Concealed Damage Field Studies

Project No.: **12-HORT14-Niederholzer**

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Objectives:

This project was conducted to test the role of different field conditions and practices on the development of concealed damage (CD) in Monterey variety nuts after significant rainfall (1") in the field. This is being done with a view towards refining management guidelines for rains at harvest. Work was conducted at the Nickels Soils Lab during the 2012 harvest and coordinated with ongoing Almond Board-funed project, "Evaluating Concealed Damage in Almonds" led by Alyson Mitchell at Food Science and Technology, UC Davis.

Interpretive Summary:

This study has demonstrated the value of conditioning. Under good drying conditions and following several conditioning treatments, initially dry Monterey nuts that received 1" of artificial rain dried to acceptable moisture levels for nut pickup 14 days afterwards. Conditioning once before rain and once 3 days after rain resulted in the lowest hull (<11%) and kernel (<6%) moisture levels. Furthermore, conditioning before and 3 days after wetting produced the highest quality in-shell product in this study. Single post-rain conditioning produced better results (lower hull and kernel moisture levels) than a single pre-rain conditioning. Conditioning before rain limited the increase in hull and kernel moisture after 1" water, but conditioning after rain was needed for hulls and kernels to redry to commercially acceptable pickup levels in 14 days. In contrast, unconditioned nuts did not begin to dry after two weeks in the field following rain.

Interior temperatures within the mass of the harvested crop did not exceed 100^{o}F in any of the treatments. No symptoms of concealed damage (internal browning) were apparent in any of the treatments after four months in storage.

Materials and Methods:

Monterey variety nuts from 7th leaf trees on Lovell rootstock were shaken (September 28), and allowed to dry on the soil surface at the Nickels Soil Lab near Arbuckle, CA. Nuts were then windrowed in preparation for commercial pickup. On October 5, when hull moisture was 11.3% and kernel moisture was 5.7%, a portion of the windrowed nuts from a single row of trees were shoveled onto a plastic tarp, mixed together, and used to fill 30 individual, 1.5 bushel plastic laundry baskets which were placed in a tractor aisle in the orchard in six groups of five. Two baskets in each of the six groups of baskets were conditioned by removing soil, leaves and sticks and then the basket was refilled with the conditioned nuts. The three remaining baskets in each group were not conditioned. The amount of water equivalent to 1" of rainfall on the surface area of the top of the baskets was applied with a watering can to all five treatments on the same day as the baskets were filled and the first two treatments were conditioned. Three days later, on October 8, three baskets in each treatment were conditioned by the same methods as those on October 5. Two baskets in each group were not conditioned. The list of treatments and pre- and post-rain practices appears in **Table 1**. Basket position in each group was rotated every other day during the study. Nut samples for moisture analysis (using a Model MCPC Laboratory Moisture Computer, Moisture Register Products, Rancho Cucamonga, CA and the Blue Diamond Growers calibration curve) were taken on the days the nuts were turned to simulate conditioning: Oct 8, 11, and 18. Nuts were picked up on October 18, roughly 2 weeks after being placed in the baskets. Nuts were hulled, tested for hull and kernel moisture, and then held for roasting. Subsamples of each treatment replication were commercially roasted (375^{o}F for 40 minutes) in February 2013. Roasted nuts were split vertically and visually examined for signs of concealed damage. Further lab analysis in Dr. Mitchell's lab were conducted to assess differences in internal nut a-hue (brown color, a* color) using a limited number of all the treatments (3 replications). Blanching (holding boiling water on kernels for 1 minute) was tried on small lot (100 kernels) samples to see if concealed damage symptoms could be enhanced by this practice.

Results and Discussion:

Weather conditions during this study were seasonal; warm days, cool nights, and no rainfall (**Table 2**). Drying conditions were good to excellent.

Artificial rainfall (1") on October 5 increased both kernel and hull moisture levels over time as the nuts rewet (**Figures 1** and **2**). Conditioning once before and once after wetting resulted in the lowest hull and kernel moisture by the end of field portion of the experiment (**Table 3, Figures 1** and **2**). Conditioning before rain limited the increase in hull and kernel moisture after 1" water, but conditioning after rain was needed for hulls and kernels to redry to commercially acceptable pickup levels in 14 days (**Figures 1** and **2**).

There were no significant differences in 1) internal nut a* color (overall browning color) and 2) visible symptoms of Concealed Damage between all treatments (**Table 1**). Some kernels from nuts not conditioned before rain showed skin discoloration, but this discoloration was not visible on the kernel after blanching.

Temperature in nuts unconditioned before the rain was elevated 10-20^{o}F after wetting compared to conditioned nuts (**Figure 3**). Temperature in the nuts not conditioned before the rain did not exceed 100^{o}F at any time. When unconditioned nuts were conditioned 3 days

after rain, temperature in those nuts quickly dropped to levels found in nuts conditioned before the rain (**Figure 3**).

Shells of nuts unconditioned before wetting were stained grey/brown compared to nuts conditioned before wetting. Some shell staining occurred within 3 days of wetting (**Figure 4**).

Conditioning before and 3 days after wetting produced the highest quality in-shell product under the conditions of this study – initially very dry nuts, 1" of water followed by 14 days of good drying weather. Conditioning nuts once (3 days after "rain") resulted in rapid nut drying and high quality kernel without concealed damage.

Table 1. Field treatment details and internal color differences of roasted nuts (Monterey). Nickels Soil Lab, Colusa County, 2012.

Treatments	Conditioned before 1" water	Conditioned after 3 days after 1" rain	Conditioned 6 days after 1" rain	Conditioned 11 days after 1" rain	Color a* value	% a* value >2
1	X				2.1	52
2	X	X			2.3	48
3		X	X	X	2.1	54
4		X			1.6	16
5					2.3	56

Table 2. Weather data during this study. Nickels Soil Lab, Oct 5-18, 2012.

Date	Air max (^{o}F)	Air min (^{o}F)	Air avg (^{o}F)	% RH min	% RH min	% RH avg	Precip (in)
5-Oct	77	51	61	90	36	69	0
6-Oct	76	49	61	92	38	69	0
7-Oct	79	49	63	89	34	61	0
8-Oct	75	46	61	90	31	61	0
9-Oct	76	46	61	90	29	62	0
10-Oct	79	51	66	80	26	50	0
11-Oct	73	50	60	91	39	69	0
12-Oct	63	49	54	90	56	77	0
13-Oct	78	48	61	89	33	64	0
14-Oct	78	48	62	92	41	71	0
15-Oct	85	54	68	88	29	62	0
16-Oct	89	58	72	83	19	57	0
17-Oct	89	61	72	42	8	21	0
18-Oct	87	53	71	75	11	32	0

Table 3. Median hull and kernel moisture levels on October 18, 2012, 2 weeks after 1" of artificial rain applied to dry nuts (5.7% moisture) and hulls (11.3% moisture) held in plastic laundry baskets in the field. Treatment details in **Table 1**. Median values followed by the same letter are not significantly different (with 95% confidence).

Treatment	% kernel moisture	% hull moisture
T1	8.05 c	27.9 c
T2	5.95 a	9.3 a
T3	7.25 bc	14.3 b
T4	6.62 ab	10.2 a
T5	11.82 d	54.8 d

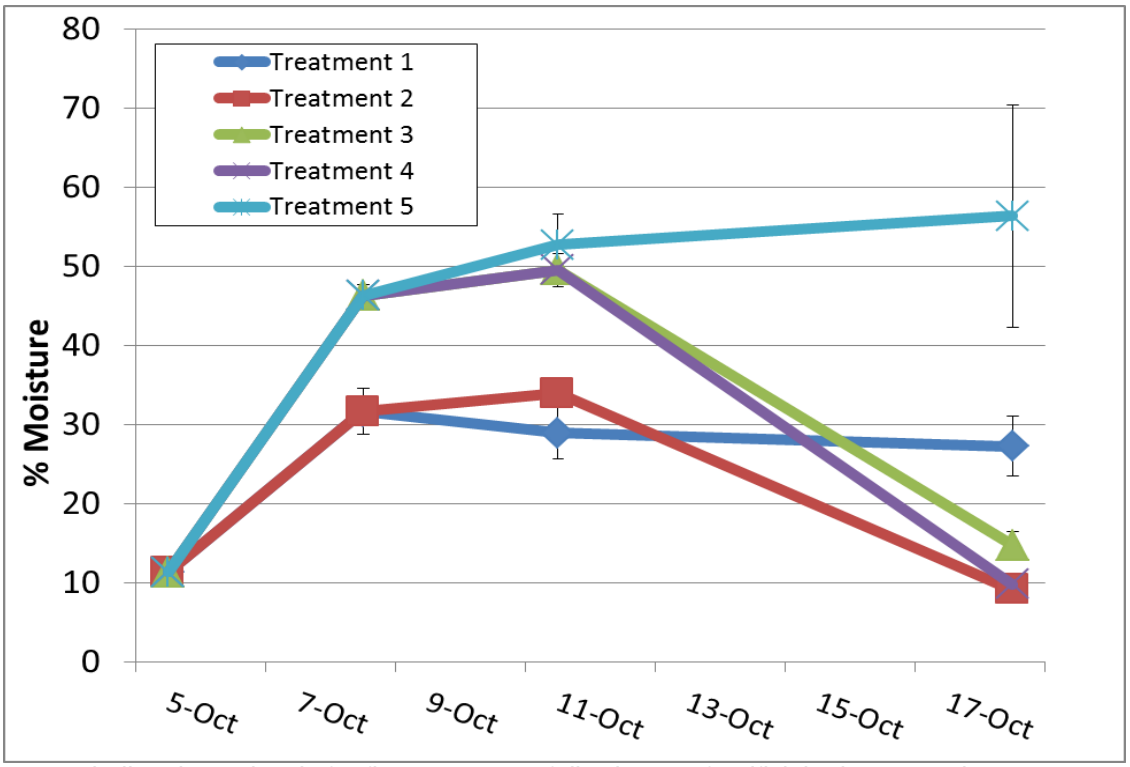

Figure 1. Mean hull moisture levels for five treatments following 1" of artificial rain on October 5, 2012. Bars indicate ± 1 standard error. Treatment details are listed in **Table 1**.

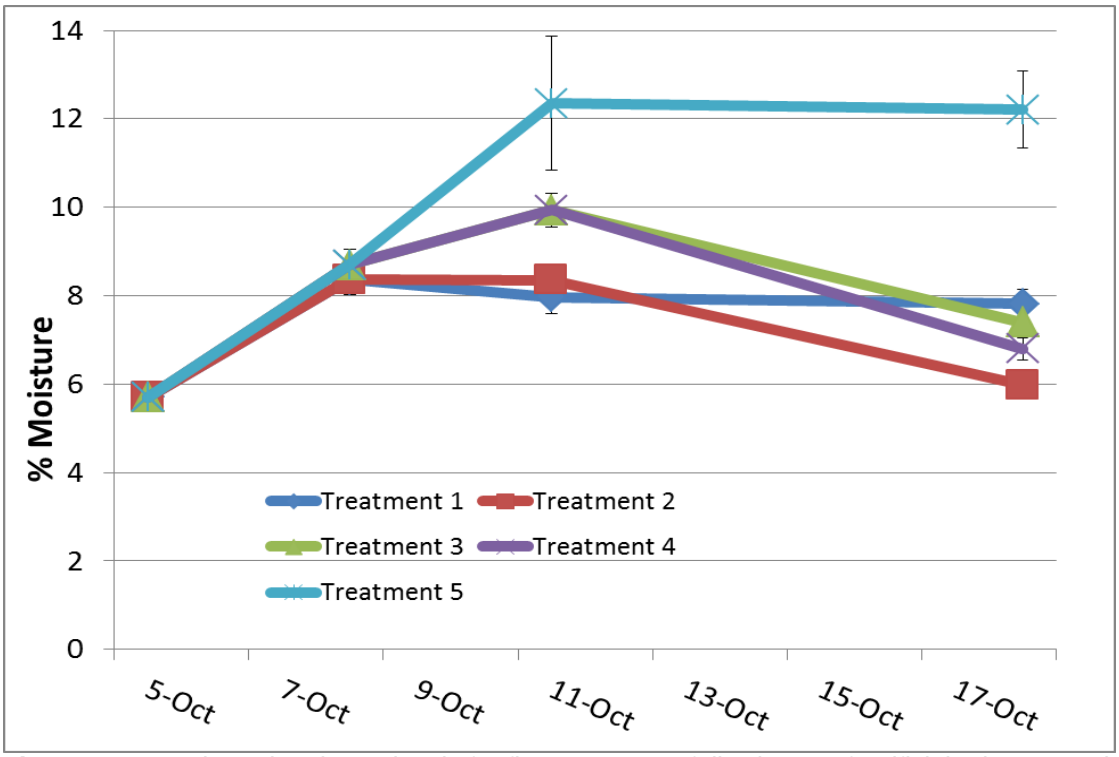

Figure 2. Mean kernel moisture levels for five treatments following 1" of artificial rain on October 5, 2012. Bars indicate ± 1 standard error. Treatment details are listed in **Table 1**.

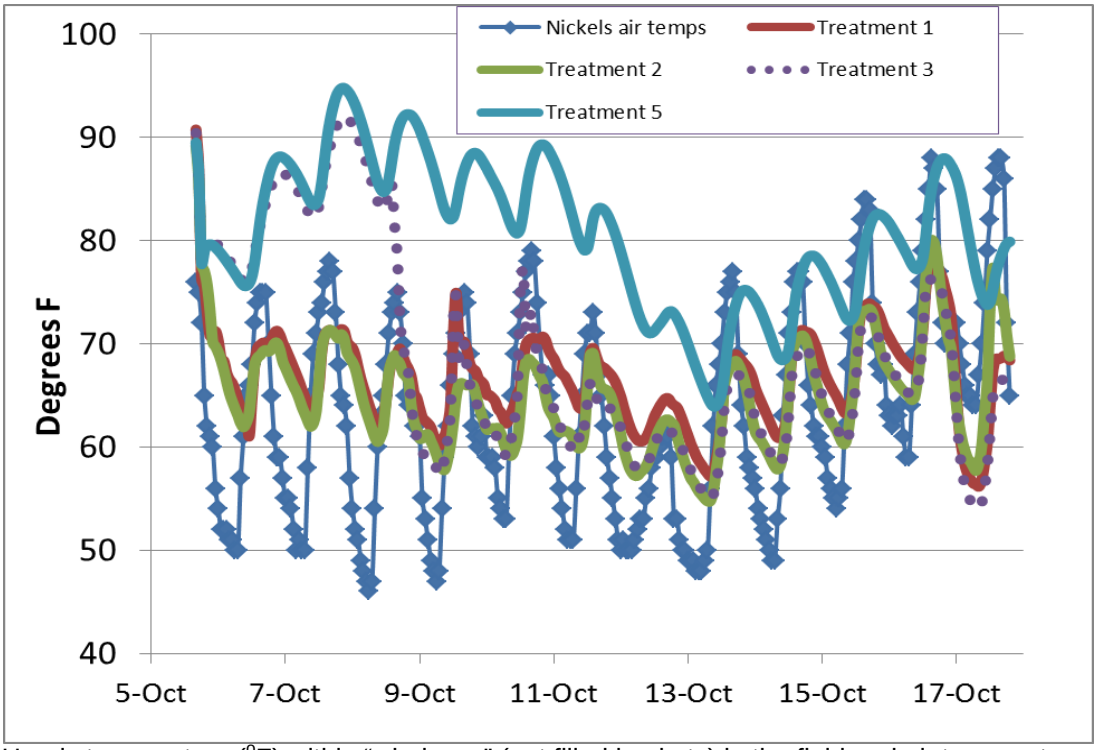

Figure 3. Hourly temperature (^{o}F) within "windrows" (nut filled baskets) in the field and air temperature, Nickels Soil Lab, October 2012. Treatment details are listed in **Table 1**.

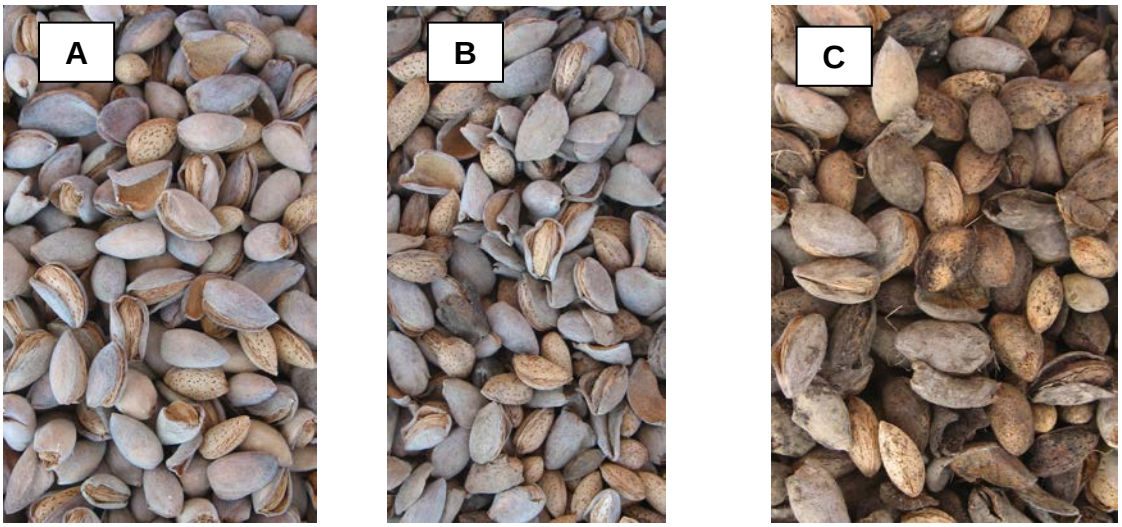

Figure 4. Nut condition at hulling in selected treatments, October 2012. A) Treatment 2 (conditioned before 1" of rain, conditioned 3 days after rain) B) Treatment 3 (conditioned once, 3 days after rain) C) Treatment 5 (unconditioned, 1" rain, unconditioned).

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