

Almond Board of California
Annual Report
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Project No.: 98-WM-o2 Field Evaluation of Almond Varieties and Rootstocks

Project Leader: Mr. Warren Micke – (530) 752-2588
University of California
Department of Pomology
Davis, CA 95616

Cooperating Personnel: T. Gradziel, J. Yeager, M. Thorpe and D. Kester (UCD), J. Connell (Butte Co.), P Verdegaal (San Joaquin Co.), M. Viveros (Kern Co.), J. Edstrom (Colusa Co.), L Hendricks (Merced Co.), R. Watkins, R. Jacobs and J. Floyd (CSU, Chico), D. Dias, D. Rough and L. Sheffield (S. J. Delta College), Paramount Farming Company (Kern Co.), Nickels Estate Trustees (Arbuckle), Arnold Farms (Atwater) and Farm Advisors working with almonds in other counties.

Objectives:

1. Three Regional Almond Variety Trials were planted in 1993. Bloom, hullsplit, yield and nut quality data will be collected in 1998. Trees will be observed and evaluated for growth, pest and disease susceptibility, and noninfectious bud failure symptoms.
2. 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 interstock studies with Marianna 2624 plum in Colusa and Butte Counties.
3. Summarize and analyze data associated with this project and publish and otherwise disseminate this information as appropriate.

Abstract:

Three Regional Almond Variety Trials (RAVTs) were planted in 1993 at Paramount Farming Company in Kern County (Kern), California State University at Chico farm in Butte County (Butte) and San Joaquin Delta College farm near Manteca in San Joaquin County (Delta). With the marginal bloom time weather in 1998, the yields for many, but not all, varieties were rather poor for trees in their sixth growing season. The Kern County trial had the highest yields this year; however, this RAVT also has more trees

per acre (86) than the other two trials (Butte - 64 and Delta - 75 trees per acre). In the early bearing years tree spacing can have a significant impact on production per acre..

In 1998 a number of varieties had a considerable number of shriveled kernels regardless of the trial location. This shrivel may be caused by the cool, wet spring and early summer followed by a hot later summer that resulted in kernels not filling properly. To date no symptoms of noninfectious bud failure have been seen in any variety in any of the three trials.

In the Merced County rootstock trial, trees on Red-Leafed Nemaguard and the two peach-almond hybrids had the highest production in 1998 with both Nonpareil and Carmel. However, trees on Red-Leafed Nemaguard had low yields in 1997 and appear to be in a pattern of alternate bearing. The planting of the four new Regional Rootstock Trials was completed except for replanting where trees were lost or where a few trees were not available in 1998. For the two Nonpareil on Marianna 2624 interstock trials in Butte and Colusa Counties, scaffold budding of interstocks of Havens 2B and Jordanolo were performing better other interstocks.

Experimental Procedures:

Three RAVTs were planted in 1993 at Paramount Farming Company in Kern County (Kern), California State University, Chico farm in Butte County (Butte) and San Joaquin Delta College farm in San Joaquin County (Delta). All trials were planted in 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 trial and Nemaguard for the two San Joaquin Valley trials) were used. The Kern trial is on Milham sandy loam soil and is irrigated with micro-sprinklers. The Butte trial is on Vina loam soil and is irrigated with solid-set sprinklers. The Delta 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 trial), Monterey, Padre, Price and Sonora.

Four Regional rootstock trials were planted in 1997 and 1998, in Colusa (97), Kern (97), Butte (98) and San Joaquin (98) Counties. The rootstocks being compared are Atlas, Bright's, Hansen, Viking and 1-82 hybrid rootstocks and Lovell (not in the Kern trial) and Nemaguard peach seedling rootstocks. In addition Guardian a new peach

rootstock was included in the two 1998 plantings. The scion variety in these trials is Nonpareil except for the Kern trial where Butte was used.

The procedures used for variety and rootstock evaluation, including interstock trials for Nonpareil on Marianna 2624, were the same as in previous years.

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 trial, 64 trees per acre in the Butte trial and 75 trees per acre in the Delta trial.

To date no symptoms of noninfectious bud failure have been seen in any variety in any of the three RAVTs.

The Kern RAVT is located near Shafter. With 86 trees per acre in this trial, the following varieties all produced more than 2000 kernel pounds per acre: Plateau, Butte, Fritz, Ruby, selection 13-1 and Chip's (Table 1). In this trial Kapareil and Donna were the only varieties to produce under 1000 kernel pounds per acre.

In the Kern RAVT the following varieties produced over 20% double kernels in 1998: Plateau (highest with 44%), Donna, Aldrich, Mission, Kahl, Sano, Fritz, Monterey and selection 2-43W. Livingston, Ruby, Carmel and Padre produced between 14 and 10% double kernels. Selection 2-19E, with 14%, was the only variety to produce more than 6% twin kernels (two kernels within the same pellicle) in this trial. Sano, Donna, Kahl, Livingston and selection 2-43W had 16 to 10% blank kernels; while Jenette and Livingston had 14% kernels with gum. Kapareil with 10% and Livingston with 6% were the only varieties to have more than 4% worm damage; the damage on these two varieties was all caused by ants.

In the Butte RAVT located near Chico, the bloom time weather appeared to significantly reduced yields. Plateau was the only variety to produce more than 2000 kernel pounds per acre in this orchard planted at 64 trees per acre. The next two highest yielding varieties were Butte and Monterey with just over 1500 kernel pounds per acre (Table 2). The lowest yielding varieties were Kapareil and selections 1-102W and 2-19E, all producing under 500 kernel pounds per acre. As in 1997, Kahl again had the lowest shelling percentage in this trial.

In this Butte trial the following varieties had over 20% double kernels: Kahl (highest with 62%), Donna, Plateau, Mission, Monterey, Ruby and Jiml. Price, Sano, Carmel, selection 1-87, Jenette, Yokut and selection 2-43W had between 20 and 10% double kernels. Kahl, Donna, Yokut, Morley and Monterey had 18 to 10% blank kernels. In this RAVT the only varieties to have more than 4% worm damage were Kapareil

(10%), Sano (10%), and selections 13-1 (6%) and 1-102W (6%), and this damage was all caused by Ants.

In the Delta RAVT located near Manteca and planted at 75 trees per acre, Plateau and Butte produced over 2000 kernel pounds per acre (Table 3). Carmel, Ruby and Yokut were the next most productive varieties with nearly 1900 kernel pounds per acre. In this trial Kapareil, Savana and selection 13-1 produced well under 500 kernel pounds per acre.

In the Delta trial, Plateau (highest with 46%), Kahl, Price, Monterey and Sano had over 20% double kernels. Varieties having between 20 and 10% double kernels were Fritz, Aldrich, Donna, Wood Colony, selection 2-43W, Livingston, Dottie Won, Mission, Jiml and Padre. Following are varieties having 10% or more twin kernels: Sonora (highest with 26%), Price, Jiml, Nonpareil and Johlyn. In this RAVT Kahl had 22% blank kernels and Price, Jiml and Johlyn had between 16 and 10% blanks. Livingston and Savana with 20% and Fritz with 10% were the only varieties to have 10% or more kernels with gum. At the Delta trial the only varieties to have more than 4% worms were Kapareil (18%) and selection 13-1 (12%). The damage on these two varieties was caused by a combination of Navel Orangeworm and ants.

Rootstock Trials. Trees on six rootstocks growing in a sandy soil in Merced County were again compared in 1998, their tenth growing season. The rootstocks being compared were Nemaguard, Red-Leafed Nemaguard, Lovell and Halford peach seedlings and Bright's and Hansen peach-almond hybrids. With both Nonpareil and Carmel, trees on Red-Leafed Nemaguard and the two peach-almond hybrids had the highest production (Table 4). Red-Leafed Nemaguard trees had low yields in 1997 and appear to be in an alternate year bearing pattern in this trial. When the seven year accumulated yields are compared for Carmel, the two hybrid rootstocks have shown the greatest production (Figure 1). With Nonpareil there has not been a great difference in accumulated production among these six rootstocks, but Hansen Hybrid has shown the highest yields.

With both Nonpareil and Carmel, the two hybrid rootstocks have produced the largest trees based on trunk circumference (Table 4 and Figure 2). Among the four peach rootstocks, the differences in tree size have been small and inconsistent between the two varieties. It appears that the greater production of trees on the hybrid rootstocks over those on peach seedling rootstocks is probably a result of their greater size and not that trees on the hybrid rootstocks are inherently higher yielding. This was probably the final year for yield data collection from this trial.

A series of four Regional Rootstock Trials for almonds have been established. Two trials were planted in Colusa and Kern Counties in 1997. In 1998 two additional trials were planted in Butte and San Joaquin Counties. The seven rootstocks being evaluated in these trials are Atlas, Bright's, Hansen, Viking and selection 1-82 hybrid rootstocks and Nemaguard and Lovell peach seedling rootstocks. A new peach rootstock,

Guardian, was included in the 1998 trials (this rootstock was not available for the 1997 plantings). Guardian is reported to have some resistance to bacterial canker.

Two interstock trials were established in 1989 to determine if longer interstocks (8-10 inches or scaffold budding) of Havens 2B between Nonpareil and Marianna 2624 would improve compatibility as compared to 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. Mission and Jordanolo were used as the compatible almond varieties in these trials. One trial was located on a deep loam soil at California State University, Chico farm (Butte County) and the other on a shallow gravelly loam soil over a heavy clay layer at the Nickels Soil Laboratory (Colusa County).

After 10 years, scaffold budding of Havens 2B and Jordanolo have produced the best trees at both sites. Nonpareil directly on Marianna 2624 and 8-10 inch interstocks of Mission have give the poorest trees and the greatest tree loss. In almost every case the longer the interstock the greater the tree vigor.

Dissemination of Information:

In an effort to make information developed from this project available to almond growers and others associated with this industry, presentations related to this project have been given at a number of meetings. A booklet on the 1998 results from the new RAVTs was published and distributed at the Almond Research Conference, other meetings and through Almond Board and county Cooperative Extension offices (a copy is included with this report). Similar booklets were also published and disseminated for the 1996 and 1997 results. Several articles and reports related to this project have also been published.

Table 1. 1998 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
Plateau	8652	1.48	53.3	28.1	2419
Butte	13711	0.91	53.2	27.4	2353
Fritz	11912	0.99	56.0	26.0	2234
Ruby	9654	1.19	56.5	25.3	2180
13-1	10034	1.13	65.1	25.0	2152
Chip's	9044	1.17	60.6	23.3	2004
Nonpareil	7718	1.34	69.8	22.7	1963
2-19E	9556	1.07	52.6	22.6	1944
Johlyn	8763	1.17	73.8	22.5	1936
Monterey	7185	1.41	55.1	22.3	1914
Jiml	7858	1.27	61.4	21.9	1887
Padre	9051	1.10	55.2	21.9	1883
Morley	9799	1.01	48.6	21.8	1871
Yokut	7406	1.31	63.7	21.3	1835
Mission	8690	1.10	47.6	21.1	1816
2-43W	7945	1.19	60.9	20.9	1794
Price	8741	1.07	67.4	20.6	1772
Sano	6612	1.40	60.0	20.4	1754
Livingston	7282	1.27	70.5	20.3	1749
1-102W	6138	1.50	67.8	20.3	1742
Kahl	8020	1.11	59.0	19.6	1683
1-87	9307	0.90	54.2	18.5	1594
Jenette	5577	1.49	73.5	18.3	1574
Carmel	6226	1.21	67.3	16.6	1427
Aldrich	5844	1.17	56.6	15.1	1295
Savana	5783	1.16	68.6	14.8	1271
25-75	6573	0.91	57.7	13.2	1138
Rosetta	3624	1.64	52.7	13.1	1123
Sonora	4228	1.40	70.3	13.0	1120
Wood Colony	5416	1.00	52.1	11.9	1024
Donna	4865	1.04	50.8	11.1	955
Kapareil	3514	1.01	73.4	7.8	670

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

Table 2. 1998 Yield Summary for the Regional Almond Variety Trial at California State University at Chico Farm, Butte County. Planted in 1993

Variety	No. of Nuts/Tree	Average Kernel Weight (g)	Shelling %	Kernel Pounds Per	
				Tree	Acre ¹
Plateau	11390	1.47	50.6	37.0	2367
Butte	11664	0.94	48.1	24.2	1549
Monterey	7541	1.44	46.9	23.9	1531
Ruby	7320	1.27	45.7	20.5	1315
Livingston	7598	1.19	63.6	19.9	1275
Carmel	6563	1.36	54.5	19.7	1260
Morley	8176	1.03	53.4	18.6	1189
Chip's	6920	1.22	56.7	18.6	1188
Sonora	4958	1.65	72.5	18.0	1152
Nonpareil	5964	1.34	67.8	17.6	1127
2-43W	6801	1.13	60.1	16.9	1081
1-87	8171	0.93	49.3	16.8	1074
Kahl	7038	1.08	35.5	16.7	1070
Johlyn	5293	1.40	70.0	16.3	1046
Sano	5153	1.40	57.2	15.9	1020
Aldrich	6167	1.16	54.9	15.7	1005
Price	6087	1.15	60.5	15.5	990
Wood Colony	4976	1.36	54.3	14.9	951
Yokut	4488	1.42	61.4	14.0	896
Mission	4926	1.28	40.8	13.9	890
Rosetta	3849	1.55	48.3	13.1	840
Padre	4911	1.20	49.7	13.0	832
25-75	6510	0.89	52.3	12.7	815
Savana	4281	1.35	64.9	12.7	815
13-1	4138	1.34	61.0	12.3	784
Jiml	3908	1.34	57.5	11.5	738
Donna	4153	1.22	51.3	11.1	712
Jenette	3350	1.42	67.7	10.5	672
2-19E	2894	1.11	43.7	7.1	454
1-102W	2041	1.51	58.1	6.8	436
Kapareil	1830	1.09	76.6	4.4	280

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

Table 3. 1998 Yield Summary for the Regional Almond Variety Trial at San Joaquin Delta College Farm, Manteca, San Joaquin County. Planted in 1993

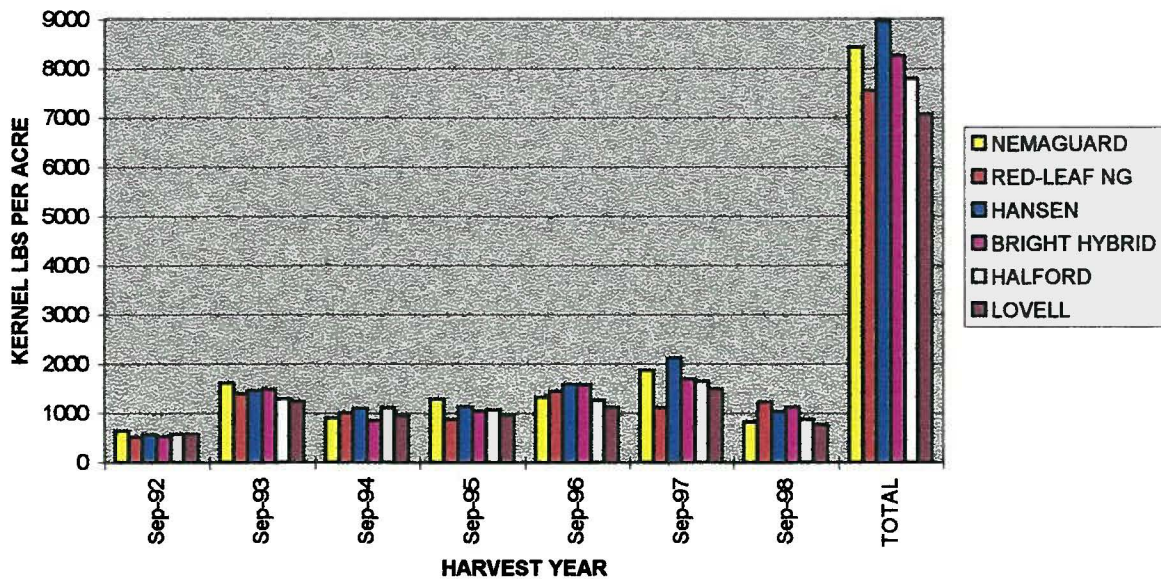
Variety	No. of Nuts/Tree	Average Kernel Weight (g)	Shelling %	Kernel Pounds Per	
				Tree	Acre ¹
Plateau	9851	1.41	51.3	30.7	2301
Butte	13058	0.96	56.8	27.7	2075
Carmel	9213	1.24	61.2	25.2	1893
Ruby	8205	1.39	60.0	25.2	1890
Yokut	8765	1.30	65.0	25.1	1882
Chips	9803	1.11	57.9	24.0	1798
Dottie Won	9904	1.07	53.0	23.4	1757
Monterey	7673	1.31	49.4	22.1	1660
Livingston	8107	1.17	59.8	21.0	1572
Fritz	8707	1.07	50.7	20.5	1539
Jenette	7579	1.22	71.8	20.4	1530
Padre	6995	1.30	54.2	20.0	1502
Mission	6617	1.22	48.9	17.8	1332
Kahl	8101	0.99	48.0	17.6	1320
1-87	7892	0.93	61.7	16.1	12.07
Wood Colony	5139	1.38	61.1	15.6	1168
Johlyn	5012	1.20	75.1	13.3	997
Sano	4314	1.40	56.9	13.3	995
Donna	4794	1.25	61.2	13.2	990
Sonora	3917	1.49	78.6	12.9	965
Nonpareil	4230	1.32	66.0	12.2	918
1-102W	3770	1.43	64.7	11.9	892
2-43W	4359	1.08	66.6	10.4	776
Jiml	3546	1.27	75.6	9.9	744
25-75	4336	0.92	63.4	8.8	660
Aldrich	3218	1.20	56.4	8.5	636
Rosetta	2540	1.43	44.9	8.0	600
Morley	3387	1.03	54.7	7.7	576
Price	3220	1.08	58.7	7.6	573
2-19E	2998	1.02	50.0	6.8	507
13-1	995	1.17	63.0	2.6	192
Savana	726	1.53	72.8	2.5	184
Kapareil	1263	0.88	68.3	2.4	183

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

Table 4. 1998 Yield and Tree Growth for an Almond Rootstock Trial Planted in 1989, Arnold Farms, Atwater, CA.

Rootstock	Nonpareil		Carmel	
	Yield Kernel Pounds/Ac.	Trunk Circumference (cm)	Yield Kernel Pounds/Ac.	Trunk Circumference (cm)
Bright's Hybrid	1120	84.2	1772	74.2
Hansen Hybrid	1024	82.3	1495	73.1
Nemaguard	814	76.6	731	62.1
Red-leafed Nemaguard	1226	70.9	1105	66.2
Halford	864	73.5	865	65.2
Lovell	761	73.5	612	60.8

ALMOND ROOTSTOCKS - NONPAREIL YIELDS



ALMOND ROOTSTOCKS - CARMEL YIELDS

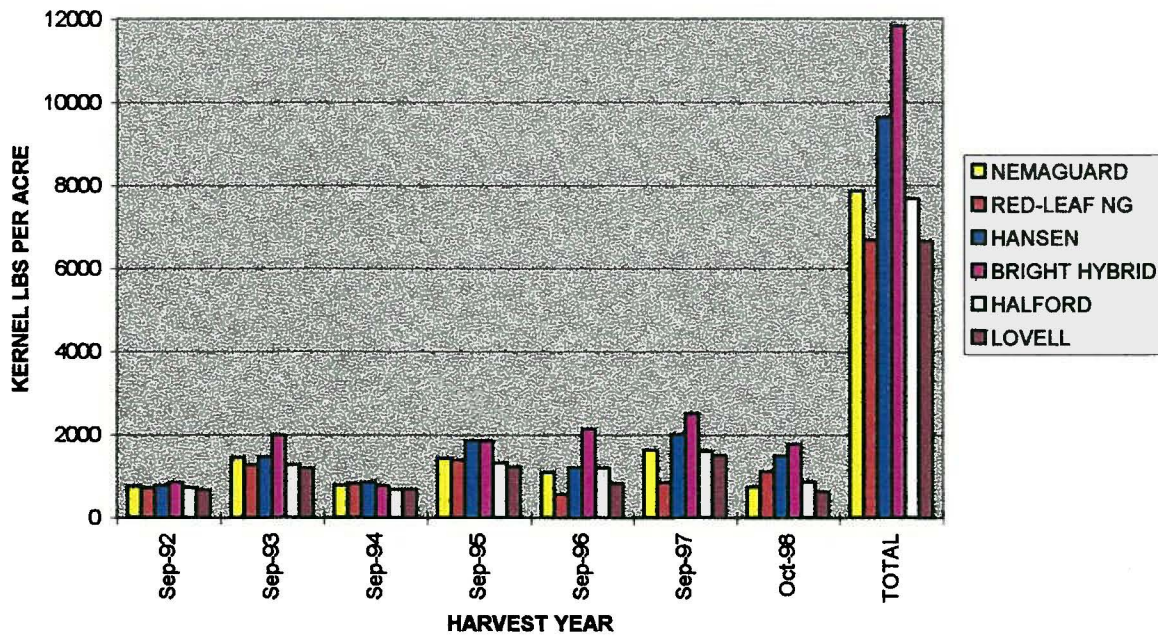


Figure 1. Yield data for an almond rootstock trial in Merced County. Production is shown by year and rootstock and accumulated (total) for seven years for Nonpareil (top figure) and Carmel (bottom figure).

TOTAL GROWTH BY VARIETY AND ROOTSTOCK 1989-97

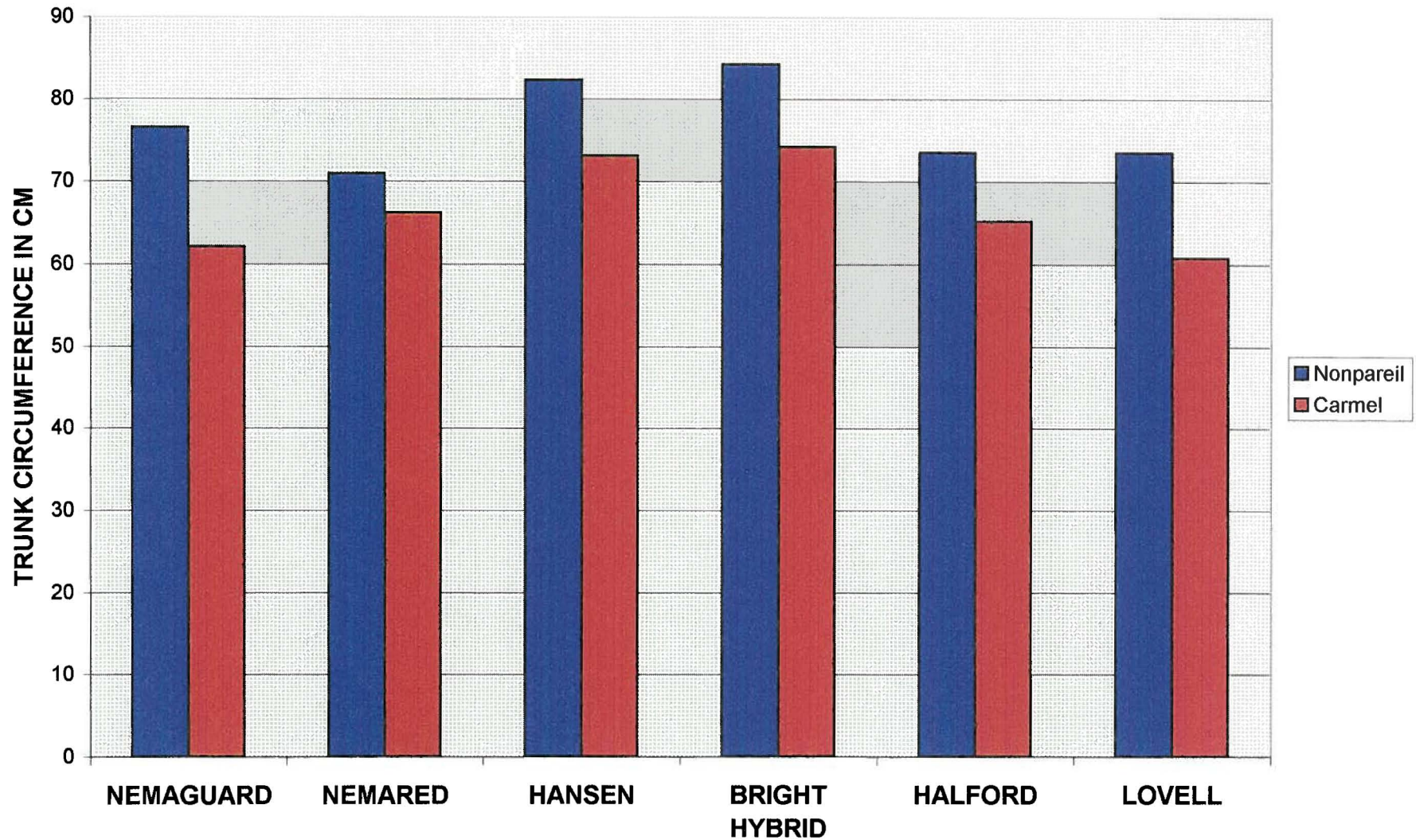


Figure 2. Tree growth, as measured by trunk circumference, for an almond rootstock trial in Merced County. Total growth over nine years is shown for six rootstocks with both Nonpareil and Carmel scion varieties.