Concealed Damage Field Studies

Project No.: **13-HORT14-Niederholzer**

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Objectives:

This project was conducted to test 1) the role of different field practices on Monterey almond nut moisture levels following irrigation delivered by complete coverage microsprinklers ("rain") between shaking and pickup and 2) potential for subsequent concealed damage (CD) development. The field work was conducted in October/November, 2013 and coordinated with ongoing studies led by Alyson Mitchell at Food Science and Technology, UC Davis.

Interpretive Summary:

Conditioning windrowed nuts 2 days after "rain" resulted in significantly lower moisture content of kernels and hulls measured 15 days after "rain", compared with no conditioning. Conditioning nuts prior to rain without additional conditioning after "rain" did not statistically improve drying compared to unconditioned nuts. Rolling nuts following "rain" on recently shaken nuts resulted in lower hull and kernel moisture levels than those of undisturbed nuts at windrowing.

Moisture samples vary significantly across the orchard floor. When sampling for moisture prior to windrowing and/or pickup, take samples for a range of locations. Areas with higher levels of leaf litter should be included in moisture sampling.

Materials and Methods:

A large scale (2 acre) field experiment was established in fall, 2013 at the Nickels Soil Lab near Arbuckle, CA to test the effect of field practices on the drying rate of almonds following simulated rainfall and the subsequent development of concealed damage. The experiment followed this timeline:

Sept 24 Entire orchard floor in the study area treated with Gramoxone.

Sept 25 Monterey variety nuts from five rows of 17th leaf trees on Brights seedling rootstock, spaced 22' x 24', were shaken and allowed to dry on the soil surface.

Sept 30 Irrigation water (0.5"; 7 hours of irrigation) was applied over the shaken nuts to mimic a steady, extended rain, using the existing, full coverage irrigation system (**Figure 1**).

Oct 3 Hull and kernel moisture levels were taken from 24 experimental plots, each 176' long (8 Monterey trees) and the study then blocked by moisture level and treatments assigned to experimental plots. The different practices and timings used in each treatment appear in **Table 1**.

Oct 6 Additional irrigation (7 hours; 0.5" of water) was applied over the downed nuts.

Oct 7 Nuts in 3 treatments were rolled to facilitate drying using a modified rake (**Figure 2**).

Oct 14 All nuts swept and windrowed.

Oct 15-16 Some treatments (**Table 1**) were conditioned before an additional 1" of simulated rain was applied via irrigation in two separate events (7 hours each; 0.5"/day).

Oct 18 Some treatments were conditioned (**Table 1**).

Oct 28 Some treatments were conditioned (**Table 1**).

Nov 1 All nuts were picked up and placed, uncovered, in small, round "stockpiles" measuring 8' in diameter by 4-5' tall (**Figures 3 & 4**). Wet nuts from treatments 2 and 6 were placed in one pile, while drier nuts from other treatments were placed in another. No replicates were possible due to the amount of nuts used in each stockpile. Temperatures in the center of the stockpiles at 1', 2', 3', and 4' from the soil surface were monitored hourly.

Nov 21 Nuts from the center of each stockpile were sampled for moisture and screened for concealed damage by blanching 100 nuts in boiling water for one minute followed by skin removal and visual and sensory evaluation.

Nut (hull and kernel) samples for moisture analysis – using a Model MCPC Laboratory Moisture Computer, Moisture Register Products, Rancho Cucamunga, CA and the Blue Diamond Growers calibration curve -- were taken on: Sept 30, Oct 3,11,18, 25, and Nov 1, 21.

Table 1. Treatment details Nickels Soil Lab, Colusa County, 2013

Treatments	Rolled after 2x 0.5" "rain"	Conditioned before 1" "rain"	Conditioned 2 days after 1" "rain"	Conditioned 13 days after 1" "rain"
1	X	X	X	X
2	X	X		
3		X	X	X
4	X		X	X
5			X	X
6*				

***** Treatment 6 - No conditioning at all

Results and Discussion:

Drying conditions at the study site from shaking to pick up were good to exceptional (**Figure 5**). No rain fell from Sept 26 – Nov 1 and dew events occurred (dewpoint met or exceeded minimum temp) only on 7 of those 34 days.

Kernel and hull moisture levels were influenced by location in the orchard, as shown by the significant differences in kernel and hull moisture levels by block (**Tables 2 and 3**). Block 1 nuts were generally dryer than other regions of the orchard. There was generally less leaf loss from the trees in Block 1 compared with other blocks, especially Blocks 3 & 4, which may have slowed the drying process in those blocks and could explain the nut moisture differences across the orchard floor. These differences illustrate a key management practice following a rain event: moisture samples used to determine pickup times after rainfall should be taken from a range of locations within the orchard, with special attention to areas where many leaves were lost during and after shaking. Leaves mixed with nuts hold moisture around the nuts and slow drying.

Following “rain”, rolling nuts enhanced nut drying relative to unrolled nuts prior to sweeping and windrowing. When all treatment data are grouped under Rolled or Unrolled categories, median hull moisture on Oct 11, five days after rolling, was significantly less for rolled vs. unrolled nuts ($p=0.03$; Kruskal-Wallis test). However, the influence of rolling on hull moisture did not carry past windrowing and further “rain” (data not presented). That is, the benefit of rolling was lost after windrowing and additional “rain”.

Conditioning windrowed nuts following “rain” produced drier nuts (hulls and kernels) at nut pickup on November 1 compared to unconditioned and unrolled nuts (**Tables 4 and 5**). Hulls and kernels from nuts conditioned only after windrowing and before “rain” were not significantly drier than those from unconditioned nuts (**Tables 4 and 5**).

Piling wet nuts in small, uncovered stockpiles did not result in elevated stockpile temperatures, contrary to expectations (**Figure 6**). The timing of the drop in stockpile temperature matches the start of dry north winds on Nov 2 (**Figure 6**); resulting in the rapid evaporative cooling of the nuts in the stockpile at all depths (see the sudden drop in dew point on Nov 2 in **Figure 5**). In retrospect, the piles should have been covered with tarps when they were formed. However, there was no rain in sight on Nov 1 when the piles were made and the intent of the study was to copy grower practices. Hull and kernel moisture levels in the unconditioned nut (nuts from Treatments 2 and 6) piles were still above that acceptable for hulling (10% moisture in kernels and 20+% moisture in hulls) on Nov 21.

No concealed damage was evident in any of the nuts sampled on Nov 21 following blanching.

Table 2. Average percent kernel moisture by block on different sampling dates. Data in the same column followed by the same letter are not significantly different at the 5% level (Tukey HSB).

Block	Oct 3	Oct 8	Oct 11	Oct 18	Oct 25	Nov 1
1	11.2 a	12.1 a	7.4 a	15.8 a	12.4 a	8.0 a
2	14.9 b	14.2 ab	8.6 ab	17.6 ab	15.1 ab	12.6 b
3	15.2 b	14.6 ab	8.6 ab	17.9 ab	17.6 ab	11.0 ab
4	16.6 b	15.1 b	9.4 b	18.3 b	18.0 b	12.4 b

Table 3. Average percent hull moisture by block on different sampling dates. Data in the same column followed by the same letter are not significantly different at the 5% level (Tukey HSB).

Block	Oct 3	Oct 8	Oct 11	Oct 18	Oct 25	Nov 1
1	23.4 a	47.1 a	14.2 a	60.6	43.4	19.6 a
2	42.9 b	60.8 b	20.6 ab	58.6	58.3	34.6 ab
3	43.2 b	61.8 b	20.3 ab	59.9	51.5	36.8 b
4	46.7 b	62.4 b	26.1 b	60.0	58.3	33.1 b

Table 4. Average percent kernel moisture by treatment and treatment descriptions on different sampling dates. Data in the same column followed by the same letter are not significantly different at the 5% level (Tukey HSB).

Treatment	Roll	Treatment practices	Oct 3	Oct 8	Oct 11	Oct 18	Oct 25	Nov 1
1	Yes	Condition 3x	14.7 a	14.0	8.1 ab	16.6	14.6	9.8 a
2	Yes	Condition 1x, before last “rain”, no conditioning after “rain”	15.4 ab	13.6	8.1 ab	16.9	17.2	12.3 ab
3	No	Condition 3x	17.1 b	15.3	9.8 b	17.2	17.0	8.9 a
4	Yes	Condition 2x after water	13.8 ab	14.0	7.9 a	17.3	13.9	10.1 ab
5	No	Condition 2x after water	12.8 a	12.5	8.2 ab	18.0	14.8	9.0 a
6	No	No conditioning at all	13.1 a	14.6	8.8 ab	18.3	17.2	15.8 b

Table 5. Average percent hull moisture by treatment and treatment descriptions on different sampling dates. Data in the same column followed by the same letter are not significantly different at the 5% level (Tukey HSB).

Treatment	Roll	Treatment practices	Oct 3	Oct 8	Oct 11	Oct 18	Oct 25	Nov 1
1	Yes	Condition 3x	39.9 ab	60.0	17.2 a	58.6	52.3	26.8 a
2	Yes	Condition 1x, before last “rain”, no conditioning after “rain”	40.7 ab	57.4	18.6 ab	60.3	61.6	40.1 ab
3	No	Condition 3x	49.6 b	63.3	28.2 b	60.2	56.0	23.4 a
4	Yes	Condition 2x after water	32.0 a	53.0	15.6 a	60.7	44.2	23.3 a
5	No	Condition 2x after water	34.8 a	53.5	20.1 ab	57.5	47.3	24.8 a
6	No	No conditioning at all	37.5 a	61.0	22.1 ab	60.3	56.0	47.7 b

Figure 1. Wetting nuts with irrigation water to simulate rainfall. October 1, 2013.

Figure 2. Modified rake to roll wet nuts. October 1, 2013.

Figure 3. Forming experimental stockpile. November 1, 2013.

Figure 4. Completed experimental stockpile with datalogger for storing temperature data in upper center of the photo. November 1, 2013.

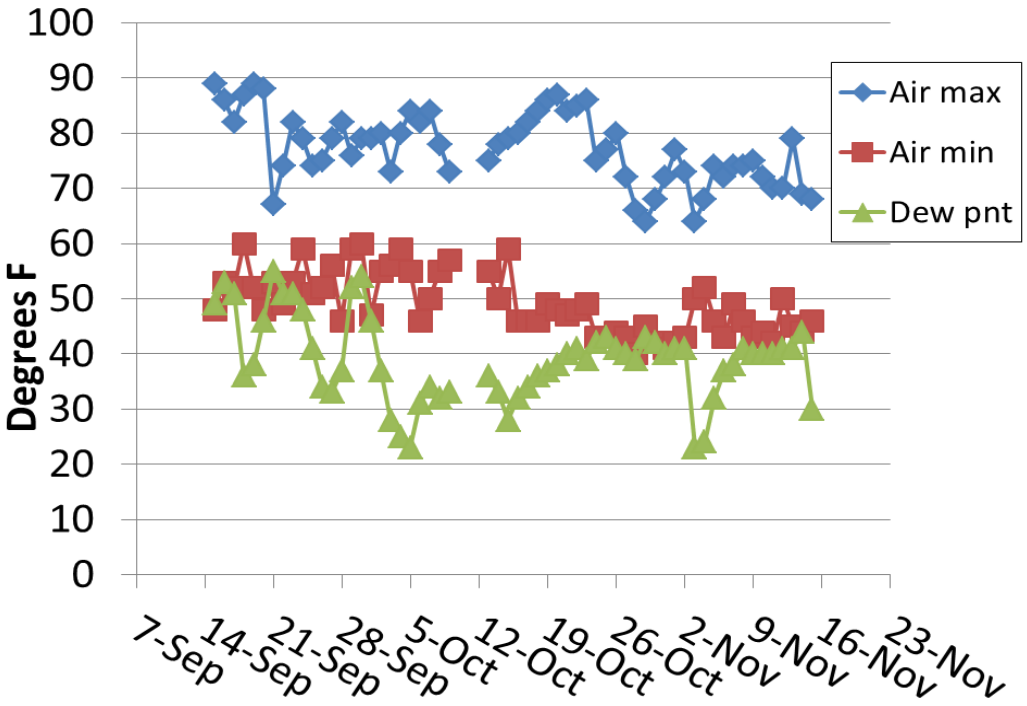

Figure 5. Maximum, minimum, and dew point temperatures at the Nickels Soil Lab, Arbuckle, CA from Sept 15 – Nov 15 (excepting Oct 10-12). Low dew point temperatures coincide with periods of high (north) wind.

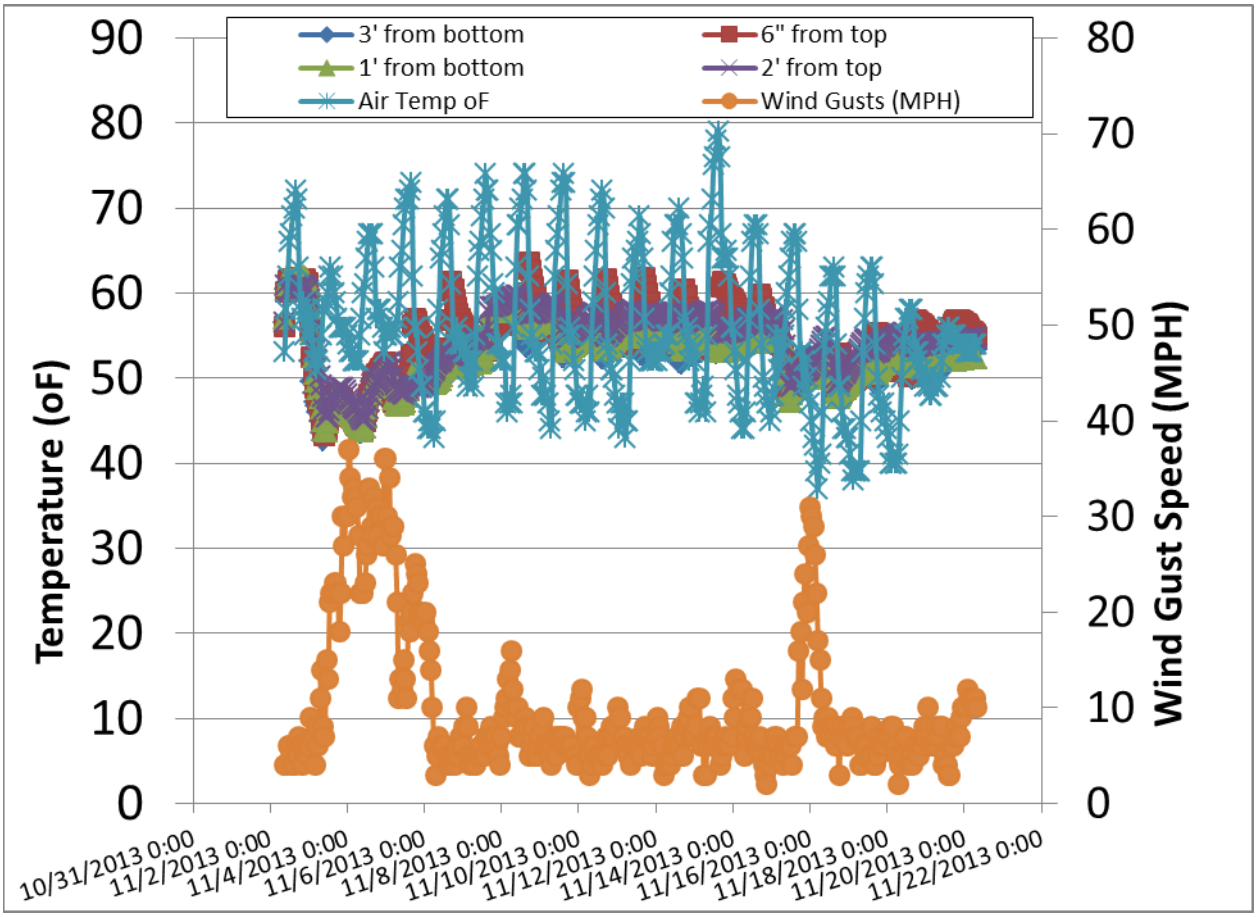

Figure 6. Houly temperatures at different depths a small stockpile, air temperature and wind gust speeds. November 1-21, 2013. Nickels Soil Lab, Arbuckle, CA

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