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Project No.: 97-WM-02 - Field Evaluation of Almond Varieties & Rootstocks

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Objectives:

1. Three new Regional Almond Variety Trials were planted in 1993. Bloom, harvest and nut data will be collected in 1997. Trees will be observed and evaluated for growth, pest and disease susceptibility and noninfectious bud failure symptoms, as appropriate.
2. Make further cross-pollinations to identify the pollen compatibility of newer varieties as well as important older varieties where this information is still lacking.
3. Continue collection of yield and tree size data from the rootstock evaluation plot in Merced County. Complete planting of new Regional Rootstock Trials in Butte, Colusa, Kern and San Joaquin Counties. Continue obtaining information on varietal compatibility and/or interstem studies with Marianna 2624 plum in Colusa and Butte Counties.
4. Summarize and analyze data associated with this project and publish and otherwise disseminate this information as appropriate.

Abstract:

Three new Regional Almond Variety Trials (RAVTs) were planted in 1993 in Butte, Kern and San Joaquin Counties. With the good bloom time weather in 1997, many varieties produced very good crops for trees in their fifth growing season, especially in the Kern County trial. In 1997 a number of varieties produced a high percentage of double kernels in all of these RAVTs. However, with trees only in their fifth growing season, it is probably too soon to draw any conclusions on production or

kernel defects.

Studies showed that Wood Colony was cross-compatible with both Rosetta and Fritz and probably with Aldrich. While Rosetta pollen set nuts on Price and Aldrich the reverse crosses did not perform well.

In a rootstock trial in Merced County, Nonpareil trees had the highest yield (though not always significantly higher) on Hansen Hybrid, while Carmel trees had the highest production on Bright's Hybrid. A new series of Regional Rootstock Trials are being established. In 1997 trials were planted in Colusa and Kern Counties. The remaining two trials in Butte and San Joaquin Counties are scheduled to be planted in early 1998.

Experimental Procedures:

Three RAVTs were planted in 1993 at Paramount Farming Company in Kern County, California State University - Chico farm in Butte County, and San Joaquin Delta College farm in San Joaquin County. All three trials were planted the same year and have essentially the same variety composition; so any differences in varietal performance among various regions should become evident.

Peach seedling rootstocks (Lovell for the Butte County trial and Nemaguard for the two RAVTs in the San Joaquin Valley) were used. The trial in Kern County is on Milham sandy loam soil and is irrigated with micro-sprinklers. The Butte County trial is on Vina loam soil and is irrigated with solid-set sprinklers. The San Joaquin County trial is on Delhi loamy sand and is flood irrigated. Probably as a result of the coarse textured soil and flood irrigation, the trees in this latter trial are generally somewhat smaller than those in the other two RAVTs.

Standard varieties are planted 1:1 with new varieties; Nonpareil for the early and mid blooming varieties and Mission for the late blooming varieties, for comparison and to ensure adequate pollination. In addition single rows of each of seven "new standard" varieties (other varieties commonly planted today) are included for comparison. These seven varieties are Butte, Carmel, Fritz (not in the Butte plot), Monterey, Padre, Price and Sonora.

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

Results and Discussion:

Regional Almond Variety Trials. In the early bearing years tree spacing can have a significant impact on production per acre. Trees per acre vary in these RAVTs with 86 trees per acre in the Kern County trial, 64 trees per acre in the Butte County trial and 75 trees per acre in the San Joaquin County trial. In 1997 no trees affected with noninfectious bud failure were found in any of the trials.

The Kern County trial is located in a Paramount Farming Company orchard near Shafter. With 86 trees per acre in this trial, the per acre yields were generally quite high. Jenette produced just over 3000 kernel pounds per acre and was followed by Plateau, Nonpareil, Ruby, Butte and selection 2-19E, all producing over 2300 kernel pounds per acre (Table 1). In this trial in 1997 Kapareil and Donna were the only varieties to produce under 1000 kernel pounds per acre.

The following varieties in The Kern County trial produced 20% or more double kernels: Donna (highest with 42%), Sano, Monterey, Kahl, Carmel, selection 2-43W and Wood Colony. Varieties that produced between 19 and 10% double kernels were Mission, Butte, Fritz, Price, Livingston, Plateau, Aldrich, Jiml, selection 2-19E, Ruby and selection 25-75. Price with 12% was the only variety in this trial to produce more than 10% twin kernels (two kernels within the same pellicle). Donna, Sano, Kahl and Price had 10% or more blank kernels. Monterey, Price, Chips and Sano had 10 to 6% worm damage, mostly caused by ants and navel orangeworm (NOW).

In the Butte County trial located at the California State University, Chico farm, with 64 trees per acre, selection 13-1 produced over 2000 kernel pounds per acre and Aldrich, selection 2-43W, and Monterey all yielded better than 1500 kernel pounds per acre (Table 2). Sonora, selection 25-75 and Kahl were the lowest yielding varieties. Kahl also had the lowest shelling percentage of any variety in this trial.

In this Butte County trial the following varieties had 20% or more double kernels: Kahl (highest with 48%), Plateau, Monterey, Donna, Sano, Price and Carmel. In addition Wood Colony, Aldrich, Jiml, selection 25-75, Mission and Ruby had between 18 and 10% double kernels. Price had 12% twin kernels and Donna had 14% blank kernels, the only varieties to have over 10% for these defects. Price and Jenette had 6% ant damage, the only varieties to have over 5% of any kind of worm damage in this trial.

At the San Joaquin County trial located at the San Joaquin Delta College farm near Manteca, with 75 trees per acre, Carmel produced over 2100 kernel pounds per acre (Table 3). Fritz, Butte and selection 13-1 were the next highest producing with between 1700 and 1500 kernel pounds per acre for these fifth-leaf trees. However, selection 25-75, Kapareil, and selections 1-102W and 1-87 all produced less than 500 kernel pounds per acre.

In this trial, Sano (highest with 32%), Plateau and Kahl were the only varieties to have more than 20% double kernels. However, Wood Colony, Fritz, Aldrich, Donna, selection 25-75, Monterey, Price and Dottie Won had between 18 and 10% double kernels. Price, Carmel, and selections 1-87, and 25-75 all had 10% or more twin kernels. Johlyn, Morley and Fritz were the only varieties to have 10% or more blank kernels, and Livingston and Johlyn had 10 and 8% kernels with gum respectively. Chips, Kapareil, Fritz, Jiml, Johlyn, Plateau and selection 2-19E had 12 to 6% worm damage. Most of this damage was caused by NOW and may be the result of later than desirable harvest for some of these varieties.

Pollination. Studies on the pollen cross-compatibility of a number of varieties, especially newer varieties, were continued. Wood Colony showed cross-compatibility (both directions) with both Rosetta and Fritz and probable cross-compatibility with Aldrich. While Rosetta pollen set nuts on both

Price and Aldrich, the reverse crosses of the pollen of either these latter two varieties on Rosetta did not perform well (set very few nuts).

Rootstock Trials. Trees of six rootstocks growing in a sandy soil in Merced County were again compared in 1997, their ninth growing season. The rootstocks being evaluated were Nemaguard, Red-Leafed Nemaguard, Lovell and Halford peach seedlings and Bright's and Hansen peach-almond hybrids. With Nonpareil, trees on Hansen Hybrid were the highest producing, and were significantly higher yielding than those on Red-Leafed Nemaguard and Lovell. Trees on Nemaguard, Bright's Hybrid and Halford also produced significantly more than trees on Red-Leafed Nemaguard (Table 4). With Carmel, trees on Bright's Hybrid significantly out-produced those on all the other rootstocks, while trees on Red-Leafed Nemaguard had the lowest yield.

When comparing rootstocks for accumulative production (1992-97) in this trial (Table 4), the results are quite similar to the 1997 yields for the various rootstocks with the two varieties. Trees on the two Hybrid rootstocks and Nemaguard peach had the highest accumulated yields for both varieties; although, the order of production for these rootstocks varied with the two varieties. Trees on Hansen Hybrid had the highest yields for Nonpareil, while those on Bright's Hybrid had the highest production for Carmel.

A series of four Regional Rootstock Trials for almond are being established. Two trials were planted in 1997 in Colusa and Kern Counties. The two remaining trials will be planted in early 1998 in Butte and San Joaquin Counties. The following seven rootstocks will be compared in these trials: Atlas, Bright's Hybrid, Hansen, Viking and 1-82 hybrid rootstocks plus Nemaguard and Lovell peach seedling rootstocks as the control treatments. A new peach rootstock, Guardian, will be included in the 1998 trials; this rootstock was not available for the 1997 plantings.

Marianna 2624 Plum. This rootstock is used for almond because of its tolerance to oak root fungus and heavy, wet soils. Not all varieties are compatible on this rootstock, and those that are compatible tend to produce smaller, less vigorous trees that should be planted closer together than trees on peach rootstocks. Trees on Marianna 2624 are more susceptible to bacterial canker than peach rootstocks and they often produce root suckers and overgrowth at the union with many almond varieties.

Trials to determine the compatibility of various almond varieties on Marianna 2624 plum rootstock have been conducted at the Nickels Soil Laboratory near Arbuckle for more than fifteen years. Two trials, one completed and one continuing, have shown apparent compatibility of the following varieties on Marianna 2624: Aldrich, Fritz, LeGrand, Norman, Ripon, Ruby and possibly Wood Colony. Previous studies have shown that Carmel, Merced, Mission, Ne Plus Ultra, Padre, Peerless, Price and Thompson were compatible on Marianna 2624. The compatibility of Butte, Monterey and Sonora on this rootstock is questionable, but there are successful orchards of these varieties on Marianna 2624. Besides Nonpareil, incompatible varieties include Dottie Won, Kapareil, Milow, Mono, Solano and possibly Livingston.

Sometimes even compatible varieties show incompatibility symptoms on Marianna 2624, especially during the second and third growing seasons. Such affected trees often recover the following year and, though smaller, appear normal in future years. A few of the affected trees may die. Thus,

even the most compatible varieties on Marianna 2624 may at times express incompatibility.

To overcome the incompatibility of Nonpareil on Marianna 2624 an interstock of Havens 2B, a plum that is compatible with both Nonpareil and Marianna 2624 can be used. Such interstock trees have had variable performance. Observations have indicated that this varying performance might be due to the length of the interstock, with trees having shorter interstocks doing poorly.

Thus, two trials were established in 1989 to determine if longer interstocks (8-10 inches or scaffold budding) of Havens 2B plum between Nonpareil and Marianna 2624 improved compatibility over shorter (4 inch) interstocks. A second objective was to determine if a long interstock (8-10 inches or scaffold budding) of a compatible almond variety would work as well or perhaps even better than Havens 2B (previous reports on the use of compatible almond interstocks were conflicting). Mission and Jordanolo were used as the compatible almond varieties in these trials.

One trial was conducted on a deep loam soil at California State University, Chico in Butte County. In this trial scaffold budding of Jordanolo, Havens 2B and Mission and 8-10 inch interstocks of Jordanolo have so far been the most vigorous and have shown acceptable compatibility. Surprisingly the control trees of Nonpareil directly on Marianna 2624 are still growing fairly well after nine years, even though this combination is considered incompatible.

The other trial at the Nickels Soil Laboratory is planted on 18 to 24 inches of gravelly loam soil over a heavy clay layer and, thus, has been subjected to greater stress. In this trial, all of the Havens 2B interstocks have performed the best with the longer interstocks producing better trees than the shorter ones. Scaffold budding of Jordanolo has so far also performed fairly well and is producing better trees than other compatible almond treatments. On this shallow soil Nonpareil directly on Marianna 2624 grew satisfactorily for a couple of years, but eventually the trees either died or performed poorly.

Dissemination of Information:

In an effort to make information developed from this project available to almond growers and others associated with this industry, approximately ten presentations related to this project were made during 1997. A booklet on the 1997 results from the new RAVTs was published and distributed at the Almond Research Conference and at other meetings (a copy is included with this report). Several articles and reports related to this project have also been published.

Table 1. 1997 Yield Summary for the Regional Almond Variety Trial at Paramount Farming Company, Shafter, Kern County. Planted in 1993

Variety	No. of Nuts/Tree	Average Kernel Weight (g)	Shelling %	Kernel Pounds Per	
				Tree	Acre ¹
Jenette	14413	1.13	68.7	35.9	3085
Plateau	11452	1.16	56.5	29.4	2525
Nonpareil	11541	1.11	66.6	28.2	2428
Ruby	11540	1.10	51.6	28.1	2413
Butte	14080	0.90	54.5	27.9	2400
2-19E	12746	0.97	52.7	27.3	2347
Aldrich	12739	0.92	60.2	25.9	2230
Johlyn	10109	1.15	66.5	25.5	2195
Monterey	9254	1.25	49.6	25.4	2184
Rosetta	10130	1.13	52.4	25.2	2164
1-102W	8235	1.37	64.8	24.9	2143
13-1	10640	1.03	53.5	24.1	2076
2-43W	10241	1.06	59.4	23.9	2056
Livingston	9517	1.09	61.4	22.9	1972
Mission	9650	1.07	44.6	22.7	1949
Carmel	8209	1.25	60.8	22.6	1944
Kahl	9260	1.06	47.1	21.5	1852
Fritz	8262	1.09	52.2	19.8	1706
Padre	7864	1.09	60.1	18.9	1624
1-87	11131	0.76	55.2	18.6	1598
Jiml	6325	1.31	63.5	18.2	1565
Wood Colony	7495	1.09	57.9	18.0	1545
Yokut	6189	1.30	55.0	17.7	1519
Chips	7794	0.96	54.7	16.5	1417
Sano	4564	1.56	55.3	15.6	1345
Sonora	5628	1.23	72.2	15.3	1315
25-75	6836	0.91	61.3	13.8	1184
Price	5143	1.15	61.7	13.0	1118
Morley	5009	1.15	50.1	12.7	1091
Savana	4943	1.08	62.1	11.7	1008
Donna	3791	1.07	52.6	8.9	766
Kapareil	4206	0.92	66.3	8.5	733

¹Based on a spacing that gives 86 trees per acre.

Table 2. 1997 Yield Summary for the Regional Almond Variety Trial at California State University—Chico Farm, Butte County. Planted in 1993

Variety	No. of Nuts/Tree	Average Kernel Weight (g)	Shelling %	Kernel Pounds Per	
				Tree	Acre ¹
13-1	14301	1.03	53.5	32.4	2076
Aldrich	12586	1.02	55.2	28.3	1813
2-43W	10625	1.08	60.3	25.2	1615
Monterey	7858	1.39	44.7	24.0	1535
Livingston	8250	1.25	68.4	22.6	1449
Nonpareil	8505	1.19	64.3	22.3	1427
2-19E	9163	1.01	51.2	20.3	1299
1-87	10707	0.86	55.3	20.2	1295
1-102W	6480	1.39	61.5	19.8	1266
Carmel	6632	1.33	56.3	19.4	1240
Plateau	6155	1.40	49.8	19.0	1215
Ruby	6645	1.29	54.4	18.9	1208
Butte	8369	0.99	54.4	18.3	1169
Kapareil	8433	0.95	71.1	17.6	1129
Morley	7250	1.08	56.8	17.2	1102
Savana	6554	1.17	68.8	16.9	1079
Johlyn	6750	1.10	68.2	16.4	1047
Rosetta	5582	1.32	51.4	16.2	1039
Sano	5429	1.35	54.2	16.2	1036
Padre	6473	1.11	54.0	15.8	1013
Wood Colony	5707	1.22	58.6	15.3	978
Mission	5713	1.17	44.5	14.7	941
Price	5654	1.17	61.9	14.5	931
Donna	5920	1.09	52.6	14.3	913
Jiml	4601	1.35	60.8	13.6	873
Jenette	5024	1.23	67.1	13.6	868
Chips	5395	1.07	54.1	12.8	817
Yokut	4074	1.33	54.0	12.0	765
Kahl	4582	1.04	37.8	10.5	672
25-75	5097	0.93	58.0	10.4	668
Sonora	2222	1.58	69.6	7.7	494

¹Based on a spacing that gives 64 trees per acre.

Table 3. 1997 Yield Summary for the Regional Almond Variety Trial at San Joaquin Delta College Farm, Manteca. Planted in 1993.

Variety	No. of Nuts/Tree	Average Kernel Weight (g)	Shelling %	Kernel Pounds Per	
				Tree	Acre ¹
Carmel	10997	1.16	60.4	28.1	2111
Fritz	9946	1.03	56.8	22.6	1692
Butte	11095	0.89	56.8	21.8	1631
13-1	10303	0.96	57.1	21.3	1591
Rosetta	7035	1.14	47.0	17.6	1323
Monterey	7068	1.13	56.2	17.5	1315
Jenette	7930	1.00	68.8	17.5	1313
Yokut	6529	1.19	59.1	17.2	1288
Dottie Won	8951	0.87	51.2	17.2	1287
Ruby	6511	1.18	54.6	17.0	1274
Sano	5959	1.23	52.7	16.2	1213
Plateau	5858	1.24	50.7	16.0	1198
Nonpareil	6680	1.06	69.7	15.5	1165
Wood Colony	5802	1.18	66.5	15.1	1131
Donna	6724	0.90	55.8	13.3	1000
Price	6324	0.91	64.8	12.6	947
Aldrich	6300	0.90	55.6	12.5	937
Chips	5890	0.95	55.9	12.3	920
Mission	4390	1.13	48.6	10.8	813
Kahl	4742	0.97	45.6	10.1	757
Livingston	3264	1.27	70.7	9.1	683
Johlyn	3403	1.13	78.1	8.5	634
Padre	3262	1.07	57.1	7.7	579
Morley	3198	1.06	53.7	7.5	559
Jiml	2865	1.13	75.0	7.1	534
2-19E	3138	0.97	55.7	6.7	503
1-87	3367	0.87	61.5	6.5	486
1-102W	2120	1.31	62.0	6.1	457
Kapareil	2528	0.86	65.8	4.8	361
25-75	1293	0.90	59.7	2.6	192

¹Based on a spacing that gives 75 trees per acre.

Table 4. 1997 and 1992-97 Accumulated Yield Data for Almond Rootstock Trial Planted in 1989, Arnold Farms, Atwater, Merced County.

Rootstock	Nonpareil Yield Kernel Pounds/Acre		Carmel Yield Kernel Pounds/Acre,	
	1997	Accum. 1992-97	1997	Accum. 1992-97
Bright's Hybrid	1,682 ab ¹	7,144	2,508 a	10,064
Hansen Hybrid	2,117 a	7,928	2,002 b	8,132
Nemaguard	1,869 ab	7,619	1,630 b	7,134
Red-leafed Nemaguard	1,106 c	6,319	852 c	5,577
Halford	1,653 ab	6,934	1,603 b	6,816
Lovell	1,490 bc	6,300	1,486 b	6,041

¹Numbers within columns followed by the same letter are not significantly different at the 5% level.