UC DAVIS
DEPARTMENT OF PLANT SCIENCES

Field Evaluation of Almond Varieties

Bruce. Lampinen*[1], Luke Milliron[2], Dani Lightle[2], Roger Duncan[3], Phoebe Gordon[4], D.A. Doll[5], J.H. Connell[6], S.G. Metcalf[1], M.L. Contador[1], S.L. Marchand[1], and T.M. Gradziel[1]

[1]UC Davis Plant Sciences [2]UCCE Butte/Glenn/Tehama Counties, [3]UCCE Stanislaus County, UCCE [4]Madera County , [5]UCCE Merced County, [6]UCCE Butte County emeriti

UNIVERSITY of CALIFORNIA

Objectives

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 objective is to evaluate new varieties and selections compared to standard varieties in three different almond production areas in the Central Valley.

Materials and Methods

Site characteristics for the sites are listed in Table 1. These planting 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.

Table 1. Site characteristics

Site	Rootstock	Spacing	#trees/acre
Butte	Krymsk 86	18′ x 22′	110
Stanislaus	Nemaguard	16′ x 21′	130
Madera	Hansen 536	12′ x 21′	173

The varieties and selections planted are listed in Table 2. 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 2.

Table 2. Varieties and selections planted at the next generation regional almond variety trials. Items 1-30 are planted at all 3 sites while additional material planted at individual sites is listed at the end.

	Variety	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	Burchell
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 only)	
31	Lone Star on Hansen 536 (Chowchilla only	

*Kester (2-19e) was planted at all three sites on the usual rootstock f In addition at the Butte and Stanislaus sites it was also planted in t replicated trial on Hansen 536 rootstock
** Y116-161-99 planted only in two reps outside of main trial at Butte


Butte RAVT- June 28, 2017


Stanislaus RAVT- July 22, 2017


Madera RAVT- June 18, 2017

Data collection including bloom, hullsplit, midday canopy light interception, yield, nut quality and harvestability was started at these sites in 2016. In addition, data on tree health and loss are taken regularly during the growing season.

Observations

Butte- **The Butte trial experienced some bacterial blast following three nights under 30°F during bloom which resulted in some varieties experiencing severe bacterial blast in the north east corner of the trial. Coupled with relatively poor hive strength, the yield will probably be lower than the orchard's potential would indicate from the light interception. Problems with rust were not widespread like they were in 2016. Hull rot was prevalent in 2017, however. Bacterial spot was also prevalent in 2017, and was confirmed on Self-fr P13.019, Self-fr P16.013 and UCD 18-20. Another issue that the trial has faced is damage from gopher feeding at the crowns of the trees, which resulted in the decline or death of approximately 12 trees, many of the Kester variety on Hansen 536 rootstock**

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.

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. Remaining missing trees will be replaced by next spring. In the spring many trees showed shot-hole like symptoms but this was not confirmed. 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.

Results

Bloom was very compact at all 3 sites in 2016 but much more protracted in 2017 (Fig. 1). Overlap with Nonpareil was good for everything except UCD 3-40 which was quite early at all sites in both years.

Midday canopy photosynthetically active radiation 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 in 2016 (Table 3). In 2017, PAR interception varied from 33 to 67 percent at the Butte trial, 38 to 51 percent at the Stanislaus trial, and 41 to 70% at the Madera trial (Table 3). 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.

Hullsplit data for 2016 and 2017 is presented in Figure 2. In 2016, 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.

Yield data for 2016 is shown in Table 3. Yields at the Butte and Stanislaus sites ranged from about 100 to 800 kernel pounds per are 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).

Yield efficiency (expressed as yield per unit PAR intercepted) is presented on the right side of Table 3. This is a useful piece of data since it can show whether a new variety or selection is more efficient at producing yield per unit PAR intercepted or whether it is yielding more simply because it is growing faster. This will be important data to follow as the orchards develop but may or may not be meaningful at this early stage

Table 3. Yield data (left), midday PAR interception (center) and yield per unit PAR intercepted (right) for 2016 by site and cultivar or selection. Yield data for Nonpareil at the Madera site was lost due to a computer problem in 2016. Note that Wood Colony at the Madera site is one year younger. Common letters indicate differences are no significantly different at the 5% level of significance.

Butte

# reps	Variety or selection	Yield (kernel lbs/ac)		# reps	Variety or selection	Midday canopy PAR interception (%)		# reps	Variety or selection	Yield per unit PAR intercepted	
4	Booth	796	a	4	UCD8-160	29.5	a	4	Kester/Hansen	43.0	a
4	Self-fruitful P13.019	764	a b	4	Self-fruitful P16.013	28.9	a b	4	Self-fruitful P13.019	39.6	a b
4	UCD18-20	717	a b c	4	Booth	23.9	a b c	4	Capitola	37.5	b c
4	UCD1-232	712	a b c	4	Y116-161-99	22.7	b c d	4	UCD18-20	33.7	c d
4	UCD8-160	670	a b c d	4	UCD1-232	22.4	b c d e	4	Y117-91-03	33.6	c d
4	Kester	649	a b c d e	4	UCD18-20	21.4	c d e f	4	Kester	33.6	c d
4	Kester/Hansen	609	b c d e f	4	UCD1-16	20.0	c d e f g	4	Booth	33.3	c d e
4	Self-fruitful P16.013	577	b c d e f	4	UCD8-27	19.6	c d e f g h	4	Folsom	33.2	c d e
4	UCD1-16	556	c d e f g	4	Eddie	19.4	c d e f g h	4	Winters	32.7	c d e
4	Y116-161-99	529	c d e f g h	4	UCD8-201	19.4	c d e f g h	4	UCD1-232	32.0	d e f
4	Folsom	523	d e f g h	4	Self-fruitful P13.019	19.3	c d e f g h	106	**Nonpareil**	31.7	d e f g
4	UCD8-201	517	d e f g h	4	Kester	19.2	c d e f g h	4	Supareil	31.2	d e f g h
4	UCD8-27	507	d e f g h	4	Wood Colony	18.1	c d e f g h i	4	Durango	29.0	d e f g h i
5	**Nonpareil**	482	d e f g h i	4	Y117-86-03	16.2	d e f g h i j	7	UCD3-40	28.7	d e f g h i j
4	Y117-91-03	481	d e f g h i j	4	Folsom	15.7	d e f g h i j k	4	Y117-86-03	28.3	d e f g h i j
4	Winters	469	e f g h i j k	5	**Nonpareil**	15.2	e f g h i j k l	4	Sterling	28.0	e f g h i j
4	Y117-86-03	460	ee f g h i j k	4	Y117-91-03	14.4	f g h i j k l	4	UCD1-16	27.8	f g h i j
4	Capitola	455	e f g h i j k l	4	Winters	14.3	f g h i j k l	4	UCD8-201	26.7	f g h i j
4	Eddie	447	f g h i j k l	4	Kester/Hansen	14.2	f g h i j k l	4	Sweetheart	26.2	g h i j k
4	Wood Colony	419	f g h i j k l	4	Durango	13.4	g h i j k l	4	UCD7-159	26.0	h i j k
4	Durango	390	g h i j k l m	4	Aldrich	12.7	g h i j k l	4	UCD8-27	25.9	h i j k
7	UCD3-40	347	h i j k l m n	4	Bennett	12.7	g h i j k l	4	Eddie	25.0	i j k l
4	Sterling	336	h i j k l m n	4	Capitola	12.3	h i j k l	4	Aldrich	25.0	i j k l
4	Aldrich	316	i j k l m n	7	UCD3-40	12.2	h i j k l	4	Jenette	24.3	i j k l
4	Sweetheart	311	i j k l m n	4	Sterling	12.1	h i j k l	4	Wood Colony	23.4	i j k l
4	Supareil	308	j k l m n	4	Jenette	11.1	i j k l m n	4	UCD8-160	23.2	j k l
4	Bennett	291	j k l m n	4	Sweetheart	10.6	i j k l m n	2	Y121-42-99	23.2	j k l
4	Jenette	271	k l m n	3	Marcona	10.4	j k l m n	4	Y116-161-99	23.1	j k l
4	UCD7-159	211	m n	4	Supareil	9.9	k l m n	4	Bennett	20.8	k l
4	UCD1-271	159	n	4	UCD7-159	8.2	l m n	4	UCD1-271	20.7	k l
				4	UCD1-271	7.9	l m n	4	self-fruitful P16.013	20.2	l

Stanislaus

# reps	Variety or selection	Yield (kernel lbs/ac)		# reps	Variety or selection	Midday canopy PAR interception (%)		# reps	Variety or selection	Yield per unit PAR intercepted	
4	Self-fruitful P13.019	460	a	4	UCD1-16	13.6	a	4	Y117-91-03	35.7	a
4	Y121-42-99	373	a b	4	Self-fruitful P13.019	13.3	a b	4	Kester/ Hansen	35.6	a
4	UCD1-16	357	a b c	4	Bennett	12.7	a b c	4	Self-fruitful P13.019	33.6	a b
3	Kester / Hansen	345	a b c d	4	Folsom	12.4	a b c	4	Sterling	31.9	a b c
4	Bennett	334	a b c d e	4	Y121-42-99	11.9	a b c d	4	Folsom	31.7	a b c
4	Y116-161-99	325	a b c d e f	3	Kester	10.4	a b c d e	4	Y121-42-99	31.7	a b c
3	Kester	321	a b c d e f g	4	Eddie	10.2	a b c d e	4	Booth	30.7	a b c d
4	Eddie	309	a b c d e f g h	3	Kester/ Hansen	8.6	a b c d e f	4	UCD18-20	30.0	a b c d
4	Folsom	281	a b c d e f g h i	4	Folsom	8.6	b c d e f g	4	UCD1-232	29.0	a b c d
4	UCD18-20	262	b c d e f g h i j	4	Y117-86-03	8.6	b c d e f g	4	UCD3-40	28.9	a b c d
4	UCD1-232	225	b c d e f g h i j	4	UCD18-20	8.5	b c d e f g	4	Eddie	28.9	a b c d
4	UCD8-160	224	b c d e f g h i j	4	UCD8-160	8.4	b c d e f g h	4	Capitola	28.1	b c d
4	Y117-86-03	213	b c d e f g h i j	4	UCD1-232	7.7	c d e f g h	4	Kester	28.1	b c d
4	Winters	195	b c d e f g h i j	4	Winters	7.2	c d e f g h	16	**Nonpareil**	27.6	b c d e
16	**Nonpareil**	179	c d e f g h i j	4	UCD8-27	7.1	d e f g h i	4	Winters	27.1	b c d e
4	Sweetheart	178	c d e f g h i j	4	Durango	6.9	e f g h i j	4	Sweetheart	26.8	b c d e
4	UCD8-27	178	c d e f g h i j	16	**Nonpareil**	6.7	e f g h i j	4	UCD8-160	26.7	b c d e
4	Y117-91-03	177	c d e f g h i j	4	Sweetheart	6.6	e f g h i j	4	Bennett	26.3	b c d e
4	Aldrich	162	c d e f g h i j	4	Aldrich	6.3	e f g h i j	4	UCD8-201	26.2	c d
4	Durango	159	d e f g h i j	4	self-fruitful P16.013	5.7	f g h i j	4	Y116-161-99	25.7	c d e
4	self-fruitful P16.013	149	e f g h i j	4	Jenette	4.9	f g h i j	4	UCD1-16	25.5	c d e
4	UCD3-40	133	f g h i j	4	Y117-91-03	4.8	f g h i j	4	Supareil	25.5	c d e
4	Booth	128	g h i j	4	UCD8-201	4.8	f g h i j	4	UCD1-271	25.3	d e
4	Capitola	123	h i j	4	UCD3-40	4.5	f g h i j	4	Aldrich	24.9	c d
4	UCD8-201	123	h i j	4	Capitola	4.4	f g h i j	4	Y117-86-03	24.7	d e
4	Jenette	120	h i j	4	Booth	4.2	g h i j	4	self-fruitful P16.013	24.6	c d
4	UCD1-271	86	i	4	UCD1-271	3.4	g h i j	4	Jenette	24.1	d
4	Sterling	54		3	Supareil	2.0	h i j	4	UCD8-27	23.7	d
3	Supareil	53		4	UCD7-159	1.8	i j	4	UCD7-159	23.5	d
4	UCD7-159	40		4	UCD1-271	1.7	j	4	Durango	23.4	d

Madera

# reps	Variety or selection	Yield (kernel lbs/ac)		# reps	Variety or selection	Midday canopy PAR interception (%)		# reps	Variety or selection	Yield per unit PAR intercepted	
4	Y-117-86-03	1999	a	4	Capitola	61.1	a	4	Y117-86-03	45.5	a
4	Self-fr P16-013	1915	a b	4	Folsom	56.6	a b	4	Bennett	42.1	a b
4	Booth	1861	a b	4	Sweetheart	54.4	a b c	4	Self-fr P16-013	41.2	a b
4	Kester	1788	a b c	4	Booth	54.1	a b c	4	UCD 1-16	38.5	a b c
4	Capitola	1786	a b c	4	Bennett	53.5	a b c d	4	Jenette	38.1	a b c
4	Bennett	1773	a b c	4	Sterling	52.0	a b c d	4	UCD-18-20	37.4	a b c d
4	Aldrich	1729	a b c d	105	Nonpareil	52.0	a b c d	4	Aldrich	36.4	a b c d
4	UCD-18-20	1683	a b c d e	4	Eddie	51.7	a b c d	4	Self-fr P13-019	34.5	a b c d e
4	Jenette	1647	a b c d e f	4	Supareil	50.9	a b c d	4	Booth	34.3	b c d e
4	Y-116-161-99	1634	a b c d e f	4	UCD-1-271	50.7	a b c d	4	Y-116-161-99	33.5	b c d e
4	Self-fr P13-019	1609	a b c d e f g	4	Y-116-161-99	49.3	a b c d	4	Kester	33.3	b c d e
4	Y-121-42-99	1537	a b c d e f g	4	Y-117-91-03	48.4	a b c d	4	Winters	33.3	b c d e
4	UCD-1-16	1473	a b c d e f g	4	Aldrich	48.2	a b c d	4	Y-121-42-99	33.2	b c d e
4	Sweetheart	1433	a b c d e f g	4	UCD-3-40	47.3	a b c d	4	UCD-3-40	31.4	c d e f
4	Y-117-91-03	1430	a b c d e f g	4	Self-fr P13-019	46.3	a b c d	4	Durango	31.3	b c d e f
4	Durango	1419	a b c d e f g h	4	Y-121-42-99	46.3	a b c d	4	Capitola	29.2	c d e f g
4	Winters	1373	a b c d e f g h	4	Self-fr P16-013	46.0	a b c d	4	Y-117-91-03	29.0	c d e f g
4	UCD-8-201	1314	b c d e f g h i	4	UCD-8-27	45.9	a b c d	4	UCD-8-27	28.4	c d e f g h
4	UCD-8-27	1148	c d e f g h i j	4	Y-117-86-03	45.2	b c d	4	Sweetheart	27.3	c d e f g h
4	Sterling	1115	c d e f g h i j	4	Durango	45.2	b c d	4	UCD-8-160	26.3	d e f g h
4	Folsom	1054	e f g h i j	4	Jenette	44.8	b c d	4	UCD-1-232	23.6	e f g h i
3	Eddie	1041	e f g h i j	4	UCD-8-201	42.3	b c d	4	Sterling	21.3	f g h i j
4	Supareil	1012	f g h i j k	4	Bennett	42.2	b c d	3	Eddie	21.3	f g h i j
4	UCD-8-160	960	g h i j k	4	UCD-7-159	41.9	b c d	4	Supareil	20.2	f g h i j
4	UCD-1-232	957	g h i j k	4	Winters	41.1	b c d	4	Folsom	18.6	g h i j k
4	UCD-7-159	778	h i j k	4	UCD-1-232	41.0	b c d	4	UCD-7-159	17.5	h i j k
4	UCD-3-40	578	k l	4	UCD-8-27	38.8	c d	4	UCD-3-40	12.2	k l
4	UCD-1-271	410	k l	4	UCD-8-160	38.1	d	4	UCD-1-271	8.0	k l
2	Wood Colony	24	l	4	UCD-1-16	38.1	d	2	Wood Colony	1.7	l
				4	Wood Colony	23.4	e				

Table 4. Main kernel defects observed in 2016 harvest by site.

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		

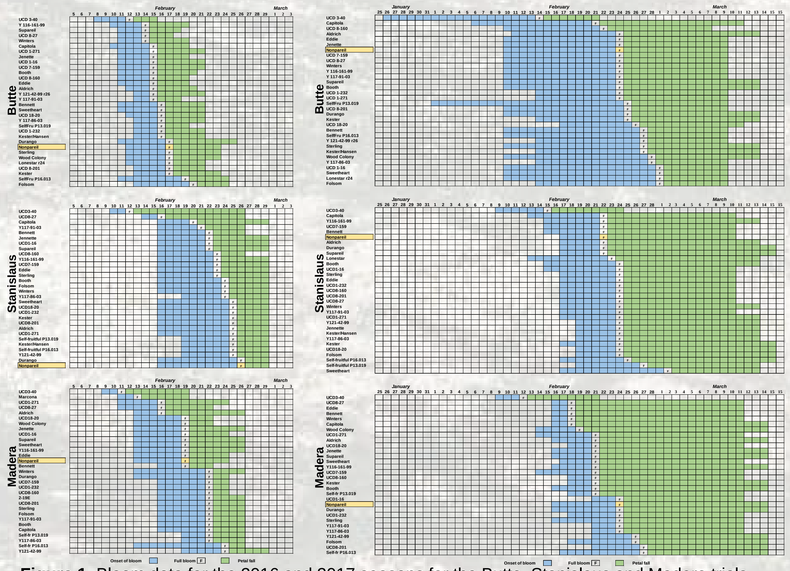

Figure 1. Bloom data for the 2016 and 2017 seasons for the Butte, Stanislaus and Madera trials

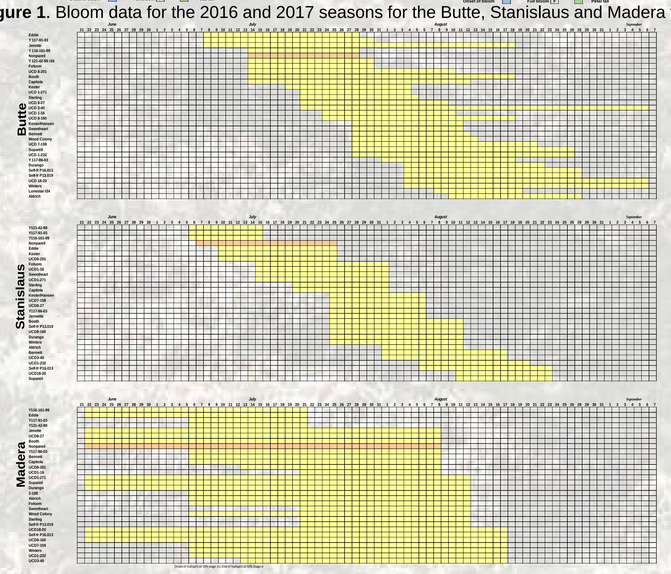

Figure 2. Hull split data for the 2016 season for the Butte, Stanislaus and Madera trials.

2018 Plans

Data collection will continue for bloom, hullsplit, midday canopy light interception, yield, quality, and harvestability in 2018. In addition any disease or insect problems that occur will be noted.

Analysis of hullsplit and yield data for 2017 was not completed at the time of poster creation and will be reported in 2018.

Acknowledgements

Thanks to the Almond Board of California, Chico State University (Jeff Boles), the Salida School District (Lane Parker), and Creekside Farming Company for supporting this work.