December, 1988

ALMOND BOARD OF CALIFORNIA
Annual Report

Project No. 88-L15 - Field Evaluation of Almond Varieties and Rootstocks

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Objectives: (1) Continue data collections and observations on varieties in the newer Regional Variety Trials (RVT) and on selected varieties in older plots where additional information is needed. (2) Evaluate varieties for yield efficiency (Yield per tree canopy size). (3) Make further cross-pollinations in an effort to identify the fourth compatibility group from Nonpareil X Mission progeny and to determine what varieties are in it. (4) Continue collection of yield and tree size data from rootstock plots. Begin determining yield efficiency of various rootstocks used for almond. (5) Complete the summarization and statistical analysis of data associated with this project and begin publication of this information.

Interpretive Summary: The years 1987 and 1988 were somewhat unique in that after a severely weather-damaged 1986 almond crop, two successive years occurred in which bloom time weather did not limit production (pollination). With back to back large crops, there has been an opportunity to study varietal response to successive large crops. After the heavy 1987 crop some varieties came back with a reduced bloom density in 1988, while other varieties had a good bloom density.

Yields in the four regional variety trials (Kern, Butte, San Joaquin and Fresno Counties) were generally quite good in 1988. In many cases, varieties from the younger plots which have not yet reached full bearing produced larger yields in 1988 than in 1987. Even in several of the full bearing plots some varieties produced as much or more in 1988 as in 1987. Information for varieties in each of the four regional trials on which harvest data were taken in 1988 can be found in tables 1 through 4. These data include the number of nuts per tree, kernel weight, percent kernel and yield per tree and per acre.

In the regional variety trial in Kern County, Butte, Nonpareil, Ruby, Sauret #1, and Mono were the highest yielding varieties. Sonora also yielded quite well in this plot and in fact somewhat better than in 1987. Kernel

(meat) sizes were quite small for many varieties, especially in the older section of this plot, possibly due to an inherent water penetration problem.

In the Butte plot at California State University, Chico, Padre, Nonpareil and Carrion were the highest yielding varieties in the block. A majority of the varieties in this plot yielded at the rate of 2000 kernel pounds or more per acre.

In the San Joaquin Delta College variety trial at Manteca, Jordanolo, Ne Plus Ultra and Tokyo were the highest yielding varieties. Merced had 14% Navel Orangeworm damage and 20% total worm damage.

The regional variety plot at California State University, Fresno, was planted in 1981 and the trees are not yet full bearing. Ruby, Heart and LeGrand were the highest yielding varieties in this plot. On the other hand, Yosemite, Planada, Sonora and Grace all produced poorly in 1988. Planada, Yosemite and Sonora produced at least 10% blanks, which may be part of the reason for their low production.

Ne Plus Ultra, Monterey, Sauret #2, Price, Merced and Peerless tended to produce 10% or more double kernels in most plots where they were evaluated. Also producing this many doubles in specific plots were Carmel (Kern plot); Pearl, Valenta, and Dottie Won (San Joaquin plot); and Lodi & Hoover (Fresno plot).

In rootstock plots at Kern and Colusa Counties, trees on almond-peach hybrid rootstocks outproduced trees on peach (Nemaguard or Lovell) and almond rootstocks as they did in 1987. Hybrid rootstocks produce larger trees than either peach or almond stocks and in commercial orchards would probably be spaced at a greater distance, thereby offsetting some of these yield differences. Nevertheless, drought tolerance of the hybrid rootstock is a significant advantage providing other conditions are satisfactory for the use of this stock. In another rootstock plot in western Fresno County, almond, Lovell and Nemaguard rootstocks were compared. In the early years of this orchard the peach stocks significantly out-produced almond and frequently Nemaguard out-yielded Lovell. However, now in the 14th season almond is yielding as well as the two peach rootstocks.

Additional cross pollinations were made this spring in an effort to further clarify the cross compatibility of various almond varieties. Based on this year's data no new varieties can be added to the compatibility charts. However, this year's studies did confirm some of the previously developed information.

Experimental Procedure: The procedures used for variety and rootstock evaluation and pollen compatibility were the same as those used in 1987 and previous years. During the past year, aerial photos were taken of all RVT at bloom and again at full leaf canopy (June). These photos will be used to evaluate and compare tree size and shape.

Results and Discussion: Yield and nut quality data were taken from all varieties in the newer regional variety trials (RVT) and from selected ones in the older trials. These data are summarized in Tables 1 through 4.

In the Kern RVT 12 varieties (including three standards) were evaluated in the older plot (Table 1). Butte, Ruby and Nonpareil were among the higher yielding varieties while Price and Padre had short crops. Kernel size and weight are generally less than in other plots, averaging 29 kernels per ounce overall. Among varieties with very small kernels were Price, Butte and Padre. In the 1981 planting, Nonpareil, Sauret #1 and #2, Mono and Tokyo yielded well, while Monarch, Bonita and Yosemite produced only half the yield of Nonpareil. Ne Plus Ultra, Carmel, Sauret #2 and Monterey produced 10% or more double kernels in these plots.

Yield was good to high for all varieties evaluated in the RVT at CSU Chico (Table 2). Both average numbers of nuts per tree and kernel size were generally higher than at the Kern plot. Padre, Nonpareil and Carrion all yielded in excess of 3,000 kernel pounds per acre. Sonora showed an alternate bearing tendency but even in the off year produced at the rate of nearly 1700 kernel pounds per acre. Ne Plus Ultra and Price produced over 10% double kernels.

Yield data from the varieties evaluated at the San Joaquin Delta College RVT are shown in Table 3. For the varieties in the older planting Jordanolo and Ne Plus Ultra yielded about 3,000 pounds per acre, partly a result of their large kernel size. Tokyo had a heavy crop following its lighter 1987 yield. Butte produced high numbers of nuts in both 1987 and 1988 but smaller kernel size reduced yield somewhat. Grace, Solano, Sonora and Merced did not produce well in 1988. Sonora, which had a very heavy crop in 1987, had a reduced number of nuts in 1988, but with a large kernel size, still produced nearly 1500 pounds per acre. Average kernel size in this plot was very good in 1988. For the younger varieties planted in 1984, Aldrich, Woods Colony and Rosetta were the highest yielding while Pearl was disappointing. Pearl and Valenta gave more than 20% double kernels while Dottie Won, Peerless, Merced, Ne Plus Ultra, Price and Monterey produced 18 to 10% doubles. Merced had 14% Navel Orangeworm damage and 20% total worm damage.

The RVT at CSU at Fresno has not yet reached full bearing. However, some varieties such as LeGrand, Ruby, Heart, Merced and Tioga yielded very well in 1988 (Table 4). On the other hand, A number of varieties had much lower yields and Yosemite, Planada, Sonora and Grace had particularly disappointing crops in 1988. Planada, Yosemite and Sonora had 10% or more blank nuts in the evaluation samples (more could have been lost in the harvesting process) and these blanks could be one explanation for the low yields. The following varieties produced 10% or more double kernels in this plot: Ne Plus Ultra, Peerless, Lodi, Monterey, Price, Sauret #2, Merced, and Hoover.

Back-to-back heavy crops in 1987 and 1988 gave an opportunity to compare varieties for these two years for consistency of bearing. Table 5 shows yields for a number of the important varieties for these two years and for three mature bearing plots (Kern, Butte and San Joaquin). Nonpareil and Butte showed the most consistent yield across these years and plots while Fritz and Mission showed reasonable consistency. Sonora, Price and possibly Ruby showed the greatest tendency to alternate bear. The Kern and Butte plots showed reasonable consistency between years while most varieties in the San Joaquin plot yielded better in 1987.

Table 1

Kern County RVT Plot
McFarland, California
Yield Summary - 1988

Variety	No. of trees	No. of nuts/tree	Ave. kernel wt (gm)	kernel no./ oz.	% Kernel	Weight lb/ tree	Weight lb/ acre
Planted 1974, 1976							
Early blooming varieties							
Sonora	25.5	12400	0.92	31	73	25.1	1907
NePlus Ultra	22.5	8157	1.18	24	61	21.1	1607
Mid blooming varieties							
Nonpareil	71	12141	1.00	28	74	26.8	2036
Jeffries	24.25	13071	0.90	32	68	25.8	1962
Carmel	26	9344	1.05	27	63	21.6	1641
Price	26	7901	0.82	35	64	14.2	1083
Late blooming varieties							
Butte	26	16439	0.83	34	61	30.0	2281
Ruby	23	11824	1.09	26	66	28.4	2159
Fritz	26	12891	0.91	31	56	25.9	1966
Carrion	26	11864	0.97	29	64	25.4	1928
Mission	78	10485	0.96	30	49	22.5	1712
Padre	23	10613	0.76	38	59	17.7	1344
Planted 1981							
Mid blooming varieties							
Nonpareil	42.5	13418	1.03	27	72	30.6	2323
Sauret #1	25.5	13480	0.95	30	71	28.1	2137
Sauret #2	25	10185	1.15	25	60	25.9	1969
Monterey	26	9866	1.04	27	47	22.6	1716
Bonita	26	6958	0.94	30	63	14.4	1091
Monarch	26	4496	1.01	28	54	10.1	764
Late blooming varieties							
Mono	24	11517	1.04	27	56	26.5	2015
Tokyo	25	11616	1.01	28	56	25.8	1962
Mission	104	10422	1.03	28	48	23.9	1815
Livingston	22.5	8961	1.21	24	73	23.8	1811
Yosemite	22.5	6426	1.10	26	58	15.6	1182

Table 2

Butte County RVT Plot
California State University, Chico (CSUC)
Durham, California
Yield Summary - 1988
Planted 1976

Variety	No. of trees	No. of nuts/tree	Ave. kernel wt. (gm)	no./ oz.	% Kernel	Weight lb/ tree	lb/ acre
Early blooming varieties							
Neplus Ultra	39	12967	1.27	22	52	36.3	2759
Sonora	21	7700	1.30	22	70	22.1	1682
Mid blooming varieties							
Nonpareil	120	17008	1.13	25	67	42.2	3205
Fritz	30	13554	1.03	28	53	30.7	2330
Solano	22	14790	0.93	31	63	30.3	2300
Price	24	13050	0.94	30	64	26.9	2047
Carmel	22	11018	1.08	26	57	26.1	1986
Late blooming varieties							
Padre	63	20763	0.99	29	55	45.3	3444
Carrion	33	14433	1.25	23	67	39.8	3028
Mission	142	13103	1.05	27	46	30.3	2300
Butte	25	11290	0.97	29	56	24.0	1827

Table 3

San Joaquin County RVT Plot
Delta College
Manteca, California
Yield Summary - 1988

Variety	No. of trees	No. of nuts/tree	Ave. kernel wt (gm)	no./ oz	% Kernel	Weight lb/ tree	lb/ acre
Planted 1978							
Early blooming varieties							
Jordanola	21	11258	1.66	17	72	41.2	3131
NePlus Ultra	25	12441	1.42	20	66	38.9	2960
Peerless	25	8760	1.17	24	49	22.7	1723
Sonora	27	6119	1.42	20	75	19.2	1456
Mid blooming varieties							
Monterey	24	10049	1.49	19	55	33.1	2512
Nonpareil	364	11089	1.33	21	71	32.5	2467
Sauret #2	26	10559	1.36	21	65	31.7	2410
Sauret #1	26	12599	1.12	25	70	31.1	2364
Carmel	26	10237	1.26	22	66	28.5	2168
Fritz	26	9486	1.11	26	57	23.1	1758
Price	27	8667	1.20	24	64	23.0	1745
Monarch	27	9879	1.03	28	57	22.4	1705
Merced	27	7360	1.30	22	71	21.0	1598
Solano	27	7861	1.05	27	72	18.1	1378
Grace	24	6314	1.02	28	67	14.3	1083
Late blooming varieties							
Tokyo	22	16180	1.09	26	57	39.0	2960
Butte	22	15662	1.05	27	62	36.4	2766
Livingston	23	12689	1.27	22	70	35.6	2709
Le Grand	25	12627	1.17	24	68	32.7	2484
Ruby	54	11024	1.28	22	60	31.2	2368
Mission	113	11969	1.16	25	52	30.6	2322
Padre	20	13975	0.98	29	60	30.3	2304
Mono	21	14341	0.94	30	46	29.7	2259
Thompson	23	10020	1.30	22	76	28.7	2182
Planted 1984							
Aldrich	27	7719	1.12	25	68	19.0	1446
Woods Colony	27	5216	1.36	21	68	15.7	1190
Rosetta	27	5377	1.29	22	51	15.3	1164
Valenta	27	4081	1.18	24	61	10.7	810
Dottie Won	27	3804	1.14	25	53	9.5	725
Jeffries	27	3143	1.23	23	75	8.5	648
Pearl	26	2432	1.18	24	62	6.3	481

Table 4

Fresno County RVT Plot
California State University, Fresno (CSUF)
Fresno, California
Yield Summary - 1988
Planted 1981

Variety	No. of trees	No. of nuts/tree	Ave. kernel wt. (gm)	kernel no./ oz.	% Kernel	Weight lb/ tree	Weight lb/ acre
Early blooming varieties							
NePlus Ultra	80	6904	1.23	23	58	18.9	1436
Jordanola	20	4806	1.07	26	61	11.4	863
Janice	19	4719	1.01	28	61	10.5	800
Peerless	20	3805	0.99	29	35	8.3	631
Sonora	20	2322	1.18	24	70	6.0	459
Mid blooming varieties							
Heart	17	14164	1.26	22	63	39.4	2995
Merced	20	13410	1.20	24	70	35.4	2692
Sauret #1	19	11111	1.16	24	70	28.5	2167
Sorrenti	20	12190	1.00	28	62	26.8	2038
Valenta	20	11662	1.01	28	76	26.0	1974
Sauret #2	20	8180	1.15	25	59	20.7	1573
Elsie	20	8384	1.10	26	62	20.4	1551
Solano	20	6161	1.36	21	88	18.5	1408
Carmel	40	7246	1.10	26	60	17.5	1327
Hoover	20	6618	1.14	25	78	16.6	1264
Monarch	20	7189	1.03	27	52	16.4	1243
Norman	19	8158	0.80	35	72	14.5	1099
Lodi	20	6542	0.95	30	61	13.7	1039
Fritz	19	4286	1.35	21	70	12.8	969
Bonita	20	6252	0.92	31	62	12.7	962
Nonpareil	508	5376	1.06	27	63	12.5	948
Milow	20	7367	0.72	39	74	11.7	889
Jeffries	20	5007	1.05	27	66	11.6	884
DB-OJ	20	5290	0.88	32	49	10.3	780
Price	20	4385	1.03	28	65	9.9	754
Monterey	20	3245	1.26	22	51	9.0	686
Grace	20	2659	1.06	27	60	6.2	472
Late blooming varieties							
LeGrand	17	18931	1.10	26	76	45.8	3483
Ruby	20	13320	1.36	21	78	39.9	3035
Tioga	18	21212	0.72	39	57	33.9	2573
Thompson	17	9623	1.12	25	71	23.8	1809
Padre	20	10960	0.96	30	68	23.2	1763
Tokyo	20	11091	0.89	32	53	21.8	1654
Mission	258	8350	1.10	27	55	20.5	1561
Livingston	20	5325	1.19	24	65	14.0	1062
Butte	20	5428	1.13	25	82	13.5	1029
Mono	20	4216	1.03	28	46	9.6	728
Ripon	19	3332	1.22	23	56	9.0	681
Planada	19	1133	1.40	20	51	3.5	265
Yosemite	20	839	1.13	25	55	2.1	159

Table 5

ALMOND YIELDS -- POUNDS/ACRE X 100

	Kern		Butte		S. Joaquin		
	87	88	87	88	87	88	Avg.
Nonpareil	23	20	28	32	30	25	26
Sonora	16	19	32	17	32	15	22
Price	21	11	18	20	30	17	20
Carmel	19	16	21	20	33	22	22
Fritz	20	20	20	23	31	18	22
Mission	14	17	18	23	20	23	19
Butte	24	23	22	18	32	28	24
Ruby	17	22	--	--	17	24	20
Padre	16	13	19	34	21	23	21

Yield efficiency data was well summarized in the 1987 annual report. We hope to be able to utilize aerial photo data to obtain differences in tree size and as another means of determining yield efficiency.

Pollen compatibility studies were again conducted in 1988 to determine what varieties are not pollen cross compatible. We were not able to add any additional varieties to the known compatibility groups in 1988 although some previous data was confirmed. Additional information on pollen compatibility is included in the annual report for project No. 88-M1, Almond Variety Improvement.

Considerable data has been collected from three rootstock plots in Kern and Colusa (Nickels Soil Laboratory) counties and at the West Side Field Station (Table 6). In both Colusa and Kern Counties, various hybrid rootstocks including Brights and both Hansen (536 and 2168) stocks are compared with peach (Lovell and Nemaguard) and almond. In Colusa County the plot was designed with eight replicates, each with two trees. In addition, most rootstocks were planted with three varieties essentially increasing the number of replications to 24. In Kern County 13 trees of a rootstock were planted in a row but with only one or two replications. In both plots trees on hybrid rootstocks tended to outyield those on peach which is consistent with data taken in 1987. It was also interesting to note that with all three varieties in Colusa County and in Kern County, Nemaguard tended to outyield Lovell. Most of the larger yield on hybrid stocks was due to increased nut numbers per tree possibly because these rootstocks produce a more vigorous and larger tree. The difference in kernel size between hybrid and peach rooted trees appeared negligible.

The plot at the West Side Field Station consists of Lovell and Nemaguard peach and almond rootstock replicated six times each with four varieties. This study has just recently been completed. In the early years of this plot Nemaguard outyielded Lovell in most years sometimes by a considerable amount. In these years almond rooted trees were smaller with lower yields. However, in 1988 there was little difference in yield between the two peach rootstocks. Trees on almond stock have about caught up with the peach stocks and in fact with two varieties almond rooted trees slightly outyielded those on peach stocks (Table 6).

Publications: No formal publications were written in 1988 except reports to the Almond Board. However, information developed from this project was presented in at least seven meetings attended by almond growers in various growing districts in California.

Table 6

1988 Summaries For Rootstock Blocks

Colusa County

Rootstock Name	Nonpareil Ave. kern	Nuts/ tree	Lbs./ tree	Mission Ave. kern	Nuts/ tree	Lbs./ tree	NePlus Ultra Ave. kern	Nuts/ tree	Lbs./ tree
PA16,5-2	1.29	18276	52.0	1.10	13858	33.5	1.49	8845	28.9
PA16,1-83	.	.	.	1.12	16484	40.7	1.43	10218	32.3
PA16,1-84	1.30	12236	35.5	1.17	14135	36.3	.	.	.
PA2-16-8-63	1.28	12515	35.5	1.13	13427	33.8	1.49	7840	26.2
PA16,1-82	1.27	11161	31.3	1.13	13741	34.4	1.49	7412	24.6
Bright Hybrid	1.33	9371	27.1	1.13	13640	34.0	.	.	.
PA5-3-6-65	1.31	11308	32.4	1.11	12925	31.8	1.41	8571	26.3
Nemaguard	1.31	9728	28.2	1.11	11515	28.1	1.40	7540	23.4
Almond	1.32	8960	26.1	1.07	11744	28.0	1.38	7073	21.3
Lovell	1.28	5274	14.9	1.09	9511	23.0	1.39	4364	13.4
M2624/2B	1.37	4633	13.8	.	.	.	.	.	.
M2624	.	.	.	1.10	9172	22.3	1.42	4566	14.2
R.L.Nemaguard	.	.	.	.	.	.	1.41	4291	13.3

Kern County

Rootstock Name	Ave. kern	Nuts/ tree	Lbs./ tree
Bright Hybrid	1.03	17203	39.1
PA2-16-8-63	0.97	15698	33.7
PA16,1-82	1.03	14092	31.9
Nemaguard	1.03	13442	30.6
PA5-3-6-65	0.90	15317	30.5
Lovell	0.91	10260	20.5

WSFS

Rootstock Name	Ave. kern	Nuts/ tree	Lbs./ tree
Nonpareil			
Nemaguard	1.16	11356	29.0
Lovell	1.1	10788	26.2
Almond	1.12	9820	24.2
Jeffries			
Nemaguard	1.02	12741	28.9
Lovell	1.03	12305	27.9
Almond	1.03	11013	24.8
Carmel			
Nemaguard	1.18	8634	22.0
Lovell	1.19	8584	22.4
Almond	1.07	9838	23.1
3-63			
Nemaguard	0.79	14597	25.3
Lovell	0.78	14340	24.5
Almond	0.72	16880	26.7
Summary of all varieties			
Nemaguard	1.04	11793	26.2
Lovell	1.02	11469	25.2
Almond	0.98	11926	24.7