

## Introduction: Why we need GAPs

Food safety and product quality are top priorities for the California Almond industry. The Almond Board's Food Quality and Safety Committee constantly examines safety and quality issues. The committee also makes recommendations on how to maintain and improve almond quality and protect the industry from food safety problems.

All food products are coming under increasing scrutiny by government agencies and consumer groups. With the fast growth of the California almond industry comes the increasing risk of contamination from various sources. Contamination control programs do not start and stop at the huller/sheller or handler. Prevention steps must begin at the farm. Current technologies cannot eliminate all potential food safety hazards; however, by utilizing GAPs you can minimize the risk of contamination.

As an almond grower, you want buyers of your almonds to know they are receiving the highest quality almonds, and that every precaution has been taken to reduce the presence of microorganisms, physical hazards and chemicals that could harm consumers.

### It's the right thing

By implementing and documenting Good Agricultural Practices, California almond growers can assure food processors, consumers and government regulators worldwide that our industry is diligent in its commitment to offer safe, high-quality almonds. Not only is it good, sound business, it's the right thing to do.

This guide is designed to help you examine and improve your own growing practices and ensure that they meet the generally accepted standards of Good Agricultural Practices. Please refer to

the Appendix to view recommended forms created for your use. These forms are provided as samples only and have not been approved for use by state or federal regulatory agencies. You may use them as is, modify them to suit your needs, or create new ones as necessary. In all cases, you should have these forms and documents reviewed by technical and/or legal experts before using them to ensure their adequacy in meeting requirements under state and/or federal regulations. In several of the following sections, when you see the word "food" used, it refers to almonds or almond products.

### Food Safety Hazard Categories

As is the case with other food crops, almonds are subject to all three major food safety hazard categories—biological, physical and chemical:

- Microorganism Contamination – Contamination from bacteria, yeasts and molds, including *Salmonella* and *E. coli*.
- Physical Contamination – Contamination from foreign materials that could cause illness or injury, such as stones, glass and metal in food products.
- Chemical Contamination – Contamination from chemicals, including crop protection chemicals, food allergens and aflatoxin.

### The basic principles of GAPs are:

1. Documentation and Traceability
2. Employee Training
3. Fertilizer and Soil Amendment Practices
4. Water Quality and Source
5. Field Sanitation and Worker Hygiene
6. Orchard Floor Management
7. Pest Control
8. Harvest and Delivery Sanitation

## Good Agricultural Practices



Thank you for helping the California almond industry--and yourself--as we continue providing the world with the highest quality, best-tasting, and safest almonds possible.

### GAP Resources to Get Started

GAP resources can be found at <http://www.AlmondBoard.com> in the Food Quality and Safety section. Also available in hard-copy form by request to:

The Almond Board of California  
Good Agricultural Practices Manual  
1150 Ninth Street Suite 1500  
Modesto, CA 95354

Additional information and access to GAP planning resources are available from the University of California, Davis at <http://ucfoodsafety.ucdavis.edu> and <http://ucgaps.ucdavis.edu>.

# 1. Documentation and Traceability

Maintaining readily retrievable records of all operations in and around almond orchards is essential and beneficial when it comes to food safety. Although there are many common elements, each farm operation is unique. Specific documentation and record keeping for each orchard block is optimal to maximize your investment in risk reduction. The resources compiled in this document are made available to get you started with a broad understanding of the issues and what is expected of you. This guide will help you develop your written plan, including documentation. It is organized by key topic area. Remember--don't be intimidated into inaction. Your GAP program can evolve in phases, working toward the point where adequate records include (but are not limited to):

- Detail of prior farm history and ownership.
- Plan for corrective action if farm history identifies food safety hazard(s).
- Documentation of monitoring and/or or mitigation of identified hazard(s).
- Detailed diagram of facility and orchard layout.
- Detailed flow chart or spreadsheet for variety mix and harvest sequence.
- Detailed diagram of adjacent land use, operations, and influences on water sources, orchard floor, and crop from bloom to harvest.
- Climatic records or documentation of access to nearest public or grower subscription weather station.
- Crop management flow chart (pre-bloom to post-harvest).
- Worker training programs and evidence of training recorded for each employee and date.
- Placement and servicing of sanitary facilities.
- Invoice records for sanitation and personal hygiene supplies.
- Water source information and water testing plan, implementation, and results.

- All pesticide and foliar application information.
- All fertility management operations.
- Detailed orchard floor management program.

## Product Traceback

Traceback is the ability to track food items at least one step forward and one step back in the supply chain. Not only should you be able to identify what orchards specific lots were grown in but you should also be able to identify what huller/sheller and handler your product was processed through. In the event of an investigation, the ability to produce all documentation readily allows suspect product to be recalled in a timely manner. A system to identify the source of almonds alone cannot prevent the occurrence of a microbiological, physical, or chemical hazard that may lead to a product recall.

### Benefits of an effective traceback system

An effective traceback system can rapidly identify and isolate suspect product to a specific region, packing facility, or orchard. Without effective traceback documentation, the scope of a product recall can be larger than needed with more product implicated. An effective traceback system speeds up investigations and limits the amount of disruption to the processing and marketing of your crop while building confidence among regulators and consumers that the industry is dedicated to producing a safe and wholesome product.

### Basic traceability program

Growers take the first steps in delivering a safe product to consumers around the world. In order to implement an effective traceback system,

growers should establish lot identification and record-keeping practices. At a minimum, growers should implement the following practices:

1. Maintain records of orchard practices prior to harvest.
2. Establish a lot numbering scheme as loads are harvested and maintain records of lot numbers for all loads of almonds leaving your farm.
3. Be sure that each load leaving your farm can be traced one step back to the orchard of origin and date of harvest, as well as one step forward to the huller/sheller, handling facility and/or customer.

An effective trace-back program will enable you trace product at least one step forward and one step back in the supply chain.

Resources (A copy of this document can be found under “Regulations and Guidelines”)

- Food And Drug Administration - Guide to Minimize Microbial Food Safety Hazards for Fresh Fruits and Vegetables Section IXI, Traceback

## 2. Employee Training

Informed and trained employees are key assets to your business and are a critical component in effectively executing your GAP program. Preparing for effective awareness and skills training begins with a written employee-training program. Implementing and documenting training sessions are crucial for a successful food safety program. Written procedures for equipment operation, with food safety in mind, can be simple to get started but should be comprehensive to include all machines and devices used in crop management and handling high quality, safe almonds. Written procedures should be available to ensure all individuals who take part in year-round or seasonal orchard management receive training in your expectations and their responsibilities in personal hygiene on the farm. Employee training in the language understood by your workers should include:

- Regularly scheduled training and reinforcement sessions for all GAP principles.
- Documentation of employees trained at each session.
- Specific training in proper use of portable toilets and hand-washing techniques and facilities.
- Clear understanding of management policy and expectations for reporting illness and injury and preventing ill or injured workers from contacting almonds.
- Cleaning and sanitation sequence for all equipment and tools used in the management of orchards.

Sample worker/employee training documentation forms are included in the appendix.

### Resources for Employee Training

Farm and ranch worker friendly videos, in English and Spanish, are available from the National GAPs Program at <http://www.gaps.cornell.edu> and the Almond Board [www.almondboard.com](http://www.almondboard.com). These short DVD training tools are an easy, informative and uniform way to introduce your employees to critical aspects and needs of personal hygiene on the farm. The shared responsibility for food safety to protect your business and employees' source of employment is evident.

## 3. Fertilizer and Soil Amendment Practices

### Soil guidelines

Know your soil

To help identify and address potential microbiological risks, document and maintain records of the soil type, production history, previous and adjacent land uses, soil testing and amendments applied to your soil.

Include in your analysis:

- Physical description of soil type--Sandy loam, clay, sandy clay loam, etc. Know your soil type and its drainage capabilities.
- Production history--Years farmed in almonds; if less than three years, document previous crops and uses. Include any potential chemical and biological hazards.
- Previous land use--Record previous land uses, paying particular attention to landfill sites, livestock operations, animal effluent discharge, biosolids applications, etc.
- Adjacent land use--Document and describe adjacent land uses, especially livestock or poultry operations. Document prevailing and significant seasonal wind direction and speeds relative to adjacent land uses. Document the potential for seasonal or crop-management-related (such as harvest operations) migration of wildlife from adjacent fields or crops to almond orchard.
- Soil amendments--Document the use of soil amendments, paying particular attention to organic amendments (compost, raw manure, etc.), including the source of the material (compost producer, feedlot, etc.), how much was used, when it was applied, how it was applied, and certification or test results for pathogen reduction. See the section on “Fertilizer Use” for more details.

- Soil testing--Testing directly for pathogens is generally not recommended. However, soil testing for indicator *E. coli* or other fecal indicators may be necessary where previous land uses could have potential for microbiological risks, such as a dairy operation, a poultry farm or high use of animal manure. It is best to consult with a certified lab, your county agricultural commissioner, and Cooperative Extension office before committing to a costly and potentially uninformative testing program.
  - Testing is suggested following flooding, leakage or unusual runoff from adjacent land.
  - If you use organic amendments, testing them prior to application is highly recommended. If you are concerned about possible microbiological soil contamination, consult your local University of California Cooperative Extension office.

When specific risks are identified, appropriate corrective actions should be taken to address the risks.

A list of UC Cooperative Extension offices and phone numbers can be found in the Resources section.

### Manure usage

The improper handling and use of animal waste (manure, bedding and litter, biosolids, liquid effluent) for soil fertility management, or as part of animal waste disposal by land application, is a clear business risk for almond growers. The Almond Board of California does not support the use of manure as fertilizer, but if used, the manure must be applied properly. The intimate and extended contact almonds have with the orchard floor during harvest demands that all practical

steps to minimize the introduction and survival of human pathogens in soil must be taken.

Carefully controlled research studies have demonstrated the potential for the almond kernel to be at risk of contamination during windrowing and sweeping. The potential for fecal contamination is also present when irrigation or other water splashes from the orchard floor onto the almonds.

Using non-composted manure (mixtures of feces, urine, and other organic matter) increases microbial risks on the farm and could contribute to food-borne illness. Stacked and aged manure is not the equivalent of well-managed compost and is known to have a greater potential to harbor surviving pathogens.

Although food safety recommendations generally specify a preharvest interval of at least 60 days between manure application and harvest, there is a lot of uncertainty about the survival potential of pathogens in soil. Some GAP guidelines and certification bodies require a minimum of 120 days preharvest interval. Research has demonstrated survival of pathogens from manure incorporation, under certain conditions, exceeding 200 days. Recent studies show that under the right conditions pathogens may survive for several years in an orchard. With this degree of uncertainty, growers are faced with difficult management decisions. If manure application is an integral part of your orchard management, following the steps below is highly recommended.

Organic certification programs include strict requirements for the handling of raw manure and allow its use only on land not intended for crops consumed by humans. Both organic and conventional growers should use only composted product (see [www.ams.usda.gov/nop](http://www.ams.usda.gov/nop) for manure and compost standards under the National Organic Program).

### First, consider the source and treatment of raw manure

Use of raw animal manure that has not been treated significantly increases the risk of microbiological contamination.

- Use only treated, composted manure to help minimize the potential for microbiological contamination. (Treated means the final stages of the composting process that occurs after compost has undergone pathogen reduction, and after most of the readily metabolized material has been decomposed and stabilized.)
- Verify that proper treatment has taken place by asking the compost producer to provide documentation that shows a process to reduce pathogens has occurred. Ask the composter for:
  - The percentage and physical makeup of composted material
  - Documentation showing that:
    - Compost maintained temperatures between 131° F and 170° F for fifteen days or longer in a windrow composting system. The standard minimum range of effective lethal temperature for pathogen reduction is 131-140° F. Aerated compost windrows may reach temperatures that exceed 170° F, but this is not desirable from a quality standpoint.
    - Compost windrows were turned a minimum of five times during composting.
    - Microbial test results showing total fecal coliform < 1,000 MPN/gram of total solids (dry weight basis) and *Salmonella* spp. < 3 MPN/4 grams of total solids (dry weight basis). (MPN = Most Probable Number).

A pathogen reduction checklist for your use in collecting this data is included in the Appendix.

Resources (A copy of this document can be found under “Regulations and Guidelines”)

- Food and Drug Administration; National Organic Program standards, 7 CFR Section 205.203).

### Storage of raw manure

- Store raw manure as far away as possible from areas where almonds are grown and handled.
- Erect physical barriers and/or diversion buffers to prevent run-off from the stacked piles into water sources, equipment storage areas, orchard traffic areas, or into the orchard.
- Consider using tarps or other barriers to minimize wind-driven drift of particles from manure piles and windrows. Although the outer surfaces of manure piles tend to be dry and have the lowest microbial numbers, these are also the areas that are typically exposed to non-lethal temperatures during aging. Wind-driven movement of pathogenic substances from manure piles alongside fields to adjacent crops has been demonstrated.
- Store manure slurry for at least 60 days in the summer and 90 days in the winter before applying to fields.
- High temperatures achieved by well-managed, aerobic compost can kill most harmful pathogens. Remember to optimize temperature, turning and time to produce high quality, stable compost. Measure the temperature of stacked manure to ensure it reaches 131-140°F for at least three days at a depth of 18-24 inches. Adding fresh manure to an aged-stacked pile is not a good practice; re-contamination and growth on residual nutrients is likely to occur.
- If raw manure has not been composted, age the manure to be applied to your field for at least six months prior to application.

Use correct application timing and method of incorporation into the soil

- Document the type of manure or compost

used, the rates, and the dates and locations of the applications.

- Apply manure at the end of the season, preferably when soils are warm, non-saturated and/or cover-cropped. Non-composted, non-treated manure should never be applied less than 120 days prior to harvest.
- Do not apply poultry manure, dairy manure, or lagoon wastewater during the growing season (after January 1).
- When planting new trees, spread the manure two weeks before planting.
- Do not side-dress with fresh or slurry manure. Do not use biosolids or municipal waste sludge at any time.
- Incorporate manure into the soil immediately after application to minimize wind drift and water runoff. Pathogen die-off is accelerated by incorporation as compared to broadcasting to the soil surface alone. If incorporation is not possible or practical under your management plan, it is strongly advised to use only adequately composted materials to maximize pathogen elimination.
- Maintain records of suppliers and hauler/spreaders of manure and compost and dates of delivery as well as dates of broadcast or, preferably, incorporation.
- If purchasing compost from a certified supplier, obtain and keep a Certificate of Analysis for documentation.
- Thoroughly clean tractors, front-end loaders, and other tools and equipment used in manure handling after each use. Prevent wash water from draining to water sources, the orchard floor, or any area where harvested almonds are handled or stored.

Resources (A copy of this document can be found under “Regulations and Guidelines”)

- Food and Drug Administration - Guide to Minimize Microbial Food Safety Hazards for Fresh Fruits and Vegetables, Section III, Manure and Municipal Biosolids.



## 4. Water Quality and Source

### Safe water practices for growers

Be sure your water is safe

Water used in the production of almonds can be both a source of microbial contaminants and a vehicle for spreading contamination. Therefore, maintaining a safe water supply is a top priority.

It is well recognized that the quality of water used in irrigation, and especially in any foliar applications to almonds, may determine the likelihood of introducing and widely disseminating pathogens to the orchard and the crop.

#### Irrigation water

To protect your business, become familiar with the sources and quality of your water supply.

- Identify and document your farm's primary and secondary sources of water, i.e., well water (capped or uncapped), surface water (canal, reservoir, or collection pond) or municipal/district water systems. The form "Water Worksheet: Verification of Water Sources and Safety" provides a guide for you to follow.

Identify and document all potential sources of contamination, such as unsafe water routes, shared water conveyances, and seasonal influences on the water supply.

- Take proactive measures to protect the quality of your water whenever it falls within your ability to control the situation. Coordinate interactions with regional Water Quality Control Boards and Irrigation Districts to ensure a continued safe water supply and timely communication of any potential or known introduction

of hazardous levels of contaminants and routine or event-response testing results.

- Identify and document your water delivery system and all lateral lines, i.e., drip irrigation, flood, furrow or sprinklers.
- Identify the type of filtration system, where filters are located in the irrigation and water delivery system, and the location of backflow washout discharge.

#### Testing for contamination

- For surface water, conduct bimonthly baseline testing for at least one season. Surface water includes uncapped wells, open canals, reservoirs and collection ponds. It is recommended that you request analysis of total fecal coliform bacteria and generic *E. coli* from the analytical lab service. Though not ideal for predictive GAP programs, these bacteria are the current practical indicators of the potential for recent fecal contamination above background environmental levels. There are other fecal indicators that may be useful, but at this time, non-pathogenic *E. coli* remain the practical minimal indicator test to conduct. Most commercial tests automatically include fecal coliform levels but this information is even less useful than *E. coli* for predicting pathogen presence in plant agricultural systems. Use this information to develop a long-term monitoring plan.
- Define an Action Threshold for your operation by completing baseline testing as detailed in the water testing guidelines below. While no federal or state regulatory standards for irrigation water exist, based on surveys within California, current recommendations follow a guidance level of 1000 fecal coliform or 126 generic *E. coli* per 100 ml of water as an Action Threshold. Although there is currently no established correlation of these levels to the presence of

true pathogens in irrigation water, if this level is exceeded:

- Temporarily increase testing frequency.
  - Attempt to determine the cause of the change from baseline.
  - Seek professional advice to determine whether a specific corrective action is necessary and feasible. Document and maintain records of all test results and decisions.
- For well water, test at least once at the beginning of the season. Monthly testing is highly recommended until sufficient experience with quality, over the course of at least two harvest seasons, is available. Because properly designed wells, with a sanitary casing that extends to bedrock and fully grouted to prevent surface water intrusion, should be adequately protected from surface water and runoff, a slightly different indicator profile is recommended. Request a microbiological evaluation of total coliform bacteria from your testing lab. This data gives a better overview of potential sources of surface contamination of ground water.
  - Well water should meet microbiological standards for potable water. If test results are positive (one coliform per 100 ml), testing should be expanded to include fecal coliform and generic *E. coli*. Shock treatment and retesting is strongly recommended.
  - Closed, underground or capped well systems should be tested annually at the beginning of the season.
  - If you use water from a municipality or water district, obtain copies of water quality reports from the municipality or water district for your files (monthly, quarterly or annually).
  - Take samples of water after it has been filtered as well.
  - Test water at the source as above and keep results on file. You can use the “Water Testing Frequency and Documentation Guidelines” checklist for this purpose.
- If wells or water sources are found contaminated with fecal coliform/*E. coli*, take corrective measures such as disinfecting, filtration or chlorinating of the well or water source. Information follows on Bacterial Sampling, Disinfecting Procedures, and Chlorine Dosages.

### Pesticide and foliar feed applications

Water used in mixing pesticides or foliar feeds can be a source of microbiological contamination. It is highly recommended that all water used for foliar applications comes from a pathogen-free source. Although not a common practice, the use of surface water for a variety of foliar treatments has occurred. Growers should ensure that applicators only recharge spray tanks from well-designed and protected ground water sources, or a municipal water supply. Ensure that no cross-connections exist between water supply and all uses potentially subjected to back-flow of contaminated water.

It is always important to inspect all water supplies used for chemical and pesticide mixing and washout to eliminate any chance of improper cross-connections to prevent back-flow. Back-flow has been the cause of on-farm contamination for pesticide- and pathogen-related illness in foods. Make sure applicators are trained in the proper placement and handling of hoses and equipment to prevent accidental contamination.

- Document the water source and test water coming from that source.
- Rinse and clean tanks after each use following all applicable federal and state pesticide laws and regulations regarding equipment and rinse water.

### Dust control and other water uses

Carefully evaluate and document the source of any water used for dust reduction in the orchard.

Application of untreated wastewater to farm access roads and within the orchard during harvest operations is not advisable.

All water used for cleaning equipment surfaces and foliar-spray tanks, lines, and nozzles should be from a potable source (protected well source or municipal water). If unavoidable, water used to clean non-food contact surfaces (tires, drag-scrappers, etc.) should be of adequate quality (meet or exceed microbiological criteria for potable water). Minimize the potential for over-spray of water used to clean orchard soil from equipment to reach food contact surfaces.

#### Water contamination risk from adjacent land

Adjacent farming operations or other land use activities may pose a potential risk for run-off or leaching of microbiological contaminants.

- Identify any potential or likely nearby sources for septic or effluent discharge into your water conveyance system and intake; e.g., landfill sites, sewage treatment facilities, septic tanks, leach fields, potential runoff sources, leaching, or storm-related discharge from adjacent or upstream farming operations (such as concentrated animal operations or compost producers), and resident or seasonal concentrations of domestic animals or wildlife that may influence water quality.
- Take corrective actions and document your corrective steps taken, such as construction of physical barriers (ditches, berms or fencing), disinfecting wells and use of a catch pond.

#### Recycled water usage

Using recycled or reclaimed water as a source of irrigation water, unless documented as having received tertiary treatment, which includes a terminal pathogen disinfection step, is not recommended.

Recycled or reclaimed water, also known as tertiary treated water, has been used in California for agricultural, turf and landscape irrigation for more than 20 years without incident. “Recycled water” refers to domestic or municipal wastewater that has been treated and disinfected to meet the California Department of Health Services (CDHS) guidelines for irrigation of agricultural crops that are consumed without cooking.

The Environmental Protection Agency (EPA) has established a standard of less than 2.2 fecal coliform per 100 milliliters of water for recycled water used on non-processed fresh produce. Water containing that amount or less is considered free of pathogens for non-potable agricultural purposes.

Recycled water quality information is publicly available on a monthly basis and as an annual report from any local wastewater treatment facility/district providing recycled water.

#### Other considerations

- Obtain, review and maintain copies of monthly reports for your records if recycled water is used in your farming operations. Information and frequently asked questions on recycled water follow this section.
- Pay special attention to specific analysis information for *E. coli* as an indicator for fecal contamination.
- Take necessary steps to reduce or minimize direct recycled water contact with the edible portion of the crop. For instance, plug leaks in drip irrigation systems that could create puddles. Use an alternative water source (municipal or well water) for sprinkler irrigation during frost control.
- Document any actions you take, such as chlorination or filtration.

### Provide safe, clean drinking water

All drinking water must be potable. Provide single-use cups, rinse and clean water containers daily, change drinking water daily and document the source of water.

Resources (A copy of this document can be found under “Regulations and Guidelines”)

- Food and Drug Administration - See Section II, Water, in the “Guide to Minimize Microbial Food Safety Hazards for Fresh Fruits and Vegetables”
- California - California Department of Industrial Relations Section 3457, Field Sanitation

## Water Testing Guidelines

Monthly testing is highly recommended until sufficient experience with quality, over the course of at least two harvest seasons, is available.

During future seasons, test ANNUALLY at the beginning of each season:

- Closed, underground or capped well systems

Test QUARTERLY throughout the season

- Uncapped wells
- Open canals
- Reservoirs
- Collection ponds/Recycled water

Maintain copies of water quality reports (monthly, quarterly or annually)

- Municipality or district water systems

Test water for possible microbial contaminants

- Fecal coliform/*E. coli*. Irrigation water standards have no established maximum contaminant level for microbiological contaminants but current research suggests that a single-point maximum for *E. coli* of 126/100 ml is a useful threshold that can be easily met in most irrigation sources in California.

Possible mitigation measures for *E. coli* detection level of “present” or “positive”

- Re-test using a quantitative or MPN (most probable number) format rather than presence/absence format
- Disinfect water source
- Retest and double frequency of testing
- Add filtration system to water source
- Add chlorination system to water source
- Check condition and protection of capped well

Note: Maximum Contaminant Level for Fecal Coliform/*E. coli* is 0.0% for Drinking Water Standards. (Title 22, California Code of Regulations, Section 644463.1). There is no current scientific basis to require Drinking Water Standards for irrigation water.

## Bacterial water sampling

### Sampling Procedure

For individual wells or other water sources, technical advice regarding the collection of bacteriological samples may be obtained from the local health department or from the laboratories that will examine the sample. If no technical assistance is available, the following procedure will suffice:

A sterile sample bottle, preferably one provided by the laboratory, must be used. It is extremely important that nothing except the water to be analyzed comes in contact with the inside of the bottle or the cap; the water must not be allowed to flow over an object or over the hands and into the bottle while it is being filled. If the water is collected from a sample tap, turn on the tap and allow the water to flow for 2 or 3 minutes before collecting the sample. Do not rinse the sample bottle. The sample should be delivered to the laboratory as soon as possible and in no case more than 30 hours after its collection. During delivery, the sample should be kept as cool as possible (but not frozen).

Refer to Section 4026, California Health and Safety Code and Chapter 15, “Domestic Water Quality and Monitoring” of Title 22, California Code of Regulations.

### Well Disinfecting procedures

Disinfection of all contaminated wells is recommended to eliminate pathogenic organisms as well as organisms that can grow in wells and thereby cause clogging and affect the quality of water produced.

Disinfection involves seven steps:

1. A chlorine solution containing at least 50 mg/l (or parts per million) available chlorine is added to the well. Table I on the next page lists quantities of various chlorine compounds required to dose 100 feet (30 meters) of water-filled casing at 50 mg/l for diameters ranging from 2 to 24 inches (50 to 600 millimeters)<sup>1</sup>.
2. The pump column or drop pipe shall be washed with the chlorine solution as it is lowered into the well.
3. After it has been placed into position, the pump shall be turned on and off several times (i.e., “surged”) so as to thoroughly mix the disinfectant with the water in the well. Pump until the water discharged has the odor of chlorine.<sup>2</sup> Repeat this procedure several times at one-hour intervals.
4. The well shall be allowed to stand without pumping for 24 hours.
5. The water shall then be pumped to waste until the presence of chlorine is no longer detectable. The absence of chlorine is best determined by testing for available chlorine residual using a test kit designed for this purpose.<sup>3</sup>
6. A bacteriological sample shall be taken and submitted to a laboratory for examination.
7. If the laboratory analysis shows the water is not free of bacterial contamination, the disinfection procedure should be repeated. Depending on the level of contamination, it may be necessary to use a higher concentration chlorine solution (several times that shown in Table 1). The water should then be retested. If repeated attempts to disinfect the well are unsuccessful, a detailed investigation to determine the cause of the contamination should be undertaken.
  - a. Where small, individual domestic wells to be treated are of unknown depth or volume, at least one pound (0.45 kilograms) of calcium hypochlorite (70 percent available chlorine) or two gallons (7.5 liters) of household bleach (sodium hypochlorite), such as Clorox or Purex, may be used in lieu of the chemicals shown in Table 1.
  - b. Disposal of the waste should be away from trees, shrubs or lawns and into storm sewers, drainage ditches, etc. Note that heavily chlorinated water should not be discharged into sewage disposal systems (septic tanks). Such strong disinfectants could neutralize the bacteria needed to stabilize the sewage and also could damage the soil absorption system.

- c. Testing for available chlorine residual is simple and inexpensive. Test kits can be obtained from chemical-supply houses, swimming-pool suppliers, etc.

### Table I: Chlorine Dosages

Chlorine compound required to dose 100 feet (30 meters) of water-filled casing at 50 milligrams per liter<sup>1</sup>.

#### Chlorine Compounds

Diameter of Casing Inch (mm)	70% Calcium Hypochlorite <sup>2</sup> (Dry Weight) <sup>3</sup>	25% Chloride of Lime (Dry Weight) <sup>3</sup>	5.25% Sodium Hypochlorite <sup>4</sup> (Liquid Measure)
2 (50)	1/2 oz (7 g)	1/2 oz. (14 g)	2 oz (59 ml)
4 (100)	1 oz (28 g)	2 oz (57 g)	9 oz (266 ml)
6 (150)	2 oz (57 g)	4 oz (113 g)	20 oz (0.61)
8 (200)	3 oz (85 g)	7 oz (0.2 kg)	2 1/8 pts (1.0 l)
10 (250)	4 oz (113 g)	11 oz (0.3 kg)	3 1/2 pts (1.7 l)
12 (300)	6 oz (0.2 kg)	1 lb (0.45 kg)	5 pts (2.4 l)
16 (400)	10 oz (0.3 kg)	2 lb (0.9 kg)	1 gal (3.8 l)
20 (510)	1 lb. (0.45 kg)	3 lb (1.4 kg)	1 2/3 gal (6.3 l)
24 (610)	1 1/2 lb (0.7 kg)	4 lb (1.8 kg)	2 1/3 gal (8.8 l)

<sup>1</sup> Some authorities recommend a minimum concentration of 100 mg/l. To obtain this concentration, double the amounts shown  
<sup>2</sup> HTH, Perchloron, Pittchlor, etc.  
<sup>3</sup> Where dry chlorine is used, it should be mixed with water to form a chlorine solution prior to placing it into the well. Note that dry chlorine should always be added to water, not vice versa. Further, the chemical should be added slowly. These precautions are necessary to lessen the possibility of a violent chemical reaction.  
<sup>4</sup> Household bleaches such as Clorox, Purex, etc.

Refer to Section 4026, California Health and Safety Code and Chapter 15, “Domestic Water Quality and Monitoring” of Title 22, California Code of Regulations.

#### Recycled water use

There is an increasing interest in the grower community to use recycled or tertiary treated water. This is due to the decreased cost and increased availability of recycled water\* throughout the state’s growing districts.

Tertiary treated water, also known or referred to as “recycled water,” has been used for a variety of agricultural and urban uses in the United States for more than 50 years. If you are considering the use of recycled water, please be aware of the following points:

- Have direct communication and interaction with the wastewater treatment facility representatives. Become knowledgeable about the treatment process and the steps taken to ensure the quality and safety of the recycled water.
- Treatment facilities are required to conduct daily water tests for total coliform organisms and heavy metals. Weekly or monthly summaries of water tests should be kept in your files.
- You may want to consider an independent test of the recycled water for *E. coli* or *Salmonella* at the point of use (on the farm) to verify quality and safety. However, testing residual chlorine levels (expected concentrations should be provided by the supplier) are generally accepted as sufficient and more practical to verify tertiary treatment.
- If you use a filtration system for your water supply, what microorganisms is your system capable of screening/filtering out of your water? Typically, filtering media used for irrigation, alone, will not reduce microbial levels very much. Be aware and keep records of your system’s capability.
- Minimize the direct contact of water to almonds. Drip irrigation or micro-jet sprinklers will minimize exposure. Consider using alterna-

tive water sources, when possible, for sprinkler irrigation.

- Document any corrective action taken, such as an on-farm filtration system combined with chlorination, UV, or ozone.

\*Authority cited: Title 22 Water Recycling Criteria  
- California Code of Regulations.

## Q & A – Recycled water use

### What is recycled water?

Recycled water is domestic/municipal wastewater that has been highly treated and disinfected so that it meets the California Department of Health guidelines for irrigation of crops that are consumed without cooking. As defined and used in Title 22 Water Recycling Criteria by the California Department of Health Services, recycled water means “disinfected tertiary recycled water.”

### Is reclaimed water synonymous with recycled water?

Yes and No. At one time reclaimed water was the general term most commonly used to describe disinfected and treated wastewater. Today, recycled water is the accepted terminology. Reclaimed water commonly refers to storm water or irrigation run-off, used processing wash water, etc. Recycled water is the end product of the disinfection and tertiary treatment of domestic/municipal sewage wastewater.

### How is recycled water regulated?

Title 22 Water Recycling Criteria of the California Code of Regulations as administered by the California Department of Health Services regulates recycled water use.

### What are the concerns over uses?

Recycled water may contain chemical elements that could cause plant damage, and pathogenic organisms including bacteria, parasites and enteric viruses that could lead to human health and safety concerns. Public/consumer perceptions and lack of knowledge of the tertiary treatment process of wastewater is a primary concern over the use of recycled water.

### What are the other uses of recycled water?

The primary use of recycled water is in landscape irrigation (parks, golf courses, school playfields, etc.). Other uses included toilet flushing and industrial use, such as carpet dyeing. The Dublin San Ramon Services District is trying to use recycled water for ground water recharge, but is facing major public opposition. The San Diego District has a quaternary (four-phase) disinfection and treatment facility capable of producing recycled water suitable for drinking purposes. The local media has coined the phrase “from toilet to tap” which has turned the public against this use.

### What are the microbial food safety precautions taken for recycled water use on ready-to-eat food?

Title 22 only requires daily analyses for total coliform organisms in recycled water applied directly to the food crop. The maximum allowable is 2.2 per 100 milliliters, which is the National Primary Drinking Water Standard. Title 22 does not require specific analyses for parasites, viral or bacterial organisms such as *Giardia*, *Cryptosporidium*, *E. coli*, *Salmonella*, etc.

### What is done if recycled water is found positive for *E. coli*?

If the problem is identified at the recycling facility, the disinfection treatment (usually chlorine) can be adjusted to eliminate the problem. If the problem is potentially at the farm site where there are several possible contamination sources such as raw water, distribution system (i.e. canal), or holding ponds, an on-farm water chlorination system is one option. The goal, whether it is recycled or raw water that is used, is to minimize water contact with the edible portion of the crop. Direct product contact by either recycled or raw water should be limited, when possible.



## 5. Orchard Floor Management

The practical realities of modern almond harvest techniques result in direct contact of nuts with the orchard floor. Whenever almonds come in direct contact with soil, or are brought into intimate contact with soil surface materials, the introduction of physical contaminants and some level of microbial contamination is assured. Some level of intermixing of harvested almonds, soil, and organic debris during windrowing is unavoidable.

Recent surveys have undeniably shown that low levels of pathogens, such as *Salmonella*, may be present in sporadic locations on the orchard floor surface. Dust aerosols generated during harvest operations can spread these highly localized hot spots within a windrow section and, potentially, across large sections of an orchard block. Most recently, university research has demonstrated that when free moisture combines with contaminated almond hulls or exposed shells, transfer of pathogens from the exterior of the nut to the interior is possible. Following passive infiltration, pathogens such as *Salmonella*, can grow quickly on the residual nutrients in all parts of the almond.

As the numbers of the pathogen increases, two elements of concern for growers and handlers increase. First, growth of the contaminating pathogen elevates the potential for food-borne illness by sheer numbers and by elevating the chance of cross-contamination within a lot and among lots during further handling and processing. And second, as pathogens grow on the almond hull their potential to resist environmental stress (such as drying and sunlight) as well as to better tolerate disinfection treatments during processing are increased. The bottom-line is that the risk to your consumers goes up under these conditions.

Although some practical, recommended steps to minimize the potential for contamination are list-

ed below, harvest operations cannot completely eliminate nut contact with soil and orchard debris or dust aerosols. During late harvest season, there is potential for rainfall, which increases potential for microbial contamination. Under these conditions, it is essential to do everything possible to minimize contamination. All stakeholders in the almond industry must participate in minimizing the sources of contamination.

Orchard floor management by the grower is a key point of risk reduction.

### Minimize the potential for contamination

- Develop a farm policy to exclude domestic animals, including poultry and pets, from free access to the orchard, especially close to harvest time. Work to minimize wild animal and bird traffic through your orchard.
- Clearly identify adjacent and surrounding concentrated animal production operations on orchard layout maps. Include any drainage potential to the orchard floor from free stalls, manure piles, and lagoon overflow during storm events. Include patterns of prevailing and seasonal wind-gust direction that could carry particulates and aerosols from animal operations to your orchard blocks. Take a similar approach with any adjacent manure holding and compost operations.
- Develop a clear plan of action in the event of storm-related flooding of the orchard from any up-flow source that may potentially carry hazardous chemicals or pathogens. For example, determine whether sewage treatment facilities experienced release of untreated wastewater during the storm event or if domestic or municipal storm drains impacted the surface water drainage system that impacted your orchard.

- Minimize all sources of habitat, nesting, and hiding places for rodents and other vermin in and around the orchard and farm operational areas. Control weeds along drainage ditches, on berms and related areas. Maintain a wide plant-free buffer between canals and adjacent natural, undeveloped land and your orchard. Rodents and other small animals are less likely to cross open ground. Keeping a lightly disked buffer in a smoothed condition also helps identify hot spots for nocturnal animal movement by their tracks.
- Keep equipment “bone-yards” and debris piles away from orchards and inspect unused buildings for possible issues with pest nesting.
- Identify and document the common and seasonal presence of wildlife adjacent to and within your orchard. Identify and document patterns of wildlife movement from surrounding natural habitats and from neighboring crops, especially following their harvest, into your orchard blocks. Controlling rodents, reptiles, birds, and other wildlife is very challenging and control strategies may vary among the diverse almond production regions. Seeking the assistance of agricultural pest specialists is highly recommended.
- Keep all food and beverage containers or other metallic and glass materials out of the orchard as these materials represent potential sources of foreign material contamination.
- Evaluate suitable methods to keep dust to a minimum. Dust reduction helps reduce the spread of contamination and also aids our industry in meeting or exceeding air quality objectives.
- As harvest nears, keep your soil as dry as possible to minimize the growth of harmful microorganisms. Set your sweeper to pick up as little dirt as possible.

### Minimize the potential for growth of pathogens on windrowed almonds

- Keep your orchard floor as level, smooth and dry as practical during the season. Although the ability of pathogens, such as *Salmonella*, to somehow survive on the inhospitable environment of a dry, bare-soil orchard floor has been clearly demonstrated, all expectations are that persistence is very low.
- Monitor soil moisture levels and try to maintain some capacity for soil to absorb some rainfall during late harvests.
- Prevent the development of uneven areas within inter-row spaces, where almonds will be windrowed, that could result in pooling of rainfall. Pooling water increases the risk of food-borne illness due to pathogen infiltration of the hulls and shells and subsequent growth under the warm temperatures during the harvest period.
- Consider the necessity and practicality of forming temporary shallow diversion channels to prevent rainfall accumulation draining from the undisturbed tree-line soil surface to the drying windrows.

### Resources for Pest and Wildlife Management.

Dealing with wildlife in an open farm environment is one of the most difficult challenges growers of all crops have to face in managing food safety risks. There are no sure cures or easy and effective methods. While the potential for contamination is undeniable, there is no known specific role of wildlife in the recent *Salmonella* outbreaks on almonds. If you have identified some potential problems in your orchard, contact your county agricultural commissioner to access CDFA expertise and obtain permits for vector and predator management.

The USDA APHIS Wildlife Services is increasingly involved in issues related to human pathogens in animal populations, especially bird control (<http://www.aphis.usda.gov/ws/index.html>).

The University of California Wildlife, Fish, & Conservation Biology Department maintains a contact resource guide for agriculture wildlife damage and pest abatement at <http://wfcb.ucdavis.edu>.

## 6. Field Sanitation and Worker Hygiene

### Worker hygiene guidelines

Worker hygiene plays a critical role in minimizing potential contamination for produce that is consumed fresh and that has multiple “touch points” with human hands during harvest and postharvest handling. Almonds do not fall in the category of high concern with regard to “touch point.” However, it is always important to build awareness of the role of personal hygiene and responsibility among management and all employees. Individual attention to the needs of proper field sanitation and hygiene should not be taken for granted. Assuring that proper attention to hygiene will be maintained starts with the quality and adequacy of supplies, and placement of facilities. The enforceable requirements for this are mandated by federal and state regulations. Easy access to the specific requirements in California is available from the Almond Board of California.

#### Train workers in good hygiene, and document their training

Begin with a written employee training program. Brief but frequent training and reinforcement of training is required to maximize compliance. A number of resources are available (see Resources). Document all training and steps taken to ensure compliance with local, state and federal worker hygiene practices.

#### Hand washing is a factor in keeping food clean

- Have written training procedures with emphasis on the importance of hand washing and personal hygiene. Document the frequency and content of training meetings.

- Remind employees daily of the importance of hand washing. Have adequate hand-washing stations available.
- Document your policy on maintenance of hand-washing facilities, including:
  - Sanitation procedures for rinsing and cleaning wash-water tanks
  - Frequency of supply replenishment
  - Source of water used for hand washing
  - Procedures to ensure that water, soap and single-use towels are always available
- Place signs in appropriate places indicating water is for “Hand washing purposes only.”
- Send workers home if they appear ill or have visible lesions to prevent sick workers from coming in direct contact with the almonds.

#### Proper hand washing procedures

Proper hand washing has been identified as the single most important factor in reducing the microbiological risk to individuals and food. Proper and frequent hand washing is one of the best ways to keep you and your family healthy, and protect the food you harvest.

Washing hands properly and frequently prevents harmful bacteria from spreading to other individuals or food. Under federal requirements, you must provide hand-washing facilities for workers that meet the following standards:

1. Pure, wholesome, and potable (drinking water quality) water is available for hand washing.
2. Hand washing facilities refilled with potable water as often as necessary to ensure an adequate supply (15 gallon minimum requirement for water tank).
3. Soap or other suitable cleansing agent and single-use towels are provided.

4. Signs posted indicating that the water is only for hand-washing purposes.
5. Hand-washing facilities are fully stocked and maintained in a clean and sanitary condition.
6. One hand washing facility is available for every twenty (20) employees or fraction thereof.
7. Hand-washing facilities are provided with the field sanitation units or in the immediate vicinity.
8. For the workers' convenience, both the hand-washing and toilet facilities must be located within a one-quarter (1/4) mile walk or within five (5) minutes, whichever is shorter. In California, an exemption to this rule is provided if workers are in the field for less than two hours.

Proper hand washing before and after the workday, using the bathroom, and eating, drinking, or smoking is a simple six-step process:

- Wet hands with clean water
- Apply soap
- Scrub hands and fingernails (for 20 seconds)
- Rinse off soap thoroughly with clean water
- Dry hands with single-use towels
- Discard used towels in trash

If you use gloves, they must also be kept clean during the workday. Wash gloves thoroughly and frequently. Take your gloves off and wash your hands as described above. Washing your hands before placing gloves back on reduces the risk of contaminating the inside of the gloves. Hand sanitizers (liquid or gel) are fine provided they are used after hands are washed, rinsed and dried. Hand sanitizers are intended to supplement, not replace hand washing.

Resources (A copy of this document can be found under "Regulations and Guidelines")

- Food and Drug Administration; Guide to Minimize Microbial Food Safety Hazards in Fresh Fruits and Vegetables Section IV, Worker Health and Hygiene; California

- CDHS Health and Safety Code Section 112015 (Hand Washing)
- CDIR Section 3457 Field Sanitation

## Sanitary facilities/field sanitation

Toilet facilities should be accessible, clean and well supplied. California's field sanitation regulations are the strictest in the nation. Be sure you document each step you take in providing clean, sanitary toilet facilities and hand-washing stations. (More information on worker hygiene is found in the previous section.)

Provide convenient, clean, well-maintained and frequently serviced toilet facilities in the field

Workers should have ready access to toilets and hand-washing stations at all times. This helps reduce the incidence of workers relieving themselves in the field, a practice that greatly increases the possibility of microbial contamination.

State and federal regulations require one restroom per 20 male employees and one restroom per 20 female employees, located within a five-minute walk. However, it is strongly recommended that field toilets be immediately accessible to all employees.

Provide properly constructed and placed facilities

They must:

- Be properly constructed to prevent ground and water contamination
- Be placed in a manner that minimizes the chance that use, clean-out, or relocation could result in contamination of irrigation water sources, equipment clean-out areas, areas of foot traffic, the orchard floor, and any other areas that may jeopardize the safety of the har-

vested almonds

- Have screened, self-closing doors
- Be rigidly constructed
- Have an inside surface of nonabsorbent material – smooth, easily cleaned and light in color to readily show dirt and grime
- Have a durable, easily cleanable wastewater tank
- Have a minimum waste water tank capacity of 40 gallons

### Avoid locating facilities near sources of irrigation

Stay away from areas that are subject to water runoff, which has the potential to contaminate soil, water sources, almonds, animals and workers.

### Keep facilities well supplied

Provide an adequate supply of toilet paper. Hand washing stations should be equipped with a basin, water, liquid soap, a waste container and sanitary hand-drying devices such as single-use disposable paper towels.

### Keep facilities clean

Set up a regular cleaning schedule and document with cleaning logs.

Document the steps you take to ensure compliance for quantity, sanitary condition and maintenance of field toilets

Have written procedures for and document the average number of field employees each week, number of field toilets in use, sanitation procedures, frequency of cleaning, individual or company responsible for maintenance and sanitation, and the procedure for checking and replenishing toilet paper.

### Do not clean portable toilets in the orchard

Sewage transport trucks need direct access to toilet facilities to ensure proper collection and disposal of wastes through a municipal sewage system or a sub-surface septic tank system. Use special caution when servicing portable toilets to prevent leaking into the fields. You should have a pre-established plan for waste containment in the case of such leakage, using appropriate barriers or physical containment, definition of the affected area, and the segregation and disposal of all affected almonds.

### Permanent facilities

For permanent or hard plumbed facilities, be aware of any potential for cross-connections to other water sources, such as foliar make-up water. Ensure that adequate back-flow protection is in place. Back-flow has been the cause of on-farm contamination for pesticide- and pathogen-related illness in foods. Make sure applicators are trained in the proper placement and handling of hoses and equipment to prevent accidental contamination.

Resources (A copy of this document can be found under “Regulations and Guidelines”)

- Food and Drug Administration
  - Guide to Minimize Microbial Food Safety Hazards for Fresh Fruits and Vegetables Section V, Sanitary Facilities, and Section VI, Field Sanitation
- California - California Department of Industrial Relations Section 3457: Field Sanitation (includes specifications for field toilet facilities).

## 7. Pest Control

### All creatures, great and small

All animals, wild and domestic, including mammals, birds, reptiles, and insects, are potential sources of contamination. They are also capable of vectoring (transferring) contamination from any form of waste or contaminated point-source to the crop, the orchard environment, water, equipment, and any almond contact surface. They can harbor and shed a variety of pathogenic agents, such as *Salmonella* or infectious and toxigenic forms of *E. coli*. Animals, especially birds, can also passively transfer human pathogens from concentrated animal production operations to adjacent farm operations. Insects create the conduit that introduces mold spores into almond kernels that can result in aflatoxin contamination. In addition to the issues of animal management in the orchard, it is important to minimize attraction, harborage, and potential for contamination by all animals at all operational facilities and sites.

### Establish a pest control system

Develop a regular program for inspection of all buildings, structures and fields to check for evidence of pest populations or deposits of animal droppings. The program should include regular and frequent monitoring of affected and treated areas to accurately assess the program's effectiveness. Document the inspections on a simple site-identified checklist.

### Establish pest control procedures

- All procedures should be written and all chemicals must be registered for use on almonds.
- Pest control procedures should include information about any bait stations you may have on your ranch or farm. Document the location

of each indoor or outdoor bait station, glue board or other pest control means. Use a map, numbering each station and recording the type of trap/bait, etc. Keep records of bait disappearance and catches for each bait station and trap.

- Describe insect control procedures.
- Describe bird control and animal control procedures. Include procedures to remove animals wandering into buildings and areas where harvesting and other equipment is stored.
- Maintain a pest control log that includes dates of inspection, inspection report, and steps taken to eliminate any problems. Establish frequent monitoring of affected and treated areas to determine the effectiveness of the treatment applied.

### Monitor and maintain facilities regularly

- Regularly inspect all buildings to check for evidence of pest populations or animal contamination. Prevent the accumulation of pest and vector attractants, including water, cull piles, and any food source such as waste, litter, and improperly stored garbage. Collect and remove garbage, trash and related debris frequently. All waste receptacles should have tight-fitting covers. Keep all grasses cut to discourage the breeding, harboring, and feeding of pests, such as rodents and reptiles.
- Preventing insect pest build-up can reduce the attraction of birds and small animals. Preventing rodent and small mammal population build-up can reduce the presence of predators (although land-based predators and raptors are often encouraged in some pest management systems).
- Promptly remove dead or trapped birds, insects, rodents, and other pests from traps and property to ensure clean and sanitary facilities

and to avoid attracting additional pests.

- Ensure that potential nesting, roosting, or hiding places for pests have been minimized.
- Store pallets and other supplies off the ground to help reduce the area's appeal for rats and mice and simplify the detection of these pests.
- Regularly inspect all equipment- and almond-storage facilities and contact surfaces for evidence of animal droppings or deposits. Clean and sanitize soiled surfaces with approved disinfectants to remove product or product remnants that may attract pests.
- Remove any unnecessary articles, including old and inoperative farm equipment that is no longer used, to eliminate areas that harbor rodents and insects.
- Maintain adequate surface drainage to reduce breeding places for pests and to eliminate water that may contribute to food contamination by seepage.
- Carefully follow all government regulations and pesticide label instructions.

### Determine the presence of rodents

Look for these signs:

- Tracks on dusty surfaces--If no dust is present, you can use a tracking powder such as chalk or flour. You will see footprints and tail drag marks.
- Droppings along bases of walls, on ledges and shelves and other hiding places.
- Burrow openings and runways around foundations and under floors, rubbish piles, stored trays and equipment. Rat and mouse nests may also be found under such material and debris.
- Smears or darkened areas where rodents' dirty, oily hair repeatedly rubs as they pass over and under beams, along walls and through narrow openings.
- Gnawing around doors, windows, cracks, holes for wires and pipes and other openings.

### Trapping alone may solve light infestation problems

Trapping will help you determine what kind of rodent you're dealing with. Ordinary wood-base snap traps are more effective when the trigger is enlarged with a square of cardboard, metal or screen that fit inside the wire deadfall. Place traps crossways to the direction of travel in runways and against walls. You can nail or wire traps to beams, pipes and posts to deal with climbing rats and mice.

Bait traps with attractive foods such as peanut butter, raisins, nutmeats or bacon rinds. Tie solid baits to the trigger of the trap.

Place traps at close intervals for mice. They may live entirely within a 15-foot radius if food and shelter are available.

### Heavy infestations may require a lethal, one-dose application

Extremely heavy rodent infestations may require initial treatment with a single-feeding/exposure poison such as zinc phosphide, which is lethal with a single dose. Use according to manufacturer's directions, and only where safety conditions for humans and animals permit. Do not repeat treatment more than twice a year because poison-shy survivors will reject more frequent applications. If necessary, follow single-exposure treatment with an anticoagulant-baiting program.

A restricted material permit is required from the county agricultural commissioner to use or possess zinc phosphide and other single-dose poisons.



### Anticoagulant baits require more time to kill pests

Rodents must feed on most anticoagulant baits several times for the bait to be effective. For this reason, the bait must be available for five or more days. For best results, provide fresh bait each day until feeding stops.

Anticoagulant baits are commonly available in meal, pellet, kernel or liquid form. Paraffin blocks impregnated with toxic grains are available for use in areas where moisture might spoil other types of baits. Anticoagulants mixed with water and sugars are particularly useful when water is scarce or when rodents have access to other food sources and you want something that's more enticing to them.

### Use bait boxes with anticoagulants

Bait boxes protect the bait from the weather and restrict accessibility mainly to rodents, thereby safeguarding people, pets and other animals. Bait boxes should be large enough to accommodate several rats or mice at a time and should contain a self-feeding hopper for holding the bait. All bait boxes should be clearly labeled "POISON" and should be locked or secured.

### Preventive measures are important

Even after the reduction program has achieved control, keep some permanent anticoagulant stations year round to help with population control. Keep the bait fresh. The stations will gradually control survivors of the initial baiting program and also rodents that come in from other areas.

Resources (A copy of this document can be found under "Regulations and Guidelines")

- Food and Drug Administration - 21 CFR 110.35(c) (Pest control) (Although this regula-

tion covers buildings and facilities, the principles apply to any area where almonds are stored or held, or come in regular contact with almonds, such as on the orchard floor.)

### Resources for Pest Control

- The USDA Wildlife Service has a number of helpful fact sheets on pest control on farms and within farming operations. (<http://www.aphis.usda.gov/ws/ca>)
- There are a diversity of model and template audits to guide you in prioritizing and developing a pest management plan. The USDA Fresh Produce Audit Verification Program (<http://www.ams.usda.gov/fv/fpbgapghp.htm>) has an extensive checklist that can be consulted for guidance in combination with the GAP resources provided by the Almond Board.
- For specific pest control recommendations, consult a licensed pest control operator.

## Pesticide use guidelines

California has the nation's most stringent pesticide regulations.

All pesticides must be registered with both the EPA and the California Department of Pesticide Regulation (CDPR). Maintain documentation of your farm's compliance with local state and federal pesticide regulations. These include:

### Use permits and posting requirements

- A restricted material permit or operator identification number is required before you possess or use any pesticide.
- Comply with all federal, state and local field posting requirements.

### Application and use records

- A notice of “Intent to Apply Restricted Material” is required.
- Pesticide use reports must be submitted monthly.
- California is the only state that requires full reporting of all pesticide use. Since 1990, any grower, commercial pest control operator, ground or aerial applicator, structural pest control operator or professional gardener must report pesticides applied, date, location and crop, and whether the application is structural. Reports are filed with the agricultural commissioner in the county where applications occur.
- Daily pesticide use completion reports are required for all restricted material applications.

### Private applicator certification, PCO/PCA licensing and registration

- Identify individuals or companies responsible for pesticide permits and applications.
- Verify proper licensing and registration of pest control operators, businesses, advisors, etc.
- Completion of private applicator certification is required prior to any pesticide possession and/or use.

### Documentation of training

- Provide written documentation of pesticide applicator and field worker safety training.

### Applicator, mixer/loader and field worker safety requirements

- Document compliance with all federal, state and local laws and regulations relating to applicator, mixer/loader and field worker safety.

### Retention of pesticide use documentation for the period required by law

- Under California state law, many pesticide use documents must be kept for the three years.

### Monitoring water quality

- Monitor the source and quality of water used for pesticide applications. Potable water from a municipality is the preferred water source for pesticide applications. Test water quality if water from sources other than a municipality is used.

## Pesticide safety guide for agricultural workers

(The following safety guidelines should be posted where workers have access to them.)

- Pesticides, used to control crop diseases and pests, are applied in liquid and solid forms, and as gases. Specific instruction beyond the scope of this training, and personal protective equipment, are needed to mix, load, apply, or otherwise handle pesticides, or to enter treated areas during post-application “restricted entry intervals.”
- Restricted entry intervals range from 4 to 72 hours or more. No one, except a properly trained and equipped person, can enter a treated area when entry is restricted. If you see warning signs posted around an orchard, do not enter the orchard until your supervisor removes the signs.
- Field workers will be informed of pesticide applications taking place or when a restricted entry interval is in effect on an employer’s establishment, orally and/or by official warning signs.

- Pesticide Safety Information Series A-9 (Hazard Communication Information for Employees Working in Fields) must be available at the worksite. These documents provide information on employee's rights to receive information about pesticides and potential work hazards.
- Pesticide applicators must assure that no pesticide is applied in a manner that it may contact anyone directly, or through drift. Applicators can't apply any more than the recommended amount of pesticide to a crop and must follow all label directions.
- Pesticides could injure field workers, including irrigators, if entry restrictions, worker hygiene, and other precautions aren't followed. Pesticide exposure can occur from spray drift, or contact with treated plants, soil or water.
- Move away if pesticides drift into your work or housing area, and tell your supervisor. Stay out of areas you are instructed by signs or supervisors not to enter, including areas where pesticides are stored or handled. Do not go near pesticide applications in progress.
- If you are working in an enclosed area and feel dizzy or have breathing problems, get to fresh air. If someone passes out in an enclosed area, get help from someone trained and equipped for rescue.
- Plants, insects, or pesticide residues can cause skin, nose, throat, or eye irritations. Pesticide residues are small, usually unseen, amounts remaining on plants, soil, and equipment that could contact your skin and eyes.
- Pesticide residues may affect some people more than others, and can cause allergic reactions. You can also be exposed to pesticides by inhaling them, or eating contaminated crops.
- Wear long sleeves, pants, hat, socks and shoes or boots. Wash your hands before eating, drinking, smoking or using the toilet, and prior to going home.
- Shower with soap and shampoo after work. Then put on clean clothes.
- Empty pesticide containers, even after rinsing, have residues on them. They're unsafe for any purpose. If you find one, tell your supervisor. Never take a pesticide container home.
- Pesticide residues can get on work clothes. Wash work clothes separately from other clothes, preferably with hot water and laundry detergent, before you wear them again.
- Symptoms of pesticide contact with skin include staining, reddening, blistering of the skin, or an itching or burning sensation. Other pesticide exposure symptoms include headaches, dizziness, upset stomach, flu-like symptoms or irritation of the eyes, nose, and throat.
- Some of these symptoms are caused by other illnesses unrelated to pesticides, including heat stress. To reduce harmful effects of working in hot conditions, drink plenty of water supplied by your employer, and take needed breaks to cool down.
- Severe heat stress, called heat stroke, can be fatal. Signs of heat stroke are fatigue, headache, chills, dizziness, loss of coordination, severe thirst, and altered behavior.
- Try to get a heat stress victim into a cool area. Splash face, neck, hands, and forearms with water. Have the person, if conscious, drink water and stay quiet until help arrives.

- If a pesticide spray ever gets on you, remove contaminated clothing. Wash contacted skin with soap and water promptly. If your eyes have been exposed, rinse immediately with clean water or an eye flush kit for at least 15 minutes.
  - Quickly tell your supervisor of all work injuries to you or others. It is the supervisor's responsibility to ensure that employees with any sign of heat stress or pesticide exposure receive medical help.
  - Do not drive yourself to the doctor. Employers will ensure that you get to a doctor or clinic, and will furnish all available information about any pesticide that may have made you ill.
  - If you are exposed to a pesticide, you may only experience short-term illness or irritation, but there's a chance chronic or delayed effects, such as reproductive harm, nervous system disorders, or cancer will appear years later. Employers must protect you from pesticide injury, but your safety is also your responsibility.
- b. The safety procedures, including routine decontamination, to be followed, engineering controls (such as enclosed cabs and closed system) to be used and the work clothing and personal protective equipment to be used;
  - c. The procedures for handling non-routine tasks or emergency situations, the ways poisoning or injury from pesticides can occur, first aid including importance of immediate decontamination of skin and eyes when exposure occurs, the common symptoms of pesticide overexposure and where to obtain emergency medical treatment;
  - d. The purposes and requirements of medical supervision, if category I or II organophosphate or carbamate pesticides with the signal words "DANGER" or "WARNING" are handled for the commercial or research production of an agricultural commodity;
  - e. Applicable laws, regulations, MSDS, PSIS leaflets and pesticide product labeling requirements.
  - f. The employee's rights, including the right:
    1. To personally receive information regarding pesticides to which they may be exposed;
    2. For the employee's physician or employee representative to receive information regarding pesticides to which the employee may be exposed; and
    3. Against discharge or other discrimination due to their exercise of these rights.
  - g. The location of the written Hazard Communication Program (Pesticide Safety Information Series leaflet A-8), pesticide use records, Pesticide Safety Information Series leaflets, Material Safety Data Sheets, employee exposure and monitoring records and training records;

## Training and hazard communication

1. Employers shall provide annual training so that each employee who handles any pesticide understands, for each pesticide to be used, all of the following that is applicable to the particular handling task:
  - a. The immediate and long term hazards involved including known or suspected acute, chronic, delayed effects, sensitization and reproductive effects as identified in Material Safety Data Sheets (MSDS), pesticide labeling and/or Pesticide Safety Information Series (PSIS) leaflets;

- h. Prevention, recognition and first aid treatment of heat related illness;
  - i. Warnings about taking pesticides or containers home;
  - j. Environmental concerns such as drift, runoff or wildlife hazards.
2. The employer must have a written training program for all pesticides that are handled by employees and maintain it at a central workplace location that is accessible to employees. The written program shall describe the materials and information that will be provided and used to train his or her employees. Examples of training materials are pesticide labels, slides, videotapes, and Material Safety Data Sheets.
  3. The employer, in a central location at the workplace, shall keep pesticide use records, Pesticide Safety Information Series, and MSDSs. This location is identified in Pesticide Safety Information Series A-8 that shall be provided to employees.
  4. Employers shall provide, upon request of his employee, employee's representative, or employee's physician, access to any records or other documents required to be maintained. Access shall be granted within 48 hours.
  5. The Pesticide Safety Information Series (PSIS) are informational handouts prepared by the California Department of Pesticide Regulation for use in the training of individuals who are required to handle pesticides in the course of their employment. The information contained in the PSIS and this training form is intended to supplement information found on pesticide labels. Employers shall post copies of the appropriate PSIS in a prominent location at the workplace. If PSISs are not posted at the workplace, the employer shall provide copies of the Safety Series to each employee who handles pesticides.

#### Label Review

6. Pesticides include herbicides, insecticides, fungicides, fumigants, nematocides, rodenticides, avicides, algicides, disinfectants, etc.
7. Before using or handling a pesticide, the pesticide label shall be read and instructions followed carefully. The pesticide label must be present at the application site.
8. The pesticide label shall never be deviated from except when using:
  - a. A decrease in dosage rate per unit treated;
  - b. A decrease in the concentration of the mixture applied;
  - c. Application at a frequency less than specified.
9. A pesticide bearing the signal words "DANGER" has a Category "I" rating and is of the highest toxicity, a pesticide bearing the signal word "WARNING" has a Category "II" rating and is of moderate toxicity and a pesticide bearing the signal word "CAUTION" has a Category "III" rating, and is of the lowest toxicity. Signal words do not indicate whether a chemical is restricted or not.
10. Be alerted by the signal words, "DANGER", "WARNING", and "CAUTION" on the pesticide label. Wear the appropriate safety clothing and equipment required as outlined on the pesticide label or Worker Safety Regulations.
11. Toxicity is the inherent capacity of a substance to produce injury or death.

#### First aid and medical supervision

12. Know where the name, address and phone number of a physician, clinic, or hospital emergency room is posted at your worksite.
13. Symptoms of pesticide poisoning include: headache, nausea, vomiting, cramps, weakness, blurred vision, pinpoint pupils, tightness in the chest, labored breathing, nervousness,

sweating, watering of eyes, drooling or frothing of the mouth and nose. Advanced pesticide poisoning signs include muscle paralysis, coma, extremely difficult breathing, and loss of bowel control.

14. Know that for pesticide emergency first aid, you must immediately:
  - a. Get away from the source of the problem
  - b. Remove contaminated clothing or shoes
  - c. Wash contaminated area of body with soap and water
  - d. Immediately wash eyes with water for 15 minutes if they are contaminated
  - e. Obtain a label of the pesticide you have been working with and
  - f. Arrange to be taken to a physician immediately. It is not safe to drive yourself.
15. If you work 6 days in any consecutive 30-day period handling organophosphate or carbamate pesticides for the purpose of producing an agricultural commodity with either signal word “DANGER” or “WARNING” on the label, your employer shall provide the services of a licensed physician. These services will consist of an initial red-blood cell and plasma cholinesterase determination followed by periodic check-ups thereafter, as recommended by the physician.
16. Severe heat stress, called heat stroke, can be fatal. Signs of heat stroke are: fatigue, headache, chills, dizziness, loss of coordination, thirst and altered behavior. To avoid heat stroke, avoid working when it is excessively hot, drink plenty of water and take needed breaks to cool down. First aid for heat stroke involves getting the person to a cooler area, splashing the face, neck and arms with water and giving fluids if the person is conscious. Get medical attention immediately.
17. When mixing/loading pesticides, always wear eye protection. If the label does not specify which type of eye protection to wear, you may wear goggles, face shield, or safety glasses that offer side and brow protection.

During the application process eye protection may not have to be worn if:

- a. The label does not specify that eye protection is required;
  - b. The spray boom is mounted below the applicator and the nozzles pointed downward; and
  - c. It is safe to apply the pesticide without wearing eye protection.
18. Rubber or neoprene gloves shall be worn while mixing/loading or applying pesticides, or handling contaminated equipment. Either new or clean gloves shall be provided each workday.
  19. It is the responsibility of your employer to provide you with clean outer clothing when working daily with pesticides in Categories I or II. You should wash and change from work clothes to street clothes before going home after mixing or applying pesticides.
  20. It is the responsibility of your employer to provide at least one change of clean work clothing at the mixing and loading site if you are handling any pesticide in toxicity Category I or II.

### Respiratory protection

21. When recommended on the label, respirators must be worn while mixing or spraying pesticides or as necessary to prevent exposure.
22. The employer shall provide annual training in the use, sanitary care and limitations of any respiratory equipment that will be required for use.
23. Certain medical conditions may interfere with wearing a respirator and a statement regarding these limitations must be kept with your training records. If you have a medical condition that interferes with use of a respirator, an evaluation by a physician is required before you are allowed to do work that requires respirator use.

### Using pesticides safely

24. You may not mix, load, or apply a pesticide in toxicity Category I for production of an agricultural commodity without periodic supervision, once every two hours during daylight, and every hour while working at night, whenever working with pesticides having the signal word “DANGER” on the label.
25. Category “I” liquid pesticides or diluted liquid mixes derived from dry pesticides in Toxicity Category “I” for the production of an agricultural commodity must be loaded through a closed system. This requirement does not apply to employees who handle a total of one gallon or less of pesticides in Toxicity Category “I” per 24-hour period exclusively in original containers of one gallon or less.
26. Do not eat, drink or smoke while handling pesticides or afterwards, until hands and face are thoroughly washed, using soap and clean towels. Cigarettes should be left in the trunk or lunch pail and not carried in pockets of clothes while mixing or spraying.
27. Know where soap, clean water, towels and clean clothing are readily available.
28. Pesticide exposure can occur by several different methods; inhalation--breathing dust or vapors, chemical spills into the eyes, chemical spills on to the skin or clothing, and swallowing chemicals.
29. Open pesticide bags with a sharp knife and stand sideways to the wind, allowing the wind to blow the material away from you.
30. When mixing pesticides, pour the concentrate from below eye level to reduce the hazard of a splash.
31. Mix pesticides in a well-ventilated and well-lit area.
32. Pesticides shall be weighed or measured accurately using devices that are calibrated to the smallest unit in which the pesticide is being weighed or measured, being careful not to exceed the required amount as it appears on the label for the crop being treated. Never use food or drink containers.
33. Pesticide containers must be properly rinsed after use before being taken to a disposal site. Closed systems, when they are required, have the rinse process as part of the mixing and loading system with the rinse water going into the mix tank.
34. Do not spray when drift may contaminate non-target plants, persons, wildlife or surrounding areas.
35. Never transport pesticides in the passenger compartment of any vehicle or on a flatbed truck unless the pesticides on the flatbed truck have been tied down securely.
36. Never place a pesticide in a container of a type commonly used for food, drink or household uses.
37. Never store or place pesticides near food or feed. Insecticides and fungicides should be kept separate from herbicides to prevent contamination.
38. Pesticides must be kept in locked storage areas or be watched at all times. A pesticide shipment must be delivered to a responsible person or placed in a locked storage area.
39. Do not take pesticides or pesticide containers home. Pesticide containers cannot be used for any other purpose.

### Pesticide accidents

40. Accidents involving the use of pesticides must be reported immediately and accurately to the county agricultural commissioner, giving location and pesticide involved.
41. Handle all pesticide containers carefully, reporting all leaking containers and spills to your supervisor. Check for leaks, weak hoses, and worn gaskets on application equipment frequently.

### Minimal exposure pesticides

42. There are special use handling requirements for pesticides designated “Minimal Exposure Pesticides.” The requirements listed below do not allow a lower standard of protection when pesticide-labeling statements require a higher standard of protection. Read the pesticide label carefully!

- a. For employees who handle minimal exposure pesticides for any period of time, regardless of the toxicity category of the product used, the employer shall provide an area where employees may change clothes and wash themselves. Clean towels, soap, and adequate water shall be available to allow for thorough washing.
- b. The employer shall provide and maintain work clothing and require it to be worn by employees, regardless of the toxicity category of the minimal exposure pesticide.
- c. The employer shall provide a closed system and require its use by all employees who mix, load or transfer liquid formulations or load diluted liquid mixes derived from dry formulations of minimal exposure pesticides, regardless of the toxicity category of the product used. These requirements do not apply to employees who handle a total of one gallon or less of these pesticides per day exclusively in containers of one gallon or less.
- d. The employer shall provide, and require employees to wear, full body chemical resistant protective clothing, in addition to work clothing, when handling minimal exposure pesticides. Employees working in the following situations are not required to wear chemical resistant full body protective clothing, but this clothing shall be present at the work site:
  - Employees using a closed system, or sealed water soluble packets, while

mixing, loading or transferring these pesticides. These employees shall wear a chemical resistant apron, chemical resistant gloves and chemical resistant boots.

- Applicators using equipment with vehicle mounted spray nozzles directed downward and located below the level of the employee.
- e. The employer shall provide and require employees to wear respiratory protection when engaged in:
    - Hand application or ground application of minimal exposure pesticides (respirators do not need to be worn when applicators are using equipment with vehicle mounted spray nozzles directed downward and located below the level of the employee);
    - Mixing/loading dry formulations of minimal exposure pesticides, except mixer/loaders using sealed water-soluble packets.
  - f. Employers shall see that all protective clothing and equipment are cleaned inside and out or discarded at the end of each day’s use.

Note: Consult with your local county agricultural commissioner regarding current information and requirements on pesticide safety training.

Resources (A copy of this document can be found under “Regulations and Guidelines”)

- California - Title 3, Division 6 and 7, California Food and Agricultural Code.



## 8. Harvest and Delivery Sanitation

Harvest is a critical time and specific attention should be made to eliminate potential sources of contamination or conditions which could result in the proliferation of microorganisms such as molds that produce aflatoxin or bacteria such as Salmonella which can cause illness. In addition, steps should be taken to prevent the introduction of foreign objects or materials into the crop during the harvest process and delivery to the processing facility.

Cross contamination of harvested almonds with bacteria can occur if the equipment or transportation vehicles used have not been cleaned and inspected prior to use. In order to minimize the potential for cross contamination, it is sometimes necessary to sanitize the equipment and transport container prior to use during harvest operations. It is important to implement cleaning and sanitation programs for equipment that you own and use in your operation. For contract services it is important that you receive documentation verifying that the equipment and transport vehicles/containers used have been properly cleaned and sanitized when necessary, prior to use in your operation.

Ensure that your almonds are dry before being picked up.

Excess moisture on the orchard floor at the time of harvest can lead to the proliferation of bacteria and mold if not properly dried; this is a concern with microbial contamination such as Salmonella as well as the development of molds leading to aflatoxin contamination. Be sure that your orchard is as level as possible to prevent the pooling of water on the orchard floor. If standing puddles of water or excess moisture is present do not harvest until properly dried. More information regarding moisture can be found in the orchard floor management section.

After nuts have been shaken from the tree they should remain spread out on the orchard floor to properly dry. If the nuts are exposed to rain while they are drying on the orchard floor extra time should be given to ensure they are properly dried prior to sweeping. If they have been wind-rowed and then rained on, it is crucial that that windrows be fully spread out and/or turned to allow proper drying of the nuts. If it is not possible to fully dry the nuts on the orchard floor it is crucial that they be further dried at a processing facility immediately after being picked up. Check with your almond handler for ideal moisture content prior to picking up.

### Cleaning and sanitation of harvest machinery/tools

#### Keep a clean pick-up machine

- Know how the pick-up machine has previously been used.
- Be sure it was not previously used in an orchard where manure or compost was applied after January 1.
- Make every effort to be sure the pick-up machine was cleaned and sanitized prior to picking up your almonds. At minimum, harvesting equipment should be cleaned and sanitized between orchards.
- Pick your almonds up as cleanly as possible, keeping excessive soil, rocks and other foreign materials out of the pick-up machine wherever possible. Soil is loaded with microorganisms you don't want to deliver to the huller/sheller.

#### Tool design and maintenance

- Harvest tools should be of non-porous and cleanable material. Use and maintain tools that

have been designed with safety in mind.

- Maintain cutting tools so they are free from damage such as ragged edges.
- Inspect tool condition periodically and replace damaged tools.
- Remove extraneous material such as tape, price labels, etc.
- Consider dipping or soaking tools in a sanitizer solution when they are not in use during harvest season, and after harvest for winter storage.
- Be alert to the presence of other non-almond nuts in harvest machinery. When found remove to insure other tree nuts are not delivered with almonds to the huller/sheller or handler.

### Clean harvest storage facilities prior to use

- Facilities used to store almonds should be cleaned and, if necessary, disinfected prior to harvest.
- Inspect buildings for evidence of rodents, birds and insects. Document your rodent and insect prevention and elimination programs as described in the section on pest control.
- Discard damaged containers that are no longer cleanable to reduce the possibility of contamination.
- Clean containers or bins before using them to transport almonds.
- New bin liners should always be used.

### Follow common-sense rules

- Use common-sense and cautionary discretion while in the orchard during harvest.
- Don't use equipment that has hauled garbage, manure or other debris to haul almonds, or can come in contact with almond containers or pallets unless the equipment has been thoroughly cleaned and sanitized.
- Never take harvesting tools or gloves inside toilet facilities.

### Some possible cleaning and sanitation methods

Using household detergent (one example is Simple Green) and a synthetic bristle brush, scrub the tool until clean, rinse with potable water and sanitize with a 200-ppm chlorine solution. One tablespoon of household bleach (5.25%) in one gallon of water is equivalent to 200-ppm chlorine. Sanitization should also be performed prior to start up and periodically during the day.

Tools can also be cleaned in a properly running household dishwasher using standard dishwasher detergent. The dried tools should be stored in a clean place. The tools should be sanitized with a 200-ppm total chlorine solution just prior to start up and periodically during the day.

Note: These recommendations are to serve as examples of proper procedures. It is important that there is both cleaning (removal of dirt) followed by sanitization. Sanitizing alone is not sufficient to get the tool really clean. In addition it is important to be aware of the composition of the chemicals used to make sure that they do not result in contamination of the soil where runoff might occur during the cleaning process.

### Transport of harvested almonds

Verify that the trailers and cargo containers have not previously been used to transport materials from animal operations such as dairy or poultry farms, and specifically that they have not been used to haul waste or manure. A form follows for your use when inspecting trailers and/or containers.

- Inspect trailers/containers
- Clean of all visible debris, dirt, and other nutmeat
- Free of odors
- Dry

Do not permit employees or transport workers to walk on or make direct contact with almonds in trailers when tarping or any other time.

Have a policy in place for trailers or cargo containers that fail to meet your satisfactory loading guidelines, and tell your huller/sheller and handler about your policy. Document any shipments not loaded because of an unsatisfactory condition of the trailer or cargo container.

### Stockpiling Guidelines

Improper stockpiling can lead to conditions which allow some molds to grow and produce aflatoxin. Nuts with excess moisture should not be placed into stockpiles. Research shows that stockpiled almonds with total fruit (in-shell nut and hull) moisture content over 6.5 - 7% will lead to mold growth and aflatoxin contamination. Stockpiling of high moisture content in-hull almonds can lead to problems particularly on outer portions of piles where there is significant condensation on tarps and moisture accumulation; therefore it is critical to monitor moisture levels in windrows prior to stockpiling.

- If you have excessive condensation, visual mold growth, or are stockpiling higher moisture almonds, stockpiles should be properly ventilated. At a minimum you should:
- Cover the stockpile at night when the air is most humid
- Air out or ventilate stockpiles during the day
- Consistently monitor moisture levels within the stockpile

When stockpiling it is important that proper fumigation practices are followed; follow label guidelines when fumigating.

### Work with the huller/sheller

Huller/shellers are part of the production process and need to have practices in place to ensure almonds are processed and stored in a safe environment.

Inspect the delivery area at the huller/sheller to ensure the area is free of signs of rodents and birds. Especially check eaves of the delivery area roof for possible bird and rodent nesting areas.

Ask your huller/sheller or handler about their company's traceback procedure. Understand the product flow within the huller/sheller's plant and have the company provide you with a copy of their traceback policy/procedure.

Ensure that your huller/sheller and your handler follow almond industry recommended Good Manufacturing Practices (GMPs).

Resources (A copy of this document can be found under "Regulations and Guidelines")

- Food and Drug Administration - Guide to Minimize Microbial Food Safety Hazards for Fresh Fruits and Vegetables Section VIII, Transportation; 21 CFR 110.35(a) (General Maintenance); 21 CFR 110.35(d)(1)-(5) (Sanitation of Food Contact Surfaces)
- California

## 9. Customizing your GAP program

In planning for your food safety program, it is important to remember that you and your employees are the most valuable and critical asset to protecting your business. Successful implementation of a GAP program is largely dependent on building an awareness of on-farm hazards and a sense of personal commitment to risk reduction practices. In addition, only motivated people, armed with knowledge and an incentive to perform, commit to a consistent performance in documentation of observations related to identifying hazards and implementing practices to achieve food safety objectives.

As you continue to evolve your dynamic GAP program, these final points should be kept in mind:

- There are no uniform, turnkey approaches to an effective GAP program.
- Each region, management style, and orchard block may have unique features that elevate or minimize a specific risk concern.
- Prevention of contamination is highly preferred over dealing with contamination.
- Details make the difference. Planning and assignment of responsibility make the difference in all prevention programs.
- GAP programs shouldn't be intimidating and/or expensive. The important step is the first one. Get started, get help and set priorities.

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