Project No: *95-NIC* --- **Nickels Soils Lab Projects** --- **1995 Final Report**

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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 factors of tree growth, survivability, and productivity 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 and other new materials for the control of Peach Twig borer.

Results:

1) ***Dual Variety Rows***

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.

Again, this season we have found an apparent yield advantage to alternating two varieties (Mission and Padre) down the same row. Figures presented in the following table show a 200 lbs./Ac. increase for the Mission-Padre-Mission rows versus solid rows of Mission and solid rows of Padre.

The accumulative yield figure shows a 1298 lbs./Ac. advantage to alternating during the three years of this trial. There also appears to be an increasing affect of this concept on percentage yield increase as the trees mature and canopies close in on this tightly spaced "hedgerow" orchard. A significant advantage to this production strategy may be realized most during years with poor pollinizing weather conditions. Poor conditions often result in higher per pound returns to growers for that season thus "magnifying" the yield advantage.

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

NICKELS SOIL LAB
TWO VARIETY ROWS -- YIELDS - LBS/AC

	1993 5th	*1994 6th*	*1995 7th*	*Accumulative*
Mission	1652	1789	1709	**3498**
Padre	2010	1763	1702	**5475**
M•P•M•P	1921	1948	1916	**5785**
Difference	+5%	+10%	+12%	**1298 lbs**

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

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

Almonds 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 and crop quality, but, also tree canopy development and long term vigor.

A 22-acre field experiment was established in 1990 to evaluate three types of low volume irrigation systems for almonds. This site closely simulates commercial production conditions allowing practical field demonstration for growers, while also permitting a replicated field growth, 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 other operational requirements.

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

1. Surface drip - single hose - 1 gal./hr. emitters - 4 per tree
2. Micro-sprinkler - one per tree - 10.5 gal./hr. - 16 ft. diameter
3. Subsurface drip - single hose, 2 ft. from tree row - 1 gal./hr. emitters - 4 per tree
4. Subsurface drip - double hose, 4 ft. from each side of tree row - 0.5 gal./hr. emitters - 8 per tree

(Subsurface drip treatments were established the first year with surface drip systems and early in the second growing season converted to subsurface installed to a depth of 15 inches.)

Tree growth for all four varieties and under all irrigation regimes was quite vigorous the 1995 season. Yields, however, were substantially lower in all varieties except Monterey (Table I). No clear differences in yield resulted from the irrigation types in this study for 1995. 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 (emission uniformity) 90%. These figures are very high for commercial installations, particularly after six years of operation (Table III).

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

Subsurface drip plots have continued to show wet areas at the soil surface (6" - 36" diameter) directly above most buried emitters. This has occurred each season since subsurface installation.

As a result we are not obtaining one claimed benefit of buried drip - dry soil surface to reduce surface evaporation. However, this condition has not resulted in appreciable weed growth and has allowed easy monitoring of clogged emitters. Gophers are not a significant problem in this orchard, probably due to regular machine and hand baiting.

Cultural considerations of note include the need for 2-3 extra foliar herbicide applications to manage weeds in the microjet irrigated plots vs drip and subsurface drip plots. Weeds were of particular concern during harvest of our latest variety - Monterey - while weeds were hardly noticeable in both the drip and subsurface drip plots.

Backhoe pits have shown that almond root development has expanded to a width of only 6 - 7 feet under drip irrigated trees and to 12 - 14 feet under microjet irrigated trees. Detailed soil moisture measurements have shown that trees prefer to extract soil water close to the trunk and at shallow depths.

In response, we have decided to include two additional irrigation configurations to the trial: 1) Double micro sprinklers positioned at either side of the trunk to uniformly wet the soil profile directly beneath the tree canopy. 2) Double line surface drip placed four feet on either side of the tree row.

Table I. **NICKELS SOIL LAB**
LV IRRIGATION -- 1995 YIELDS LBS/AC

	Nonpareil	*Butte*	*Monterey*	*Carmel*	*Average*
Surface Drip	920	746	1437	645	937
Microjet	983	727	1392	755	964
Subsurface Drip -					
single hose	1028	877	1308	865	1020
double hose	639	701	1241	779	840

Table II. **TRUNK DIAMETER -- CM**

	Nonpareil	*Butte*	*Monterey*	*Carmel*	*Average*
Surface Drip	15.5	16.4	15.2	13.9	15.3
Microjet	16.1	17.5	17.0	14.6	16.3
Subsurface Drip	15.5	16.7	15.3	14.1	15.4

Table III.

Irrigation System	1993		1994		1995	
	Avg.q (l/hr)	EU (%)	Avg.q (l/hr)	EU (%)	Avg.q (l/hr)	EU (%)
Surf. drip/1 lateral	3.79	94	3.94	91	4.06	87
Surf. drip/1 lateral	4.24	91	4.05	89	4.16	91
Surf. drip/1 lateral	4.39	91	4.13	90	4.15	88
Surf. drip/1 lateral	4.62	85	4.28	84	3.95	95
Surf. drip/1 lateral	4.01	96	4.05	92	3.95	93
Surf. drip/1 lateral	4.16	95	4.20	91	4.02	92
Surf. drip/2 laterals	4.01	96	3.97	94	1.84	96
Surf. drip/2 laterals	4.54	96	4.24	88	1.87	94
Surf. drip/2 laterals	4.09	95	4.54	84	1.89	94
Surf. drip/2 laterals	4.54	92	3.97	89	1.77	95
Surf. drip/2 laterals	4.09	95	4.05	91	1.91	94
Surf. drip/2 laterals	4.16	94	4.01	92	1.82	92
Microsprinkler	29.9	87	38.1	90	40.3	89
Microsprinkler	33.3	98	42.1	92	43.5	90
Microsprinkler	39.0	95	41.0	93	41.6	93
Microsprinkler			38.5	94	41.5	94
Microsprinkler			38.0	80	38.9	86
Microsprinkler			39.9	88	39.7	88
Microsprinkler	37.7	85	37.1	94	39.2	92
Microsprinkler			36.8	94	39.3	94
Microsprinkler			40.8	89	46.6	90
Microsprinkler			39.5	90	41.4	93
Microsprinkler	36.7	94	37.5	92	40.1	93
Microsprinkler	46.6	94	43.3	97	48.3	94

Field-measured output (Avg.q) and emission uniformities (EU) for the irrigation treatments.

3. *Almond-Marianna 2624 Performance*

Prior research at Nickels Soil Lab suggested that numerous 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 a second or even third time before healthy plantings were fully established. Viruses have been implicated in similar graft union disorders.

A 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 virus interaction on orchard establishment. 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.

All four varieties have continued to perform satisfactorily on M2624 rootstock, with no tree losses occurring. Shoot growth in 1995 was quite 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. Yield results for this season are depicted in Table 1. (Yield for the Butte variety is not available. Visual estimates indicated Butte crop size similar to Ruby and Mission.) Yields for this season were similar to 1994 except for the Padre variety which showed a decrease. Given the relatively poor pollination weather during the bloom period these are acceptable yields. Considerable shoot growth (increase on bearing potential) occurred this season, following a year of poor tree vigor. Potassium fertilizer application of 3 lbs. K_2SO_4/tree (624 lbs/Ac) in October of 1994 may have proved beneficial. However, considerable canopy expansion will be required to fill the allotted space and reach optimum bearing-potential in this block. An unusual leaf necrosis symptom has occurred only on the Butte variety each July or August. Marginal necrosis and shoot stunting on randomly affected branches throughout the planting has been observed on about 12% of the Buttes. No disease organism, toxic salt or other explanation has been confirmed as the cause. Affected branches show symptoms year to year but overall tree size is only slightly diminished. This maybe a new form of incompatibility of the Butte variety on M2624 rootstock. Kernel sizes in grams per kernel are also provided. Table 2 lists historical yield data for this trial.

Table 1. **NICKELS SOIL LAB -- 1995 DATA**
MARIANNA 2624 HEDGEROW -- YIELD LBS/AC

	gms/kernel	*Rep 1*	*Rep 2*	*Rep 3*	*Rep 4*	*Average*
Mission	1.23	1486	1670	1695	1625	1619
Padre	1.26	1258	1289	1317	1357	1305
Ruby	1.37	1602	1660	1582	1882	1682

Table 2. YIELD LBS/AC -- 1991-1995

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

4. *Control of Peach Twig Borer*

Five years of research has shown the effectiveness of the stomach poison ***Bacillus thuringiensis*** (B.t.) in the control of PTB when applied during larval emergence at bloom. In addition to being selective, B.t. is regarded as being non-toxic to bees, humans and wildlife, and is considered safe to the environment. Two or three bloom applications of B.t. have been as effective as dormant insecticides when applied to emerging larvae.

However, PTB populations can resurge after B.t. treatments and after dormant insecticides to infest the crop throughout the summer. Additional sprays are often required to prevent kernel damage. Standard insecticidal sprays targeted at hatching larvae of the first summer generation (May) have been effective in decreasing PTB populations in almonds. B.t. sprays targeted to hatching larvae may likewise aid in PTB control while having the added benefit of not disrupting beneficials so important in controlling mites and other pests. This project will evaluate various strategies involving B.t. sprays applied throughout the growing season to improve "non-toxic" control of peach twig borer.

Various treatments were applied three times during bloom at popcorn, 2/10, full bloom, 2/17, and late petal fall, 3/7, to Peerless almonds and compared to other materials applied as dormant sprays for the control of PTB. Overwintering twig borer levels were determined by shoot tip strike counts and the number of pupal cases captured in cardboard bands affixed to tree trunks. Results tabulated for Trial 1 indicate a substantial and equal degree of control was afforded by all materials tested.

The B.t. materials - MVP and Dipel ES - again reduced twig borer populations as effectively as dormant insecticides. Cryolite 96, a newly evaluated fluorine-stomach poison, also compared favorably to the dormant insecticides tested.

Two additional trials were conducted to evaluate the effectiveness of B.t.s (Dipel ES, MVP and Able) against lst generation twig borers in May. Sprays evaluated are listed in the tables for Trial 2 and Trial 3. These materials were applied using the degree day model to coincide with 1st generation egg hatch at 300± degree days, 5/18, and 500 degree days, 5/31.

Asana XL, a synthetic pyrethroid, out performed all other treatments in reducing twig borer numbers in these tests. Although the level of control from B.t.s was low, there does appear to be some activity against twig borers at this May timing. We reduced PTB numbers by 50-70% from two in-season sprays of B.t. Although not as effective as other more toxic materials, B.t. may still be useful in lowering overall PTB populations in orchards without disrupting beneficials, which can be a serious problem with other registered insecticides.

TRIAL 1: PEACH TWIG BORER CONTROL
OVERWINTERING GENERATION

	Rate/Ac.	*Timing*	*Strikes/tree*	*Pupae/band/tree*
Untreated	---	NA	9.17	37.50
Imidan 50 WP	@ 4 lbs	dormant	0.40	0.17
Diazinon 50WP	@ 4 lbs	dormant	0.00	1.00
Asana XL	@ 8 oz	dormant	0.00	1.34
Cryolite 96	@ 8 lbs	bloom	0.80	3.50
MVP	@ 2 qts	bloom	0.17	3.17
Dipel ES	@ 1 qt	bloom	0.17	2.17
Dipel Es + Kinetic	@ 1 qt	bloom	0.00	0.83

TRIAL 2: PEACH TWIG BORER CONTROL
MAY GENERATION

	Rate/Ac.	*Strikes/tree*	*Pupae/band*
Untreated	--	19.17	--
Asana XL	@ 8 oz	0.17	0.83
MVP	@ 2 qts	10.00	2.17
Dipel ES	@ 1 qt	6.00	2.33
Dipel ES + Kinetic	@ 1 qt + 8 oz	7.33	1.50

TRIAL 3: PEACH TWIG BORER CONTROL
MAY GENERATION

	Rate/Ac.	*Strikes/tree*	*Pupae/band*
Untreated	--	7.67	2.17
Able	@ .05 lb.	3.34	0.00
Able	@ 1.0 lb.	3.67	0.33
Dipel ES	@ 1 qt.	3.33	0.83
Dipel ES + Kinetic	@ 1 qt. + 8 oz.	2.33	0.17
Asana XL	@ 8 oz.	1.17	0.33
MVP	@ 2 qts.	3.83	0.50