Field Evaluation of Almond Varieties

Project No.: **07-HORT2-Lampinen**

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Objectives:

The Almond Workgroup reached a consensus decision to discontinue yield data collection at the Butte, Delta and Kern Regional Almond Variety Trials (planted in 1993) effective with the 2007 season. Bloom and maturity data for the McFarland Variety Trial and Chico RAVT as well as bloom and weather data for the Delta RAVT are included in this report.

Materials and Methods:

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, Solano, 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.

The objectives of the trial are to evaluate pollenizers and Nonpareil clones in a replicated trial where relative yield performance as well as bloom dates, maturity dates, disease/insect susceptibility, etc. can be assessed.

Results:

Weather during bloom was generally good at the McFarland trial site. Bloom data for 2007 is shown in Table 1. Marcona, Chips, Winters and Sweetheart were the varieties to reach full bloom the earliest and Kochi and Selection 2-19e were the latest. Bloom overlap was very good in 2007. The earliest varieties to begin hullsplit were the Nonpareil clones which started about July 18th followed by Kochi and selection 2-19e (Table 2). The latest varieties to begin hullsplit were Kahl, Winters and Marcona which began about four weeks after Nonpareil in 2007 (Table 2).

Yield data for the 2006 and 2007 seasons are shown in Table 1. Selection 2-19e and Winters had significantly higher yields compared to all the other varieties and Nonpareil clones at the McFarland trial in 2006 (Table 3). In 2007, Selection 2-19e and Winters had significantly higher yields than the other pollenizers but similar yields to most of the Nonpareil clones (Table 1). The lowest yielding varieties in both 2006 and 2007 were Solano and Sweetheart. The variety that was thought to be Solano in the trial was part of a budwood mixup and was not Solano. Marcona yields have been relatively high, particularly considering the low shelling percentage (around 30%). There were no significant differences in yields among the Nonpareil clones in 2006 but in 2007 there were some differences with the Nonpareil 5, Nonpareil-J and Nonpareil 6 clones yielding significantly less than the others (Table 1).

At the Butte RAVT, only a limited selection of items were harvested including Winters, Carmel and Nonpareil from the original planting and Durango, Avalon, Kochi and Carmel from a 2001 high density planting. Winters and Carmel continued to produce higher cumulative yields than Nonpareil at the Butte RAVT (Table 2). Bloom and maturity data for the Butte RAVT is presented in Figure 3-6.

Only bloom data was collected at the Delta RAVT in 2007. Bloom progression at the Delta RAVT is shown in Fig. 7. Rainfall data for the Delta RAVT is shown in Fig. 8.

Acknowledgements

The authors wish to thank the Almond Board of California for their continued support of this project. The following nurseries supplied trees at reduced cost for these trials: Bright's Nursery, Burchell Nursery, Dave Wilson Nursery, Fowler Nursery, Sierra Gold Nurseries and Spoto Nursery. We particularly want to express our appreciation and thanks to the staffs of California State University at Chico, San Joaquin Delta College, Paramount Farming Company and the Billings Ranches for excellent cooperation in managing and maintaining these trials. The assistance of Cooperative Extension field assistants in Kern, Butte and San Joaquin Counties and field personnel of the University of California Plant Sciences Department is gratefully acknowledged.

Table 1. Yield, number of nuts, average kernel weight, shelling percentage and kernel pound per acre yield for the 2006 and 2007 seasons.

2006

Variety	No. of nuts/tree	Average kernel wt (g)	Shelling percentage	Kernel pounds per	
				Tree	Acre
2-19e	6852 a	0.94 g	53.0 d	14.2 a	1718 a
Winters	6648 a	0.87 h	53.4 d	12.7 a	1540 a
Marcona	3611 bcd	1.31 a	30.7 f	10.4 b	1258 b
Nonpareil-Ni	4246 b	1.09 cde	67.2 a	10.2 b	1232 bc
Nonpareil-5	3713 bcd	1.12 bcd	67.9 a	9.1 bcd	1110 bcd
Nonpareil-D	3867 bc	1.07 def	63.4 abc	9.1 bcd	1103 bcd
Nonpareil-3-8-2-70	3848 bc	1.07 cde	64.6 ab	9.1 bcd	1101 bcd
Nonpareil-Ne	3815 bc	1.07 cde	67.7 a	9.0 bcd	1086 bcd
Nonpareil-6	3886 bcd	1.12 bc	67.0 a	8.9 bcd	1075 bcd
Nonpareil-J	3717 bcd	1.08 cde	64.0 abc	8.8 bcd	1066 bcd
Chips	3623 bcd	1.02 f	53.8 d	8.1 bcde	985 bcde
Kochi	3134 cd	1.16 b	59.9 c	8.0 cdef	965 cdef
Nonpareil-7	3288 bcd	1.08 cde	65.1 a	7.8 def	940 def
Kahl	3139 cd	1.06 ef	47.8 e	7.3 def	889 def
Sweetheart	2777 d	0.95 g	67.8 a	5.8 f	588 f

2007

Variety	No. of nuts/tree	Average kernel wt (g)	Shelling percentage	Kernel pounds per	
				Tree	Acre
2-19e	13149 a	0.78 e	54.3 d	22.8 a	2756 a
Winters	11972 ab	0.83 de	60.2 b	21.8 ab	2634 ab
Nonpareil-Newell	10659 bc	0.90 bc	67.3 a	20.9 abc	2536 abc
Nonpareil-Driver	9793 cd	0.91 bc	65.6 a	19.6 abcd	2370 abcd
Kahl	9594 cd	0.91 bc	47.6 e	19.3 abcd	2332 abcd
Nonpareil-7	9517 cd	0.92 bc	67.9 a	19.3 abcd	2332 abcd
Nonpareil-3-8-2-70	9340 cde	0.92 bc	66.3 a	18.9 abcde	2291 abcde
Nonpareil-Nico	9260 cde	0.92 bc	66.0 a	18.8 abcde	2279 abcde
Nonpareil-5	8905 cdef	0.95 b	67.0 a	18.6 abcde	2251 bcde
Nonpareil-J	9137 cde	0.89 bcd	65.5 a	17.8 bcde	2152 bcdef
Nonpareil-6	8396 def	0.94 b	67.1 a	17.4 def	2103 def
Marcona	6938 fg	1.08 a	29.8 f	16.5 defg	1995 defg
Chips	7681 defg	0.87 cd	54.4 d	14.7 efg	1780 efg
Kochi	6006 g	1.08 a	59.4 bc	14.3 fg	1729 fg
Sweetheart	6767 fg	0.89 bcd	66.6 a	13.1 g	1588 g

Table 2. Butte RAVT data for varieties harvested in 2007.

Variety	Yield (kernel pounds/acre)												
	1996	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**Accum.**
Winters (13-1)	425	2076	784	2736	2446	2677	2479	3333	2425	2571	3359	3513	28823
Carmel	741	1240	1260	1700	1934	2070	2320	2330	2830	2455	3708	1992	24580
Nonpareil	**494**	**1427**	**1127**	**1952**	**1762**	**1846**	**2587**	**2000**	**1897**	**2257**	**3002**	**2435**	**22786**
Sonora												3233	3233

*64 trees/acre

Durango	.	.	.	.	.	.	.	.	1089	1300	2515	2102	7006
Avalon	.	.	.	.	.	.	.	.	511	1958	1702	2503	6673
Kochi	.	.	.	.	.	.	.	.	237	1181	1982	1932	5331
Carmel	.	.	.	.	.	.	.	.	.	1521	1415	1567	4503

*128 trees/acre

Fig. 1. 2007 bloom data for the McFarland trial

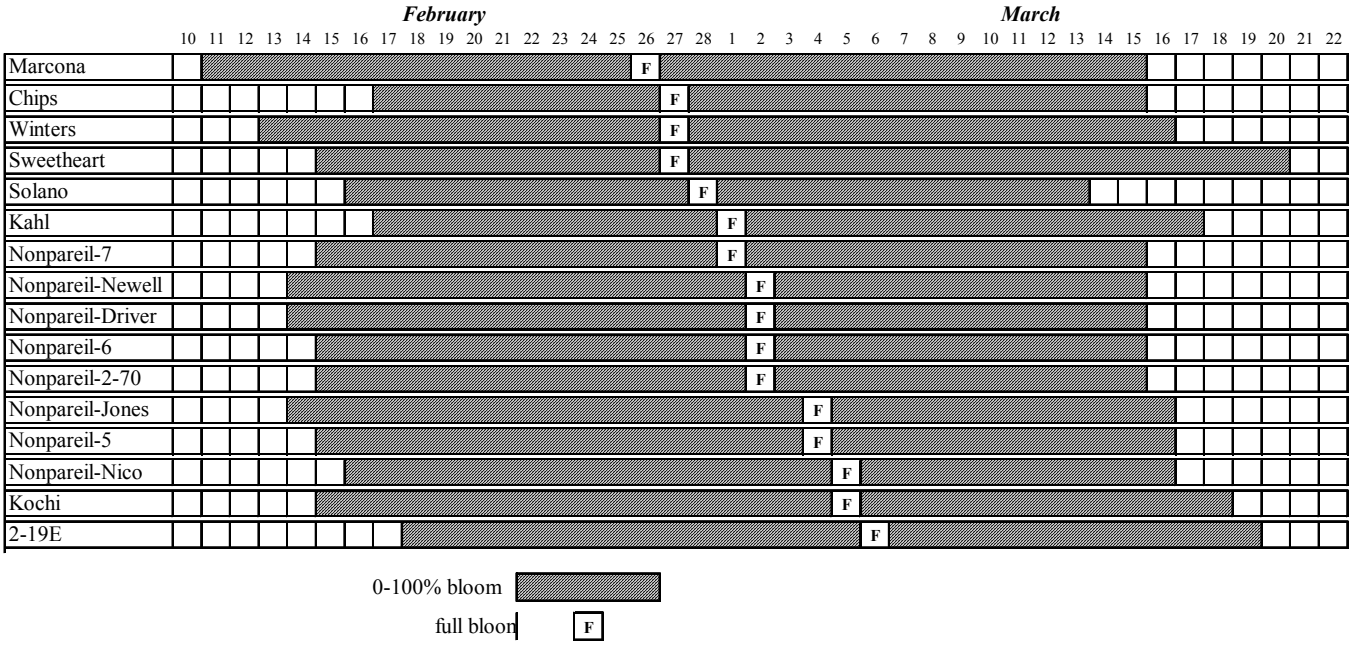


Fig.2. Beginning of hull split at the McFarland trial in 2007.

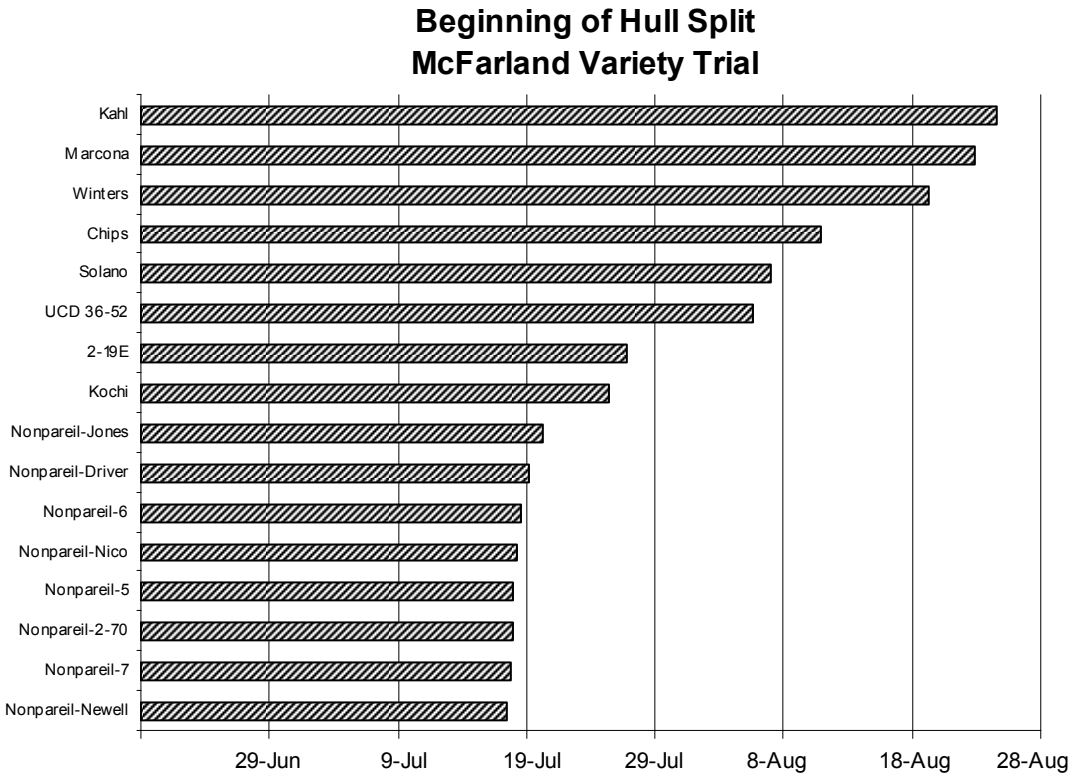


Fig. 3. Bloom density for the 1996 to 2007 seasons at the Butte RAVT.

Bloom Density* -- CSU Chico, Regional Variety Trial

Variety	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Sonora	4	2	5	4	4	3	5	3	3	5	4	4
Sano	4	4	3	4	4	4	4	5	5	5	4	5
Kapareil	5	5	5	5	5	5	5	5	5	5	5	5
Rosetta	3	4	2	3	4	4	3	5	5	5	4	5
Winters	5	4	3	4	4	3	2	5	3	4	4	4
Donna	3	3	3	4	3	3	4	2	3	2	3	2
Aldrich	4	5	3	5	5	4	5	5	5	5	5	5
Chips	3	4	4	4	4	3	3	4	4	3	4	3
Jenette	4	5	3	5	5	4	5	3	5	5	5	5
Jiml	2	3	2	2	3	3	4	1	5	1	5	1
Nonpareil	4	4	3	4	3	3	3	2	3	3	3	3
Price	1	1	4	2	4	3	3	3	4	2	4	2
Yokut	1	3	1	2	1	4	2	4	2	4	3	4
Carmel	3	3	3	5	3	4	3	5	3	5	4	3
Kahl	2	3	2	3	2	4	3	5	2	5	3	4
Wood Colony	4	3	3	3	3	4	4	3	4	4	5	4
Johlyn	4	4	1	4	3	3	3	2	2	3	1	4
Monterey	4	4	2	3	3	2	4	2	3	4	4	3
Plateau	2	3	3	3	4	3	3	1	4	2	3	2
Butte	4	4	3	4	4	4	4	4	4	4	4	4
2-19E	3	3	2	5	2	5	2	5	2	5	3	3
2-43W	4	3	2	3	4	---	---	---	---	---	---	---
Padre	3	3	4	5	4	5	5	5	5	5	5	5
1-102W	4	4	4	4	4	---	---	---	---	---	---	---
1-87	3	3	3	3	3	4	3	3	3	4	3	3
Livingston	3	4	3	4	4	4	4	3	3	4	3	4
Mission	3	3	3	3	4	4	4	4	3	5	4	3
Ruby	3	3	3	3	4	3	4	4	3	3	3	4
25-75	2	3	3	3	4	3	3	3	3	4	3	4
Morley	3	3	3	3	4	4	4	4	4	5	4	5
Savana	4	3	3	3	2	3	2	3	2	4	2	3
Avalon									4	4	2	4
Carmel			Young trees planted spring 2001						3	4	4	2
Durango									4	4	4	3
Kochi									3	3	2	2

*** The density of bloom is rated annually for each variety on a subjective scale of 1 to 5 with a rating of 5 being the heaviest bloom. Consistency of bloom from one year to the next and tendencies toward alternate bloom/bearing may be indicated by these ratings. Consistently heavy bloom may also indicate consistently light cropping (see Kapareil).**

Fig. 4. Full bloom timing by variety for the 1996 to 2007 season at the Butte RAVT.

Full Bloom Timing -- Almond Regional Variety Trial, CSU Chico.

	# Days before or after Nonpareil Full Bloom 1/												
Variety	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**Average**
Sonora	-8	-6	-9	-5	-7	-8	-1	-7	-5	-3	-8	-5	-6.0
Sano	-12	-4	-4	-3	-7	-3	-3	-6	-6	-6	-8	-6	-5.7
Kapareil	-11	-2	-5	-3	-7	-3	-2	-8	-1	-3	-5	-3	-4.4
Rosetta	-4	-4	-5	-2	-7	-7	-4	-4	-7	-4	-7	-5	-5.0
Winters (13-1)	-4	-6	-6	-2	-4	-3	0	-2	-3	-2	-6	-2	-3.3
Donna	-6	-4	-2	-4	-4	-3	-1	-2	-4	-3	-5	-4	-3.5
Avalon									-3	-2	-8	-5	-4.5
Durango									-3	-1	0	3	-0.3
Aldrich	-3	0	0	1	-5	-2	-1	-1	-4	-1	-6	-3	-2.1
Chips	0	-2	-1	-1	-2	-2	0	0	-3	0	-5	-1	-1.4
Jenette	-1	3	4	2	-5	-5	-2	-2	-3	-1	-7	-3	-1.7
Jiml	-2	0	1	3	-3	-1	0	-2	-3	-3	-6	-1	-1.4
Nonpareil	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Price	2	0	3	1	-1	-1	-1	0	2	-1	-5	0	-0.1
Yokut	2	-2	4	2	0	0	2	1	2	1	-5	0	0.6
Carmel	2	1	6	2	0	-1	0	1	2	1	1	3	1.5
Kahl	0	1	5	3	1	2	0	-1	1	1	-5	2	0.8
Wood Colony	0	-1	7	2	2	0	0	1	2	0	0	3	1.3
Johlyn	1	6	3	4	0	2	0	-1	2	1	-3	3	1.5
Monterey	2	0	6	4	0	2	0	1	2	1	0	3	1.8
Plateau	0	0	8	4	4	1	2	3	2	2	2	3	2.6
Kochi									2	2	2	2	2.0
Butte	3	6	8	6	4	0	3	4	2	2	2	4	3.7
2-19E	3	6	5	5	4	3	2	7	2	3	3	7	4.2
2-43W	1	0	9	5	7	---	---	---	---	---	---	---	4.4
Padre	4	8	9	6	4	0	3	7	3	2	3	5	4.5
1-102W	4	6	8	3	6	---	---	---	---	---	---	---	5.4
1-87	4	11	8	5	4	5	3	5	3	3	3	6	5.0
Livingston	4	4	7	10	7	4	3	6	3	5	6	8	5.6
Mission	4	8	10	6	6	5	4	6	3	2	3	5	5.2
Ruby	6	11	17	10	10	6	5	13	8	7	10	13	9.7
25-75	11	13	10	12	15	9	9	15	6	4	7	11	10.2
Morley	6	11	19	18	16	12	10	13	9	5	13	15	12.3
Savana	11	17	20	18	17	12	16	20	10	12	21	15	15.8
Good Bee Hours 2/	77	74	43	37	24	42	61	61	54	40	68	55	

1/ Full bloom as defined here equals the day when 80% of the flowers are open.

2/ Good bee hours = total daylight hours between 1% bloom on Sonora and 100% bloom on Mission when temperatures are ≥ 59 F, wind ≤ 10 mph, and no rain.

Bloom Conditions

1996 - Cold, rainy & windy prior to Nonpareil full bloom, excellent weather from then on.

1997 - A low chilling year, cool during entire blooming period but generally good weather.

1998 - Cold, rainy & windy through much of bloom, a few good days for Butte through Mission bloom.

1999 - Cold throughout bloom, 1 good day each at Sonora & Carmel full bloom, 3 good days for last 10% of late varieties

2000 - Cold, windy & rainy throughout bloom, 3 ok days around Sonora full bloom, 1 good day after Butte full bloom.

2001 - Cold, windy & rainy throughout bloom, 3 good days Winters-Nonpareil full bloom, 2 good days-last 10% of late varieties.

2002 - Cold early bloom, good weather 10% Nonpareil bloom through Mission bloom. 3 windy days during peak Mission bloom.

2003 - Cool to cold & windy through much of bloom, late bloom warmer w/ 25 of 61 bee hours occurring after Buttes full bloom.

2004 - Cold & windy through much of bloom, warmer late in bloom with 30 of the 54 bee hours occurring after Mission full bloom.

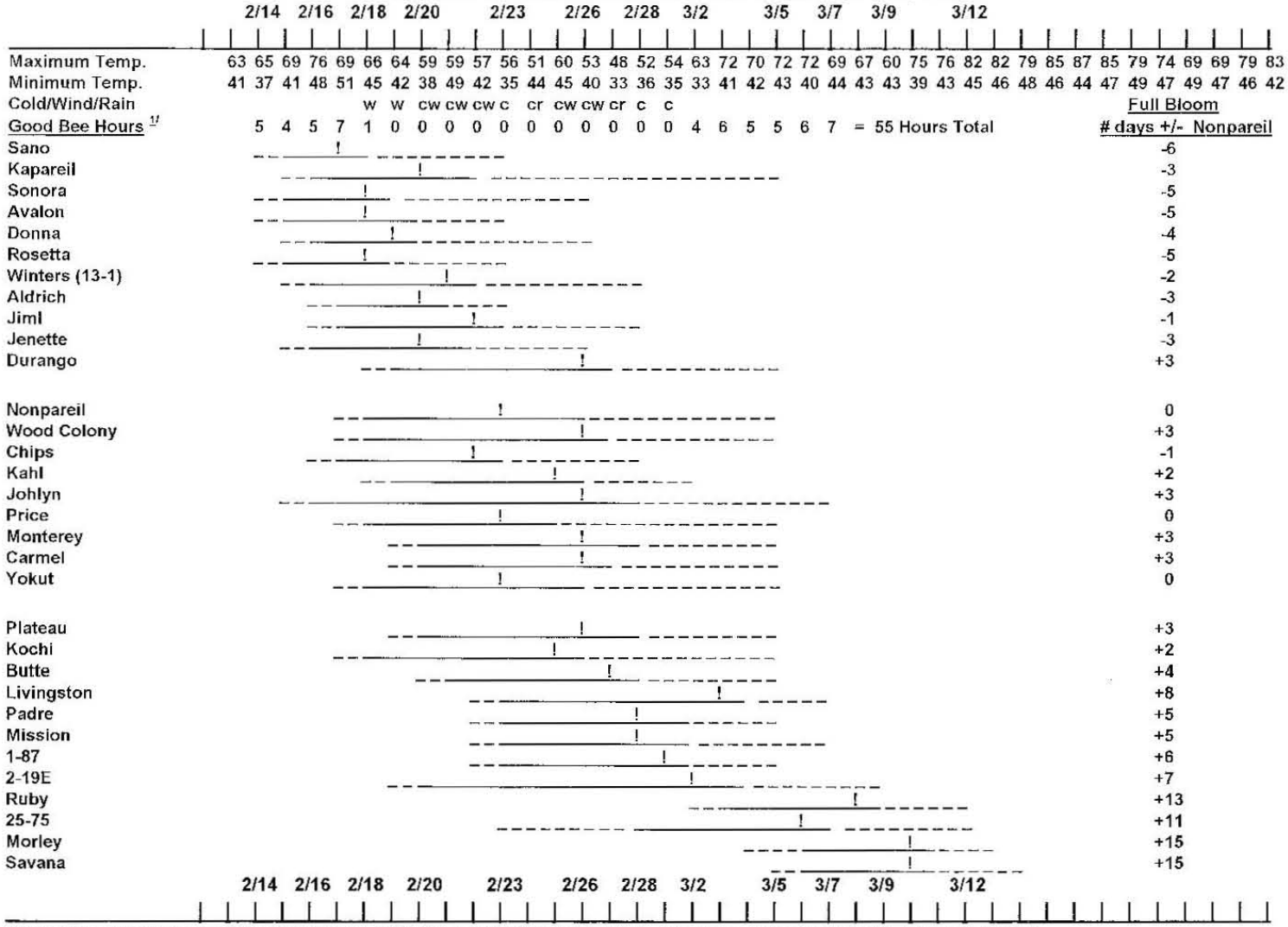
2005 - Warm rain prior Nonpareil FB led to fast bloom w/ good variety overlap, cold for bee flight, some good days in late bloom.

2006 - Warm thru 30% Nonpareil bloom, cold thru mid-bloom, Butte full bloom thru Mission warm, then cold rainy weather.

2007 - Warm until 10% Nonpareil bloom, then cold from mid-bloom thru 90% Mission bloom, then very warm.

ALMOND REGIONAL VARIETY TRIAL - 2007 BLOOM

Planted in 1993 at the California State University Farm, Chico



Dashed line encompasses 1 to 100% bloom, solid line covers 10 to 90% bloom, full bloom date marked with a ! = 80% bloom.

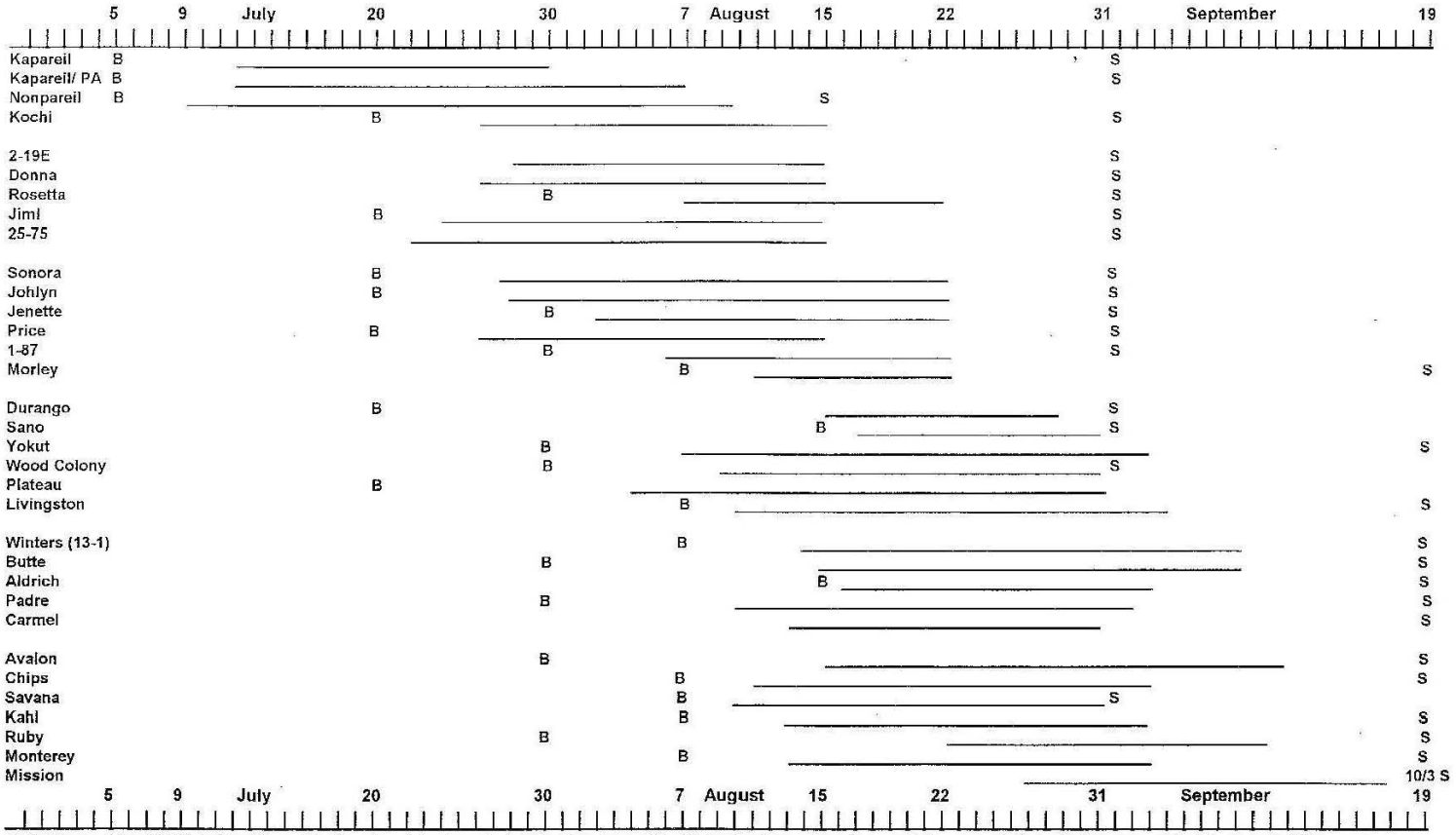
1/ Good Bee Hours = total daylight hours between 1% bloom on Sonora and 100% bloom on Mission when temperatures are ≥ 59 F, wind ≤ 10 mph, and no rain. This is a cooperative project between The Almond Board of California, CSU-Chico, and University of California Cooperative Extension.

Prepared by: Joseph H. Connell, U.C. Farm Advisor, Butte County, July 25, 2007.

Fig. 5. 2007 bloom progression data for the Butte RAVT.

ALMOND REGIONAL VARIETY TRIAL - 2007 HARVEST MATURITY

Planted in 1993 at the California State University Farm, Chico



Solid line =1 to 100% hullsplit. B--denotes blank nuts beginning to split. S--indicates when the variety was shaken to the ground, 4 harvests this year. Kochi, Durango and Avalon are young trees in their 6th growing season. This is a cooperative project between the Almond Board of California, CSU-Chico, and University of California Cooperative Extension. Prepared by: Joseph H. Connell, U.C. Farm Advisor, Butte Co. 10/20/07.

Fig. 6. 2007 Harvest maturity data for the Butte RAVT.

Fig. 7. 2007 bloom progression at the Delta RAVT.

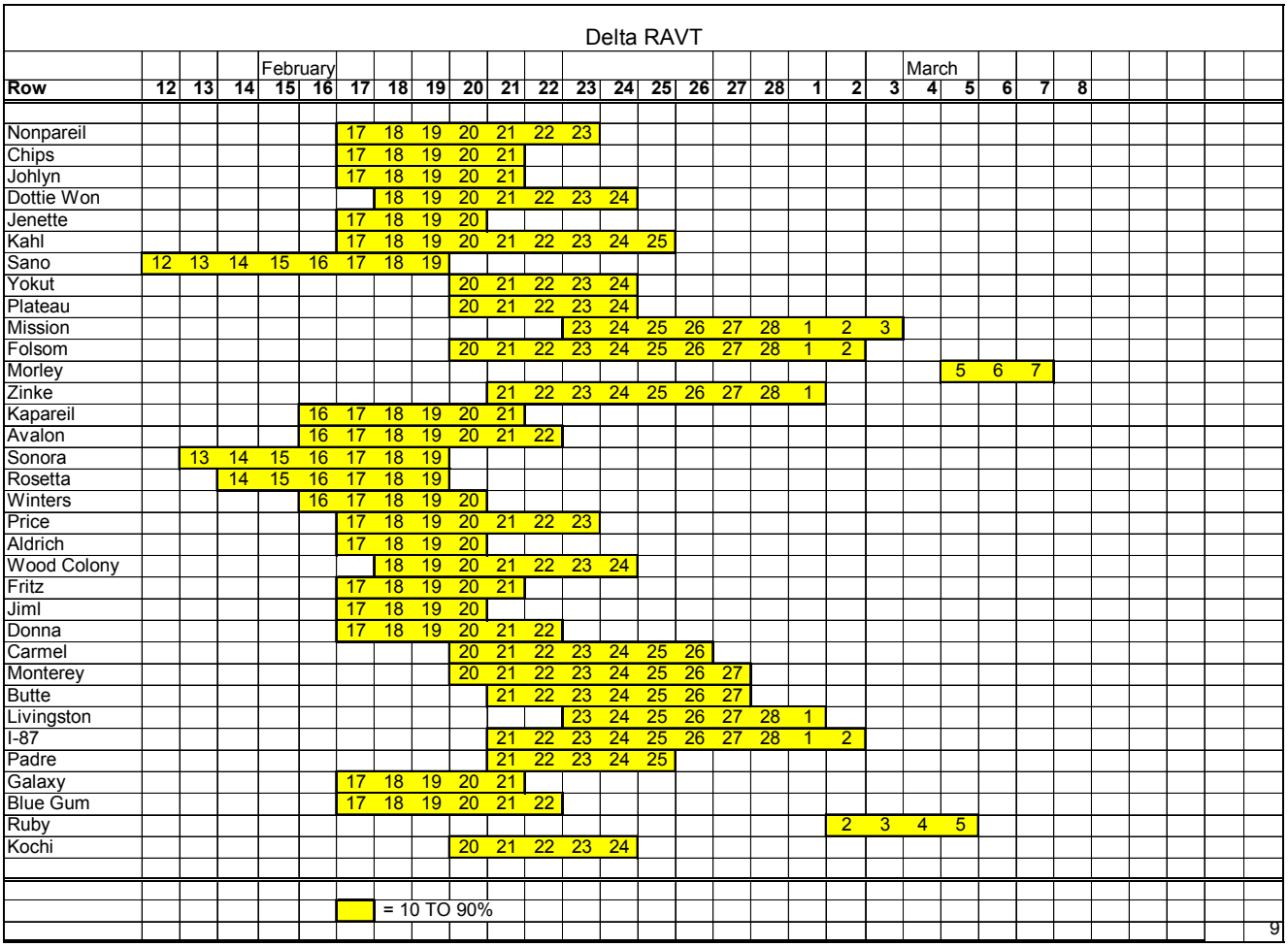


Fig. 8. 2007 rainfall data for the Delta RAVT

MANTECA, CALIFORNIA

Date	Rain (inches)	Air Temperature Max	Air Temperature Min	Wind > 5 mph
February 1	0.00	51.5	31.6	
2	0.00	57.7	37.9	
3	0.00	62.0	30.4	
4	0.00	66.6	33.4	
5	0.00	65.2	35.9	
6	0.00	66.5	39.6	
7	0.04	57.7	47.6	5.4
8	0.20	59.4	46.9	
9	0.35	56.7	53.6	6.5
10	0.83	63.4	54.1	7.9
11	0.04	64.0	47.9	5.8
12	0.04	61.4	39.5	
13	0.00	57.5	45.2	5.1
14	0.00	62.5	35.6	
15	0.00	69.1	38.9	
16	0.00	73.4	40.9	
17	0.00	73.7	39.7	
18	0.00	64.4	45.4	6.0
19	0.00	65.0	40.5	7.5
20	0.00	60.8	34.2	
21	0.00	64.3	40.3	
22	0.04	57.1	42.1	6.4
23	0.00	56.2	35.0	
24	0.00	58.0	33.6	6.0
25	0.08	58.6	44.9	6.9
26	0.12	57.6	43.8	6.6
27	0.08	55.3	34.1	
28	0.04	54.9	36.4	
March 1	0.00	57.2	30.8	
2	0.00	62.3	38.4	5.6
3	0.00	66.5	38.0	
4	0.00	69.1	40.7	
5	0.00	72.8	48.5	
6	0.00	75.9	41.0	
7	0.00	71.1	49.7	

Shaded area indicates bloom period

Rainfall subtotal for: (inches)

	2007	2006	2005	2004
January	0.32	3.32	3.48	1.58
February	1.86	1.03	2.78	3.51
March	0.04	4.34	4.41	0.62
TOTAL	2.22	8.69	10.77	5.74