Almond Culture and Orchard Management

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University of California
Agriculture and Natural Resources
Making a Difference for California

Problem and Significance: This project supports Farm Advisors general extension research programs related to almond production and highlights research results addressing local issues.

Increasing the Nonpareil Percentage: Pollenizer Arrangement & Bloom Timing

Joe Connell, Farm Advisor, Butte County   Cooperating personnel: Brian Miller, CSU Chico Farm.

Objectives:

1) To determine if the Nonpareil percentage can be increased with careful placement of pollenizers and still maintain yields of a 1:1 planting.
2) Does the addition of an early pollenizer improve performance?

Methods:

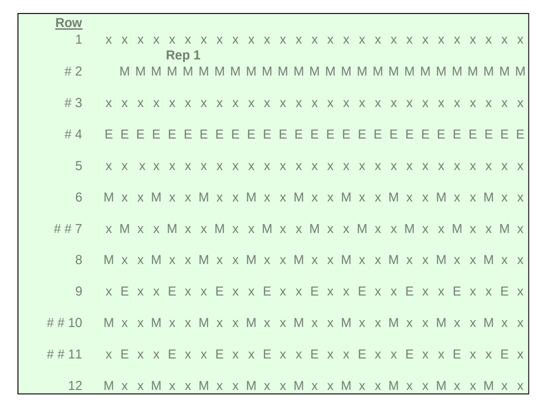
A new orchard was planted in 2002 at the CSU Chico farm; 18 x 21 feet, 116 trees/acre. Yield is consulted from the # rows representing the three treatments. Each plot is 27 trees long and is replicated four times.

Three treatments:

- **Standard 1:1 planting, Nonpareil at 50%, a mid pollenizer at 25%, and an early pollenizer at 25%**
- **Nonpareil in every row, pollenizers every two trees down the row, Nonpareil 66%, an early pollenizer 17% and a mid pollenizer 17%**
- **Nonpareil in every row, pollenizers every two trees down the row, Nonpareil 66%, and a mid pollenizer 34%**

Plot layout

X = Nonpareil
M = mid pollenizer
E = early pollenizer



Number of Trees per Acre by Variety and % of Planting

		Nonpareil	Price	Sano
Standard 1:1 Planting, 3 Varieties	Variety %	50%	25%	25%
	# Trees/acre	58	29	29
Nonpareil in Every Row, 3 Varieties	Variety %	66%	17%	17%
	# Trees/acre	76	20	20
Nonpareil in Every Row, 2 Varieties	Variety %	66%	34%	
	# Trees/acre	76	40	

Results & Discussion:

- **Yield per tree was not significantly different between treatments in 2010.**
- **In 2010 the total yield per acre was not significantly different between treatments.**
- **The cumulative yield numerical trend favors the higher percentage of pollenizers found in the standard 1:1 planting.**
- **The addition of an early blooming pollenizer did not enhance Nonpareil yield.**
- **The variety percentage makes an obvious difference in the number of pounds of each variety produced per planted acre.**
- **Although "Nonpareil in Every Row" treatments have a higher Nonpareil %, the $/Ac differences are not significant since cumulative yields are lower.**

2010 Mean Yield per Tree & per Planted Acre by Variety Percentage

	Nonpareil lbs/tree	Nonpareil lbs/acre	Price lbs/tree	Price lbs/acre	Sano lbs/tree	Sano lbs/acre
Standard 1:1 Planting, 3 Varieties	17.8	1034	17.6	511	17.8	516
Nonpareil in Every Row, 3 Varieties	16.9	1287	18.8	377	15.7	314
Nonpareil in Every Row, 2 Varieties	19.2	1462	15.8	633		
	ns*		ns		ns	

*ns at bottom of column indicates no significant treatment effects at P ≤ 0.05.

Cumulative Yield and 2010 Value per Acre of All Varieties in Each Treatment

	2005-2010 Cumulative Yield -- lbs/acre	2010 Value lbs/acre	2010 Value $ / Acre
Standard 1:1 Planting, 3 Varieties	9795	2061	$ 3,052
Nonpareil in Every Row, 3 Varieties	9504	1978	$ 3,094
Nonpareil in Every Row, 2 Varieties	9544	2095	$ 3,333
		ns*	ns

*ns at bottom of column indicates no significant treatment effects at P ≤ 0.05.

2010 value calculated with Nonpareil at $1.70/lb, Price & Sano at $1.20/lb

The affects of delaying pruning until early spring in young almond trees

Carolyn DeBuse, Farm Advisor, UCCE Solano/Yolo Counties

The traditional pruning time for young almond trees is the dormant season after the leaves have dropped but this is also one of wettest times of year with regular fog, rain and dew. The open wound that is created by the pruning cut is vulnerable to infection from canker causing bacterial and fungal pathogens which are transferred in wet weather.

Objective:

To see if pruning in the early spring will have an affect tree size by comparing the second season growth and first season growth of trees that were pruned at three different times; dormant, after leaf bud break, during leaf expansion.

Methods:

Second year tree
- 72 Nonpareil trees planted winter of 2008/09
- 3 pruning timings (6 replicates of 4 trees each)
  1) Dormant, February 16th
  2) Leaf bud break , March 9th
  3) During leaf expansion, April 27th
- Measurements of circumference, height, and canopy size

First year tree
- 64 Nonpareil trees planted March 19, 2010
- 3 heading timings & 2 pruning heights (4 reps of 4 trees each)
  1) 36" high at planting, March 19th
  2) 36" high at leaf bud break, 19 days after planting
  3) 48" high at leaf bud break, 19 days after planting
  4) 36" high during leaf expansion, 42 days after planting
- Measurements of diameter, height, and branch number

Results:

Second year trees:
•No significant differences were found in any of the tree growth measurements of circumference, height, or canopy size compared to dormant pruning.

First year trees:
•No significant difference was found in growth measurements of diameter or height compared to control trees headed at planting.
• Trees headed at 48" at bud break had 28% more branches than control trees headed at 36" when planted and 31% more than the trees headed at 36" during leaf expansion; significance at p<0.05.

Conclusion:

This experiment shows that the growth of young almond trees is not reduced by pruning in the spring when the trees are at bud break. There may be the added benefit of reducing pathogen infection by pruning after the wet winter weather has passed. This experiment needs continued evaluation and to be repeated before confirmation of these results.

Figure 1. Dormant pruning treatment second year trees, Feb. 16, 2010 (left photo -before, right photo- after)

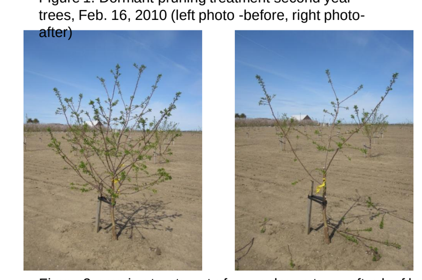


Figure 2. pruning treatment of second year trees after leaf bud break, March 9, 2010 (left photo-before, right-photo after)

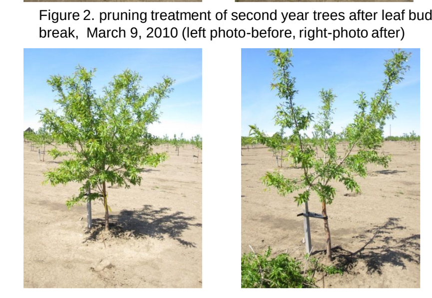
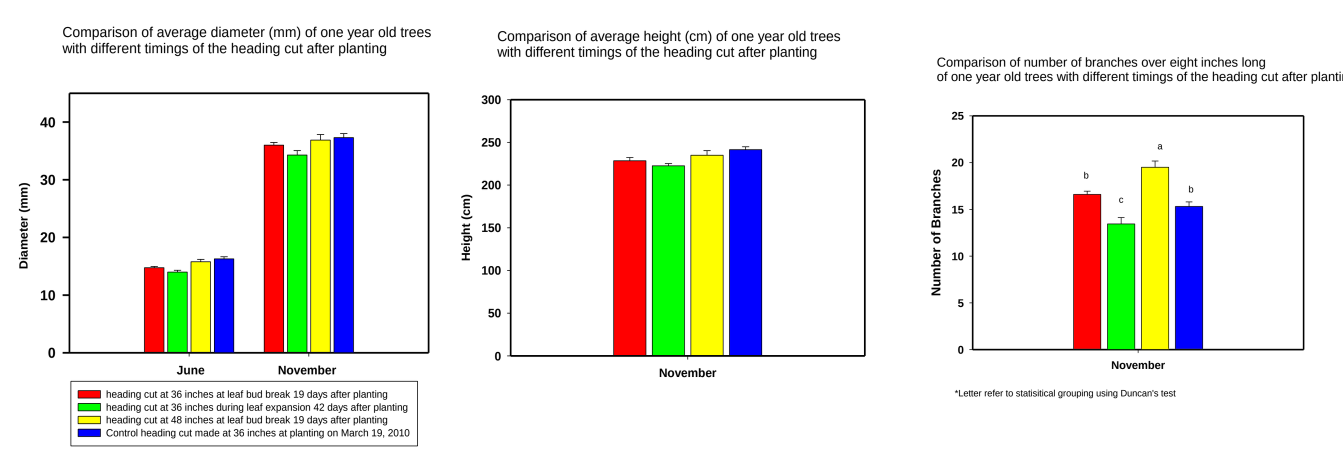
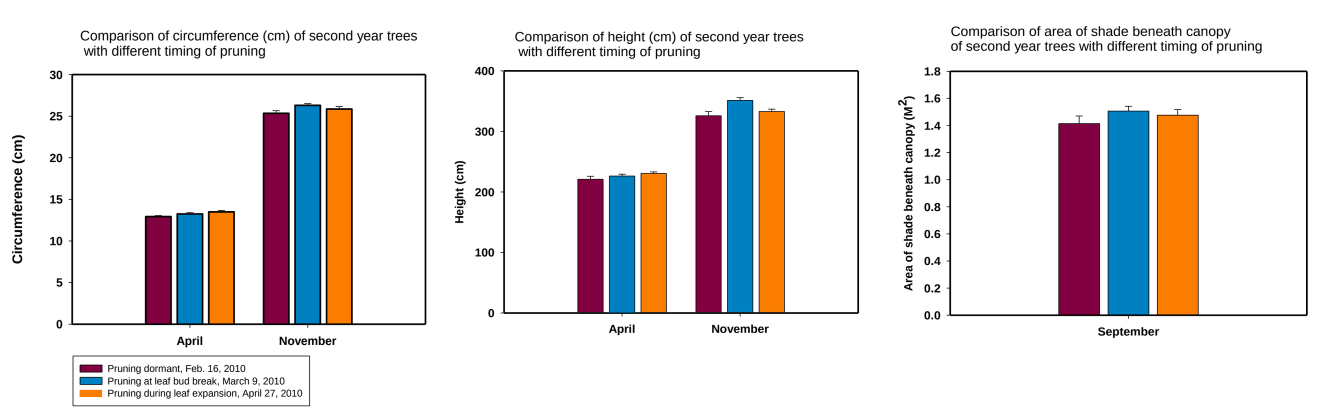


Figure . Pruning treatment of second year trees during leaf expansion , April 27, 2010 (left photo-before, right photo- after)





Salinity Tolerance of Six Almond Rootstocks

David Doll, Farm Advisor, Merced Co.   Cooperating personnel: Arnold Farms, Roger Duncan (UCCE Stanislaus Co.

Introduction:

A rootstock trial was established in 1990 on loamy sand soil in northern Merced County. Four peach rootstocks, Halford, Nemaguard, Nemared, and Lovell, and two peach almond hybrid rootstocks, Brights P.A. Hybrid and Hansen 536, were planted in a randomized complete block design containing 5 blocks of 5 replicate trees spaced 24'x24' containing two varieties, Nonpareil and Carmel. The block was irrigated with solid-set sprinklers using well water with moderately high sodium. All rootstocks and both varieties were farmed according to the grower's standard practice. Earlier research within this trial has demonstrated that peach x almond hybrids out-grow and out yield peach rootstocks. Furthermore, leaves of trees planted on peach rootstocks have showed symptoms of salt burn during late summer while symptoms are not present on the trees planted with peach x almond hybrid rootstocks. It is thought that peach x almond hybrid rootstocks perform better than peach rootstocks in areas of elevated sodium levels.

Objectives:

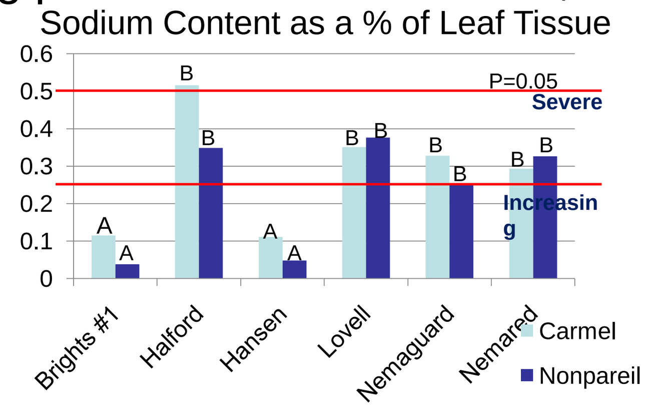
1. Use tissue analysis to determine the influence of the six rootstocks on the leaf concentrations of sodium and chloride,
2. Count the number of trees expressing symptoms of salt burn in the orchard,
3. Measure the yield of the various rootstocks and compare their performance.

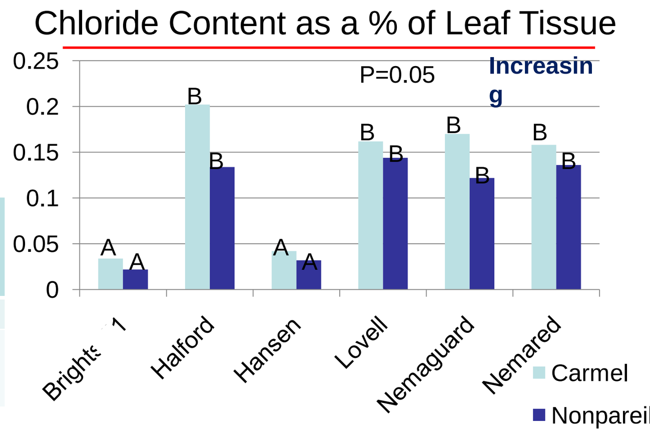
Methods:

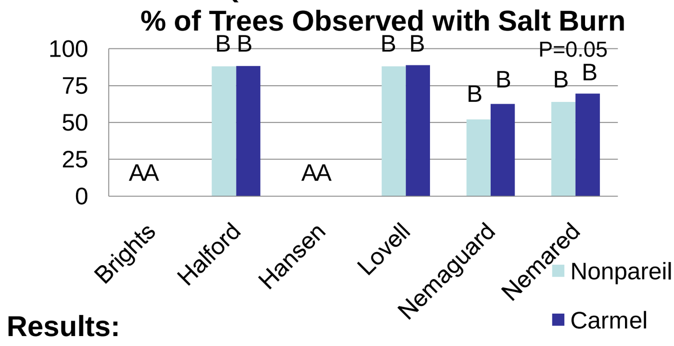
Mid-July leaf sampling was conducted following University of California recommendations. Leaves from replicate trees of the same variety and block were pooled for analysis. All samples were submitted to UC Davis Analytical Laboratory for analysis. Prior to harvest, observations of the trees expressing symptom of salt burn were made. Harvest yields were taken to allow a comparison of rootstocks 20 year post planting.

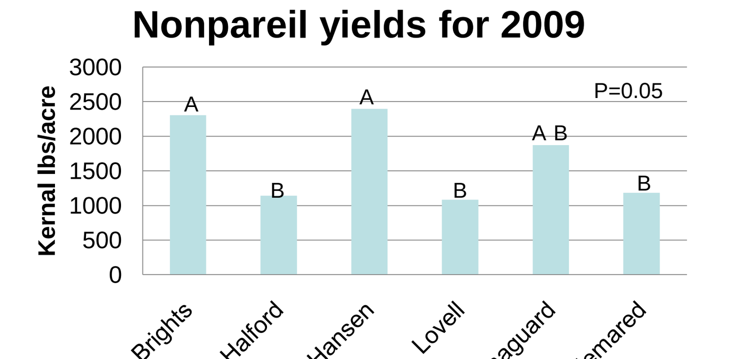
Table 1: Analysis of the well water used for irrigation within the trial

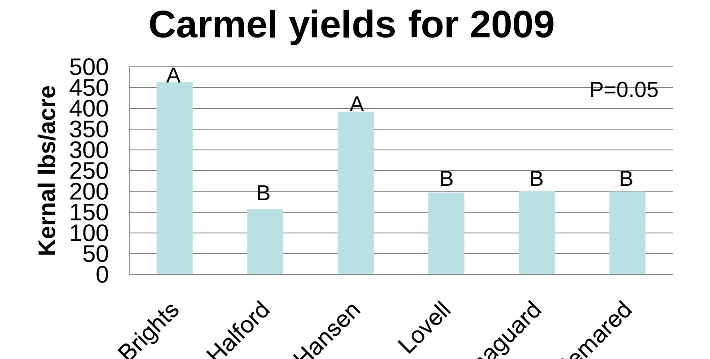
	Sodium (meq/L)	Calcium (meq/L)	Magnesium (meq/L)	Carbonate (meq/L)	Chloride (meq/L)	E.C. (meq/L)
Well	6.35	2.10	5.59	0.00	0.63	1.38
UC Rec Values	3.0				4.0	>1.00











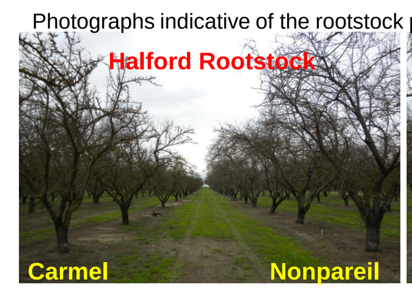
Results:

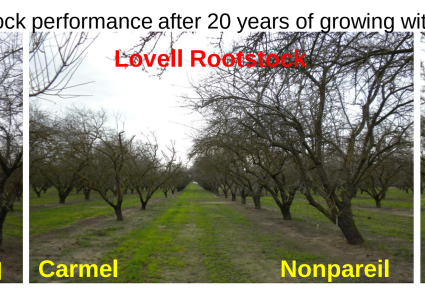
1. Peach x almond hybrid rootstocks had lower concentrations of sodium and chloride within the leaf tissues in comparison to the peach rootstocks;
2. A high percentage of peach rootstocks had symptoms of salt burn, while trees planted with peach x almond hybrid rootstocks had no leaf burn present;
3. Peach x almond hybrid rootstocks produced more yield than Halford, Lovell, and Nemared rootstocks within the Nonpareil variety; peach x almond hybrids outperformed all peach rootstocks within the Carmel variety.

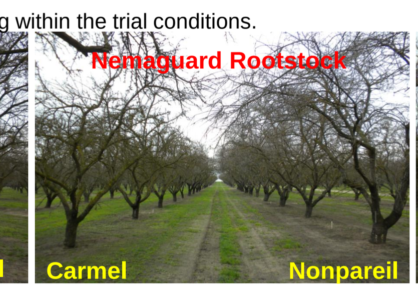
Conclusions:

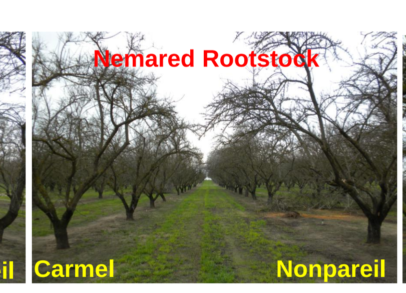
1. Peach x almond hybrids appear to have a higher sodium and chloride tolerance than peach rootstocks, and are able to out-yield peach rootstocks in conditions of high sodium;
2. Peach x almond hybrids can be used to help manage sodium issues within orchards, but the genetic tolerance to sodium should not take the place of proper irrigation and salt management strategies – i.e. applying a leaching fraction;
3. Keep in mind that peach x almond hybrids are susceptible to Ring Nematode, Bacterial Canker, and Phytophthora Root and Crown Rot.

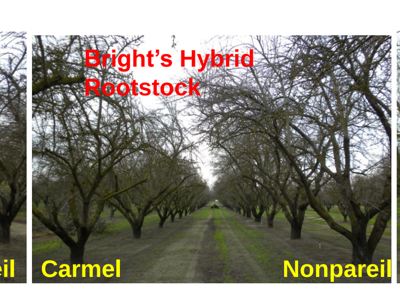
Photographs indicative of the rootstock performance after 20 years of growing within the trial conditions.

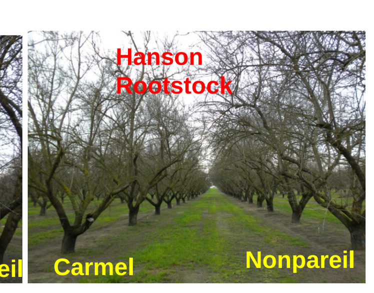












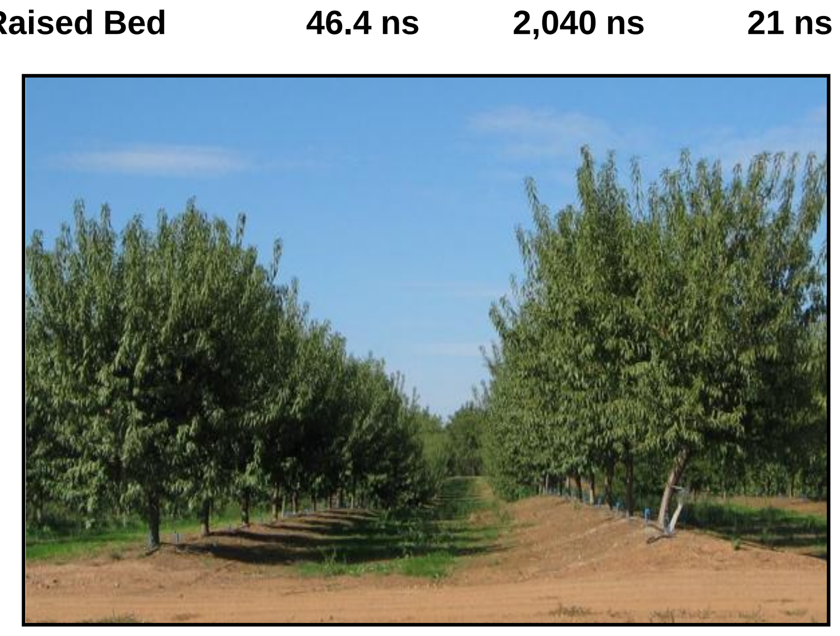
Evaluation of Almond Production on Raised Beds

John Edstrom, Farm Advisor, Colusa County.

Objectives:

Evaluate the feasibility and possible advantages of a large Raised Bed planting system in almonds to expand the potential root zone and overcome the restriction imposed to root development by shallow or layered soils .

	Trunk Circ. cm	Yield lbs/ac	Kernels/oz.
Standard Berm	45.7	1,830	21
Raised Bed	46.4 ns	2,040 ns	21 ns



Standard Berm 8" x 5'   Raised Bed 20" x 11'

Results:

- After the 5th growing season, Nonpareil trees showed no difference in trunk size between the Raised Bed and Standard Berm.
- Yield figures show no statistical difference in yield, but production appeared 200 lbs higher for Raised Beds, 2040 vs. 1830 lbs/acre.
- Large beds have not interfered significantly with mowing and sweeping/blowing/harvesting nuts.
- Large beds do restrict the affective width of row middles and could require machinery adjustments. This bed size (20 inches high x 11 feet wide) required adjustments to the herbicide spray boom to evenly apply herbicides in this 16'x22' spacing.
- The micro-sprinkler irrigation system that failed to evenly wet the raised bed soil in past years was replaced with a dual drip system this season and now uniformly wets the raised bed soil. This has allowed a fair evaluation of raised beds verses the standard berms for the 2010 season.

Discussion:

Only time will tell if this is the beginning of a trend towards higher production from the larger soil volume created by the raised beds or simply a fluke.

In addition to the affects of deeper topsoil, raised beds are reported to increase nutrient availability, soil temperature and oxygen levels providing a more optimal root environment. The use of sizable berms/beds improves the drainage of winter rain and allows tree planting earlier in the season than flat/level plantings.

Almond Culture and Orchard Management continued

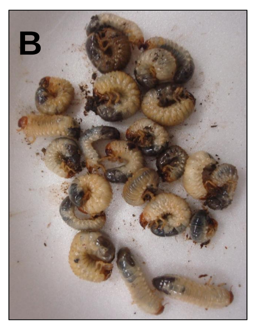
Joe Connell, Farm Advisor, Butte Co., Carolyn DeBuse, Farm Advisor ,Yolo Co., David Doll, Farm Advisor, Merced Co., John Edstrom, Farm Advisor, Colusa Co., Elizabeth Fichtner, Farm Advisor, Tulare Co., and Franz Niederholzer, Farm Advisor, Sutter and Yuba Counties

Problem and Significance: This project supports Farm Advisors general extension research programs related to almond production and highlights research results addressing local issues.

Measure of Tenlined June Beetle activity using soil microbial respiration technique

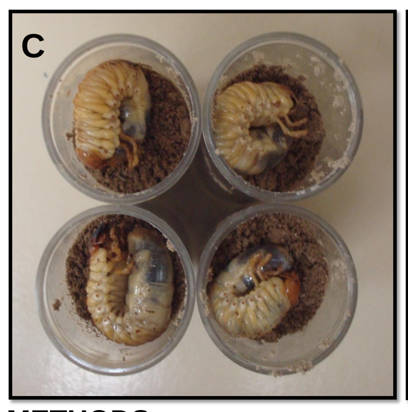
Elizabeth Fichtner, Farm Advisor, Tulare County Cooperating personnel: Marshall Johnson, UC Riverside

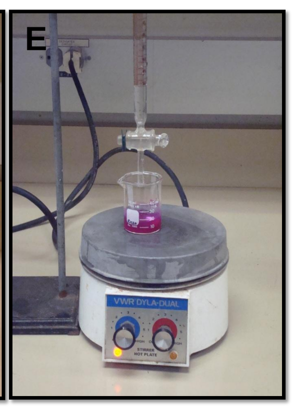
Background: Though Tenline June Beetle (TLJB) is an inhabitant in many orchards, it only causes damage in a fraction of infested blocks. TLJB damage is sporadic within orchards and is often associated with sand streaks, particularly during drought years.
Damage: Extensive larval feeding on roots results in rapid tree decline and death. Additionally, wounds caused by feeding may serve as infection courts for soilborne pathogens.
Hypothesis: TLJB larval activity may be suppressed by soil saturation.
Problem: Assessment of cultural practices for TLJB management relies exclusively on determining larval mortality. There is currently no method utilized to assess larval fitness or activity (a continuous, dependant variable).



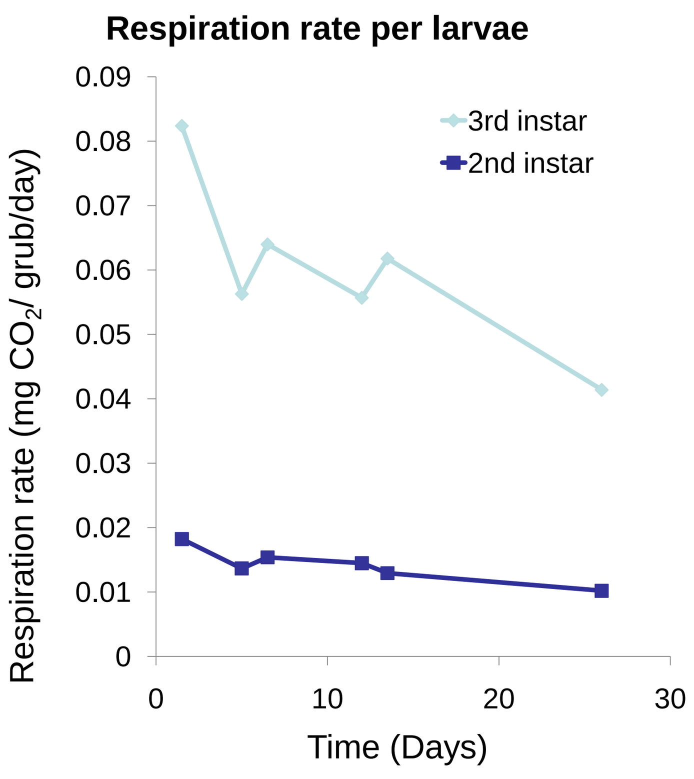
A. Larval feeding on roots may predispose trees to wind damage (Photo: Walt Bentley).
B. Larvae may be excavated from root zone of affected trees.

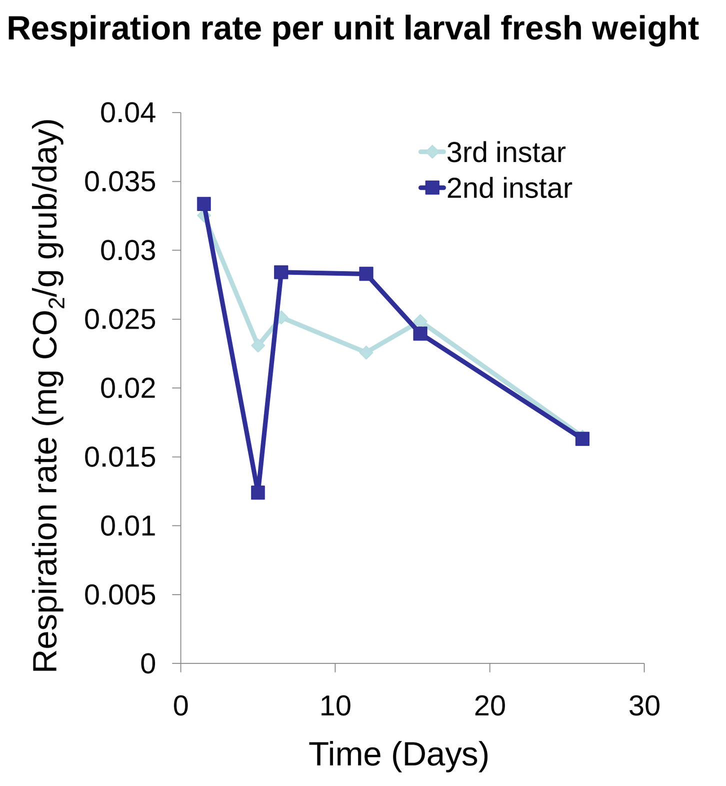
OBJECTIVES
1. Adapt technique for measuring CO_2 evolution from soil to assessment of TLJB activity.
2. Compare metabolic activity of third and second instar larvae.





METHODS
- 2nd and 3rd instar larvae were collected from infested orchards.
- Larvae were individually incubated in non-sterile sand (Photo C).
- Sand and larvae were incubated in sealed respiration chambers (Photo D).
- Additional sand was incubated in absence of larvae to account for soil microbe contribution to total CO_2 evolution.
- CO_2 trapped with NaOH; carbonates precipitated with $BaCl_2$; titration with HCl using phenolphathalein indicator (Photo E).





RESULTS
- Third instar larvae exhibited higher respiration rate than second instar larvae on an individual basis.
- No difference in respiration rate per unit body weight was observed between third- and second instar larvae.

Results suggest that the difference in respiration rate between these two life stages is merely a function of larval size.

APPLICATIONS
- Larval CO_2 evolution can be measured and used as a dependant variable for assessing TLJB activity.
- This technique can be utilized to quantitatively measure larval response to cultural practices (ie. water management, susceptibility to insecticides, etc.).

Increasing almond tree boron levels in Sutter County – how long can it last?

Franz Niederholzer, Farm Advisor, UCCE Sutter/Yuba Counties Cooperating Personnel: Jed Walton, PCA, Big Valley Ag Service, Gridley, CA

Question:

Target boron levels in almond are generally 100-125 ppm B in the hull at harvest. However, hull B values in Sutter Co. often range from 50-75 ppm B – even when fall or pink-bud foliar sprays of 2-3 lbs Solubor®/acre are regularly used. Can a single application of a large rate of boron fertilizer (20-50 lbs of a 14-20% B fertilizer material) increase hull boron levels to 100-125 ppm B? If this application can increase almond tree B to those levels, how long can this "boost" last?

What has been done:

Nonpareil/Lovell almond trees with low B status (<50 ppm hull B at harvest, 2007) were treated with 20 or 40 lbs/acre Solubor® (20% B) on October, 2008 or late May, 2009. Granubor® (14% B) was applied at 50 lb/acre in late May, 2009. Material was applied evenly to half the distance across rows on each side of the study trees using a weed sprayer (20 gpa or hand applied with belly grinder). Soil is an Olashes sandy loam, and irrigation water is delivered by hose-pull impact sprinklers. The unfertilized soil has very low boron levels (≤0.05 ppm B) by saturated paste extract method. The grower applies a liquid B equivalent to 0.6 pounds of B/acre (= 3 pounds of Solubor/acre) as a foliar spray each November. Flower samples were taken at full bloom in 2009 and 2010. Leaf and hull samples were taken in 2009, and hull samples taken in 2010.

Results:

Soil applied boron as 20 or 40 pounds/acre Solubor® in October, 2008 did not significantly increase flower B levels at bloom in 2009 (see Table 1). Similar results with bloom B levels were obtained in 2008 following application of 10 or 20 pounds of Solubor® in October, 2007.

Soil applied boron, as Solubor® (20 or 40 lb/acre in the fall, 2008) or Granubor® (50 lb/acre in spring, 2009) increased hull and leaf B levels in summer, 2009 (Table 2**).**

High rates of soil applied boron, as Solubor® (40 lb/acre in the spring, 2009) or Granubor® (50 lb/acre in spring, 2009) increased flower B levels in 2010 (Table 2). A lower rate of Solubor (20 lb/acre), applied at the same time, did not significantly increase flower B in 2010.

High levels of B were found in all flower samples in 2010, compared with 2009 and 2008. Decreases in fruit set and crop yield were measured in 'Butte' trees fertilized (in the fall) with foliar B where flower B levels > 60 ppm B. It is not possible – this year (2010) -- to test if high rates of soil applied B fertilizer increased or decreased yield, due to poor Non-pareil set across the study orchard in treated and untreated trees. 2010 hull analysis results are not yet available.

Table 1. 'Nonpareil' almond flower boron concentrations (average of eight trees for each treatment) in 2009 and 2010 following soil applied boron fertilizer in fall, 2008 or spring, 2009. There is a 95% chance that data in the same column are significantly different if they do not share a letter, based on Tukey's HSD test.

Treatment	Flower Boron (ppm B) 2009	Flower Boron (ppm B) 2010
Untreated	30 a	47 a
20 lb/acre Solubor® October, 2008	36 a	52 a
40 lb/acre Solubor® October, 2008	38 a	69 b
20 lb/acre Solubor® May, 2009		60 ab
40 lb/acre Solubor® May, 2009		86 c
50 lb/acre Granubor® May, 2009		90 c

Table 2. 'Nonpareil' almond summer leaf and harvest hull boron concentrations (low, high, and average measurement, eight individual trees sampled per treatment) in 2009 following soil applied boron fertilizer in fall, 2008 or spring, 2009. Lowest reading per treatment appears on the left of each column, the highest reading is on the right of each column. The average value appears in the middle in bold print.

Treatment	Leaf Boron (ppm) 2009	Hull Boron (ppm) 2009
Untreated	29 **33** 38	35 **41** 44
20 lb/acre Solubor® October, 2008	35 **41** 52	40 **65** 84
40 lb/acre Solubor® October, 2008	37 **42** 47	72 **104** 153
20 lb/acre Solubor® May, 2009	30 **42** 55	47 **67** 63
40 lb/acre Solubor® May, 2009	38 **44** 53	45 **59** 78
50 lb/acre Granubor® May, 2009	41 **43** 46	60 **77** 94