
Butte	110	159-796	405-2145	570-3265	870-3002
Stanislaus	130	40-460	907-2058	1130-2614	964-2630
Madera	173	410-1999	708-2604	236-3483	462-3521

Fig. 6. Average annual yield for all varieties and selections combined at each trial by orchard age. Kern, Butte old and Delta are from the previous generation variety trials and the McFarland trial was in Kern County with Mario Viveros.

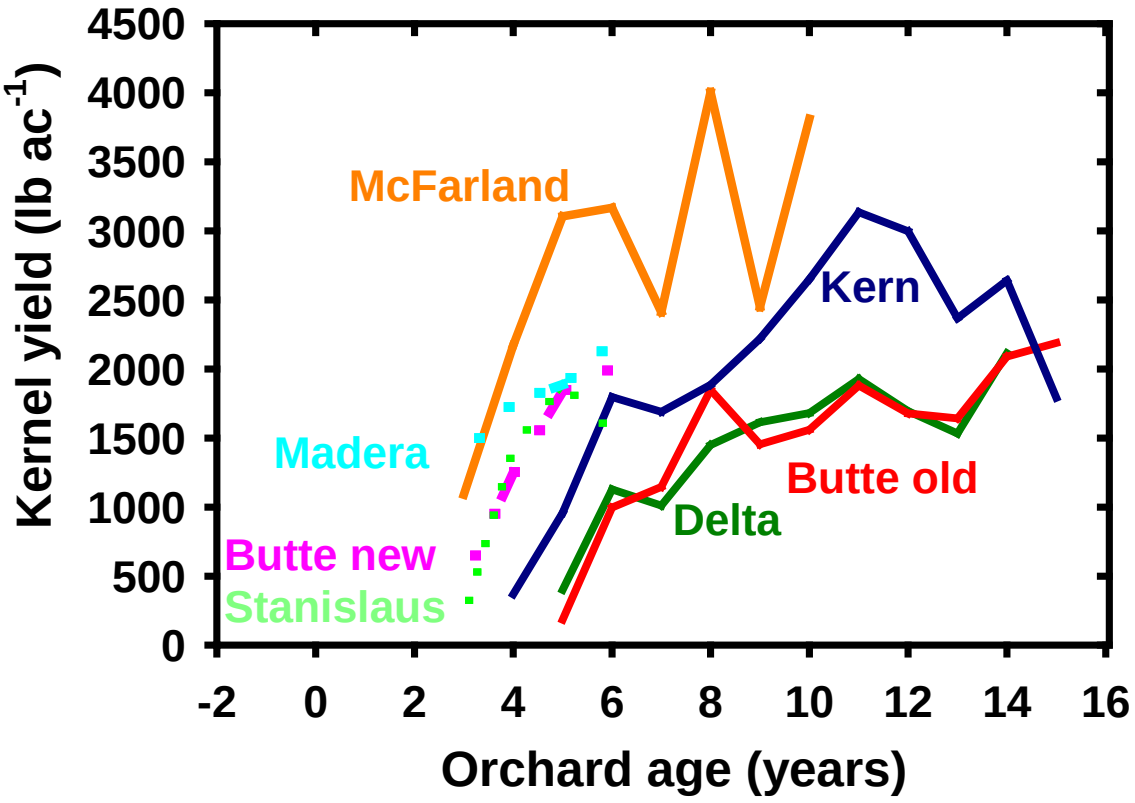


Fig. 7. Google Earth images of the three sites. Note extensive tree loss in several areas at the Madera trial and Stanislaus trials.

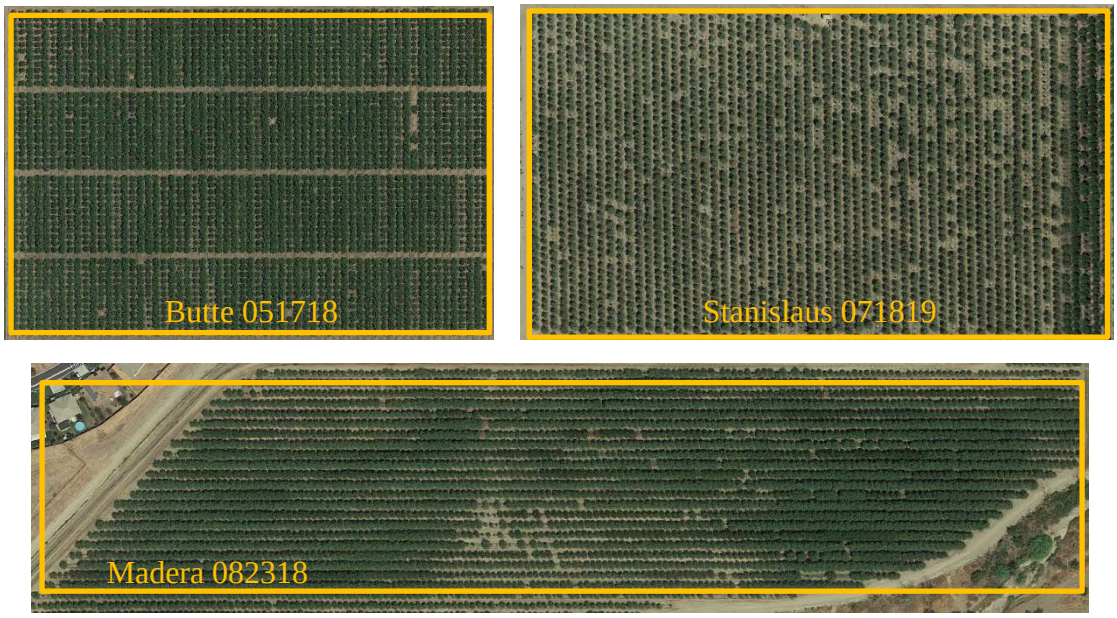


Fig. 8. Description of different tree architectures of the UCD selections at the Chico State University Butte RAVT. Insets show typical branching patterns.

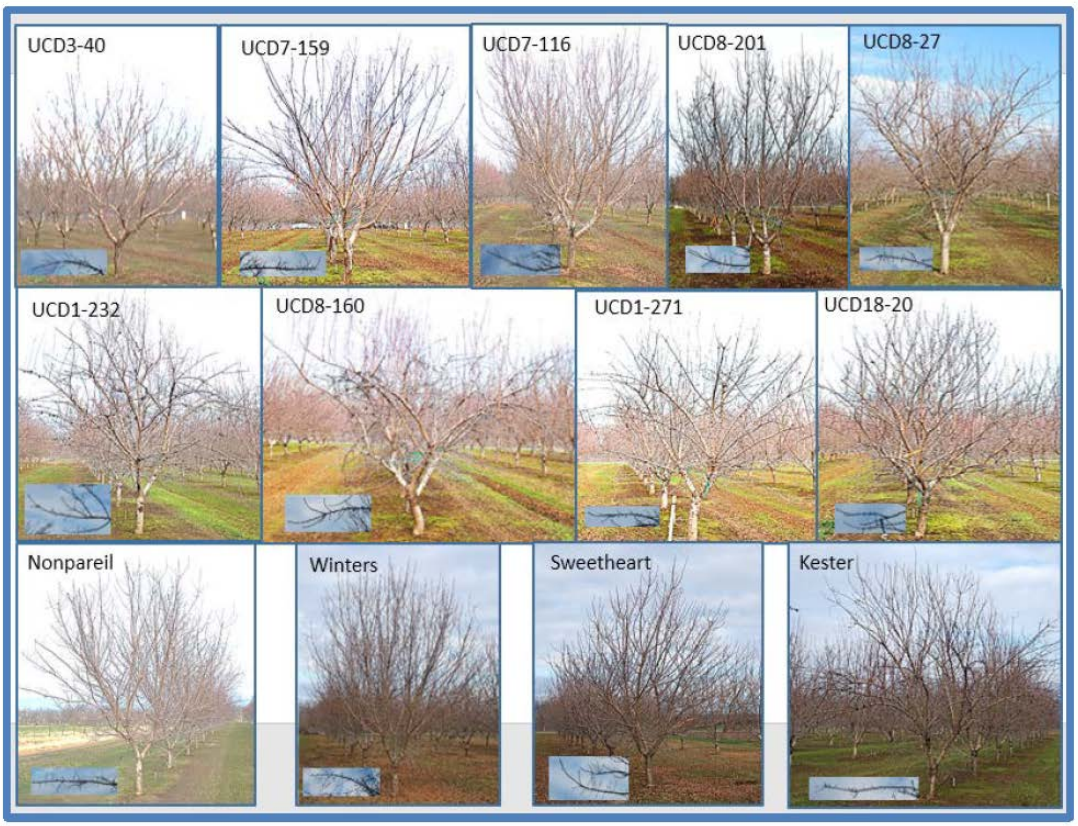


Fig. 9. Photos from the Chico RAVT from the GoPro camera on the mobile platform lightbar over years.


6/17/17 Nonpareil on left UCD8-160 on right


6/22/18 Nonpareil on left UCD8-160 on right


6/16/19 Nonpareil on left UCD8-160 on right