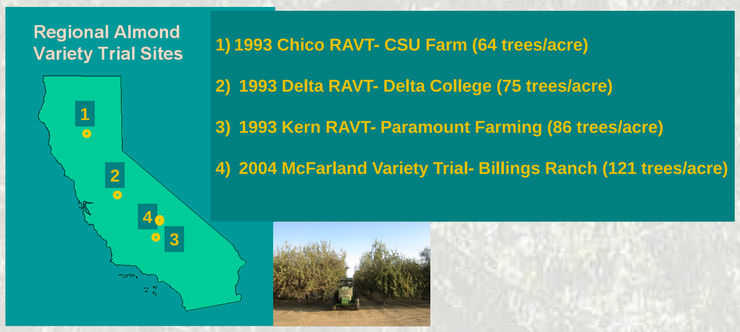
Regional Almond Variety Trials for Cultivar Evaluation in California

B.D. Lampinen[1], Joe Connell[2], Paul Verdegaal[3], M. Viveros[4], Minerva Gonzalez[4],S.G. Metcalf[1], W.L. Stewart[1], Loreto Contador[1], M.A. Thorpe[1] and T. M. Gradziel[1]

[1]UC Davis Plant Science [2]UCCE Butte County [3]UCCE San Joaquin County [4]UCCE Kern County



Background

Regional Almond Variety Trials (RAVTs) were designed to evaluate newer varieties in a semi-commercial (20 to 40 trees per variety) manner and to compare them to standard varieties such as Nonpareil, Mission and currently accepted pollenizers.

1993 Trials

To be comparable, the 1993 trials were all planted in the same year and with essentially the same variety composition. Thus, any differences in varietal performance among various regions should become evident.

Varieties were planted on peach rootstock; Lovell for those at CSU-Chico and Nemaguard for trees in the Delta College and Kern plots.

Yield data collection discontinued on most varieties at the Butte RAVT after the 2005 season due to extensive tree damage and loss in most varieties. The replacement varieties (Avalon, Durango, Kochi, and Carmel) which were planted in 2001 at a density of 128 trees per acre were also harvested in 2007. All trees were removed from the Butte trial in 2008.

After the 2006 season, yield data collection was discontinued for the Delta and Kern RAVTs as well.

2004 McFarland Trial

A replicated variety trial was planted in 2004 near McFarland in Kern County. This trial consists of eight almond varieties and eight Nonpareil clones planted at a spacing of 18' x 20' (121 trees/acre). It is irrigated with double line drip. The soil is Class I McFarland loam and Wasco sandy loam. Trees in this trial are growing rapidly with Nonpareil yields from 4600 to near 5000 kernel pounds per acre in the eight leaf. The budwood for the Sonora variety was a mixture of several other varieties and hence will not be reported on here. Kernel yield for this trial continues to be well above that for any of the 1993 trial yields (Fig. 1).

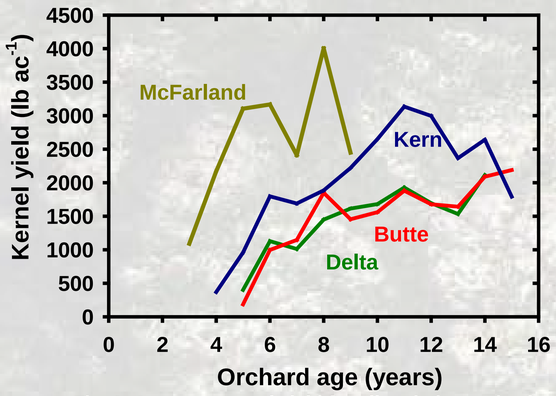


Fig. 1. Average annual yield for all varieties and selections combined at each trial by orchard age.

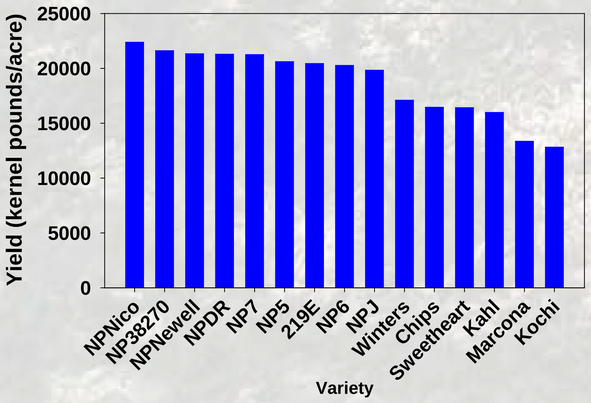


Fig. 2. Average cumulative yield (2006-2012) by variety for McFarland trial.

McFarland Replicated Variety Trial

Selection of new and old pollenizers + Nonpareil clones

- Planted 2004
- Eight almond varieties and eight Nonpareil clones replicated six times
- 20' X 18' planting distance
- 121 trees per acre
- Irrigated with double line drip
- Class 1 McFarland loam/ Wasco sandy loam

Varieties	Nonpareil clones
Selection 2-19e	Nonpareil- 3-8-2-70
Chips	Nonpareil- 5
Kahl	Nonpareil- 6
Kochi	Nonpareil- 7
Marcona	Nonpareil-Driver
Sonora	Nonpareil-Jones
Sweetheart	Nonpareil-Newell
Winters	Nonpareil-Nico

Kern - McFarland Variety Trial

Table 1. Average kernel weight, shelling percentage, yield per unit light (PAR) intercepted, kernel pounds per acre yield, and cumulative yield for the McFarland variety trial 2008 to 2012 (see Annual Report for earlier data).

2008	Average kernel wt (g)		Kernel pounds per			Cumulative kernel yield
Variety	No. of nuts/tree	Shelling percentage	unit PAR int.	Tree	Acre	(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	7036 bc
Winters	9872 e	1.02 e	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 g	14.5 h	1748 h	5001 g
Kochi	5882 f	1.28 b	59.5 bc	35.0 g	16.5 h	2002 h	4696 g

2009	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	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 ab
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 fg
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 gh
Kochi	7252 g	1.17 a	68.9 de	52.6 e	18.7 e	2259 e	6955 h

2010	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	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	10611 ab	1.16 bcdef	69.8 ab	49.4 a	27.1 a	3282 a	13510 abc
Nonpareil-5	9410 abc	1.24 abcde	72.3 ab	50.8 a	25.8 a	3130 a	13708 abc
Nonpareil-6	9498 abc	1.21 abcdef	71.8 ab	48.7 ab	25.5 a	3081 a	13220 bc
2-19e	6832 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 g	71.8 ab	42.2 abcd	23.4 a	2839 a	10803 d
Kahl	7587 cde	1.01 f	56.5 de	43.4 abcd	16.9 b	2048 c	10561 d
Marcona	5072 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	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	18776 a	0.99 bcde	68.0 abc	86.7 a	41.0 a	4964 a	19523 a
Nonpareil-3-8-2-70	17744 abc	1.05 bc	70.7 a	87.9 a	41.0 a	4962 a	18878 ab
Nonpareil-Newell	17790 abc	1.00 bcd	70.1 ab	81.0 ab	39.2 a	4745 a	18767 abc
Nonpareil-Driver	17943 ab	0.98 bcde	66.0 abcd	84.3 a	38.7 a	4683 a	18593 abc
Nonpareil-7	17078 abcd	0.83 e	69.2 abc	76.1 ab	31.4 a	4555 a	18443 abc
Nonpareil-5	15745 de	1.03 bc	70.4 ab	78.0 ab	35.9 a	4342 a	18050 bcd
Nonpareil-6	16630 bcde	1.04 bc	70.0 ab	81.6 ab	38.2 a	4619 a	17838 bcd
2-19e	18253 ab	0.91 bcde	64.8 abcd	73.6 ab	36.8 a	4460 a	17560 cd
Nonpareil-Jones	16993 abcd	0.96 bcde	70.0 ab	81.6 ab	36.0 a	4360 a	17051 d
Winters	15979 cde	0.83 e	58.7 ef	67.3 bc	29.4 b	3554 b	14757 e
Sweetheart	14969 e	0.86 de	64.1 bcde	52.5 de	28.2 bc	3412 bc	14215 e
Chips	11901 f	0.94 bcde	60.3 de	51.4 de	24.7 bcd	2985 bcd	13918 e
Kahl	12420 f	0.89 cde	53.5 f	59.1 cd	24.4 bcd	2953 bcd	13514 e
Marcona	9633 g	1.07 b	30.8 g	51.8 de	22.7 d	2746 d	12054 f
Kochi	8701 g	1.22 a	63.5 cde	43.4 e	23.3 d	2825 d	11247 f

2012	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	9520 b	1.13 de	67.7 bcd	38.2 abc	23.6 a	2861 a	22384 a
Nonpareil-3-8-2-70	8530 b	1.2 bc	70.9 bc	36.2 abcde	22.6 ab	2733 ab	21611 ab
Nonpareil-Newell	8481 b	1.15 cde	66.9 bcd	33.4 bcde	21.2 abc	2563 abc	21329 ab
Nonpareil-Driver	8606 b	1.18 bcd	67.6 bcd	36.6 abcde	22.3 ab	2695 ab	21288 ab
Nonpareil-7	9262 b	1.14 cde	85.2 a	36.7 abcd	23.2 a	2811 a	21254 abc
Nonpareil-5	8090 bc	1.19 bcd	69.0 bcd	34.7 abcde	21.2 abc	2563 abc	20613 bc
2-19e	11507 a	0.94 h	59.6 cd	41.8 ab	23.8 a	2881 a	20441 bc
Nonpareil-6	7617 bc	1.19 bcd	69.4 bcd	32.1 cde	20.1 abc	2432 abc	20270 bc
Nonpareil-Jones	8855 b	1.18 bcd	67.7 bcd	38.2 abc	23.0 ab	2783 ab	19833 c
Winters	8679 b	1.01 g	61.9 bcd	38.4 abc	19.3 abc	2338 abc	17095 d
Chips	8653 b	1.10 ef	59.8 cd	37.1 abcd	21.0 abc	2538 abc	16456 d
Sweetheart	9008 b	0.92 h	75.3 ab	28.8 de	18.2 bc	2201 bc	16416 d
Kahl	8830 b	1.05 fg	55.0 d	43.0 a	20.4 abc	2465 abc	15979 d
Kochi	6449 c	1.22 b	65.5 bcd	28.2 e	17.4 c	2104 c	13351 e
Marcona	2025 d	1.41 a	26.0 e	12.7 f	6.3 d	763 d	12816 e

Table 2. Scab rating and hull rot strikes per tree for 2012 season by variety.

	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

Table 3. Bloom progression for McFarland Trial by variety for 2012 season.

Onset of Bloom		*Full Bloom*		*Petal Fall*	
Sweetheart	8-Feb a	Sweetheart	18-Feb a	Sweetheart	22-Feb a
Marcona	9-Feb a	Marcona	19-Feb a	Marcona	25-Feb b
Winters	9-Feb a b	Nonpareil-DR	22-Feb b	Kahl	28-Feb c
Nonpareil-J	11-Feb c d	Nonpareil-J	23-Feb b c	Winters	28-Feb c
Nonpareil-Newell	11-Feb d	Winters	23-Feb b c	Chips	28-Feb c d
Nonpareil-5	11-Feb d e	Nonpareil-6	23-Feb b c d	Nonpareil-J	1-Mar d e
Nonpareil-7	12-Feb d e	Chips	23-Feb b c d	Nonpareil-7	1-Mar e
Nonpareil-Nico	12-Feb d e	Nonpareil-7	23-Feb b c d	Nonpareil-DR	1-Mar e
Nonpareil-DR	12-Feb d e	Nonpareil-Nico	24-Feb b c d	Nonpareil-Nico	1-Mar e
Nonpareil-6	12-Feb d e	Nonpareil-Newell	24-Feb c d e	Nonpareil-Newell	1-Mar e
Nonpareil 3-8-2-70	12-Feb d e f	Nonpareil-5	24-Feb c d e	Nonpareil-5	1-Mar e
Kahl	13-Feb e f	Kahl	24-Feb c d e	Nonpareil-6	1-Mar e
Chips	14-Feb f	Nonpareil 3-8-2-70	25-Feb d e f	Nonpareil 3-8-2-70	2-Mar e
Kochi	15-Feb g	Kochi	26-Feb e f	Kochi	4-Mar f
2-19E	16-Feb g	2-19E	26-Feb f	2-19E	6-Mar g

Summary

Yields at the McFarland Trial have tended to alternate bear for the last 4 years (Fig. 1). The orchard tends to go through fairly severe stress cycles as evidenced by the -15 to -18 bar midday stem water potentials seen in May 2009 (data not shown). It appears that water penetration problems may have contributed to these problems. From 2010 on, every other row middle has been ripped and water penetration has been significantly improved.

There have also been severe problems with *Alternaria* and hull rot in the orchard (especially in 2008) and both have generally been worse in the wetter trees so this will also be investigated. In 2012, hull rot decreased in severity for both Kochi and Winters and was moderate in the Nonpareil clones (Table 2). Hull rot was least severe in Marcona, Kahl and Chips (Table 2).

Yield per unit light (PAR) intercepted is a measure of the efficiency of production. Well managed orchards can average about 50 kernel pounds per unit light intercepted. The McFarland trial has been alternating around this level of production with the average for the last four years at 46 for all varieties and selections. For the Nonpareil clones, they have averaged between 51 and 60 kernel pounds per unit light intercepted which is quite good.

Some differences in cumulative yields are occurring among Nonpareil clones with Nonpareil-Nico producing significantly higher cumulative yields compared to Nonpareil-5, Nonpareil-6, and Nonpareil-Jones (Table 1). Among the pollenizers, only Selection 2-19e is producing equivalent yields to Nonpareil (except significantly less than Nonpareil-Nico).

Acknowledgements

Thanks to the Almond Board of California and the Billings Ranches for supporting this work.