Project No: 96-NIC --- Nickels Soils Lab Projects

Project Leader: John Edstrom
University of California Cooperative Extension
P. O. Box 180
Colusa, CA 95932
(916) 458-0570

Cooperating Personnel: Nickels Trust
L. Schwankl
W. Micke

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 LV 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 survivability of four almond varieties (Butte, Padre, Mission and Ruby) when planted on Marianna 2624 rootstock in a dense hedgerow.

4) **Control of Peach Twig Borer** - evaluate the effectiveness of various B.t. formulations, spinosad and other new materials for the control of Peach Twig Borer.

1) *Dual Variety Rows*

Methods: Our strategy here is simply to alternate two compatible cultivars down the same hedgerow and compare yields of the same two cultivars planted in solid hedgerows. Solid rows of Padre are compared to solid rows of Mission versus rows alternating with Padre and Mission (M•P•M•P). 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.

Results: Again, this season we have found an apparent yield advantage to alternating two varieties (Mission and Padre) down the same row. Figures for 1996 presented in Table I show a 8.5% increase in yield for the Mission-Padre-Mission rows versus solid rows of Mission and solid rows of Padre. The accumulative yield figures show a 1455 lbs./Ac. advantage to alternating over the four years of this trial.

TABLE I.

TWO VARIETY ROWS -- YIELDS - LBS/AC

Year	*1993*	*1994*	*1995*	*1996*	
Leaf	*5th*	*6th*	*7th*	*8th*	*Accumulative*
Mission	1652	1789	1709	1720	5218
Padre	2010	1763	1702	1966	7441
M•P•M•P	1921	1948	1916	2000	7785
Difference	+5%	+10%	+12%	+8.5%	1455 lbs

*** Difference** = Percentage or lbs./Ac difference between Mission + Padre/2 vs. M•P•M•P.

Table II shows the yield comparisons for the individual varieties when planted either in solid rows or alternating two variety rows. Padre figures for 1996 show a 14% yield increase when alternated with Mission down the same row. Mission showed little yield increase from alternating this year.

TABLE II.

1996 Yields
lbs./Ac.

	Solid Rows	*Two Variety Row*	*% Increase*
Padre	1966	2240	14%
Mission	1720	1757	2%

The effect of the 50% Butte pollenizers in this planting may be important. The benefit of alternating two varieties down the same row could be even greater when only two varieties are planted in the block. Here, where Buttes are planted in every other row, the Butte pollen may be responsible for much of the Mission/Padre set thus masking the effect of alternating varieties.

Unfortunately, due to the stick tight tendency in harvesting the Padre variety late, we cannot accomplish a once over harvest operation. Padre nuts require earlier shaking than the Mission to obtain acceptable nut removal. Two passes down the same row with the shaker is required on the alternating M•P•M•P rows. Sweeping and pickup operations are accomplished as a single pass combining the two varieties.

2. ***Low Volume Irrigation System Comparison***

Methods: Growers considering a new installation or conversion to drip or micro-sprinklers have numerous questions regarding design, management, and operation of low volume irrigation systems. Of utmost importance is the performance of our major almond varieties, particularly yield, quality and tree growth in the near term and over the life of the orchard.

A 22-acre field demonstration was established in 1990 to evaluate the merits of low volume irrigation systems for almonds. This site simulates commercial production conditions and allows practical field demonstration for growers, while also accommodating a replicated field design to critically evaluate both almond performance and system characteristics. Various tree growth, yield and quality parameters are measured, in addition to system evaluations for water application efficiency and uniformity, system maintenance and operation requirements.

Four almond varieties, Nonpareil, Butte, Carmel and Monterey, are under study with each of the following irrigation systems:

1. Surface drip - single hose - 4 - 1 gph emitters
2. Surface drip - double hose - 8 - 0.5 gph emitters
3. Micro-sprinkler - single Fanjet - 10.5 gph
4. Subsurface drip - single hose, 4 - 1 gph - 2 ft. from tree
5. Subsurface drip - NetaFim double hose, 8 - 0.5 gph - 4 ft. from tree
6. Subsurface drip - GeoFlow double hose, 8 - 0.5 gph - 4 ft. from tree

Subsurface drip treatments were established the first year with single hose surface drip systems and early in the second growing season converted to subsurface drip with the drip tubing installed to a depth of 15 inches. Chlorine is injected monthly at 7 ppm to help prevent emitter and microjet clogging.

Results: Yields for 1996 (Table I) show a trend towards higher yields for microsprinklers over the other systems. This difference appears greatest for varieties producing higher yields this year (Nonpareil and Monterey) and less for those with lower production (Carmel and Butte). Data not presented also shows kernel sizes are 10% larger from micro irrigated trees than from all other systems tested. These yield differences may reflect the limited soil conditions at this location more than show a true production advantage for micros. This gravelly soil is quite shallow (2' - 4') with low moisture holding capacity. Given the narrow wetted rooting area created by drip (6 ft.) combined with the shallow soil depth - drip root systems here maybe overly confined. By comparison micros wet a much wider soil area (12 ft.) and can compensate for the shallow soil depth to allow a more adequate rootzone. Further evaluation will be necessary to clarify this situation and draw conclusions on almond productivity under the various systems.

During June of 1995 one-half of the single hose drip irrigated plots were retrofitted with a double hose drip system consisting of 8 - Bowsmith 0.5 gph emitters per tree. Hoses were placed on both sides, 2 ft. away from the tree row during the 1995 season. The hoses were moved out to 3 ft. for the 1996 season. Almond yields resulting from this retrofit appear to be reduced in all varieties for 1996 even though equal amounts of water were applied to both systems. Possibly the water applied by the low flow 0.5 gph emitters didn't wet the rootzone as deeply compared to the 1 gph single hose emitters. In addition, evaporative moisture losses may have been greater with twice the number of emitters. Water uptake by double hose irrigated trees may have been limited and resulted in lower production.

TABLE I.

1996 Yields
lbs./Ac.

	Nonpareil	*Butte*	*Carmel*	*Monterey*	*Average*
Surface Drip					
Single	2361a	1923b	1777a	2491a	2138
Double	2182a	1663b	1522a	2199b	1892
Micros	2633a	2275a	1748a	2884a	2385
Subsurface Drip					
Single	2005b	1708b	1519a	2038b	1818
NetaFim Double	2411a	1769b	1764a	2255b	2050
GeoFlow Double	1962a	1919b	1581a	2205b	1917

LSD $P \leq 0.02$

Subsurface drip yields continue to equal those of surface drip. No problems of root intrusion have been found to-date. However, a few flexible hose risers have been pinched closed (strangulation) by enlarging roots in the subsurface drip plots. We suspect that this is due mainly to the close proximity (within 2 feet) of the risers to the tree trunks.

Cultural considerations of note include the necessity for 2 extra foliar herbicide applications to manage weeds in the microjet irrigated plots vs drip and two less in the subsurface drip plots. Weeds were of particular concern during harvest of our latest variety, Monterey, in micro plots while weeds were hardly noticeable in all the subsurface drip plots. Except for the tightening of bark for the shaker, the normal limitations to irrigating around harvest are overcome with the buried drip system. Water can be applied easily close to harvest and between varieties. Harvest operations are also accelerated in buried drip areas without the need for hand raking.

Tree growth measurements (Table II) show a trend towards larger trunk development for the microjet treatment vs drip and subsurface drip. All irrigation systems continued to maintain water application uniformities (distribution uniformity) of 90% or greater. These figures are very high for commercial installations, particularly after seven years of operation.

TABLE II.

TRUNK DIAMETERS
inches

	Nonpareil	*Butte*	*Carmel*	*Monterey*
Surface Drip				
Single	7.13	7.52	6.25	6.77
Double	6.90	7.34	6.30	6.58
Micros	7.42	8.19	6.72	7.86
Subsurface Drip				
Single	6.73	7.19	6.04	6.35
NetaFim Double	6.98	7.52	6.19	6.79
GeoFlow Double	6.92	7.85	6.23	6.85

3. ***Almond-Marianna 2624 Performance***

Methods: Prior research at Nickels Soil Lab suggested that many almond cultivars can be quite productive when planted on Marianna 2624 plum rootstock. But this rootstock has a considerable dwarfing effect on most almond varieties and requires tighter tree spacing to realize its maximum bearing potential. Mission, Ruby and Padre cultivars have shown excellent compatibility with M2624.

However, the Butte cultivar has shown inconsistent performance on M2624. Numerous tree failures have been reported amid blocks of acceptable Butte/M2624 combinations. Growers faced with Butte/M2624 problems have rogued out bad trees and replanted many trees in the early years before healthy plantings were fully established. Viruses or mycoplasms have been implicated in similar graft union disorders.

A drip irrigated test planting was established in 1989 to evaluate 4 almond cultivars in a close planted hedgerow on M2624 rootstock. Butte trees were obtained as certified virus free to help remove the effects of virus on orchard establishment. Four commercially harvestable replications were designed into the test for yield data

collection. Butte, Mission, Ruby and Padre almonds were planted as single rows at 10' x 20' spacings for a 218 trees/ acre. Potassium fertilizer was applied in the Fall of 1995 as potassium sulfate at 3lbs/tree (650 lbs/ac). One row (65 trees) of each variety was retrofitted with a second drip hose to expand the root zone and to help invigorate and close in the canopy.

Results: All four varieties have continued to perform satisfactorily on M2624 rootstock, with few tree losses occurring. Shoot growth in 1996 was good and has increased the yield potential for future crops. Considerable canopy expansion is still required to adequately fill allotted space and reach optimum bearing potential. No differences have been observed, as yet, from adding the second drip hose. The twenty feet distance between rows for M2624 may prove to be too wide given the shallow soil at this test site and dwarfing effect of plum rootstock. A more appropriate row width would be 18 feet.

Yields for 1996 were the highest to date for this 8th leaf test orchard. Padre and Ruby both exceeded 2000 lbs./Ac., while Butte approached a ton/Ac. Mission lagged behind at 1555 lbs./Ac. These production levels are comparable to the same varieties on Lovell rootstock planted nearby at 15' x 20' on somewhat deeper soil. Trunk size measurements can be seen in Table II. Padre continues to produce the largest trunks followed by Butte, Mission and Ruby.

The leaf scorch symptoms reported previously continue to show only in the Butte variety. Beginning in June, this marginal leaf necrosis occurs 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.

TABLE I.

YIELD LBS/AC -- 1991-1996

Year / *Leaf*	*1991* *3rd*	*1992* *4th*	*1993* *5th*	*1994* *6th*	*1995* *7th*	*1996* *8th*
Mission	177	780	1772	1596	1619	1555
Padre	252	973	2097	1706	1305	2302
Ruby	178	936	1857	1843	1682	2055
Butte	361	1229	1893	1695	--	1945

TABLE II.

ALMOND/MARIANNA 2624 HEDGEROW

	Trunk Circ. cm.
Padre	59.4
Butte	56.3
Mission	52.1
Ruby	50.2

4. ***Control of Peach Twig Borer***

Methods: In an ongoing effort to develop alternatives to dormant organophosphate sprays various materials have been evaluated to control Peach Twig Borer. A new biologically based material from Dow/Elanco, Spinosad, "Sucess," was tested at the dormant timing with and without oil compared to our standard Supracide + oil treatment.

At bloom, two applications of Cryolite at 4lbs & 6lbs/Ac were compared to our standard B.t., Dipel ES, and to two other B.t. formulations, Abele and MVP II. A three application bloom regime of Dipel ES was included for a long residual comparison. All sprays were applied dilute handgun @ 200 gpa to third leaf Aldrich ctv. almonds in a randomized complete block design with four replicates. Shoot tips were evaluated April 8 to determine the number of PTB strikes per tree. Nutlet counts were conducted April 11 to determine the number of nuts set per tree as an evaluation of chemical phytotoxicity.

Results: Insect pressure was quite low in the trial area despite a significant worm population late during the prior season. Such low insect activity doesn't provide for an adequate test of these materials. However, we can say that all treatments tested appear to show some activity against PTB when applied as dilute sprays. (Table 1)

Success, Supracide and all B.t. materials performed equally in the test, while Cryolite appeared somewhat weaker in reducing the overwintering population of PTB when applied at bloom. Additionally, we have some concern aver the suitability of Cryolite as a bloom treatment for almonds. Nutlet counts made in April, which should reflect nut set, show a consistent reduction in nut numbers on trees receiving Cryolite bloom sprays at 4lbs and 6lbs/AC. (Table 2) This trial appears to confirm other reports of Cryolite damage to almond flowers. Further testing will be required to adequately evaluate Success, Abele and MVP II for the control of peach twig borer in almonds.

TABLE 1.

PTB Shoot Strikes

Treatment	Rate/Ac	Timing	Strikes/Tree
Untreated	---	---	6.5
Cryolite & Nufilm 17	6lbs 8oz/100	BL-2	2.75
Cryolite & Nufilm 17	4lbs 8oz/100	BL-2	1.75
Spinosad	100gms	D	0.5
Abele	400gms	BL-2	0.5
MVP II	1qt.	BL-2	0.5
Dipel ES	1qt.	BL-2	0.25
Dipel ES	1qt.	BL-3	0.25
Spinosad	50gms	D	0
Spinosad & Omni Oil	50gms 4gal	D	0
Spinosad & Omni Oil	100gms 4gal	D	0
Supracide 2E & Omni Oil	1gal 4gal	D	0

D-dormant - 2\1\96, BL-2, bloom twice - 2\23 & 3\7\96, BL-3, bloom three times - 2\23, 3\7, 3\15\96.

TABLE 2.

Nut Count

Treatment	Rate	# Nuts/Tree
Spinosad & Omni Oil	100gms 4gal	127
Spinosad & Omni Oil	50gms 4gal	115
Supracide 2E & Omni Oil	1gal 4gal	114
Spinosad	50gms	101
Spinosad	100gms	79
Dipel ES BL-2	1qt.	71
Cryolite & Nufilm 17	4lbs.	46
Cryolite & Nufilm 17	6lbs.	31