Almond Board of California
Annual Report
March 1996

Project No.: 95-L22 - Field Evaluation of Almond Varieties & Rootstocks (cont. of Project 94-L21)

Project Leader: Mr. Warren Micke - (916) 752-2588
University of California
Department of Pomology
Davis, CA 95616

Cooperating Personnel: T. Gradziel, D. Kester, J. Yeager, V. Rose, M. Thorpe, (UCD), J. Connell (Butte Co.), P. Verdegaal (San Joaquin Co.), M. Viveros (Kern Co.), M. Freeman (Fresno Co.), J. Edstrom (Colusa Co.), L. Hendricks (Merced Co.), R. Watkins, R. Jacobs and J. Floyd (CSU, Chico), D. Dias (San Joaquin Delta College), Paramount Farming (Kern Co.), Nickels Estate Trustees (Arbuckle), Harris Ranch (Coalinga), Arnold Farms (Atwater) and farm advisors working with almonds in other counties.

Objectives:

1. Continue observing and possibly collecting a final year of yield and nut quality data from selected varieties in the older Butte and Delta Regional Variety Trials (RVTs) since long-term performance of promising varieties has been indicated as important by members of the almond industry. Data on susceptibility to pests, diseases and other disorders will be collected as opportunities occur.

2. Three new RVTs were planted in 1993. Advise/assist grower cooperators for these trials on tree training and management decisions as needed. Observe and evaluate trees for growth, pest and disease susceptibility and noninfectious bud failure symptoms, as appropriate. Bloom, harvest and nut data will be collected in 1995 if bloom density and/or crop load is sufficient.

3. Make further cross-pollinations to identify the pollen compatibility of newer varieties as well as important older varieties where this information is still lacking.

4. Continue collection of yield and tree size data from the rootstock evaluation plots in Fresno and Merced Counties. Continue obtaining information on varietal compatibility and/or interstem studies with Marianna 2624 plum in Colusa and Butte counties.

5. Summarize and analyze data associated with this project and publish and otherwise disseminate this information as appropriate.

Abstract:

Production and nut quality data were again collected from many, but not all, varieties in the older Regional Variety Trial (RVT) at San Joaquin Delta College (Delta College). Data collection from the older RVT at California State University at Chico (CSU, Chico) was terminated because of severe tree blow-over and loss from spring 1995 storms.

Trees in the three new RVT's planted in 1993 generally continued to grow well. Yields were obtained from the Kern RVT this past season, but production was too low (due to bloom time weather conditions) in the other two newer RVT's for yield information to be meaningful.

Studies of cross-compatibility of a number of varieties were continued. However, because of inclement bloom time weather little was learned last spring. Crosses between Butte and Monterey continue to give poor nut sets, and it is likely that these two varieties are in the same pollen compatibility group.

In two trials, trees on peach-almond hybrid rootstocks tended to be larger and generally out-produced those on peach rootstocks.

Experimental Procedure:

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

Results and Discussion:

Older Regional Variety Trials.

At the Delta College RVT near Manteca, yields were generally moderate with a few varieties producing well and some poorly. In the 1978 planting, Butte, Ruby, Fritz and Livingston all produced over 2000 kernel pounds per acre and were followed closely by Sauret #2, Monterey, Padre and Mission (table 1). On the other hand Sonora had a very light bloom and produced just under 400 kernel pounds per acre. This was only the second poor crop for Sonora in the past seven years at Delta College even though this variety has had a tendency toward alternate (every other year) bearing in some situations. Seven varieties were added to this trial in 1984. Of these Dottie Won and Valenta were the highest producing at over 1300 kernel pounds per acre. With a relatively light crop in 1995 nut removal on some varieties in the Delta College plot was less than desirable. Also with the light crop this year kernel sizes tended to be larger than normal.

A number of varieties in this trial produced a high percentage of double kernels. The following varieties produced more than 20% double kernels: Valenta (60%), Pearl (34%), Monterey (34%), Fritz (28%) and Ne Plus Ultra (22%). In this trial LeGrand with 8% worm damage was the only variety to be over 2% in 1995. Sauret #2, Fritz and Dottie Won all had 10% blank nuts followed closely by Ne Plus Ultra, Valenta and Monterey with 8% blanks.

Newer Regional Variety Trials.

Three new RVT's were planted in 1993 at CSU, Chico, Delta College and Paramount Farming (Kern County). Production in 1995 was quite low from the CSU, Chico and Delta College trials and, while harvest of a few varieties was attempted, yields were so low that harvest was discontinued. However, yields at the Kern RVT were higher and production data were taken and is presented below.

In the third growing season at the Kern RVT most varieties had enough production that harvesting was feasible. For third-leaf trees some varieties had a very good yield with the highest producing varieties being Padre, Ruby, Carmel, selection 13-1, Monterey, Wood Colony and Mission (table 2).

Four varieties had 20% or more double kernels, a condition that is sometimes worse on young trees.

These varieties were Donna (32%), Plateau (28%), Sano (24%) and Kahl (20). Price, Donna and Kahl had 15 to 10% blank nuts. There was not a great deal of worm damage in this trial with the most affected varieties being Plateau with 10% damage and Chip's and Kapareil each with 6% damage.

Pollination.

Studies on the cross-compatibility on a number of varieties, especially newer ones, were continued; however, because of the inclement bloom time weather little was learned this year. Crosses between Butte and Monterey continued to give poor nut sets and it is likely that these varieties are in the same pollen compatibility group and are not cross-compatible. Thus, these varieties should not be planted in the same orchard unless other pollen compatible varieties with coincident bloom are also included to ensure adequate cross-pollination. Rosetta was thought to be in the Ne Plus Ultra pollen compatibility group; however, recent studies have raised questions about this classification and further work will be needed to clarify its status.

Rootstock Plots.

Four rootstocks (Bright's hybrid, Hansen hybrid, Lovell peach and Nemaguard peach) were compared during their tenth growing season in a test plot in western Fresno County. Based on trunk circumference, the two hybrid rootstocks produced larger trees than did Lovell which gave significantly larger trees than did Nemaguard; although, numerically the difference between the two peach rootstocks was not great (table 3). In 1995 trees on the two hybrid rootstocks substantially out-produced those on the two peach rootstocks. Of the two peach rootstocks, trees on Lovell yielded significantly more than those on Nemaguard. When evaluating the data for the six years, it seemed evident that while trees on the hybrid rootstocks out-produced those on peach rootstocks on a per tree basis, the trees on hybrid rootstocks were also larger and their greater production was mostly a result of larger tree size and not that they were inherently more productive if the tree size factor was removed.

Trees on six rootstocks growing in a sandy soil in Merced County were compared in 1995, their seventh growing season. The rootstocks compared were Nemaguard, Red-Leafed Nemaguard, Lovell and Halford peach and Bright's and Hansen peach-almond hybrids. With Nonpareil there was no difference in tree size between rootstocks. Also with this variety there was no significant difference in production; although trees on Nemaguard produced the most and those on Red-Leafed Nemaguard the least with other rootstocks intermediate. With Carmel trees on the two hybrid rootstocks were the largest with those on Bright's hybrid significantly larger than trees on any of the peach rootstocks (table 4). With this variety trees on the two hybrid rootstocks had the highest production and those on Lovell and Halford the lowest yields.

Thus, when comparing rootstocks for almond, it seems that scion variety, soil conditions and perhaps tree age can make a difference and should be taken into consideration when evaluating rootstock performance.

In the 1986 planting of Nine Varieties on Marianna 2624 in Colusa County (Nickels Soil Laboratory) Butte, Aldrich and Monterey were the highest yielding, while Sonora and Grace had low production (table 5). Sonora is known to sometimes biennially bear. In 1994 Sonora had the highest production of any variety in this planting and, thus, it appears to be going into a biennial bearing cycle. Accumulated production since 1990 shows Butte to be the highest yielding followed closely by Aldrich and then by Monterey and Wood Colony (table 5). Grace has had the lowest accumulated production with Valenta and Solano also yielding poorly. All trees of Pearl, a tenth variety originally in this planting, died when the trees were young.

Several selections of Marianna and other plum rootstocks have been tested in a 1989 planting for

compatibility with the Nonpareil and Mission varieties. With Nonpareil none of these experimental rootstocks had any better compatibility than Nonpareil directly on Marianna 2624 (a known incompatible combination), and most were even less compatible. Thus, the Nonpareil portion of this trial has been discontinued, and the trees have been removed.

With Mission several of the experimental rootstocks have shown promise. In 1995 yield data was take from trees on most of these rootstocks. Production data was not taken from trees on numbers 9 and 30 nor from those on Corrotta Marianna and P. salicina because of poor horticultural performance (tree loss, sick/weak trees, etc.). There were no significant differences among rootstocks evaluated in number of nuts per tree and kernel pounds per tree (table 6). However, trees on Marianna 2624 had significantly smaller kernels than did those on numbers 40, 58 and 75.

With Mission, Marianna 2624 produced the greatest number of suckers per tree. Marianna 2624 is noted for sucker production, and this is a major disadvantage of this commercial rootstock. Rootstock numbers 9 and 16 also suckered and number 58 produced a few suckers. No other rootstocks in this trial produced suckers in 1995. In this trial, the only trees that have been lost since planting were 25% of the trees on Corrotta Marianna, and these trees died when they were young.

Two 1989 Interstock trials were initiated in Colusa and Butte Counties to determine if longer interstocks (8-10 inches or scaffold budding) of Havens 2B plum between Nonpareil and Marianna 2624 improved compatibility over shorter, more commonly used (4 inch) interstocks. A second objective was to determine if a long interstock of a compatible almond variety would work as well or possibly even better than Havens 2B.

In the Colusa County planting on class 2 soil trees of Nonpareil directly on Marianna 2624 and those with a 10 inch interstock of Mission have performed poorly, with several trees of each combination dying and others showing weak growth and off-colored foliage. Among the best combinations have been the longer interstocks (scaffold budded and 10 inch) of Havens 2B. In the Butte County planting on class 1 soil all combinations have grown better with less difference between the best and worse combinations. However, the order of performance was similar to the Colusa County trial.

Dissemination of Information:

In an effort to make information developed from this project available to almond growers and other associated with the almond industry, at least seven presentations were made at grower/industry meetings during 1995-96. Much of the information in chapters on Varieties and Rootstocks in the soon-to-be-released "Almond Production Manual" was obtained directly from this project. Several articles and reports related to this project have also been published.

Table 1. 1995 Yield Summary for the older Almond Regional Variety Trial at San Joaquin Delta College, Manteca

Variety	No. of Nuts/Tree	Average Kernel Weight (g)	Shelling %	Kernel Pounds Per Tree	Kernel Pounds Per Acre
1978 Planting					
Early Blooming Varieties					
Peerless	5,175	1.36	38	16	1,164
Ne Plus Ultra	3,905	1.56	60	13	1,004
Sonora	1,320	1.74	73	5	379
Mid Blooming Varieties					
Fritz	12,023	1.09	51	29	2,165
Sauret 2	8,971	1.33	62	26	1,968
Monterey	8,417	1.40	49	26	1,949
Carmel	8,091	1.33	62	24	1,772
Sauret 1	7,515	1.39	79	23	1,728
Price	6,237	1.32	63	18	1,364
Nonpareil	4,866	1.50	68	16	1,205
Late Blooming Varieties					
Butte	13,708	1.10	54	33	2,486
Ruby	11,408	1.28	51	32	2,420
Livingston	10,614	1.23	59	29	2,150
Padre	10,609	1.09	54	26	1,914
Mission	9,119	1.25	48	25	1,877
Mono	7,287	1.24	45	20	1,495
Tokyo	5,812	1.51	56	19	1,454
LeGrand	4,942	1.31	61	14	1,068
Thompson	4,539	1.37	65	14	1,027
1984 Planting					
Dottie Won	6,759	1.23	57	18	1,369
Valenta	7,292	1.11	48	18	1,335
Aldrich	6,395	1.12	57	16	1,183
Wood Colony	4,215	1.61	64	15	1,120
Rosetta	3,239	1.77	53	13	949
Pearl	3,900	1.16	58	10	745
Jeffries	2,521	1.54	66	9	643

Table 2. 1995 Yield Summary for the Almond Regional Variety Trial at Paramount Farming in Kern County. Planted in 1993

Variety	No. of Nuts/Tree	Average Kernel Weight (g)	Shelling %	Kernel Pounds Per Tree	Kernel Pounds Per Acre
Early-Mid Blooming Varieties					
Carmel	2,236	1.50	66	7.4	634
13-1	2,483	1.27	61	7.0	599
Monterey	1,893	1.65	58	6.9	591
Wood Colony	2,161	1.37	59	6.5	559
Aldrich	1,797	1.24	60	4.9	422
Chip's	1,507	1.40	56	4.7	401
Kahl	1,430	1.42	53	4.5	383
Yogut (Yokit)	1,362	1.48	56	4.4	382
Sonora	1,240	1.44	77	3.9	337
Donna	1,446	1.18	53	3.8	324
Price	1,235	1.27	70	3.5	297
Jenette	1,040	1.49	73	3.4	294
Johlyn	1,135	1.35	70	3.4	291
Sano	938	1.64	61	3.4	291
Plateau	863	1.73	51	3.3	282
Nonpareil	1,024	1.34	71	3.0	259
Jiml	396	1.43	63	1.2	107
Rosetta	286	1.73	52	1.1	93
Kapareil	208	1.03	67	0.5	41
Late-Very Late Blooming Varieties					
Padre	3,293	1.29	47	9.3	802
Ruby	2,248	1.56	57	7.7	664
Mission	1,994	1.45	50	6.3	545
2-43 W	1,789	1.41	67	5.5	477
Savana	1,502	1.47	58	4.9	418
Butte	1,668	1.19	65	4.4	377
2-19 E	1,528	1.18	56	4.0	341
Livingston	1,331	1.28	63	3.8	323
1-102 W	878	1.83	69	3.5	304
1-87	1,046	1.15	58	2.7	228
Morley	713	1.31	52	2.0	176
25-75	1,049	0.84	59	1.9	167

Table 3. 1995 Yield and Tree Growth Data for Almond Rootstock Trial Planted in 1986, Harris Ranch, Coalinga, CA

Rootstock	Yield Kernel Pounds/Ac.	Trunk Circumference (cm)
Bright's Hybrid	2,234 a	78.4 a[1]
Hansen Hybrid	2,242 a	79.8 a
Lovell	1,428 b	71.6 b
Nemaguard	1,166 c	68.8 c

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

Table 4. 1995 Yield and Tree Growth Data for Almond Rootstock Trial Planted in 1989, Arnold Farms, Atwater, CA

	Nonpareil		Carmel	
.ootstock	Yield Kernel Pounds/Ac.	Trunk Circumference (cm)	Yield Kernel Pounds/Ac.	Trunk Circumference (cm)
Bright's Hybrid	1,036 a[1]	64.6 a	1,842 a	62.3 a
Hansen Hybrid	1,129 a	63.6 a	1,839 a	60.1 ab
Nemaguard	1,286 a	61.2 a	1,424 ab	54.7 bc
Red-leafed Nemaguard	874 a	60.2 a	1,391 ab	54.4 bc
Halford	1,059 a	58.9 a	1,323 b	54.4 bc
Lovell	954 a	57.8 a	1,223 b	52.6 c

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

Table 5. Yield from the 1986 planting to study almond variety compatibility on Marianna 2624. Nickels Soil Laboratory, Arbuckle.

		Yield in kernel pounds/tree	
Variety	**No. of Trees**	**1995**	**total 1990-1994**
Butte	4	12.3	45
Aldrich	7	9.8	45
Monterey	5	8.1	43
Bonita	3	7.7	39
Solano	3	6.8	31
Wood Colony	6	6.7	44
Valenta	7	5.9	30
Grace	8	4.6	26
Sonora	8	3.6	43

Table 6. Tree survival, suckering and production from 1989 planting to evaluate performance of Mission almond on Marianna selections and other plum rootstocks. Nickels Soil Laboratory, Arbuckle.

Rootstock	Number of Nuts/Tree	Average Kernel Weight (g)	Kernel Pounds Per Tree	% Survival	Notes on Suckering
9[1/]	[2/]			100	Suckers
16	1052 a[3/]	1.52 ab	3.5 a	100	Suckers
30	[2/]			100	None
40	1338 a	1.58 a	4.6 a	100	None
58	1239 a	1.59 a	4.3 a	100	Few suckers
64	1247 a	1.55 ab	4.25 a	100	None
65	1600 a	1.49 ab	5.2 a	100	"
69	1324 a	1.50 ab	4.4 a	100	"
75	1182 a	1.61 a	4.2 a	100	"
Corrotta Marianna	[2/]			75	"
P. Salicina	[2/]			100	"
Marianna 2624	1339 a	1.46 b	4.3 a	100	Many suckers

[1/] Numbers 9 through 75 represent specific clones within a group of rootstocks referred to as the Marianna Series.

[2/] Because of poor survival or previous horticultural performance yield data was not taken.

[3/] Numbers within columns followed by the same letter are not significantly different at the 5% level.

Almond Board of California

Project No. 95-MFI-Using Barn Owls to Control Pocket Gophers in Almond Orchards

Project Leader: Mark Freeman, Farm Advisor
UCCE
1720 South Maple Ave.
Fresno, CA 93702

Objectives:

1. Adapt the present system of raising and releasing barn owls for use in almond orchards
2. Work with a limited number of almond growers to successfully release and promote barn owl predation in their orchards
3. Experimentally determine the most successful nesting site to attract and keep barn owls in a specific site.
4. To determine the effectiveness of barn owls on controlling pocket gophers in almond orchards.

Thirty-five barn owls chicks were brought into Fresno Wildlife Rehabilitation and all were raised and released safely in 1995 with the assistance of almond growers. The low number of birds found was thought to be caused by the severe weather during late Winter and early Spring. Unfortunately, none of these "banded" owls chose to reside in owl boxes or in areas where they could be captured and identified. However, there were owls noted in the general area by sightings and sounds at night. It has been noted by rehabilitation personnel throughout the state and growers that many owls are found dead along roadsides. We are cooperating with Dr. Barry Wilson at UCD to investigate this problem.

The modified release cage that we designed was used in all the releases. However, even the mobile release cage is somewhat big as it comes apart in 4' x 8' sections, and costs about $150 to build. Some of the almond growers that built mobile release cages have indicated a willingness to loan those cages to others. For most growers, it is much more feasible to attract native owls with simple nesting sites than participate in a more expensive and time consuming release program.

Towards that goal of promoting barn owl usage in orchards, we are cooperating with several organizations. A local elementary school is dissecting the owl pellets for us. The resulting bones and pellets are identified by a UCD scientist, a student artist is drawing diagrams, and the results will be used to develop an identification guide for elementary science classes and for growers. This work and a booklet on Predatory

Birds of CA is funded by a federal grant we just received. Two local high schools are building owl boxes out of re-cycled raisin sweat boxes and trays, and plan to sell them at a low cost. We are organizing this effort along with packing houses and growers that are supplying those wooden items. A final booklet on promoting barn owls in agricultural areas will be completed later in 1996. It will include information about the release program, construction of nesting sites, owl pellet identification, and owl behavior. When that booklet is completed, we will notify the Almond Board and agricultural media.

We met numerous times with wildlife experts and reviewed the literature regarding how to measure the effect of owls on gopher populations. We do not have acceptable gopher monitoring methods or techniques to correlate the actual numbers of gophers with activity (such as mounds). We do not have economic threshold levels established either. There are gaps in our basic knowledge of pocket gopher behavior such as the percent of time spent above ground and where burrows are located within the orchard. It will be extremely difficult to measure the percent control of gophers by barn owls without some of this knowledge. It is definitely beyond our ability to determine the amount of control at this time. However, all these discussions and interest have led to new research proposals being developed by UC personnel.

In December, 1995, we started the research comparing two different box designs to enhance barn owl acceptance and habitation. We especially are interested in "mimicking" a palm tree which is attractive to owls but not a good nesting site. We are collecting owl pellets which contain the bones and skulls of animals eaten by owls. These results will be analyzed for animal age and type, and may give a clue to the owl's effectiveness. If mature gophers are found versus very young or very old gophers, that could indicate owls may help to lower gopher populations.

Almond Board of California

1104 12th Street Modesto, CA 95354 USA
Phone: (209) 549-8262 Fax: (209) 549-8267

March 22, 1996

Mark Freeman
U.C. Cooperative Ext.
1720 S. Maple Avenue
Fresno, CA 93702

Dear Mr. Freeman:

When your project was funded by the Almond Board of California, is was clearly stipulated that "Final Reports" were to be submitted to the Research Director no later than April 1, 1996. As of the date of this letter, we have not received your final report.

After April 1st, the Almond Board of California **will not** make any further funding payments to your research project, according to the terms of the contract, until the final report has been submitted to our office. Please contact Kandi Cruz at extension 11.

Sincerely,

Rodger Wasson

Rodger Wasson
President and Chief Executive Officer

cc: Joe MacIlvaine