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Project No. 90-L17 - 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 and on selected varieties in older plots where additional information is needed. (2) Make further cross-pollinations in an effort to learn the pollen compatibility of new varieties and to identify the fourth incompatibility group from Nonpareil X Mission progeny and to determine what varieties are in it. (3) Continue collection of yield and tree size data from rootstock plots. Begin determining yield efficiency of various rootstocks used for almond. (4) Summarize and analyze the data associated with this project and publish this information as appropriate.

Interpretive Summary:

Yields in the northern Regional Variety Trials (RVT) were generally quite high in 1990, while those in the southern plots were considerably lower. We are not sure why the yields in the two southern plots were this low, but it may be related to soil conditions or previous crops. Price was low yielding in most of the trials this year. This was partly due to Price's known tendency to bear heavy crops in alternate years, though it was also low in some plots where it did not produce heavily in 1989. Continuing studies to determine the pollen cross-compatibility of newer varieties gave preliminary information on several varieties that are pollen compatible with Aldrich and Woods Colony.

Yield and tree size measurements were taken in rootstock plots in Colusa and Fresno counties. Generally trees on peach-almond hybrid were larger than those on peach, but yields were not necessarily higher on peach-almond rooted trees. Of the newer varieties Aldrich and Sonora showed good compatibility on Marianna 2624 rootstock in preliminary data. While Butte also is showing good compatibility to date in this test, in the past it has sometimes shown partial incompatibility.

Experimental Procedure:

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

Results and Discussion:

Regional Variety Trials (RVT)

In the Kern RVT, Fritz, Carrion, Nonpareil, Butte and Carmel had the highest yields in the 1974 planting, while Price had relatively low production (Table 1). In the 1981 planting, Mission, Sauret 2, Livingston and Nonpareil were the highest producing this year, while Bonita, Monarch and Sauret 1 were the lowest yielding. Fritz, Livingston, Sauret 1, Solano and Jeffries all had 10% or more Navel Orangeworm damage. Mission was the only variety harvested that had many double kernels, which is somewhat characteristic of Mission. As was the case with this trial in 1989, the kernel size was smaller this year than in other plots, possibly the result of an inherent water penetration problem.

In the RVT at California State University at Chico, Nonpareil, Padre and Sonora were very high producing in 1990 following a light, rain-damaged crop in 1989 (Table 2). Carrion and Price were the lowest yielding of the varieties on which data were taken in 1990. Price, Carrion and Mission all had more than 10% double kernels.

At the San Joaquin Delta College RVT almost all varieties yielded very well in 1990 with Mono, Tokyo, LeGrand and Mission being the highest producing of those planted in 1978 (Table 3). In this planting Price was the only variety to yield less than 2000 pounds on a per acre basis this year. In the 1984 planting, Rosetta was the highest producing, while Pearl was poor yielding and the other five varieties were intermediate and similar in production. Pearl and Valenta had a very large number of double kernels with 44 and 38 percent respectively. Other varieties having more than 10 percent double kernels were Ne Plus Ultra, Dottie Won, Carmel, Sauret 2, Price and Peerless. Sauret 1 had 10 percent Navel Orangeworm damage and was the only variety to have such damage from this pest.

In the RVT at California State University at Fresno the yields were generally disappointing. However, Milow had a very good yield, followed by Thompson, Ruby, Sauret 2 and Bonita, while Grace, Planada, Price and Yosemite were the lowest producing varieties (Table 4). Price, Monterey, Merced, Valenta and Carmel all produced 10 percent or more double kernels in 1990.

Pollination

Two new varieties, Aldrich and Woods Colony, were cross-pollinated with several other varieties to learn more about their cross-compatibility characteristics. In 1990 Woods Colony showed cross-compatibility with Nonpareil, Carmel and Sonora and possible cross-compatibility with several other varieties. Aldrich showed probable cross-compatibility with Fritz and Monterey. These results will need to be confirmed in 1991. In addition Monterey was confirmed to be in the fourth pollination group of varieties originating from Nonpareil X Mission parents. No other named varieties are currently known to be in this group.

Table 1
Kern RVT Plot
McFarland, California
Yield Summary - 1990

Variety	No. of nuts/tree	Ave. wt. (gm)	Kernel no./ oz.	% Kernel	Weight lb/ tree	Weight lb/ acre
Planted 1974, 1976						
Early blooming varieties						
Sonora	8464	1.00	28		18.6	1412
Mid blooming varieties						
Fritz	15456	0.83	34		28.4	2160
Nonpareil	11301	0.99	29	70	25.0	1902
Carmel	11882	0.93	30		24.4	1855
Solano	12916	0.76	37		21.6	1645
Jeffries	11217	0.83	34		20.6	1567
Price	9138	0.82	35		16.5	1252
Late blooming varieties						
Carrion	13966	0.88	32		27.2	2064
Butte	16585	0.67	42		24.5	1862
Ruby	13364	0.79	36		23.2	1760
Mission	12164	0.79	36		21.2	1608
Padre	13337	0.71	40		21.0	1596
Planted 1981						
Mid blooming varieties						
Sauret #2	10599	0.95	30	61	22.2	1684
Nonpareil	9759	0.99	29	69	21.4	1623
Monterey	7084	1.07	26	49	16.7	1270
Sauret #1	7065	0.87	33	65	13.5	1025
Monarch	7036	0.85	34	52	13.1	997
Bonita	5427	0.82	34	68	9.8	749
Late blooming varieties						
Mission	13254	0.81	35	43	23.6	1793
Livingston	10867	0.91	31	62	21.7	1650
Yosemite	11744	0.82	34	52	21.2	1613
Mono	11014	0.79	36	46	19.2	1462
Tokyo	7995	0.85	33	48	15.0	1144

Table 2

Butte RVT Plot
California State University, Chico (CSUC)
Durham, California
Yield Summary - 1990
Planted 1976

Variety	No. of nuts/tree	Ave. wt. (gm)	Kernel no./ oz.	% Kernel	Weight lb/ tree	Weight lb/ acre
Early blooming varieties						
Sonora	22304	0.96	29	74	47.4	3602
Mid blooming varieties						
Nonpareil	21634	1.12	25	66	53.3	4052
Fritz	18538	0.92	31		37.8	2870
Carmel	16815	0.98	29	55	36.4	2767
Price	14013	0.92	31	57	28.5	2165
Late blooming varieties						
Padre	25256	0.87	33	51	48.2	3664
Mission	17278	0.92	31		34.9	2652
Carrion	9501	1.13	25		23.7	1799

Table 3

San Joaquin RVT Plot
Delta College
Manteca, California
Yield Summary - 1990

Variety	No. of nuts/tree	Ave. wt. (gm)	Kernel no./ oz.	% Kernel	Weight lb/ tree	Weight lb/ acre
1978 Planting						
Early blooming varieties						
Sonora	14398	1.23	23		39.1	2972
Ne Plus Ultra	12531	1.37	21		37.8	2872
Jordanolo	9782	1.71	17		36.8	2796
Peerless	11037	1.10	26		26.8	2034
Mid blooming varieties						
Sauret #1	17360	1.02	28		39.0	2961
Carmel	16410	1.07	26		38.6	2936
Nonpareil	15226	1.14	25	71	38.2	2907
Sauret #2	15510	1.10	26		37.6	2859
Fritz	18627	0.90	32		37.0	2809
Monterey	14281	1.12	25		35.2	2675
Price	8916	1.19	24		23.4	1775
Late blooming varieties						
Mono	21724	0.97	29		46.4	3530
Tokyo	18100	1.04	27		41.6	3160
LeGrand	20304	0.93	31		41.4	3150
Mission	19391	0.96	29		41.2	3136
Butte	21079	0.85	34		39.3	2988
Livingston	16138	1.09	26		38.6	2936
Ruby	15640	1.03	28		35.4	2694
Padre	17906	0.88	32		34.8	2646
Thompson	12751	1.09	26		30.8	2337
1984 Planting						
Rosetta	9369	1.28	22	52	26.4	2003
Dottie Won	10208	1.04	27	49	23.5	1786
Aldrich	10881	0.94	30	58	22.6	1721
Valenta	11077	0.91	31	50	22.2	1685
Woods Colony	8522	1.15	25	64	21.6	1639
Jeffries	8659	1.10	26	72	21.1	1602
Pearl	4208	1.02	28	49	9.4	718

Table 4

Fresno RVT Plot
California State University, Fresno (CSUF)
Fresno, California
Yield Summary - 1990
Planted 1981

Variety	No. of nuts/tree	Ave. wt. (gm)	Kernel no./ oz.	% Kernel	Weight lb/ tree	Weight lb/ acre
Early blooming varieties						
Ne Plus Ultra	5840	1.20	24	60	15.5	1178
Jordanolo	4822	1.32	22	63	14.0	1063
Janice	5906	1.02	28	63	13.2	1005
Peerless	4600	1.09	26	34	11.0	839
Sonora	2881	1.29	22	67	8.2	621
Mid blooming varieties						
Milow	12946	0.93	31	69	26.4	2008
Sauret #2	7574	1.01	28	57	16.9	1284
Bonita	8621	0.89	32	60	16.8	1280
Sauret #1	7109	0.97	29	61	15.2	1155
Elsie	5780	1.17	24	56	15.0	1137
Sorrenti	6732	1.00	28	59	14.9	1130
Fritz	7292	0.89	32	48	14.3	1087
Monterey	5054	1.28	22	45	14.3	1087
Nonpareil	5942	1.10	26	62	14.2	1079
Hoover	6468	0.99	29	62	14.1	1073
Norman	7403	0.82	35	67	13.3	1014
Jeffries	5509	1.05	27	66	12.8	973
DB-OJ	6339	0.89	32	48	12.4	943
Merced	4575	1.16	24	61	11.7	889
Heart	3872	1.36	21	80	11.6	885
Lodi	5863	0.86	33	47	11.1	841
Solano	4879	1.01	28	60	10.9	827
Carmel	3879	1.08	26	51	9.2	699
Valenta	4169	0.99	29	52	9.1	691
Monarch	3345	1.04	27	47	7.7	584
Price	2333	1.08	26	55	5.6	422
Grace	1479	0.95	30	52	3.1	236
Late blooming varieties						
Thompson	8552	1.00	28	59	18.8	1427
Ruby	7775	0.99	28	53	17.0	1292
Butte	8342	0.84	34	54	15.4	1168
Tokyo	7425	0.89	32	42	14.6	1107
Padre	8211	0.79	36	44	14.2	1081
Ripon	6567	0.93	30	44	13.5	1028
Livingston	5452	1.11	25	60	13.4	1016
Mission	6129	0.97	29	46	13.0	985
Tioga	7174	0.77	37	56	12.2	928
Mono	5184	1.04	27	46	11.9	905
LeGrand	4896	0.90	32	61	9.7	738
Yosemite	2287	1.14	25	53	5.7	435
Planada	1602	1.35	21	43	4.8	362

Rootstock Plots

In the twelve-year-old Colusa County (Nickels) plot the trees on peach-almond hybrid rootstock were generally larger in size than those on the other rootstocks and had high total yields (Table 5). Nemaguard also had very good yields with almond seedling often intermediate and Lovell and Marianna 2624 lower. When compared for yield efficiency (nuts/cross sectional area of the trunk); however, the picture is somewhat different. On this basis, Nemaguard is the outstanding rootstock for all three varieties with the highest yields per given size. Almond seedling and Bright's Hybrid ranked next, but both Hansen Hybrids, Lovell and Marianna were lower in yield efficiency.

At the Fresno County plot trees in their fifth growing season on peach-almond hybrid tended to be larger and generally out yielded those on peach. However, when tree size was factored out, there was no difference between rootstocks in production for Nonpareil, but with Fritz, trees on peach-almond hybrids still out-produced those on peach. Trees on Nemaguard tended to out yield those on Lovell even though Lovell had produced slightly larger trees.

In the Merced County plot there was little difference in tree size as affected by rootstock after one year in the orchard. However, greater differences are expected to the future.

1978 planting of six varieties on Marianna 2624 (Nickels, Colusa County). In 1990 Mission trees were the highest producing followed by Padre, Carmel, Price, and Butte; with little difference between the last four. When comparing the average for the years 1986-89, Mission again has been the highest yielding followed closely by Padre. During these four years the other varieties (Carrion, Carmel, Butte, and Price) yielded similarly, but a little, though not significantly, less than Mission and Padre.

1982 planting of thirteen varieties on Marianna 2624 (Nickels, Colusa County). Table 6 gives yield, trunk circumference, compatibility and survival data for this planting. There was a graduation in yield for both the 1990 and six year average data. However, the two sets of data are not that comparable, thus additional yield data will be needed to better sort out differences among varieties in this trial. One must realize that some of the differences in yield in this planting may be related to differences in the varieties themselves and not only to compatibility with Marianna 2624. There were not large differences in trunk circumferences; although Dottie Won produced a somewhat smaller tree. Also this variety and Monarch had the lowest compatibility ratings. Since only live trees are used for evaluations, previous tree loss is also important. Significant tree losses have occurred with Mono, Dottie Won and Monterey.

1986 planting of nine varieties on Marianna 2624 (Nickels, Colusa County). The 1990 yield, trunk circumferences and compatibility ratings are given in Table 7. Butte, Aldrich and Sonora had the heaviest yields while Solano, Grace and Valenta had the poorest production in 1990. Butte, Sonora and Aldrich were the largest trees in the planting with all other varieties being similar in size. Solano and Valenta had relatively poor compatibility ratings, while all other varieties generally showed good compatibility. All three Pearl trees died several years ago.

1989 planting of almond on various Marianna rootstocks (Nickels, Colusa County). Several selections of Marianna and other plum rootstocks are being tested with both Nonpareil and Mission to determine compatibility with almond. For Nonpareil none of the rootstocks look very encouraging with Marianna 2624 (a known incompatible combination) currently surviving best, while selections 75 and 16 show very limited promise. With Mission, Marianna 2624, selections 16, 40 and 65 and

Table 5. 1990 yield and tree size as affected by rootstock for three varieties. Planted in 1977. Nickels Soil Laboratory, Arbuckle.

Rootstock	n	Nonpareil Nuts per Tree Pounds	Number	Trunk Cir. cm	Nuts/Cross-Sectional Area of Trunk
Bright	8	3130 a	20,600 a	95.2 ab	28.9 ab
Hansen 2168	7	2980 ab	17,560 ab	101.2 a	21.4 d
PA 1-82	8	2960 ab	18,240 ab	96.3 ab	24.8 abcd
Nemaguard	8	2950 ab	17,960 ab	87.3 bc	29.9 a
Hansen 536	7	2630 ab	17,700 ab	101.0 a	21.8 d
Almond	8	2570 abc	15,500 bc	83.9 c	27.6 abc
Lovell	6	2100 bc	12,620 cd	84.3 c	22.8 cd
Havens 2B/mar	7	1730 c	10,940 d	74.8 d	24.6 bcd
Rootstock	n	Mission Nuts per Tree Pounds	Number	Trunk Cir. cm	Nuts/Cross-Sectional Area of Trunk
PA 1-82	7	2500 a	17,900 a	87.3 ab	30.4 bc
Hansen 2168	7	2370 ab	17,840 a	91.4 a	26.0 c
Nemaguard	8	2260 ab	17,100 a	77.8 cd	38.2 a
Hansen 536	7	2260 ab	17,110	88.1 ab	25.7 c
Bright	7	2180 ab	16,390 a	80.0 bcd	32.6 ab
Lovell	6	2130 ab	16,020 a	84.4 ab	29.6 c
Almond	6	1990 ab	15,000 a	74.4 d	34.1 ab
Marianna	8	1740 b	13,400 a	81.6 bcd	25.3 c
Rootstock	n	Ne Plus Ultra Nuts per Tree Pounds	Numbers	Trunk Cir. cm	Nuts/Cross-Sectional Area of Trunk
PA 1-82	8	2540 a	12,075 a	88.6 a	19.4 b
Nemaguard	8	2490 a	11,955 a	77.6 c	25.1 a
Hansen 2168	6	2450 a	12,160 a	90.7 a	18.9 bc
Hansen 536	8	2435 a	12,070 a	86.0 ab	20.7 b
Almond	7	1950 ab	10,905 ab	79.8 bc	21.9 ab
Red Lv Nema	7	1940 ab	9,620 ab	76.8 c	20.5 b
Marianna	7	1840 ab	9,400 ab	85.6 ab	15.0 c
Lovell	7	1640 b	8,520 b	76.1 c	20.3 b

Table 6. 1982 planting to study almond variety compatibility on Marianna 2624. Nickels, Colusa County.

Variety	1990 Yield (lbs/tree)	Average Yield 1985-1990 (lbs/tree)	Trunk Circ. (cm) May 1990	Compatibility rating* Oct. 1990	Percent Trees Alive
LeGrand	15	7	56	4.0	100
Livingston	14	7	60	3.0	100
Monarch	13	5	55	2.2	100
Mission	13	8	55	3.7	100
Mono	13	6	57	3.2	63
Monterey	12	9	61	3.6	75
Ripon	12	6	57	3.8	100
Fritz	12	9	58	3.5	100
Ruby	12	8	54	3.7	100
Dottie Won	11	4	50	2.7	75
Sauret 2	10	7	54	3.3	100
Norman	10	5	58	3.4	100
Planada	10	7	61	3.0	100

*4 = good trees; 3 = fairly good trees; 2 = mediocre trees; 1 = poor trees.

Table 7. 1986 planting to study almond variety compatibility on Marianna 2624. Nickels, Colusa County.

Variety	1990 Yield (lbs/tree)	Trunk Circ. (cm) May 1990	Compatibility Rating* Oct. 1990
Butte	6.4	34	2.4
Aldrich	6.0	33	2.5
Sonora	5.5	34	2.4
Monterey	4.6	29	2.6
Woods Colony	4.5	29	2.3
Bonita	4.3	29	2.3
Valenta	3.5	27	1.9
Grace	2.6	29	2.4
Solano	2.4	28	1.5

*3 = good trees; 2 = mediocre trees; 1 = poor trees.

Corotta Marianna all currently look very good followed closely by selections 75 and 69. However, Mission has done poorly on Salicina plum and Marianna selections 30 and 9.

1989 interstock trial (Butte County and Nickels, Colusa County). In an effort to determine if longer interstocks of Havens 2B between Nonpareil and Marianna 2624 will give better compatibility than shorter interstocks, two trials were initiated. A second objective was to determine if long interstocks of compatible almond varieties would also work as well or possibly even better than Havens 2B. Some field budding and grafting is still being done, and thus, no data have been taken from these trials.