

ALMOND BOARD OF CALIFORNIA
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Project No. 89-L16 - Field Evaluation of Almond Varieties and Rootstocks

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Objectives:

(1) Continue data collections and observations on varieties in the new Regional Variety Trials and on selected varieties in older plots where additional information is needed. (2) Make further cross-pollinations in an effort to identify the fourth incompatibility group from Nonpareil X Mission progeny and to determine what varieties are in it, and to learn the pollen compatibility of other new varieties. (3) Continue collection of yield and tree size data from rootstock plots. Begin determining yield efficiency of various rootstocks used for almond. (4) Complete the summarization and statistical analysis of data associated with this project and publication of this information.

Interpretive Summary:

Like most commercial orchards in California, the yields in some of the Regional Variety Trials (RVT) were down noticeably in 1989, especially in the plots in Kern and Fresno counties. While yields for a number of varieties were down in the plots in Butte and San Joaquin counties, they generally were not down as much as the southern plots and in fact some varieties in the northern plots produced quite well.

We do not have a full explanation why the northern plots yielded better than the southern plots which is the opposite of what generally happened in commercial orchards. At least part of the reason the northern plots yielded better is that kernel (meat) size of most varieties was considerably larger than in the southern plots. It appears that following a heavy crop in 1988 (and 1987) some varieties are now showing reduced yields. Production could also be affected by conditions existing in particular plots, especially when specific varieties

bloomed during poor weather conditions at those locations. Another general observation in 1989 is that worm damage, especially Navel Orangeworm (NOW), tended to be worse in most plots than in the previous several years.

Experimental Procedure:

The procedures used for variety and rootstock evaluation, including the compatibility of almond varieties on Marianna 2624, were the same as those used in previous years as were those for studying pollen compatibility.

Several test plots were planted in 1989 that are related to this project. These include a plot to evaluate various peach and peach-almond rootstocks for almond in sandy soil conditions; a study to determine the compatibility of almond on various Marianna selections and other plums, and tests with interstems to improve the compatibility of Nonpareil on Marianna 2624.

Results and Discussion:

Regional Variety Trials (RVT)

In the Kern County RVT, Nonpareil, Fritz and Butte were the highest yielding varieties in the 1974 planted block, while Monterey and Livingston were the highest producing in the 1981 planting (Table 1). In this latter planting, Yosemite, Monarch and Bonita had disappointing yields. In this plot, Sauret 1, Monterey, Ruby, Livingston and Jeffries had serious worm damage. Ne Plus Ultra, as in most plots, and Carmel produced significant double kernels; this was the only plot where Carmel had many doubles. Kernel sizes were quite small in this plot, possibly the result of an inherent water penetration problem.

In the Butte County plot at California State University, Chico, Ne Plus Ultra was the highest yielding variety followed by Carmel and Butte (Table 2). Ne Plus Ultra is an outside row and trees may be a little larger, and this variety probably also had better conditions for pollination than most other varieties in this planting. Price and Fritz had particularly disappointing yields. It is possible that they were more effected by the inclement bloom time weather than other varieties in this plot.

In the San Joaquin Delta College plot at Manteca, yields of most varieties were surprisingly good considering the relatively poor bloom time weather. Butte, Price, Carmel, Monterey and Ne Plus Ultra were the highest producing varieties (Table 3). In 1984 seven newer varieties were added to this plot. Of these new varieties, Valenta, Aldrich, Dottie Won and Rosetta were the highest yielding, all producing at the rate of more than 1000 kernel pounds per acre. However, Valenta produced a third double kernels. Other varieties in this plot producing more than ten percent doubles were Peerless, Ne Plus Ultra, Pearl and Butte (this was the only plot where Butte produced a significant number of doubles). LeGrand and Dottie Won had NOW damage of eight percent or more this year.

Yields in the California State University, Fresno planting were somewhat low, partially the result of smaller than anticipated kernel size. However, the varieties Grace, Livingston, Valenta and Heart produced fairly well in 1989 and were the highest yielding in this plot (Table 4). On the other hand, Yosemite,

Kern County RVT Plot
McFarland, California
Yield Summary - 1989

Table 1.

Variety	No. of trees	No. of nuts/tree	Ave. wt. (gm)	Kernel no./oz.	% Kernel	Weight lb/tree	lb/acre
Planted 1974, 1976							
Early blooming varieties							
Nepplus Ultra	21	9450	0.98	29	54	20.4	1548
Sonora	25	8282	0.86	33	70	15.8	1199
Mid blooming varieties							
Nonpareil	71	11425	0.89	32	63	22.3	1695
Fritz	25	13193	0.75	38	51	21.8	1658
Carmel	25	9310	0.91	31	63	18.8	1426
Jeffries	24	10499	0.78	36	69	18.1	1379
Price	25	9298	0.75	38	63	15.4	1172
Late blooming varieties							
Butte	26	13334	0.73	39	54	21.3	1622
Padre	23	13021	0.71	40	43	20.4	1549
Ruby	26	10049	0.91	31	56	20.2	1532
Carrion	26	9670	0.89	32	59	19.0	1445
Mission	78	10998	0.78	36	43	18.9	1438
Planted 1981							
Mid blooming varieties							
Monterey	26	8143	1.02	28	57	18.3	1394
Sauret#2	25	7353	1.00	28	57	16.2	1234
Nonpareil	149	5710	1.06	27	62	13.3	1013
Sauret#1	25	7053	0.86	33	61	13.3	1012
Bonita	26	5771	0.79	36	59	10.1	768
Monarch	23	2926	1.04	27	53	6.7	512
Late blooming varieties							
Livingston	23	8120	0.97	29	62	17.4	1322
Mono	25	9555	0.73	39	45	15.4	1169
Tokyo	25	7755	0.83	34	44	14.2	1078
Mission	150	7088	0.82	35	44	12.8	971
Yosemite	25	1701	1.10	26	56	4.1	315

Butte County RVT Plot
 California State University, Chico (CSUC)
 Durham, California
 Yield Summary - 1989
 Planted 1976

Table 2.

Variety	No. of trees	No. of nuts/tree	Ave. wt. (gm)	Kernel no./oz.	% Kernel	Weight lb/tree	Weight lb/acre
Early blooming varieties							
NePlus Ultra	39	12251	1.47	19	56	39.6	3013
Sonora	21	5101	1.44	20	67	16.1	1227
Mid blooming varieties							
Carmel	22	10801	1.17	24	64	27.8	2114
Nonpareil	120	5327	1.42	20	67	16.2	1234
Fritz	30	5258	1.08	26	51	12.5	953
Price	24	3133	1.18	24	64	8.2	619
Late blooming varieties							
Butte	25	12589	0.98	29	56	27.1	2059
Carrion	33	8669	1.26	22	65	24.1	1830
Padre	63	9783	0.96	29	52	20.8	1580
Mission	142	5990	1.09	26	44	14.3	1088

San Joaquin County RVT Plot
Delta College
Manteca, California
Yield Summary - 1989

Table 3.

Variety	No. of trees	No. of nuts/tree	Ave. wt. (gm)	Kernel no./oz.	% Kernel	Weight lb/tree	lb/acre
1978 Planting							
Early blooming varieties							
NePlus Ultra	25	8901	1.57	18	61	30.8	2344
Sonora	27	8663	1.41	20	70	26.9	2044
Jordanolo	21	6014	1.75	16	72	23.2	1767
Peerless	25	7657	1.25	23	41	21.0	1598
Mid blooming varieties							
Price	27	14626	1.05	27	70	33.7	2563
Carmel	26	11654	1.31	22	65	33.6	2554
Monterey	24	9625	1.49	19	54	31.5	2396
Nonpareil	364	8272	1.44	20	69	26.0	1979
Sauret#2	26	8513	1.33	21	61	25.0	1900
Fritz	26	9349	1.08	26	55	22.2	1692
Sauret#1	26	5689	1.37	21	67	17.1	1302
Late blooming varieties							
Butte	22	18522	0.93	30	57	38.0	2892
Ruby	22	9881	1.29	22	60	28.1	2136
Padre	20	11562	1.01	28	55	25.6	1949
Livingston	23	8297	1.35	21	66	24.8	1882
Thompson	23	6817	1.43	20	67	21.4	1631
Le Grand	25	7241	1.32	21	67	21.1	1606
Mission	113	8366	1.12	26	46	20.6	1562
Tokyo	22	5582	1.54	18	56	19.0	1444
Mono	21	6043	1.38	20	53	18.4	1397
1984 Planting							
Valenta	27	7580	0.99	28	49	16.6	1260
Aldrich	27	6132	1.10	26	60	14.9	1134
Dottie Won	27	6194	1.09	26	52	14.8	1129
Rosetta	27	4334	1.49	19	51	14.2	1084
Woods Colony	27	3720	1.45	20	67	11.8	901
Jeffries	27	3787	1.26	22	77	10.5	798
Pearl	26	4111	1.00	28	53	9.0	687

Fresno County RVT Plot
 California State University, Fresno (CSUF)
 Fresno, California
 Yield Summary - 1989
 Planted 1981

Table 4.

Variety	No. of trees	No. of nuts/tree	Ave. wt. (gm)	Kernel no./oz.	% Kernel	Weight lb/tree	lb/acre
Early blooming varieties							
Jordanolo	20	4800	1.20	23	54	12.7	965
Peerless	20	5235	0.99	25	66	10.8	820
Sonora	20	4331	1.13	25	66	10.8	820
NePlus Ultra	80	3133	1.49	20	55	9.9	754
Janice	19	3230	1.13	25	58	8.1	613
Mid blooming varieties							
Grace	20	9194	0.88	32	49	17.8	1356
Valenta	20	8178	0.93	30	51	16.7	1272
Heart	17	5827	1.28	22	63	16.4	1248
Elsie	20	6606	0.99	29	58	14.4	1091
Monterey	20	5502	1.17	24	45	14.1	1075
Carmel	40	6298	0.96	30	56	13.3	1013
Fritz	19	6820	0.88	32	49	13.3	1010
Price	20	6757	0.85	33	59	12.7	967
Sorrenti	20	5309	1.03	28	56	12.0	914
Lodi	20	6349	0.85	33	57	12.0	908
Hoover	20	5695	0.95	30	58	12.0	908
Nonpareil	508	4780	1.12	25	60	11.7	888
Sauret#2	19	5025	0.98	29	40	10.9	827
Merced	20	4192	1.14	25	65	10.6	804
Jeffries	20	4555	1.04	27	64	10.5	797
Norman	20	4522	0.95	30	64	9.5	723
Sauret#1	20	3997	1.05	27	60	9.3	704
DB-OJ	20	4206	0.90	31	44	8.4	637
Solano	20	3834	0.97	29	58	8.2	626
Milow	20	4030	0.87	33	67	7.7	586
Bonita	20	2626	1.13	25	58	6.5	497
Monarch	20	2245	1.08	26	44	5.4	407
Late blooming varieties							
Livingston	20	7411	1.06	27	64	17.3	1316
Butte	20	7538	0.81	35	50	13.5	1028
LeGrand	17	5967	0.92	31	54	12.1	920
Mission	258	5142	1.05	27	43	11.8	896
Ruby	20	4413	1.08	26	52	10.5	799
Padre	20	6062	0.77	37	48	10.3	784
Tioga	18	5889	0.78	36	54	10.1	768
Mono	20	4571	1.00	28	43	10.1	766
Ripon	19	5056	0.89	32	41	9.9	754
Thompson	17	2974	1.13	25	56	7.4	565
Tokyo	20	2242	1.18	24	39	5.8	444
Planada	19	1722	1.24	23	49	4.7	358
Yosemite	20	385	1.16	24	57	1.0	75

Planada, Monarch, Tokyo and Bonita had disappointing yields. Several varieties (Merced, Carmel) in this planting show some symptoms of Noninfectious Bud Failure, but the worse is the Sorrenti variety.

Other than data reported in project 89-M2 on the fourth incompatibility group for Nonpareil-Mission progeny, little was learned in 1989 regarding the pollen compatibility of newer varieties because of the inclement bloom time weather.

Rootstock Plots

At the Nickels soil laboratory in Colusa County overall yield of the different scion cultivars followed the trends for this area for 1989 with the earliest blooming varieties yielding the most. Thus, Ne Plus Ultra > Nonpareil > Mission. With Ne Plus Ultra, there was a significantly wide range of yield of the different rootstocks. The two peach-almond hybrid rootstocks 1-82 and Hansen 536 were outstanding, producing over a ton and a half of kernels per acre (Table 5). Hansen 2168, Nemaguard and almond were intermediate with Red Leaf Nemaguard, Marianna 2624 and Lovell lowest in total yield. The same trends were shown by number of nuts per tree. The same basic trend was shown with Nonpareil although the differences between upper and lower yield were less. Mission also had a similar trend but with Nemaguard yielding least. Yields tended to be related to tree size; therefore production per acre may have favored the vigorous hybrid stocks. Yield comparisons between rootstocks may have shown a different pattern had tree size been factored in. Kernel size was significantly different in several combinations. In general the vigorous hybrid rootstocks produced the larger sized nuts whereas kernel size on almond seedling and Lovell tended to be low.

Tree survival from this 1977 planting at the Nickels soil laboratory was recalculated (Table 6). The trends appear to be significant but statistical differences have not yet been calculated. Nevertheless, Marianna 2624 survived at the highest rate but Nemaguard and Bright's hybrid were nearly as good. The experimental peach-almond hybrid 1-82 also had good survival, slightly better than Lovell. Almond and the two Hansen hybrids had the lowest rate of survival.

A young rootstock trial, planted in 1986, comparing peach-almond and peach rootstocks in western Fresno County was harvested for the first time in 1989. Nonpareil trees on peach-almond tended to out yield those on peach but the differences were not great.

Marianna Compatibility Studies

When reviewing the yield data for the first three of the following plots (oldest), one must take into account that inclement 1989 bloom time weather may have effected various varieties differently. Therefore, low yield could either be a reflection of possible incompatibility or poor weather at bloom.

1977 Planting. Price, Padre and Carmel on Marianna 2624 yielded very well this season as did the couple of trees regrafted to Sonora. Mission had disappointing yields while Butte and Carrion had intermediate production on this rootstock. It appears that Price is bearing biennially in this planting.

Table 5. Yield data for 1989 of various cultivar/rootstock combinations in the replicated rootstock planting at the Nickels Research Farm, Arbuckle. Trees were planted in 1977. A few replants in 1978 and 1979 are included in some plots.

Rootstock	N	lbs/acre (lbs)		Nuts/tree (no.)		Av.kernel (grams)	
A. Ne Plus Ultra (early bloom)							
PA 1-82	8	3840	A	14,830	A	1.53	A
Hansen 536	9	3767	A	15,400	A	1.45	AB
Hansen 2168	8	3060	AB	12,100	AB	1.50	AB
Nemaguard	8	2995	AB	12,245	AB	1.46	AB
Almond	7	2840	B	11,380	B	1.475	AB
RL Nemaguard	9	2450	B	10,495	B	1.44	AB
Mar.2624	8	2230	B	9,580	B	1.40	AB
Lovell	8	2165	B	9,285	B	1.35	B
A. Nonpareil							
PA 1-82	8	2400	A	11,280	A	1.27	ABC
Hansen 536	9	2340	AB	11,080	A	1.28	ABC
Nemaguard	8	2250	AB	10,310	A	1.32	ABC
Almond	8	2070	AB	9,790	A	1.26	ABC
Hansen 2168	7	1950	AB	8,830	A	1.33	AB
Lovell	7	1820	AB	9,220	A	1.20	C
Bright Hyb	8	1710	AB	7,550	A	1.36	A
H2B/Marianna	8	1490	B	7,230	A	1.24	BC
C. Mission							
PA 1-82	7	1460	A	7,615	A	1.14	AB
Bright Hyb	7	1450	A	7,384	A	1.17	AB
Hansen 536	7	1390	AB	6,860	AB	1.20	A
Almond	6	1340	AB	7,355	A	1.09	B
Lovell	6	1250	AB	6,550	AB	1.14	AB
Mar. 2624	8	1180	AB	6,080	AB	1.17	AB
Hansen 2168	7	1155	AB	5,840	AB	1.16	AB
Nemaguard	8	920	B	4,790	B	1.17	AB

Table 6. Survival of different cultivar/rootstock combinations through 1989. Planted 1977.

Rootstock	Ne Plus Ultra		<u>Scion variety:</u> Nonpareil		Mission		Overall Ave.
	No.	%	No.	%	No	%	
Marianna 2624	15/16	94	16/16*	100	15/16	94	96
Nemaguard	16/16	100	14/16	87.5	15/16	94	94
Bright Hyb	-		15/16	94	15/16	94	94
PA 1-82	15/16	94	14/16	87.5	13/16	81	87.5
Lovell	16/16	100	13/16	81	11/16	69	83
Almond	12/16	75	16/16	100	8/16	50	75
Hansen 536	14/16	87.5	10/16	62.5	12/16	75	75
Hansen 2168	10/16	62.5	10/16	62.5	13/16	81	69
<hr/>							
Average %		87.6		84.4		80	
* Havens 2B/Marianna 2624							

1982 Planting. Livingston, Monarch, Mono, Dottie Won, Jeffries, Bonita and possibly Yosemite show signs of incompatibility on Marianna 2624. Of these varieties Livingston and Mono gave fair yields in 1989 while Monarch, Bonita, and Dottie Won produced poorly (yields are no longer taken from Jeffries and Yosemite since the trees are too poor).

Of the varieties that appear compatible on Marianna 2624, Monterey, Planada, Ripon and Ruby yielded the highest. However, planting of Planada and Ripon might be discouraged on any rootstock because of other horticultural considerations. Norman and LeGrand, though compatible on Marianna 2624, yielded poorly in 1989 possibly due to bloom time conditions.

1986 Planting. When rated visually for compatibility on Marianna 2624, trees of Aldrich, Sonora and Woods Colony were the best followed closely by Monterey, Bonita, and Valenta. Butte was also performing well while Solano was doing fair. However, all trees of Pearl on Marianna 2624 had died.

During 1989 yields were taken for the first time in this planting. Woods Colony, Aldrich and Butte were the highest yielding varieties in this plot. Conversely Grace, Valenta, and Bonita yielded poorly in 1989.

1989 interstem trials. Plots were established in Colusa and Butte Counties this past spring to study various interstems to provide compatibility for Nonpareil on Marianna 2624. Three lengths of interstems (4", 10" and $\pm 2'$) of Havens 2B plum are being compared with 2 lengths (10" and $\pm 2'$) of two compatible almond varieties, Mission and Jordanolo. Some field budding is still being done to complete these plots.

1989 Marianna selection plots. A study to determine the compatibility of almond on a number of Marianna selections and other plums was planted in February 1989 at two locations. These stocks are also being evaluated for use with other Prunus species and promising ones may be patented and released in the future. Nonpareil and Mission are being used as the test varieties. While it is too early to draw any conclusions, it appears at this time that there will be differences between these rootstocks in compatibility with almond and that Mission will more likely be compatible than Nonpareil.