Final Report to the Almond Board of California

Project Number: 99-JE-o0

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Nickels Trust

Objective:

1) **Dual Variety Rows** - evaluate the effect on yield of alternating two varieties (Mission and Padre) down the same row versus solid rows of each variety.

2.) **Low Volume Irrigation System Comparison** - evaluate the performance of three types of micro-irrigation systems (surface drip, microjet, subsurface drip) and their effect on production of Nonpareil, Butte, Carmel and Monterey.

3.) **Almond/Marianna 2624 Performance** - compare the productivity, tree growth and survival of four almond varieties (Butte, Padre, Mission and Ruby) when planted on Marianna 2624 rootstock in a dense hedgerow.

Results:

1. ***Dual Variety Rows***

Our strategy here is simply to alternate two compatible varieties down the same row and compare yields of the same two varieties planted in solid rows. Solid rows of Padre are compared to solid rows of Mission versus rows alternating with Padre and Mission (M•P•M) down the row. Solid rows of Butte border all treatment rows as a pollinizer. All trees are planted to Lovell peach rootstock at 15' x 20" spacing for 145 trees per acre on Class II soil.

Yield results for 1999 show no advantage to alternating two varieties down the same row. Weather during bloom was quite conducive to bee flight which has been found to diminish the alternating advantage A severe frost event in April probably reduced overall yields in this block further limiting any treatment affect.

Orchard Design	B	P	B	P	B

The effect of Butte pollen on the set of Padre and Mission is significant in this block. We suspect that Butte pollen fertilizing Padre flowers in solid rows of Padre greatly increases yields and "masks" the real potential advantage of alternating Mission in the row. To examine this we again used paternity testing with the help of Plant Development International, Bakersfield, California.

Isozyme analyses of Padre nuts showed 61% Mission pollen parentage in alternating P•M•P rows and only 23% in rows of solid Padre. (Table 2)

Only 2% of Padres were set by outside pollen (likely Nonpareil). About 37% Butte parentage was found for Padre in alternating rows and 62% Butte parentage in solid rows. Padre set in solid Padre rows was again greatly affected by Butte. This supports our suspicion that Butte maybe limiting the positive effect of alternating varieties down the row in this orchard.

But even with the equalizing effect of Butte in this test we still find that in many years alternating varieties shows yield advantages. Rows planted with alternating M•P•M or possibly P•B•P would likely show a greater yield advantage verses solid rows of 2 varieties than our test where a third variety, (Butte) is planted.

This orchard continues to experience poorly anchored Padres. Extra attention seems necessary with Padre to develop vertical trunks, well balanced canopies and strong roots to limit this tree loss problem or avoid the severe pruning necessary to retain trees. It is unclear so far what affect the mechanical topping of Padre trees in 1998 has had on the anchorage problem. This may have been done too late in the development of the trees to be useful. Yield loss during the 98 crop was about 700 lbs./acre from topping. Carryover effects reduced the 1999 was about 300 lbs/ac.

Table 1.
Two Variety Rows
1998 Yields
Lbs. Per Acre

Padre Solid	1691	
Padre-M	1749	ns
Mission Solid	1639	
Mission•P	1583	ns

Table 2.
Paternity Testing Results - Padre Nuts

	B	M	B	P	B
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Pollen Source of Padres	=	61% M 2% Non 37% B		23% M 10-15% Non 62% B	

2. ***Low Volume Irrigation Systems***

Micro-irrigation systems are in widespread use throughout all central valley almond districts. Controversy continues as to the relative merits of the different types of systems-surface drip, microsprinkler/jet and subsurface drip, SDI. To evaluate these systems under commercial conditions a 22 acre replicated field trial was established in 1990 planted to Nonpareil (1/3), Butte (1/3), Carmel

(1/6) and Monterey (1/6). Eight irrigation designs were initially under evaluation. Two types of SDI were abandoned this year (#7 & #8) leaving systems 1-6:

1. Surface drip single hose 4-1 gph Netafim PC emitters
2. Surface drip - double hose - 8-0.5 emitters Bowsmith TFS-05
3. Micros - single - 10.5 gph Bowsmith fanjet E blue
4. Micros - double fanjet 2 @ 5.25 gph Bowsmith fanjet C orange w/ FJ-10
5. Micros @ 1.2 Et double fanjet 2 @ 8.4 gph C orange
6. Subsurface drip Geoflow double hose 8-0.5 gph emitters
7. Subsurface drip Ram PC single hose 4-1 gph emitters
8. Subsurface drip Ram PC double hose 8-0.5 gph emitters

Production figures for 1999 (table 1) show that all irrigation systems (that continue to function) yielded the same. No differences in kernel size found between any of the irrigation systems for any variety.

Flow meters measured 36" of applied water this season, equal to full 1.0 as calculated from Colusa CIMIS station data.

The 1.2 Etc treatment was added in 1997 to check the adequacy of our 1.0 ET calculated application rate. The 1998 data provided some indication that Butte responds to moisture levels higher than our ET amounts.

Beginning in 1999 we readjusted our irrigation system efficiency factor which increased applied water by 10%.

All systems continued to receive equal amounts of applied water, 5-6 days/week for drip/SDI and twice per week for Micros. Tree moisture stress levels as monitored by pressure bomb readings were minimal except for short periods around harvest. Leaf yellowing and drop was more evident on the Monterey variety again this season during harvest.

Due to the root intrusion problem discovered last year the SDI systems without trifluralin have been disconnected and will be converted to double hose Geoflow SDI before the 2000 season. We plan to install this dual hose system at a depth of 6-8 inches (above the old 16 inch deep hoses). Affected trees will be monitored for their recovery.

This year we experienced two insect related irrigation problems. First, earwigs invaded the irrigation system airvents resulting in clogged drip and microjet emitters. This problem was solved by attaching screens to all airvent openings. Second came the Fullers rose weevil depositing eggs in jet openings, again clogging the microjets and increasing maintenance expenses. Daily purging of all microjets may help avoid this problem in the future. Insecticides sprayed on berms for ant control are reported to reduce this problem also. Weeds were not as troublesome this year as reported last season do to more diligent herbicide

"middles management" before harvest. But again, additional strip spraying of weeds was required mainly in the micro plots.

Subsurface drip continues to excel in relation to orchard floor management and harvest efficiency. After nine years of experience we are beginning to see more commercial potential for this management intensive technique. The root intrusion problem has so far been avoided using trifluralin emitters. However, we still have concerns regarding tree roots pinching buried hoses ("strangulation"), the siphoning of silt into emitters upon system shutdown and damage to buried lines by gophers.

Table 1.

MICRO-IRRIGATION

ALMOND YIELDS 1999

	Lbs/Acre			
System	**VARIETY**			
	Nonpareil	**Butte**	**Carmel**	**Monterey**
Drip	**2,688**	**2,657**	**2,155**	**2,384**
Drip Double	**2,690**	**2,654**	**1,944**	**2,255**
Micros	**2,530**	**2,303**	**2,134**	**2,273**
Micros Double	**2,758**	**2,523**	**2,145**	**2,323**
Micros Double 1.2	**2,955**	**2,731**	**2,348**	**2,650**
Subsurface Drip-Netafim Single	**2,129**	**2,144**	**1,828**	**1,847**
Double	**2,352**	**2,184**	**2,123**	**1,979**
Geoflow Double	**n.s. 2,590**	**n.s. 2,326**	**n.s. 1,978**	**n.s. 2,277**

3. *Almond-Marianna 2624 Performance*

Prior research at Nickels Soil Lab suggested that some almond varieties can be quite productive when planted on Marianna 2624 plum rootstock. However, this rootstock has a considerable dwarfing effect on most varieties and requires tighter tree spacing to realize its maximum bearing potential. Yield potential of M2624 is generally considered to be less than like varieties on peach rootstocks. Given sites with Oak Root Fungus or heavy/wet soils, plum root is preferred. Mission, Ruby and Padre cultivars have shown excellent compatibility with M2624. However, the Butte variety has shown inconsistent M2624 in the field.

This test planting was established in 1989 to evaluate 4 almond cultivars in a close planted hedgerow on M2624 rootstock. Commercially harvestable replications were designed into the test to collect yield data. Butte, Mission, Ruby and Padre almonds were planted as single rows at 10' x 20' spacings for 218 trees/acre.

Yields declined significantly in this planting in 1999 (Table I). Although frost was reported in nearby orchards the cropping pattern in this block and within individual trees did not suggest frost greatly hurt yields. Frost may have had some affect but yield decline was also due to alternate bearing following a record crop last season. Ruby led the four varieties in production at 2050 lbs/ac, followed by Padre at 1838 lbs/ac, Butte at 1715 lbs/ac, and Mission at 1500 lbs/ac. Kernel sizes (Table II) were within the normal range given the yields except for Butte. Butte kernels appeared somewhat shriveled this year (particularly given the modest yield) which may reflect the marginal M2624 compatibility of this variety. We have not found this affect on kernels before.

All four varieties continue to perform satisfactorily on M2624 rootstock, with few tree losses occurring. Some canopy expansion is still required to adequately fill allotted space and reach optimum bearing potential. The large 1998 crop limited shoot growth last year and greatly limited canopy expansion. Overall tree vigor is reduced with this rootstock compared to peach. The twenty feet distance between rows for M2624 appears too wide given the shallow soil at this test site and dwarfing effect of plum rootstock. A more appropriate row width here would be 18 feet but harvest machinery problems would likely result at such a close spacing.

Root suckering (typically troublesome with M2624) has been reduced by deeper tree planting. Growers considering M2624 blocks may want to special order trees high budded to allow deeper planting to help prevent root suckers and also employ an aggressive sucker removal program in early years to limit longterm troubles.

On the more positive side, M2624 production levels in 1999 equaled those of the same varieties on Lovell rootstock planted nearby at 15"x 20" on a somewhat deeper soil. Also, Padres on M2624 are not leaning over in these short statured trees like Padres on Lovell.

The leaf scorch symptoms reported here previously for the Butte variety on M2624 did not develop this season. During some years marginal leaf necrosis forms in mid summer on random limbs in scattered trees. Affected trees appear smaller in size while individual limbs affected show reduced vigor and defoliate before harvest. No disease organism, salt, fertilizer, chemical, or other cause has been found to explain this symptom. This problem seems to be separate from the mild etch malady afflicting young trees on M2624 in many commercial orchards. Numerous growers in 1999 reported problems resembling mild etch/leaf burn symptoms with Butte, Mission and others on M2624 in 2nd and 3rd leaf orchards. Mild etch has not been found in this test.

Table I.

Yield Lbs/Ac -- 1991-1999

Year	1991	1992	1993	1994	1995	1996	1997	1998	1999
Leaf	3rd	4th	5th	6th	7th	8th	9th	10th	11th
Mission	177	780	1772	1596	1619	1555	2256	2251	1500
Padre	252	973	2097	1706	1305	2302	2785	3226	1838
Ruby	178	936	1857	1843	1682	2055	2514	2557	2000
Butte	361	1229	1893	1695	--	1945	2427	2808	1714

Table II.

Kernel size

	kernels/oz	gms/K
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