

The Seven Practices of Successful Almond Growers

1: Documentation

Maintaining readily retrievable records of all almond farm operations 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 down to the orchard are optimal to maximize YOUR investment in risk reduction. There are no off-the-shelf GAP programs but resources are available to get you started with a written plan and key documentation development. Remember – **don't be intimidated into inaction**- your GAP program can evolve in phases, working toward the point where adequate records include (but not limited to):

- ❖ Detail of prior farm history and ownership.
- ❖ 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.
- ❖ Crop management flow chart (pre-bloom to post-harvest).
- ❖ Worker training programs and evidence of training.
- ❖ Placement and servicing of sanitary facilities.
- ❖ Invoice records for sanitation and personal hygiene supplies.
- ❖ Water source information, water testing plan and results.
- ❖ All pesticide and foliar application information.
- ❖ All fertility management operations.
- ❖ Detailed orchard floor management program.

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>.

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 to the success of your food safety risk reduction 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 should include:

- ❖ Regularly scheduled training and reinforcement sessions.
- ❖ Documentation of employees trained at each session.
- ❖ Specific training in proper use of portable toilet and hand wash facilities.
- ❖ Specific training in thorough hand washing techniques.
- ❖ Clear understanding of management policy and expectations for reporting illness and injury.
- ❖ Management policies and procedures to prevent ill or injured workers from contacting almonds.
- ❖ Cleaning and sanitation sequence for all equipment and tools used in the management of orchards.

Resources for Employee Training

Visit the www.AlmondBoard.com “Food Safety” section for additional online resources.

Farm and ranch worker friendly videos, in English and Spanish, are available from the National GAPs Program at <http://www.gaps.cornell.edu>. These short VHS or DVD training tools made for fruit and vegetable producers and harvest operations were filmed extensively in California. They are an easy, informative and uniform way to introduce your employees to critical aspects and needs of personal hygiene on the farm. Though not specific to almonds, the shared responsibility for food safety to protect your business and employees’ source of employment is evident.

3: Fertilizer and Soil Amendment Practices

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 harvested almonds have with the orchard floor demands that all practical steps to minimize the intentional introduction and survival of human pathogens in soil must be taken. Recent almond-associated outbreaks of *Salmonella* and detection of *Salmonella* in several orchard floor surveys has elevated the level of concern for raw almonds. Carefully controlled research studies have demonstrated the potential for the almond kernel to be at risk of contamination during windrowing and sweeping. 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, the following steps are highly recommended.

- ❖ Manure should not be applied to almond orchards during the growing season.
- ❖ Store manure away from areas where almonds are grown and handled.
- ❖ If under your control, 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.
- ❖ 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 transfer of pathogen indicators from field-side manure piles to adjacent crops has been demonstrated.
- ❖ It is highly recommended that manure be fully incorporated into the soil. 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.

Access to Regulations and Standards for Manure and Compost

To get started on GAP specifics for soil amendments go to Food Quality and Safety at <http://www.AlmondBoard.com>.

Standards for composting are regulated by the California Integrated Waste Management Board (Title 14, California Code of Regulations, Section 17868.3) at <http://www.ciwmb.ca.gov/>.

Resources for industry standards and testing are available at from the US Compost Council at <http://www.compostingcouncil.org/>.

Additional information and access to GAP resources about manure use and pathogen survival in soils are available from the University of California, Davis at <http://ucgaps.ucdavis.edu>.

4: Water Quality and Source

Water used in the production of almonds can be a source of microbiological contaminants. It is well recognized that the quality of water used in irrigation and especially in any foliar applications to almonds may dictate the likelihood of introducing and widely disseminating pathogens to the orchard and the crop. To protect your business, become familiar with the sources and quality of your water supply. Identify all potential sources of contamination, such as unsafe water routes, shared water conveyance conduits, and seasonal influences upon the water supply. Identify any potential or likely nearby sources for septic or effluent discharge into your water conveyance system and intake. 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 District to ensure a continued safe water supply and timely communication of any testing results.

It is highly recommended that all water used for foliar applications come 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 groundwater sources or a

municipal water supply. 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 backflow. Backflow 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.

In developing your GAP plan, the following measures are strongly recommended.

- ❖ Identify and document your farm's primary and secondary sources of water. Develop and periodically review a farm map of all known on-farm and surrounding risk factors that could influence your water sources.
- ❖ Identify and document nearby landfill sites, sewage treatment facilities, leach fields, potential run-off, 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.
- ❖ Develop a flow diagram or seasonal outline of all operations involving water use: irrigation, all foliar pest control and fertility applications, weed management, frost control, growth regulators, orchard floor management, etc.
- ❖ For surface water, conduct bimonthly baseline testing for at least one season. It is recommended to request analysis of total fecal coliform bacteria and generic *E.coli* from the analytical lab service. Though not ideal for predictive GAPs programs, these bacteria are the current practical indicators of the potential for recent fecal contamination. Use this information to develop a long-term monitoring plan.
- ❖ Define an Action Threshold for your operation in relation to water monitoring information. 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; 1. Temporarily increase testing frequency; 2. Attempt to determine the cause of the change from baseline; 3. 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. Properly designed wells should be adequately protected from surface water and run-off effects. Request a microbiological evaluation of total coliform bacteria from your service 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 re-testing is strongly recommended.
- ❖ Using recycled or reclaimed water, unless documented as having received tertiary treatment (which includes a terminal pathogen disinfection step) as a source of irrigation water is not recommended.
 - ❖ 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.

Resources on Developing a Water Quality Plan

Additional background information on irrigation water quality standards, GAPs microbial testing and access to Water Quality planning resources are available from the University of California, Davis at <http://ucgaps.ucdavis.edu> and the Water Quality and Technical Assistance Program for California Agriculture at <http://waterquality.ucanr.org>.

5: Field Sanitation and Employee Hygiene

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. Performance in assuring that proper attention to hygiene will be maintained starts with the quality, 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.

Brief but frequent training and re-enforcement of training is required to maximize compliance. A number of resources are available to get started (See Resources box). With regard to toilet facilities, the following key guidance applies to all situations and locations.

- ❖ Workers should have ready access to toilets and fully stocked hand washing stations at all times. Toilets must be placed within one-quarter of a mile from the fieldwork area. In California, an exemption to this rule is provided if workers are in the field for less than two hours.
- ❖ Placement of portable toilets should only be done in a manner that minimizes the chance that usage, cleaning, or relocation could result in contamination of irrigation water sources, equipment cleaning areas, areas of foot traffic, the orchard floor, and any other areas that may jeopardize the safety of the harvested almonds.

- ❖ Use special caution when servicing portable toilets to prevent leaking into the fields. In the case of leakage, you should have an established plan for waste contamination, which includes definition of the affected area and the segregation and disposal of all impacted almonds.
- ❖ 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. Backflow 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 on Field Sanitary Facilities and Employee Hygiene Training

There are a number of simple-to-use resources related to regulatory requirements and training tools to teach owners, supervisors and farm workers about the need and how to's of personal hygiene and handwashing techniques. Straightforward fact sheets and checklists on all aspects of Farm Labor Safety, including portable toilets and hand washing, from CAL OSHA, together with farm labor extension training bulletins are available from the University of California, Davis at <http://ucgaps.ucdavis.edu>. Additional training material, including worker training DVD's (in English and Spanish that focus on employee hygiene), and laminated posters may be ordered from the National Good Agricultural Practices program at Cornell University (<http://www.gaps.cornell.edu/>).

6: Orchard Floor Management

The practical realities of modern almond harvest management 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, some level of microbial contamination is assured and the potential for contamination with pathogens greatly increases. 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. This passive infiltration is rapidly followed by multiplication of pathogens, such as *Salmonella*, which grows quickly on the residual nutrients in all parts surrounding the kernel. As the numbers of the pathogen increases, two elements of concern for growers and handlers increase. 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 (even among fields) during further handling and processing. In addition, 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 listed below, there is no expectation that harvest operations could completely eliminate soil and orchard debris contact or dust aerosols. During late harvest season, there is an unavoidable potential for rainfall, which is a challenge for proper orchard floor management. However, doing nothing is not good business sense for the individual grower and not acceptable for the industry as a whole. 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.

To minimize the potential for contamination:

- ❖ Develop a farm policy to exclude domestic animals from free access to the 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.
- ❖ 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 smoothed periodically 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 different among the diverse almond production regions. Seeking the assistance of agricultural pest specialists is highly recommended.
- ❖ Evaluate suitable methods to keep dust to a minimum. Dust reduction helps reduce the spread of contamination and is one additional benefit of meeting or exceeding air quality objectives.

To 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.

- ❖ 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://wfcf.ucdavis.edu>.

7: Pest Control

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. In addition to the issues of animal management in the orchard and orchard floor, discussed in the previous section, it is important to minimize attraction, harborage, and potential for contamination at all operational facilities and sites.

- ❖ Develop a regular program for inspection of all buildings and structures to check for evidence of pest populations or deposits of animal droppings. Document these inspections on a simple site-identified checklist.

- ❖ Prevent the accumulation of pest and vector attractants, including water, cull piles, and any food source. Collect and remove garbage, trash, and related debris frequently. All waste receptacles should have tight-fitting covers.
- ❖ Preventing insect pest build-up can prevent the attraction of birds, reptiles, and amphibians. 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).
- ❖ Remove dead or trapped birds, insects, rodents, and other pests from traps and property in a timely manner.
- ❖ Ensure that potential nesting, roosting, or hiding places for pests have been minimized.
- ❖ Regularly inspect all equipment and almond handling or contact surfaces for evidence of animal droppings or deposits. Clean and sanitize soiled surfaces with approved disinfectants.
- ❖ Carefully follow all government regulations and pesticide label instructions.
- ❖ Document your pest control program.

Resources for Pest Control

The California Department of Pesticide Registration has a number of helpful Fact Sheets on pest control on farms and within farming operations.

(<http://www.cdpr.ca.gov/docs/factshts/pestcont.htm>)

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

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Final Thoughts

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 these Seven Practices 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 the final points should be kept in mind:

- ❖ There are no uniform, turnkey approaches to an effective GAPs 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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