Almond Stockpile Monitoring for Aflatoxin Potential 2010

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Introduction

The first objective of this project is to study the process of stockpiling including examining temperature and moisture conditions in stockpiled almonds in different production areas in California. A second goal is to determine the impact of different tarp materials on stockpile conditions. A third goal is to examine variability in nut drying on the orchard floor as it relates to position in the orchard and midday canopy light interception. The ultimate goal is to develop recommendations for stockpiling that minimize potential for growth of *Aspergillus* spp. (*A. flavus* and/or *A. parasiticus*) that result in aflatoxin contamination of nuts.

Almond stockpiles in Kern, San Joaquin and Glenn Counties were monitored following the 2007 and 2008 harvests and in Kern County in 2009 and 2010. Of particular note in the 2007/2008 season, stockpiling of nuts with a water activity notably above the recommended 0.65 - 0.70 resulted in significant mold growth near the pile surfaces. The two piles where this was observed had initial moisture contents of: 1) hulls 13.1% and kernels 5.2% (total fruit moisture content 9.2%); and 2) hulls 12.0% and kernels 7.3% (total fruit moisture content 9.7%). There was *Aspergillus* growth at the top and bottom edge of these stockpiles and analysis of one pile showed this was associated with aflatoxin production.

2010 Objectives

1. Investigate the impact of different tarp materials (clear and white/black) on stockpile conditions as they relate to aflatoxin potential
2. Develop methods to assess nut moisture before harvest
3. Investigate conditions affecting variability of nut drying on the orchard floor

Results

Objective 1 (Tarp investigations)- Results in 2010 suggest that fluctuations in temperature were again greatest under clear tarps, and significantly lower under white on black tarps (Fig. 1). Nuts under white on black tarps were slightly cooler than ambient temperature at midday and were significantly warmer than ambient temperatures at night (Fig. 1).

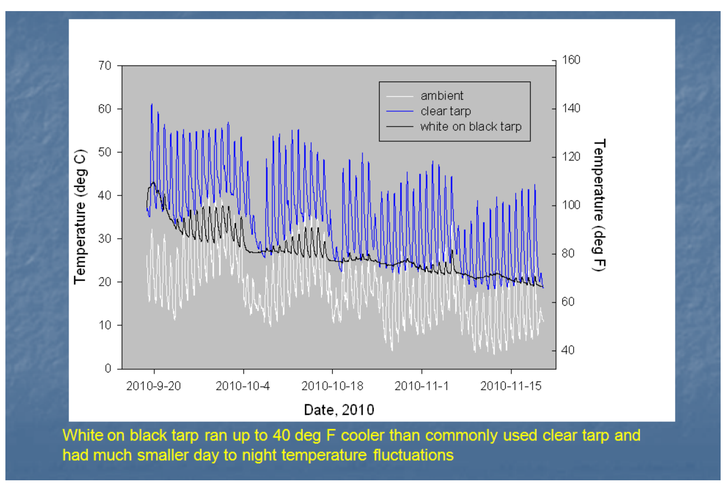

Fig. 1. Ambient temperature and temperatures at top of stockpiles covered with clear and white on black tarps from September to November 2010.

Objective 2 (Develop methods to assess nut moisture before harvest)- Methodology was developed to take nuts from the orchard floor, place them in sealed plastic containers, and after allowing temperature to stabilize, read the relative humidity in the air space at the top of the container using a sensitive relative humidity/temperature probe (Rotronic HygroPalm 23 with HC2-C05 miniprobe; Photo 1).

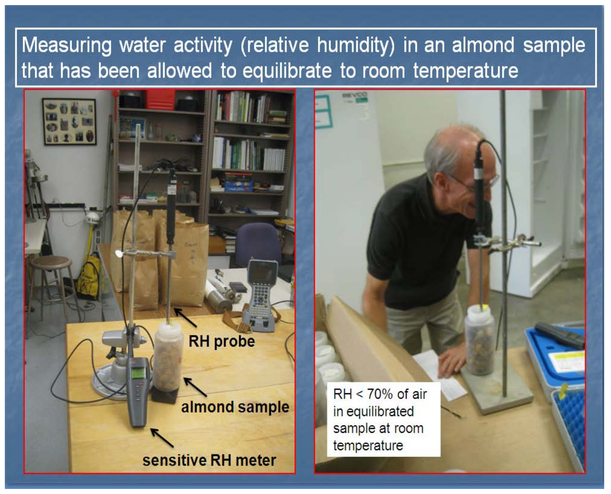

Photo 1. Measuring water activity using a sensitive temperature/relative humidity gauge. Nut samples were collected from the orchard floor and were allowed to equilibrate to room temperature before measurement.

The relative humidity in the air space of the container at temperature equilibrium is equal to the water activity which can be converted to a percent moisture using the data in Fig. 2.

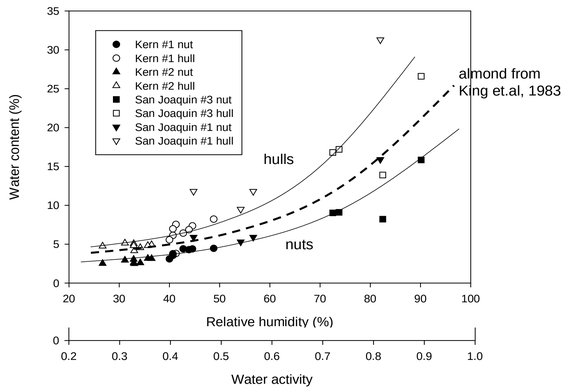

Fig. 2. Relative humidity and water activity versus water content for nuts (including shell) and hulls from the Kern and San Joaquin County stockpiles. Data include cv. Nonpareil from Kern County as well as stockpile #1 and stockpile #3 from San Joaquin County. Dashed line is the approximate curve for almonds (77 deg F) from King et. al, 1983.

This method can work well but it is important that nuts are allowed to equilibrate to a constant temperature (room temperature) before taking readings.

Objective 3 (Investigate conditions affecting nut drying on the orchard floor)- The wettest nuts occurred in the middle of the tree row to the north of the tree trunk. As expected, the driest nuts came from the middle of the drive row. Difference in moisture content from the middle of the drive row to the area north of the trunk averaged about 2%. In a separate study, nuts dried in a windrow also varied with nuts from the bottom of the windrow averaging 2% higher moisture content than those from the top.

Photo 2. Sampling nuts from orchard floor for moisture content analysis. Nut samples were collected through the windrow from top to bottom.

In 2010, nuts were sampled from a variety of areas from the least to most heavily canopied parts of 4 orchards that had previous been mapped with our Mule light bar mobile platform. Nuts varied in moisture content with those in the most heavily canopied parts of the orchard remaining significantly wetter at the time of harvest (Fig. 3).

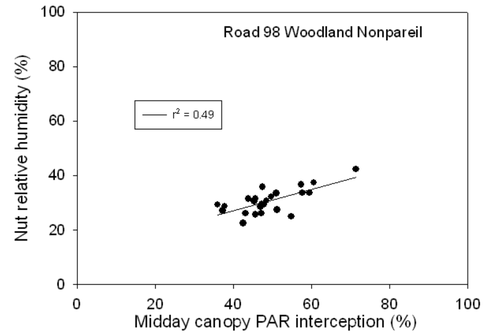

Fig. 3. Nut relative humidity (in temperature stabilized chamber described in photo 1) as it varied in relation to canopy light interception as measured by the Mule light bar.

Conclusions

- Based on 2007-2010 data, stockpiling of high moisture content in-hull almonds can lead to problems with fungal growth
- White on black and white on white tarps appear to have lower daytime high temperatures and less day to night temperature fluctuations which should lead to decreased condensation problems on pile edges
- Substantial variation in moisture content of nuts can occur due to variation in orchard floor drying conditions related to tree canopy density.
- Windrowed nuts can also have substantial differences in moisture content from the top to the bottom of the windrow
- Samples should be taken from the extreme areas (most and least shaded parts of the orchard) where the wettest and driest nuts would likely be found to aid in determining appropriate harvest date.

Reference

King, A.D.Jr., W.U. Halbrook, G. Fuller, and L.C. Whitehand. 1983. Almond nutmeat moisture and water activity and it influence on fungal flora and seed composition. J. Food Sci. 48: 615-617.