Field Evaluation of Almond Varieties

Project No.: **15-HORT2-Lampinen**

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Objectives:

The first objective of this project is to evaluate performance of pollenizers and Nonpareil clones in a replicated field trial in McFarland California. The final year of data collection at the McFarland site was in 2015. The second objective is to use the replicated data on light interception and yield to assess the relative productivity per unit of light intercepted for the Nonpareil clones, varieties and selections. The third objective is to begin data collection on the next generation almond variety trials.

Interpretive Summary:

Yields at the McFarland trial continue to be high compared to the 1993 regional almond variety trials. The McFarland trial reached an average production of 3000 kernel pounds per acre in the 5th growing season which was six years earlier than the 1993 Kern RAVT while neither the 1993 Butte or the 1993 Delta trials ever reached this level of production. In order to develop the canopy this quickly, water and other inputs need to be high and this has resulted in high disease pressure (especially hullrot). Because this trial is replicated, unlike the earlier regional almond variety trials, we have the opportunity to more accurately assess yield differences among the Nonpareil clones, varieties and selections. In addition, because we have detailed light interception data, we can assess whether differences in productivity among varieties and selections are due to faster canopy growth or higher productivity per unit light intercepted. Nonpareil yields varied from 4300 to almost 5000 kernel pounds per acre in 2011 and continued to be generally higher than pollenizer yields. In 2012, yields were down substantially compared to 2011, most likely due to alternate bearing. In 2013, yields increased but

were not as high as 2011. Yields in 2014 and 2015 were still quite high although there appears to be a gradual decline since 2011 or so. There is some separation of cumulative yields for the Nonpareil clones with Nonpareil-Nico highest and Nonpareil-5, Nonpareil-6 and Nonpareil-Jones all having significantly lower cumulative yields. Hullrot continued to be the major disease related problem with the highest levels in 2-19e (Kester) and Kochi with the Nonpareil clones having intermediate hullrot pressure. Hullrot pressure was minimal in 2013-2015. Summary data from the 2006 to 2015 seasons shows that although bloom period varied significantly from one year to the next, in general, overlap of Nonpareil bloom with pollenizers was good in all years.

The next generation Regional 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. Nonpareil was alternated with 30 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.

Materials and Methods:

<u>McFarland Variety Trial</u>

This report will concentrate on a replicated variety trial of eight varieties and eight Nonpareil clones that was planted in 2004 in Kern County near McFarland. Soils at the site consist of McFarland loam and Wasco sandy loam (both Class I soils). The irrigation system is double line drip. Tree spacing is 20 feet between tree rows and 18 feet between trees for a density of 121 trees per acre. Varieties planted included Chips, Kahl, Kochi, Marcona, Selection 2-19e (Kester), Sweetheart and Winters. Nonpareil clones planted include Nonpareil 3-8-2-70, Nonpareil 5, Nonpareil 6, Nonpareil 7, Nonpareil Dr., Nonpareil-J, Nonpareil-Newell and Nonpareil-Nico. There are six replications of each variety and Nonpareil clone with 34 trees per replication. Pollenizer and Nonpareil rows alternate in the orchard.

In 2015, data was collected on bloom and maturity timing, yield and midday canopy light interception. In 2006, 2007 and 2008, midday canopy light interception was measured manually using a hand lightbar. From 2009 to 2015, the mobile platform light bar (described in report for Almond Board project titled 15-HORT13-Lampinen, “Development and Testing of a Mobile Platform for Measuring Canopy Light Interception and Stress in Almond”) was used to measure midday canopy light interception at the McFarland trial.

<u>Regional Almond Variety Trials Planted in 2014</u>

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 5**. The first 31 items are common to all 3 sites and a few different items added at individual sites are listed at the bottom of **Table 5**. 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**). 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 32 items planted in the main trials, fourteen are either partially of fully self-fertile.

Results and Discussion:

McFarland Trial

The grower started ripping every other row center in 2009 and this has resulted in significant improvements in water penetration in the orchard. This procedure has continued and appears to be beneficial with much better water penetration observed.

Weather during bloom was generally good at the McFarland trial site. For the 2015 bloom period there were 150 good bee flying hours (temperature $\geq 59°$F, windspeed ≤ 10MPH, and no rain). This compared to 182, 91, 58, 94, 103, 175 and 146 good bee flying hours in 2008-2014 respectively.

Although the absolute date of bloom for all varieties varied from year to year, bloom overlap among the Nonpareil clones and pollenizers was good in every year (**Figure 3, 4**). Although the bloom dates vary considerably from year to year, the relative bloom dates among the Nonpareil versus pollenizers all appear to shift together. Average bloom dates for the 2006 to 2015 seasons are shown in **Figure 5**.

In 2015 hullsplit initiation and completion was earlier than average by about 2.5 weeks (**Figure 7**). This is the earliest we have observed during this trial to date. The average hullsplit progression for 2006 to 2015 is shown in **Figures 6 and 7** and the average progression for all years in **Figure 8**.

In 2010, scab was only observed on Winters and Nonpareil-5 and in 2011 on Winters and selection 2-19e (Kester) (**Table 1**). In 2012, scab was present at low level on most varieties and selections. In 2013, scab was present only in Kahl, Marcona and Winters and in 2014 only in Kochi and Winters (**Table 1**). *Alternaria* was not present in 2010 but in 2011 and 2012 all Nonpareil selections and pollenizers had some present with the worst being in Kahl, Winters, Kochi and Marcona (**Table 1**). In 2013, *Alternaria* was not observed in Nonpareil selections but was present in Sweetheart, Chips, Kahl, Marcona and Winters (**Table 1**). In 2014, Alternaria was worst in Winters, Kahl, Sweetheart and Marcona (**Table 1**). Hullrot continued to be the main problem at this site. There was substantial hullrot in all varieties and selections with the most severe disease pressure in Kochi and Winters in both 2010 and 2011 (**Table 1**). Kochi also displayed severe hullrot in 2008 and 2009. There was also substantial hullrot in all the Nonpareil clones in 2010 and slightly less in 2011(**Table 1**). Overall, hullrot levels decreased from 2012 to 2014, with 2014 showing the lowest presence in five years (**Table 1**).

Yield data for the McFarland trial from the 2006 through 2015 seasons are shown in **Table 2, 3 and 4**. All of the Nonpareil clones have tended to have higher cumulative yield compared to most of the pollenizers (**Table 4**). Among the Nonpareil clones, there is some separation regarding cumulative yield with Nonpareil Nico, Nonpareil 38270 and Nonpareil Newell having the highest cumulative yields (**Table 4**). Selection 2-19e (Kester) has had the highest cumulative yield among all of the pollenizers in the trial followed by Winters, Chips, Kahl, Sweetheart, Kochi and Marcona (**Table 4**). The replication provided in this trial adds much value to the data compared to earlier unreplicated variety trials but it comes at a cost in terms of the time required for maintaining, rating and harvesting the plots.

The yields from this trial continue to be high for the age of the orchard. **Figure 1** shows average yield by orchard age for all varieties, selections and Nonpareil sources for the Butte, Delta and Kern trials planted in 1993 compared to the McFarland trial planted in 2004. The McFarland trial reached an average production of 3000 kernel pounds per acre six years earlier than the 1993 Kern RAVT while neither the Butte or Delta trials ever reached this level of production (**Figure 1**). Yields have tended to alternate around 3700 kernel pounds per acre for the past few years which is in the range of what would be expected based on light interception levels although there appears to have been a gradual decline since 2011 or so (**Figure 2**). This has been observed on other orchards as well with the peak in production occurring around 11 years of age.

The productivity per unit canopy light interception was quite high for the size of the tree in 2009 (ranging from 52 to 85 kernel pounds per unit light intercepted) and was still fairly high in 2010 (ranging from 23 to 51 kernel pounds per unit light intercepted) since our previous data has suggested 50 kernel pounds per unit light intercepted is near the normal maximum for almond (**Table 3**). In 2011, yield per unit light intercepted averaged 74.8 for the Nonpareil clones and 40 to 65 for the pollenizers (**Table 3**). This trend towards yield per unit PAR intercepted in the range of 50 has continued in 2013 and 2014 (**Table 4**). **Figure 2** shows the yield per unit PAR intercepted by variety or selection for all years of the study (data for Nonpareil sources are averaged). This figure suggests that the yields tend to alternate around 50 kernel pounds per 1% PAR intercepted confirming our earlier observations. Nonpareil has produced above the 50 kernel pounds per 1% PAR intercepted line while some other varieties have averaged below the line (see average values in legend for **Figure 2**). As noted earlier though, overall yields appear to have been declining for several years.

Regional Almond Variety Trials Planted in 2014

The Butte, Stanislaus and Madera sites were planted in the winter of 2014 (see Materials and Methods section). **Table 5** lists items planted at the trials. Bloom, hullsplit, canopy light interception and yield data collection were initiated in 2016. All of the sites are growing well and although the Butte trial was short about 60 trees from the nursery at planting and some trees were lost at all 3 sites, they have mostly been replaced. Bloom, hullsplit and yield data were collected starting in 2016 and will be reported at the 2016 Almond Board Conference and in the 2017 Annual Report.

Butte Trial- August 2016

Madera Trial- August 2016

Stanislaus Trial- July 2016

Acknowledgements

The authors wish to thank the Almond Board of California for their continued support of this project. We also want to thank the Billings Ranches for their excellent cooperation in managing and maintaining the McFarland trial. In addition, we would like to thank Chico State University/Jeff Boles, the Salida School District/Lane Parker as well as the Creekside Farming Company for their cooperation on the next generation variety trials.

Table 1. Scab rating, *Alternaria* rating, and hullrot strikes per tree for the 2010-2014 seasons at the McFarland trial. Letters indicate significant difference at the 5% level of significance.

2010

Scab Rating			***Alternaria rating***			***Hull Rot Strikes***		
selection 2-19e	0.00	a	Chips	0.00	a	Kahl	8.33	a
Chips	0.00	a	Kahl	0.00	a	Sweetheart	11.00	a
Kahl	0.00	a	Kochi	0.00	a	Marcona	13.33	a
Kochi	0.00	a	Marcona	0.00	a	selection 2-19e	18.83	a
Marcona	0.00	a	Nonpareil 3-8-2-70	0.00	a	Price	23.01	a
Nonpareil 3-8-2-70	0.00	a	Nonpareil-5	0.00	a	Chips	24.00	a
Nonpareil-6	0.00	a	Nonpareil-6	0.00	a	Nonpareil-Nico	30.67	a
Nonpareil-7	0.00	a	Nonpareil-7	0.00	a	Nonpareil 3-8-2-70	61.33	a
Nonpareil-DR	0.00	a	Nonpareil-DR	0.00	a	Nonpareil-J	62.67	a
Nonpareil-J	0.00	a	Nonpareil-J	0.00	a	Nonpareil-5	65.17	a
Nonpareil-Newell	0.00	a	Nonpareil-Newell	0.00	a	Nonpareil-7	72.67	a
Nonpareil-Nico	0.00	a	Nonpareil-Nico	0.00	a	Nonpareil-6	82.83	a
Price	0.00	a	Price	0.00	a	Nonpareil-Newell	83.67	a
Sweetheart	0.00	a	selection 2-19e	0.00	a	Nonpareil-DR	98.17	a
Nonpareil-5	1.00	a	Sweetheart	0.00	a	Kochi	262.00	b
Winters	2.00	b	Winters	0.00	a	Winters	539.67	c

2011

Scab Rating			***Alternaria rating***			***Hull Rot Strikes***		
Chips	0.00	a	Nonpareil-Nico	0.67	a	Kahl	2.33	a
Kahl	0.00	a	Nonpareil-7	0.67	a	Marcona	3.33	a
Kochi	0.00	a	Nonpareil-J	0.83	a b	Chips	5.00	a b
Marcona	0.00	a	Sweetheart	1.00	a b	Nonpareil-DR	10.33	a b
Nonpareil 3-8-2-70	0.00	a	Nonpareil-Newell	1.00	a b c	Nonpareil-Nico	10.67	a b
Nonpareil-5	0.00	a	Nonpareil-5	1.00	a b c	Nonpareil-5	15.00	a b
Nonpareil-6	0.00	a	Nonpareil-6	1.00	a b c	Nonpareil 3-8-2-70	22.00	a b c
Nonpareil-7	0.00	a	Nonpareil 3-8-2-70	1.00	a b c	Nonpareil-J	26.67	a b c
Nonpareil-DR	0.00	a	2-19E	1.17	a b c d	Nonpareil-7	31.00	a b c
Nonpareil-J	0.00	a	Nonpareil-DR	1.17	a b c d	Nonpareil-Newell	34.00	a b c
Nonpareil-Newell	0.00	a	Chips	1.50	b c d	Nonpareil-6	39.67	a b c
Nonpareil-Nico	0.00	a	Marcona	1.67	c d e	Sweetheart	48.67	a b c
Sweetheart	0.00	a	Kochi	1.83	d e	2-19E	94.00	b c
2-19E	0.17	b	Winters	2.33	e	Winters	104.83	c
Winters	3.00	c	Kahl	2.33	e	Kochi	325.83	d

2012

Scab Rating			***Alternaria rating***			***Hull Rot Strikes***		
Nonpareil-5	0.0	a	Nonpareil-6	0.67	a	Marcona	0.00	a
Chips	0.0	a	Nonpareil-Newell	0.83	a	Kahl	1.83	a b
Kahl	0.2	a b	Nonpareil 3-8-2-70	0.83	a	Chips	4.17	a b c
Nonpareil-J	0.2	a b	Nonpareil-Nico	0.83	a	Nonpareil-Nico	13.83	a b c d
Nonpareil-6	0.2	a b	Nonpareil-DR	0.83	a	Nonpareil-DR	17.17	a b c d
2-19E	0.3	a b c	Chips	1.00	a	Nonpareil 3-8-2-70	23.67	a b c d e
Nonpareil-Nico	0.3	a b c	Nonpareil-J	1.00	a	Nonpareil-5	25.00	a b c d e
Nonpareil-7	0.5	a b c	Sweetheart	1.00	a	Nonpareil-7	25.00	a b c d e
Nonpareil-DR	0.5	a b c	Nonpareil-7	1.00	a	Nonpareil-Newell	30.67	b c d e
Marcona	0.5	a b c	Kahl	1.17	a	Nonpareil-J	33.17	c d e f
Kochi	0.5	a b c	Nonpareil-5	1.17	a	Sweetheart	41.83	d e f
Nonpareil 3-8-2-70	0.7	b c	Marcona	1.50	b	Winters	47.17	e f
Nonpareil-Newell	0.8	c	Kochi	1.50	b	Nonpareil-6	47.17	e f
Sweetheart	1.8	d	2-19E	1.50	b	Kochi	56.67	f g
Winters	3.0	e	Winters	2.50	c	2-19E	81.00	g

2013

Scab Rating			***Alternaria rating***			***Hull Rot Strikes***		
Nonpareil-DR	0.0	a	Nonpareil-J	0	a	Marcona	2.83	a
Nonpareil-7	0.0	a	Nonpareil-DR	0	a	Kahl	3.33	a
Nonpareil-J	0.0	a	Nonpareil-7	0	a	Chips	9.50	a b
Nonpareil-5	0.0	a	Nonpareil-Newell	0	a	Winters	16.83	a b
Nonpareil-6	0.0	a	Nonpareil-Nico	0	a	Nonpareil-Nico	21.00	a b c
Nonpareil-Newell	0.0	a	Nonpareil 3-8-2-70	0	a	Nonpareil-6	21.50	a b c
Kochi	0.0	a	Nonpareil-5	0	a	Sweetheart	22.00	a b c
Nonpareil 3-8-2-70	0.0	a	Nonpareil-6	0	a	Nonpareil 3-8-2-70	22.67	a b c
2-19E	0.0	a	Kochi	0	a	Nonpareil-5	23.17	a b c
Sweetheart	0.0	a	2-19E	0	a	Nonpareil-7	24.17	a b c
Nonpareil-Nico	0.0	a	Sweetheart	1	a	Nonpareil-J	28.17	a b c
Chips	0.0	a	Chips	1	b	Nonpareil-DR	30.33	a b c
Kahl	0.2	a b	Kahl	1	b	Nonpareil-Newell	33.33	b c
Marcona	0.3	b	Marcona	1	b	Kochi	51.00	c d
Winters	1.2	c	Winters	2	c	2-19E	68.67	d

Scab Rating			*Alternaria rating*			*Hull Rot Strikes*		
Kester (2-19E)	0	a	Nonpareil-J	0.0	a	Kahl	0	a
Nonpareil-7	0	a	Nonpareil-5	0.0	a	Marcona	0	a
Nonpareil-Newell	0	a	Nonpareil 3-8-2-70	0.0	a	Sweetheart	1	a
Nonpareil-J	0	a	Nonpareil-7	0.0	a	2-19E	2	a
Nonpareil-5	0	a	Nonpareil-Nico	0.0	a	Nonpareil 3-8-2-70	2	a
Nonpareil 3-8-2-70	0	a	Nonpareil-6	0.0	a	Winters	2	a
Nonpareil-DR	0	a	Nonpareil-Newell	0.2	a b	Chips	3	a
Nonpareil-6	0	a	Kochi	0.3	a b	Nonpareil-Nico	3	a b
Marcona	0	a	2-19E	0.5	b c	Nonpareil-7	4	a b c
Kahl	0	a	Nonpareil-DR	0.5	b c	Nonpareil-6	5	a b c
Sweetheart	0	a	Chips	0.5	b c	Nonpareil-Newell	5	a b c
Nonpareil-Nico	0	a	Marcona	0.8	c d	Nonpareil-5	6	a b c
Chips	0	a	Sweetheart	1.0	d e	Nonpareil-J	11	b c
Kochi	0.17	a	Kahl	1.3	e	Nonpareil-DR	11	c
Winters	2.17	b	Winters	3.0	f	Kochi	25	d

Table 2. Number of nuts per tree, average kernel weight, shelling percentage, kernel pounds per unit of photosynthetically active radiation (PAR) intercepted, kernel pound per acre, cumulative kernel pounds per acre for the 2006 through 2008 seasons. Data for each year is sorted by cumulative yield, which is summed from the beginning of the project. Selection 2-19e was recently released as Kester. Letters indicate significant difference at the 5% level of significance.

2006				**Kernel pounds per**			
Variety	**No. of nuts/tree**	**verage kernel wt (**	**Shelling percentage**	**unit PAR int.**	**Tree**	**Acre**	**Cumulative kernel yield (lbs/acre)**
2-19e	6852 a	0.94 g	53.0 d	45.5 a	14.2 a	1718 a	1718 a
Winters	6648 a	0.87 h	53.4 d	47.9 a	12.7 a	1540 a	1540 a
Marcona	3611 bcd	1.31 a	30.7 f	41.4 a	10.4 b	1258 b	1258 b
Nonpareil-Ni	4246 b	1.09 cde	67.2 a	32.4 b	10.2 bc	1232 bc	1232 bc
Nonpareil-5	3713 bcd	1.12 bcd	67.9 a	30.1 b	9.2 bcd	1110 bcd	1110 bcd
Nonpareil-D	3867 bc	1.07 def	63.4 abc	29.9 b	9.1 bcd	1103 bcd	1103 bcd
Nonpareil-3-8-2-70	3848 bc	1.07 cde	64.6 ab	30.6 b	9.1 bcd	1101 bcd	1101 bcd
Nonpareil-Ne	3815 bc	1.07 cde	67.7 a	28.2 b	9.0 bcd	1086 bcd	1086 bcd
Nonpareil-6	3886 bcd	1.12 bc	67.0 a	28.3 b	8.9 bcd	1075 bcd	1075 bcd
Nonpareil-J	3717 bcd	1.08 cde	64.0 abc	28.4 b	8.8 bcd	1066 bcd	1066 bcd
Chips	3623 bcd	1.02 f	53.8 d	26.9 b	8.1 bcde	985 bcde	985 bcde
Kochi	3134 cd	1.16 b	59.9 c	26.7 b	8.0 cde	965 cde	965 cde
Nonpareil-7	3288 bcd	1.08 cde	65.1 a	24.4 bc	7.8 de	941 de	941 de
Kahl	3139 cd	1.06 ef	47.8 e	31.0 b	7.4 de	889 def	889 def
Sweetheart	2777 d	0.95 g	67.8 a	16.7 c	5.6 f	681 f	681 f

2007				**Kernel pounds per**			
Variety	**No. of nuts/tree**	**verage kernel wt (**	**Shelling percentage**	**unit PAR int.**	**Tree**	**Acre**	**Cumulative kernel yield (lbs/acre)**
2-19e	13149 a	0.78 e	54.3 d	58.4 ab	22.8 a	2756 a	4474 a
Winters	11972 ab	0.83 de	60.2 b	65.8 a	21.8 ab	2634 ab	4173 a
Nonpareil-Newell	10659 bc	0.90 bc	67.3 a	52.9 bc	21.0 abc	2543 abc	3626 b
Nonpareil-Nico	9260 cde	0.92 bc	66.0 a	47.1 cde	18.8 abcd	2279 abcd	3511 b
Nonpareil-Driver	9793 cd	0.91 bc	65.6 a	51.1 bc	19.6 abcd	2371 abcd	3474 b
Nonpareil-5	8905 cdef	0.95 b	67.0 a	49.3 bcd	19.0 abcd	2299 abcd	3410 b
Nonpareil-3-8-2-70	9340 cde	0.92 bc	66.3 a	50.8 bc	18.9 abcd	2291 abcd	3393 b
Nonpareil-7	9517 cd	0.92 bc	67.9 a	48.1 bcde	19.3 abcd	2332 abcd	3272 bc
Marcona	6938 fg	1.08 a	29.8 f	52.8 bc	16.5 def	1995 def	3252 bcd
Kahl	9594 cd	0.91 bc	47.6 e	65.2 a	19.3 abcd	2332 abcd	3222 bcd
Nonpareil-J	9137 cde	0.89 bcd	65.5 a	44.4 cde	17.8 bcde	2152 bcde	3218 bcd
Nonpareil-6	8396 def	0.94 b	67.1 a	43.3 cde	17.4 cde	2103 cde	3178 bcd
Chips	7681 defg	0.87 cd	54.4 d	38.9 def	14.7 ef	1780 ef	2766 bcd
Kochi	6006 g	1.08 a	59.4 bc	37.9 ef	14.3 ef	1729 ef	2694 de
Sweetheart	6767 fg	0.89 bcd	66.6 a	31.2	13.1 f	1588 f	2165 e

2008				**Kernel pounds per**			
Variety	**No. of nuts/tree**	**verage kernel wt (**	**Shelling percentage**	**unit PAR int.**	**Tree**	**Acre**	**Cumulative kernel yield (lbs/acre)**
2-19e	13472 a	0.93 g	54.3 d	56.5 bcde	27.4 cd	3321 cd	7795 a
Nonpareil-Nico	13879 a	1.10 cd	66.0 a	67.5 a	33.5 a	4056 a	7567 ab
Nonpareil-3-8-2-70	12506 bcd	1.17 cd	66.3 a	66.0 a	30.7 b	3714 b	7106 bc
Nonpareil-5	12883 ab	1.08 de	67.0 a	63.9 ab	30.5 b	3692 b	7102 bc
Nonpareil-Newell	11916 bcd	1.09 de	67.3 a	57.3 bcde	28.6 cd	3456 cd	7086 bc
Nonpareil-Driver	12729 abc	1.07 de	65.6 a	62.5 abc	29.8 bc	3611 bc	7085 bc
Nonpareil-7	13250 ab	1.06 de	67.9 a	62.3 abc	31.1 ab	3763 ab	7035 bc
Winters	9872 e	1.02	60.2 b	53.4 def	22.1 fg	2670 g	6843 c
Nonpareil-6	10707 de	1.16 c	67.1 a	54.7 cde	27.3 cd	3300 cd	6478 cd
Nonpareil-J	11071 d	1.09 cde	65.5 a	54.6 cde	26.6 de	3224 de	6442 cd
Kahl	10720 de	0.96 fg	47.6 e	61.2 abcd	22.6 fg	2733 fg	5954 de
Chips	11465 cd	0.97 fg	54.4 d	51.8 ef	24.4 ef	2956 ef	5722 ef
Sweetheart	13149 ab	0.82 g	66.6 a	45.3 f	23.9 ef	2893 ef	5059 g
Marcona	4721 f	1.39 a	29.8 f	36.9	14.5 h	1748 h	5001 g
Kochi	5882 f	1.28 b	59.5 bc	35.0	16.5 h	2002 h	4696 g

Table 3. Number of nuts per tree, average kernel weight, shelling percentage, kernel pounds per unit of photosynthetically active radiation (PAR) intercepted, kernel pound per acre, cumulative kernel pounds per acre for the 2009 through 2012 seasons. Data for each year is sorted by cumulative yield, which is summed from the beginning of the project. Selection 2-19e was recently released as Kester. Letters indicate significant difference at the 5% level of significance.

2009				Kernel pounds per			
Variety	No. of nuts/tree	Average kernel wt (g)	Shelling percentage	unit PAR int.	Tree	Acre	Cumulative kernel yield (lbs/acre)
Nonpareil-Nico	13773 ab	1.05 bcd	74.7 ab	69.3 abcd	31.8 ab	3851 a	11417 a
Nonpareil-Newell	14513 a	1.03 bcd	74.8 ab	72.8 abc	33.1 a	4004 a	11090 a
2-19e	14706 a	0.84 f	65.6 f	71.6 abc	27.1 c	3285 c	11080 a
Nonpareil-Driver	13856 ab	1.08 ab	75.8 a	76.1 ab	32.9 a	3977 a	11062 a
Nonpareil-3-8-2-70	13756 ab	1.04 bcd	74.6 ab	71.8 abc	31.4 ab	3798 ab	10905 abc
Nonpareil-7	13051 ab	1.03 bcd	72.6 abc		29.5 bc	3571 bc	10606 abc
Nonpareil-5	12070 bcd	1.08 ab	74.2 ab	68.5 abcd	28.7 bc	3476 bc	10577 abc
Nonpareil-6	13505 ab	1.02 bcd	71.2 cd	68.9 abcd	30.2 abc	3661 abc	10139 bc
Nonpareil-J	12803 abc	1.04 bcd	71.6 bcd	63.4 bcde	29.0 bc	3513 bc	9955 cd
Winters	9434 ef	0.96 bcde	61.6 g	63.8 bcde	20.0 e	2415 e	9258 de
Kahl	11035 cde	0.87 ef	59.1 g	79.2 a	21.1 de	2559 de	8513 ef
Chips	9771 ef	0.93 def	58.6 g	55.9 de	20.0 e	2422 e	8144 ef
Sweetheart	12798 abc	0.85 ef	73.3 abc	59.6 cde	24.0 d	2906 d	7965 fg
Marcona	8977 fg	1.07 abc	32.5 h	77.7 a	21.2 de	2562 de	7563 gl
Kochi	7252 g	1.17 a	68.9 de	52.6 e	18.7 e	2259 e	6955

2010				Kernel pounds per			
Variety	No. of nuts/tree	Average kernel wt (g)	Shelling percentage	unit PAR int.	Tree	Acre	Cumulative kernel yield (lbs/acre)
Nonpareil-Nico	9521 abc	1.24 abcdef	72.5 ab	49.7 a	25.9 a	3141 a	14558 a
Nonpareil-Newell	8429 cde	1.31 ab	73.6 a	45.2 abc	24.2 a	2931 a	14022 ab
Nonpareil-3-8-2-70	8823 bcd	1.28 abcd	72.3 ab	47.1 ab	24.9 a	3011 a	13916 ab
Nonpareil-Driver	8368 cde	1.28 abcd	71.0 ab	46.2 abc	23.6 a	2849 a	13911 ab
Nonpareil-7	10612 ab	1.16 bcdef	69.8 ab	49.4 a	27.1 a	3282 a	13916 ab
Nonpareil-5	9410 abc	1.24 abcde	72.3 ab	50.8 a	25.8 a	3130 a	13708 abc
Nonpareil-6	9499 abc	1.21 abcdef	71.8 ab	48.7 ab	25.5 a	3081 a	13220 bc
2-19e	6833 efg	1.10 bcdef	56.1 e	33.7 def	16.7 bc	2020 bc	13100 bc
Nonpareil-Jones	8315 cde	1.23 abcdef	70.9 ab	43.8 abc	22.6 a	2737 a	12691 c
Winters	6601 efg	1.11 bcdef	60.7 cde	38.5 bcde	16.0 bc	1945 bc	11203 d
Chips	9089 abc	1.15 bcdef	65.9 abc	48.4 a	23.0 a	2789 a	10933 d
Sweetheart	10915 a	0.80	71.8 ab	42.2 abcd	23.4 a	2839 a	10804 d
Kahl	7587 cde	1.01	56.5 de	43.4 abcd	16.9 b	2048 c	10561 d
Marcona	5073 gh	1.28 abc	26.2 g	36.7 cdef	14.4 bc	1745 bc	9308 e
Kochi	3902 h	1.40 a	64.4 bcd	23.5 g	12.1 bc	1466 bc	8421 e

2011				Kernel pounds per			
Variety	No. of nuts/tree	Average kernel wt (g)	Shelling percentage	unit PAR int.	Tree	Acre	Cumulative kernel yield (lbs/acre)
Nonpareil-Nico	18776 a	0.99 bcde	68.0 abc	90.1 a	41.0 a	4964 a	19523 a
Nonpareil-3-8-2-70	17744 abc	1.05 bc	70.7 a	79.5 ab	41.0 a	4962 a	18878 ab
Nonpareil-Newell	17790 abc	1.00 bcd	70.1 ab	69.4 abc	39.2 a	4745 a	18767 abc
Nonpareil-Driver	17943 ab	0.98 bcde	66.0 abcd	72.8 ab	38.7 a	4683 a	18593 abc
Nonpareil-7	17078 abcd	0.83 e	69.2 abc	72.3 ab	31.4 a	4555 a	18443 abc
Nonpareil-5	15744 de	1.03 bc	70.4 ab	70.2 abc	35.9 a	4342 a	18050 bcd
Nonpareil-6	16630 bcde	1.04 bc	70.0 ab	74.7 ab	38.2 a	4619 a	17838 bcd
2-19e	18253 ab	0.91 bcde	64.8 abcd	65.2 bcd	36.8 a	4460 a	17560 cd
Nonpareil-Jones	16993 abcd	0.96 bcde	70.0 ab	70.0 abc	36.0 a	4360 a	17051 d
Winters	15979 cde	0.83 e	58.7 ef	56.8 cde	29.4 b	3554 b	14757 e
Sweetheart	14969 e	0.86 de	64.1 bcde	47.3 cde	28.2 bc	3412 bc	14215 e
Chips	11901 f	0.94 bcde	60.3 de	44.7 de	24.7 bcd	2985 bcd	13918 e
Kahl	12420 f	0.89 cde	53.5 f	45.6 de	24.4 bcd	2953 bcd	13514 e
Marcona	9633 g	1.07 b	30.8 g	45.0 de	22.7 d	2746 d	12054 f
Kochi	8701 g	1.22 a	63.5 cde	9.4 e	23.3 d	2825 d	11247 f

2012				Kernel pounds per			
Variety	No. of nuts/tree	Average kernel wt (g)	Shelling percentage	unit PAR int.	Tree	Acre	kernel yield (lbs/acre)
Nonpareil-Nico	9520 b	1.13 de	67.7 bcd	75.0 ab	23.6 a	2861 a	22384 a
Nonpareil-3-8-2-70	8530 b	1.20 bc	70.9 bc	75.6 ab	22.6 ab	2733 ab	21611 ab
Nonpareil-Newell	8481 b	1.15 cde	66.9 bcd	76.8 a	21.2 abc	2563 abc	21329 ab
Nonpareil-Driver	8606 b	1.18 bcd	67.6 bcd	73.8 ab	22.3 ab	2695 ab	21288 ab
Nonpareil-7	9262 b	1.14 cde	85.2 a	76.7 a	23.2 a	2811 a	21254 abc
Nonpareil-5	8090 bc	1.19 bcd	69.0 bcd	74.1 ab	21.2 abc	2563 abc	20613 bc
Nonpareil-6	11507 a	0.94	59.6 cd	69.3 c	23.8 a	2881 a	20441 bc
2-19e	7617 bc	1.19 bcd	69.4 bcd	75.7 ab	20.1 abc	2432 abc	20270 bc
Nonpareil-Jones	8855 b	1.18 bcd	67.7 bcd	73.3 b	23.0 ab	2783 ab	19833 c
Winters	8679 b	1.01	61.9 bcd	61.0 d	19.3 abc	2338 abc	17095 d
Sweetheart	8653 b	1.10 ef	59.8 cd	68.5 c	21.0 abc	2538 abc	16456 d
Chips	9008 b	0.92	75.3 ab	76.2 ab	18.2 bc	2201 bc	16416 d
Kahl	8830 b	1.05 fg	55.0 d	57.5 e	20.4 abc	2465 abc	15979 d
Marcona	6449 c	1.22 b	65.5 bcd	74.5 ab	17.4 c	2104 c	13351 e
Kochi	2025 d	1.41 a	26.0 e	60.0 de	6.3 d	763 d	12816 e

Table 4. Number of nuts per tree, average kernel weight, shelling percentage, kernel pounds per unit of photosynthetically active radiation (PAR) intercepted, kernel pound per acre, cumulative kernel pounds per acre for the 2013 and 2014 seasons. Data for each year is sorted by cumulative yield, which is summed from the beginning of the project. Selection 2-19e was recently released as Kester. Letters indicate significant difference at the 5% level of significance.

2013		Average kernel wt	Shelling	Kernel pounds per			Cumulative kernel yield
Variety	No. of nuts/tree	(g)	percentage	unit PAR int.	Tree	Acre	(lbs/acre)
Nonpareil-Nico	20367 a	0.87 b	63.5 a	61.6 a	39.2 a	4738 a	27121 a
Nonpareil-3-8-2-70	18718 b	0.87 b	63.5 ab	56.5 ab	36.0 a	4354 a	25965 ab
Nonpareil-Newell	19539 ab	0.87 b	63.5 ab	58.0 ab	37.6 a	4545 a	25874 ab
Nonpareil-Driver	19539 ab	0.87 b	63.5 ab	60.2 a	37.4 a	4529 a	25817 ab
Nonpareil-7	19439 ab	0.87 b	63.5 ab	58.6 ab	37.4 a	4522 a	25776 ab
Nonpareil-5	18202 b	0.87 b	63.5 ab	55.4 ab	35.0 a	4234 a	24847 bc
Nonpareil-6	18769 b	0.87 b	63.5 ab	56.8 ab	36.1 a	4366 a	24636 bc
Nonpareil-Jones	18241 b	0.87 b	63.5 ab	54.7 ab	35.1 a	4243 a	24076 c
2-19e	16267 c	0.66 c	56.6 b	44.0 cd	23.9 c	2890 c	22958 c
Winters	13894 d	0.86 b	55.6 b	50.3 bc	26.5 bc	3201 bc	20296 d
Kahl	15587 c	0.85 b	55.3 b	57.9 ab	29.1 b	3524 b	19503 d
Chips	12689 d	0.89 b	57.3 b	39.7 de	24.9 bc	3010 bc	19466 d
Sweetheart	13943 d	0.78 b	66.5 a	40.4 de	24.0 c	2902 c	19318 d
Marcona	10858 e	1.11 a	28.9 c	49.4 bc	26.5 bc	3206 bc	16023 e
Kochi	7911	1.09 a	63.7 ab	33.5 e	19.0 d	2300 d	15651 e

2014				Kernel pounds per			Cumulative kernel yield
Variety	No. of nuts/tree	Average kernel wt (g)	Shelling percentage	unit PAR int.	Tree	Acre	(lbs/acre)
Nonpareil-Nico	15387 b	0.91 de	70.1 bc	57.0 b	37.0 ab	4476 ab	31379 a
Nonpareil-3-8-2-70	15105 b	1.12 bcd	70.5 bc	57.6 b	37.4 ab	4522 ab	30486 ab
Nonpareil-Newell	14172 bc	1.12 bcd	69.8 bc	51.9 bc	34.8 ab	4208 ab	30082 abc
Nonpareil-Driver	13082 bcd	1.15 bc	70.3 bc	51.2 bc	33.1 b	4007 b	29824 bcd
Nonpareil-7	14201 bc	1.12 bcd	70.4 bc	52.1 bc	34.9 ab	4224 ab	29467 bcd
Nonpareil-5	14523 bc	1.15 bc	71.7 b	57.6 b	36.8 ab	4450 ab	29297 bcd
Nonpareil-6	13930 bc	1.13 bcd	69.5 bcd	52.8 bc	34.7 ab	4195 ab	28831 cd
Nonpareil-Jones	16267 c	0.86 e	57.6 d	48.4 bc	32.2 b	3901 b	28584 d
2-19e	14378 bc	0.92 cde	69.5 bcd	49.1 bc	29.1 bc	3616 bc	27075 e
Winters	17427 a	0.91 de	77.1 a	67.0 a	35.0 ab	4237 ab	24532 f
Chips	11188 cde	0.98 cde	67.7 bcd	39.9 cd	23.9 cd	2886 cd	22353 g
Kahl	9310 e	1.03 bcde	55.3 e	40.6 cd	21.0 d	2543 d	22046 g
Sweetheart	10145 de	0.92 cde	66.7 cd	31.5 d	20.5 d	2477 d	21794 g
Kochi	5981 f	1.25 b	66.8 cd	26.4 d	16.5 d	1996 d	17646 h
Marcona	1721 g	1.48 a	57.6 e	10.3 e	5.6 e	682 e	16705 h

2015				Kernel pounds per			Cumulative kernel yield
Variety	No. of nuts/tree	Average kernel wt (g)	Shelling percentage	unit PAR int.	Tree	Acre	(lbs/acre)
Nonpareil-Nico	12982 abc	1.07 bc	68.6 ab	46.5 ab	30.8 ab	3728 ab	35046 a
Nonpareil-3-8-2-70	11502 de	1.10 b	71.3 a	41.8 bcd	27.9 bc	3383 bc	33870 ab
Nonpareil-Newell	12638 bcd	1.10 b	72.8 a	44.2 abcd	30.5 ab	3702 ab	33784 ab
Nonpareil-Driver	12664 bcd	1.07 bc	72.8 a	45.1 abc	29.9 ab	3623 ab	33447 bc
Nonpareil-7	14058 a	1.01 cd	73.9 a	46.1 ab	31.3 a	3797 a	33222 bcd
Nonpareil-5	11025 e	1.11 b	72.6 a	40.7 cde	26.9 c	3263 c	32560 bcd
Nonpareil-Jones	13579 ab	1.00 d	69.5 ab	45.1 abc	30.2 ab	3659 ab	32286 cd
Nonpareil-6	11439 de	1.06 bcd	71.0 a	40.0 cde	26.8 c	3246 c	32077 d
2-19e	7827 g	0.94 e	52.5 e	25.0 g	16.2 e	1965 e	29086 e
Winters	5464 h	1.06 bcd	62.1 cd	22.6 gh	12.7 f	1542 f	26075 f
Chips	11843 cde	0.89 ef	57.4 d	37.2 ef	23.1 d	2806 d	25159 f
Kahl	13661 ab	0.84 f	58.4 d	47.9 a	25.4 cd	3081 cd	25127 f
Sweetheart	6953 g	0.86 f	64.9 bc	20.0 h	13.2 f	1607 f	23402 g
Kochi	9506 f	1.08 b	65.3 bc	35.8 f	22.7 d	2758 d	20404 h
Marcona	2798 i	1.27 a	26.2 f	13.2 i	7.7 g	943 g	17548 i

Table 5. Varieties and selections planted at the next generation regional almond variety trials. Items 1-31 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).

Varieties for 2014 Almond Regional Variety Trials

#	Variety or selection	Self-fertile*	Source	Provides bud wood
1	Eddie		Bright's	Bright's
2	Capitola		Burchell	Burchell
3	Supareil		Burchell	Burchell
4	P15.044	yes	Burchell	Burchell
5	P10.001	yes	Burchell	Burchell
6	Booth		Burchell	Burchell
7	Sterling		Burchell	Burchell
8	Bennett		Duarte	Duarte
9	Nonpareil		Fowler	Fowler
10	Durango		Fowler	Fowler
11	Jenette		Fowler	Fowler
12	Marcona		Spain	Gradziel
13	Winters	partial	UCD	Fowler
14	Sweetheart	partial	UCD	Fowler
15	Kester (2-19E)		UCD	Gradziel
16	UCD3-40		UCD	Gradziel
17	UCD18-20		UCD	Gradziel
18	UCD1-16		UCD	Gradziel
19	UCD8-160	yes	UCD	Gradziel
20	UCD8-27	yes	UCD	Gradziel
21	UCD1-271	yes	UCD	Gradziel
22	UCD1-232	yes	UCD	Gradziel
23	UCD7-159	yes	UCD	Gradziel
24	UCD8-201	yes	UCD	Gradziel
25	Y121-42-99	yes	USDA	Ledbetter
26	Y117-86-03	yes	USDA	Ledbetter
27	Y116-161-99	yes	USDA	Ledbetter
28	Y117-91-03	yes	USDA	Ledbetter
29	Folsom		Wilson	Wilson
30	Aldrich			Fowler

* of the thirty-two varieties in the main trials fourteen are either partially or fully self-fertile (as is Lonestar- see below)

Additional items

Chico site- Wood Colony on Kyrmsk 86, one rep of Lone Star (self-fertile) on Krymsk 86
Madera site- Lonestar (self-fertile) on Hanson 536

Butte and Stanislaus sites- Kester on Hanson 531 in addition to on normal site rootstock

Stanislaus site- one rep of Lonestar (self-fertile) on Nemaguard

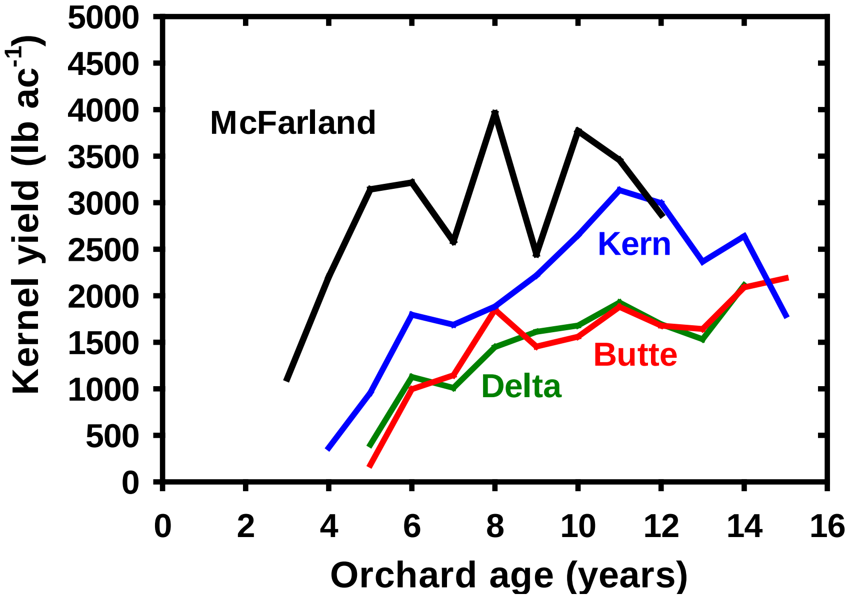

Figure. 1. Average yield for all varieties, selections and Nonpareil sources by orchard age for the 1993 Butte, Delta and Kern Regional Variety Trials as well as the McFarland Variety Trial that was planted in 2004. Number in parenthesis after trial name is number of trees per acre.

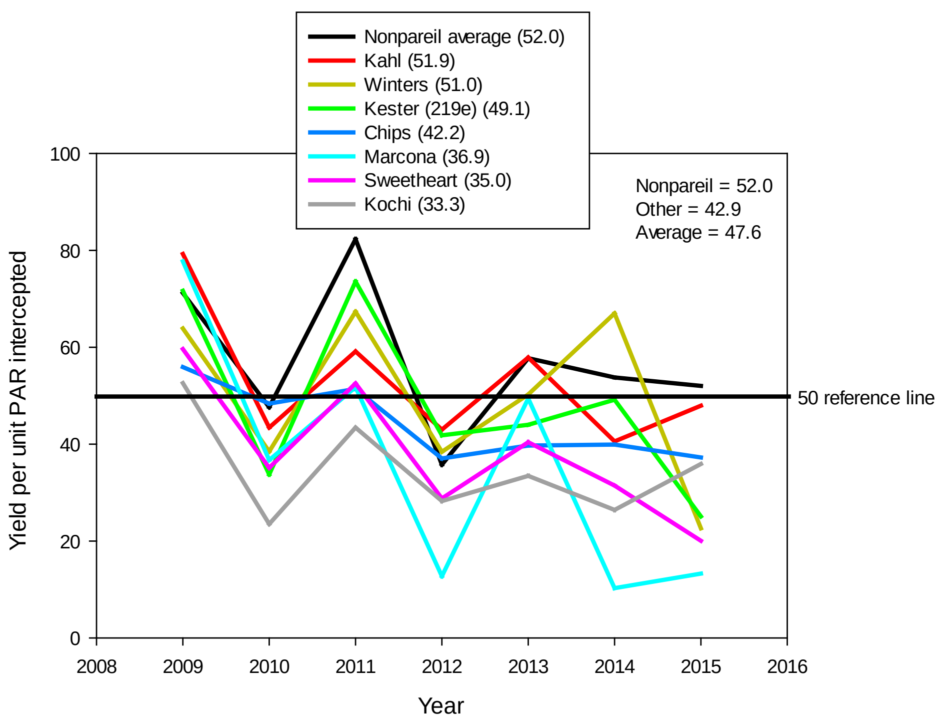

Figure 2. Yield per unit PAR intercepted by variety and year (kernel pounds per 1% light intercepted). Number following variety name in legend indicates the average from 2009 to 2015. Average for all varieties and years was 47.6. A value of 50 is what we have found the best orchards can average over several years.

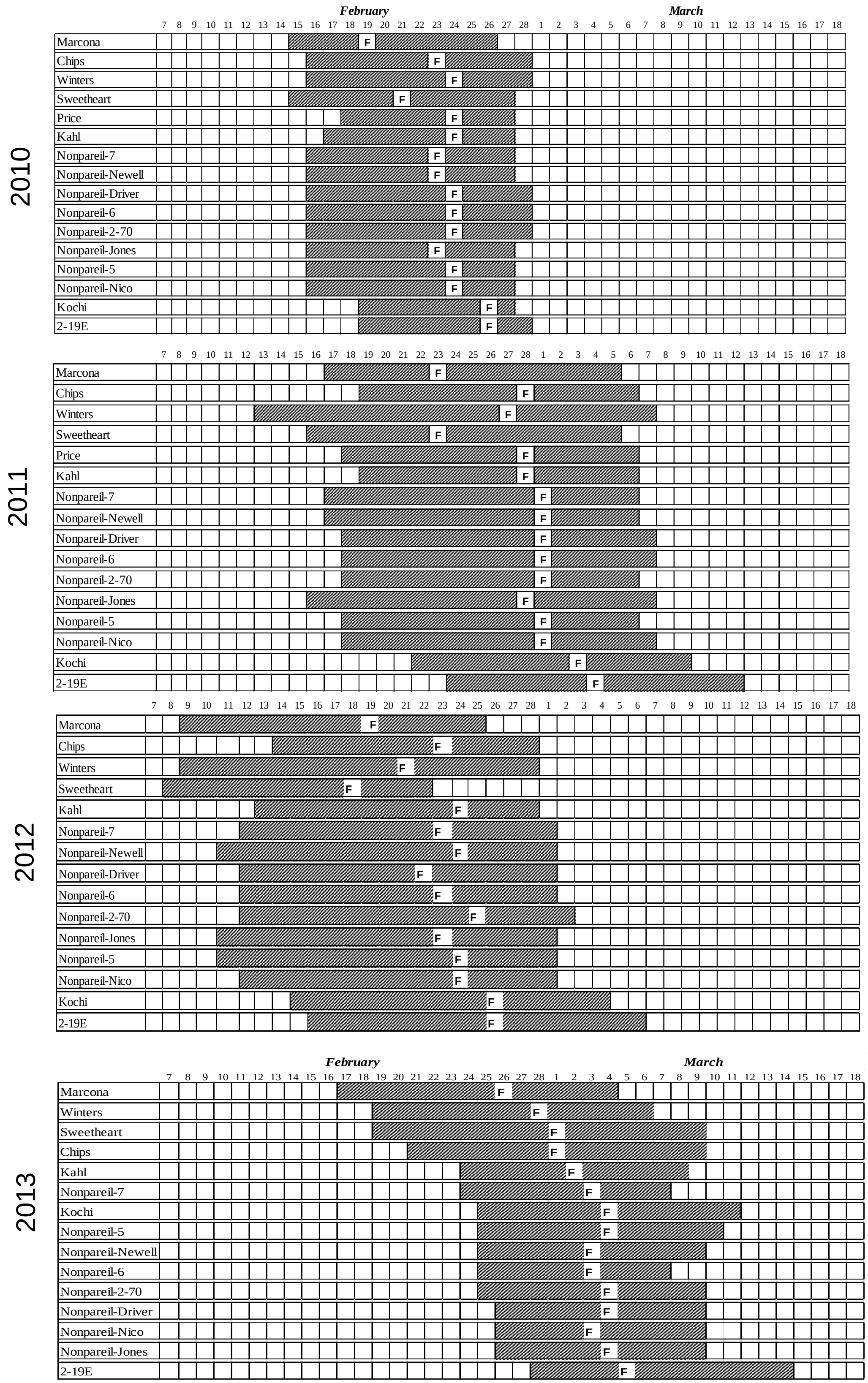

Figure 3. Bloom data for the McFarland Trial for the 2010-2013 seasons. Cross hatched area indicates onset of bloom to 100% petal fall. “F” indicates full bloom.

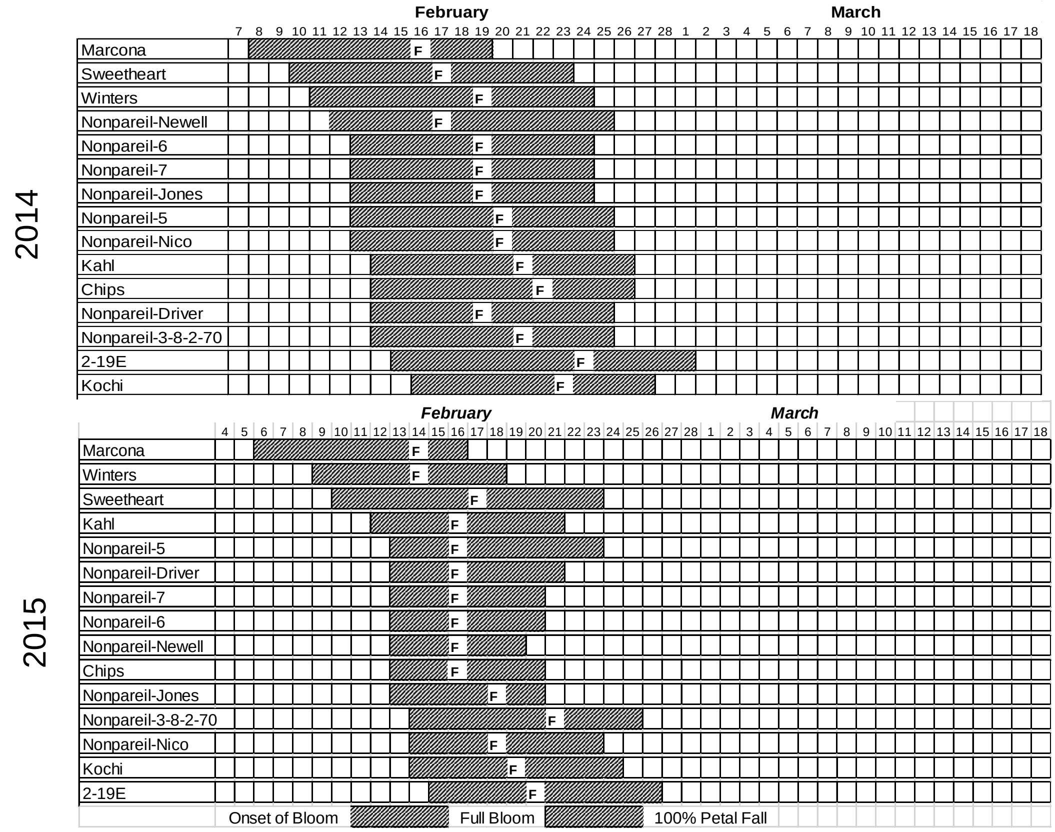

Figure 4. Bloom data for the McFarland Trial for the 2014-2015 seasons. Cross hatched area indicates onset of bloom to 100% petal fall. "F" indicates full bloom.

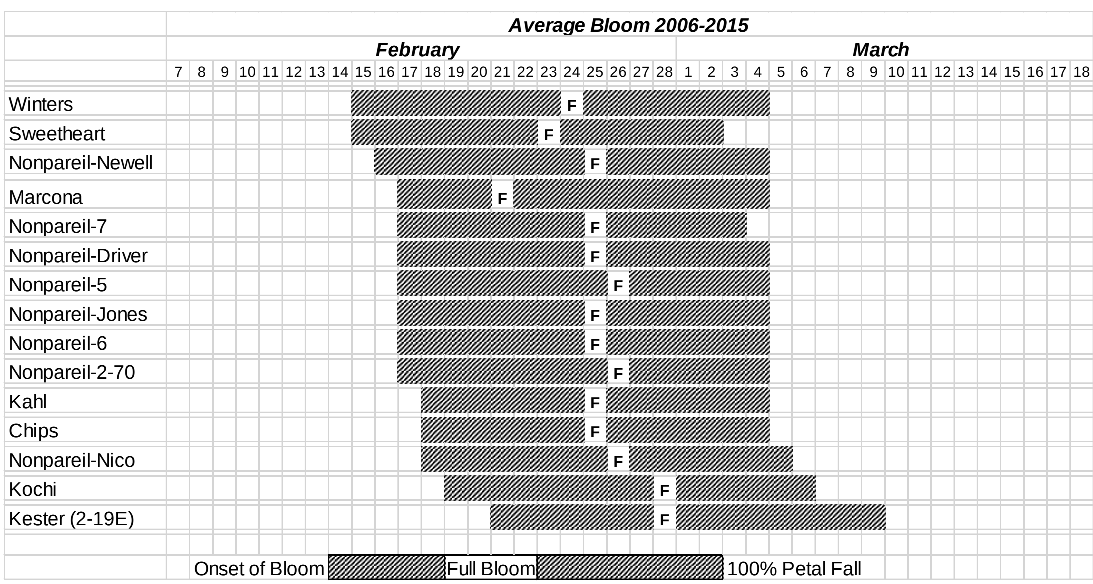

Figure 5. Average bloom data (2006 to 2015) for the McFarland Trial. Cross hatched area indicates onset of bloom to 100% petal fall. "F" indicates full bloom.

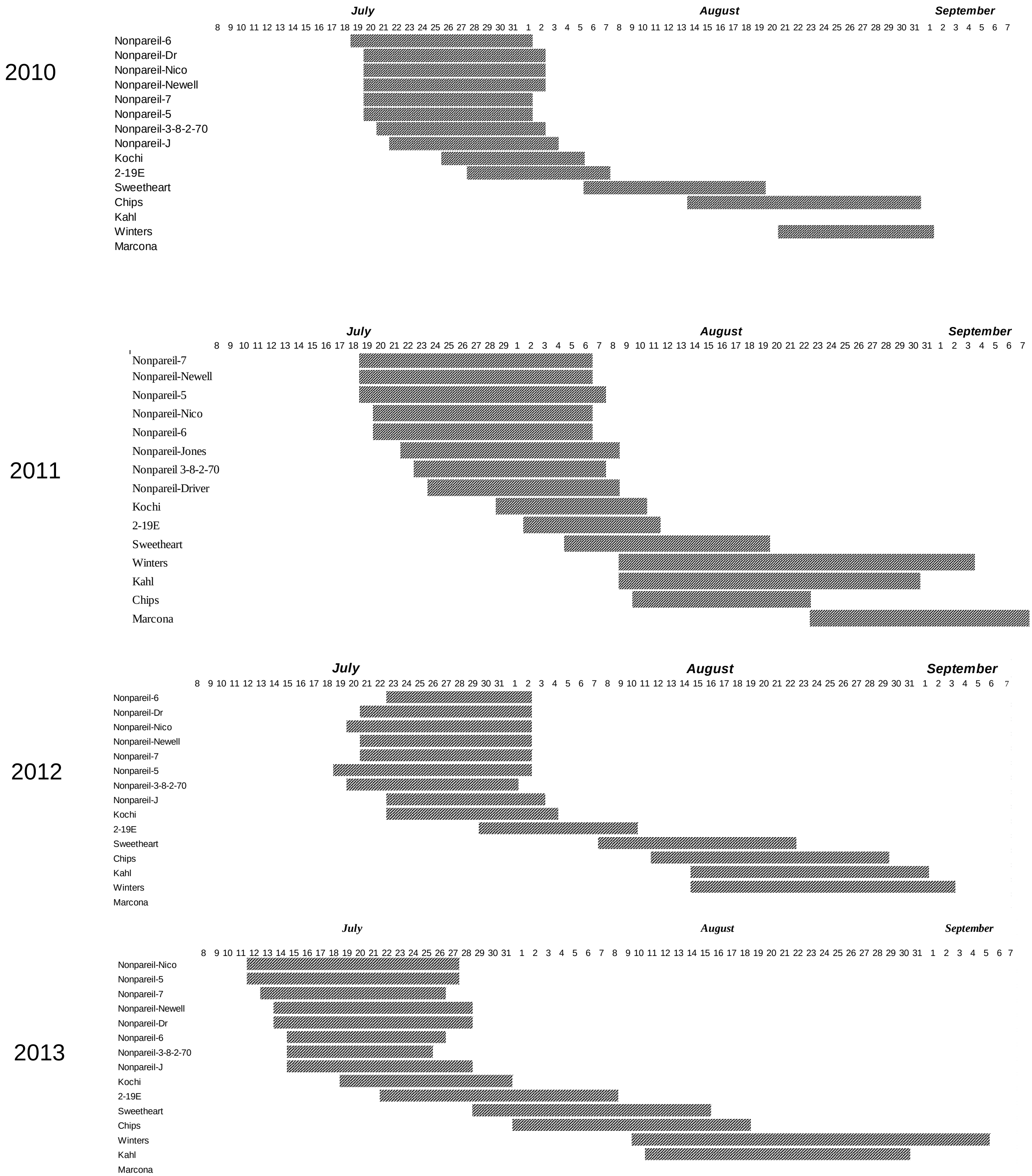

Figure 6. Hullsplit progression by variety and Nonpareil source for the 2010-2013 seasons at the McFarland trial.

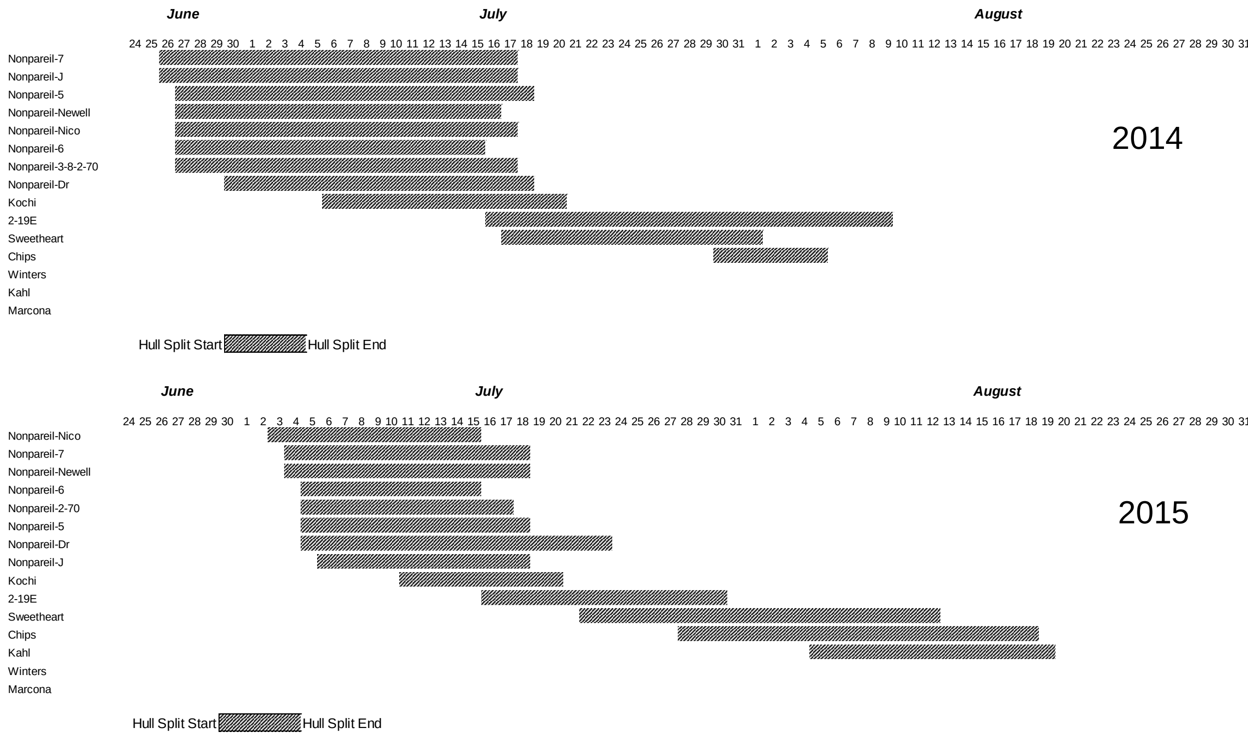

Figure 7. Hullsplit progression by variety and Nonpareil source for 2014 and 2015 seasons at the McFarland trial.

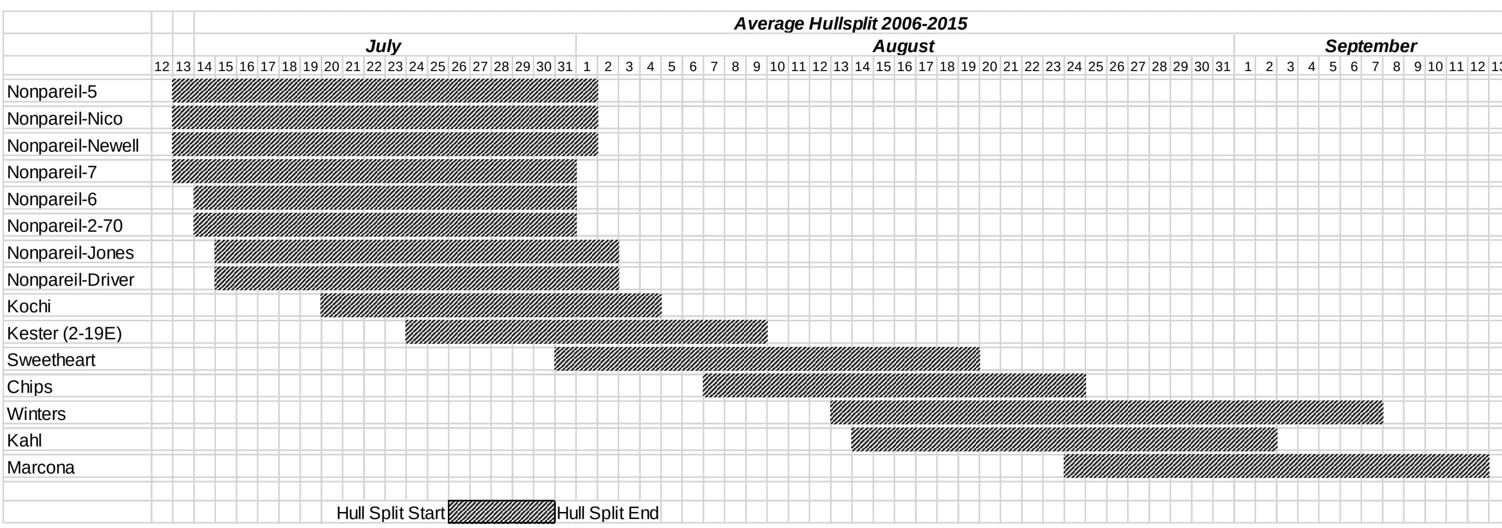

Figure 8. Average hullsplit progression by variety and Nonpareil source for the 2006 to 2015 seasons at the McFarland trial.