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GAPs for the Florida Citrus Grower: Understanding the Principles of Good Agricultural Practices[1]

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Introduction and Objective

Good Agricultural Practices (GAPs) refer to preharvest practices (e.g., in the field, or before the farm gate) that are established to prevent, minimize, or eliminate contamination and hazards to human health. Essential components of the GAPs process include careful planning, implementation, and documentation of required steps and procedures that together analyze and minimize risks imposed by biological, chemical, and physical hazards.

The development of GAPs is based on sound science, including outbreak investigations and scientific literature. Although important scientific information related to citrus GAPs is still lacking, enough is known to develop a practical framework. GAPs related to citrus will continue to evolve as new information comes forth.

Growers represent the first step in the farm-to-table food chain. The general guidelines presented in this document were developed by UF/IFAS for Florida citrus growers, in partnership with the citrus industry.

The objective of this document is to present general GAPs principles needed to plan, execute, and document production practices that will prevent, minimize, or eliminate the possibility of fruit contamination. The materials contained in this document are recommendations based on the best available science and should be adapted to suit the needs of individual companies and supply chain partners. This document represents the current strategies and will be reviewed and updated as new risk data emerges.

Background

While the consumption of whole fresh-citrus fruit has not been associated with foodborne illness or injury, GAPs represent important procedures that Florida citrus growers should follow to minimize the potential for fruit contamination. Many growers are documenting production, harvest, and transportation practices before the farm gate

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Good Agricultural Practices (GAPs) focus on preventing food contamination and are distinctly different from citrus Best Management Practices (BMPs), which deal with other, non-pathogenic, water quality issues. For more information about citrus BMPs, see http://citrusbmp.ifas.ufl.edu/.

Use pesticides safely. Read and follow directions on the manufacturer's label. All chemicals should be used in accordance with directions on the manufacturer's label.

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as part of their normal operations to prevent, minimize, or eliminate the potential for foodborne illnesses.

Florida's processors and fresh citrus packers have invested considerable resources developing and implementing food safety protocols. Citrus juice processors implement the *Hazard Analysis and Critical Control Point Program (HACCP),* which is required by the FDA (21 CFR Part 120). Farm owners and managers who produce citrus intended for fresh squeezed juice should be aware of and follow the Juice HACCP regulation (21 CFR Part 120). Florida's fresh fruit packers adhere to guidance developed by the USDA and FDA to minimize microbial contamination on fresh citrus fruit. Florida citrus processors and packers also participate in third party programs that require audits and testing to ensure product safety and compliance with state, federal, and, in the case of exports, international requirements.

GAPs are a prerequisite of these fresh citrus food-safety requirements. Although a HACCP program with carefully controlled critical limits is not possible in a natural grove environment, HACCP principles and preventive measures can and need to be applied. A GAPs program that has been developed, supervised, and properly implemented protects the health of consumers and the producer's investment in the product.

In general, GAPs programs address the potential risk of three types of contamination or hazards:

1. Biological

2. Chemical

3. Physical

Biological contaminants, including *pathogenic organisms* such as bacteria, viruses and parasites, can lead to widespread foodborne illness if practices are not in place to minimize or eliminate product contact with such contamination. *Chemical contaminants* can include residues of agrochemicals, sanitizers, and pathogen toxins that may be present in or on fruit. While agrochemicals can enhance production of horticultural commodities and are valuable tools for growers, practices must document that materials were applied only according to label instructions because ***the label is the law***. *Physical hazards* can include hard or sharp objects in food that may result in personal injuries. Such objects, if present, are removed during sorting and culling of citrus fruit.

There are many routes biological hazards may take to contaminate produce. Biological contamination can occur by contact with feces. Direct contact may be through untreated or improperly treated manure or bio-solids used as soil amendments or when animals contact fruit in the grove. Indirect contact can include transfer from contaminated soil, water, bins, gloves, equipment, and hands or clothes of field workers onto citrus during production, harvesting, or handling.

The ability to identify the source of a product is an important component of food safety programs. Under the Bioterrorism Act of 2002, registration with FDA (http://www.fda.gov/food/guidancecomplianceregulatoryinformation/registrationoffoodfacilities/default.htm) is now mandatory for any processors, packers, or shippers of fresh fruits and vegetables covered in this Act. Under most circumstances, the finding of any hazard, through testing or otherwise, that could cause serious health problems or death (such as from foodborne pathogens) must be reported to FDA within 24 hours through the Reportable Food Registry (http://www.fda.gov/Food/FoodSafety/FoodSafetyPrograms/RFR/default.htm). Under the Food Safety Modernization Act (FSMA) that was signed into law January 2011, FDA will assess the vulnerability of the nation's food system and implement science-based measures to protect against intentional adulteration. Procedures that restrict grove access to only authorized personnel help assure a secure food supply.

An example of GAPs guidelines produced by and available to the fresh citrus industry can be found at http://ircitrusleague.org/issues.html.

GAPs Topics

Management Responsibility

Food safety is a shared responsibility; the collective efforts of growers, processors, packers, shippers, and regulators of fresh and processed citrus products are essential to ensure a safe and wholesome product. Each company should specifically designate an individual or team that is responsible for food safety.

Water

Water use in citrus production involves several field operations including irrigation, freeze protection, and the application of agrochemicals. Moreover, water is used in cleaning hands and equipment. Water can be a direct or indirect source of contamination, so policies and

procedures must be in place to minimize the risk that may be imposed.

WATER FOR FIELD USE

Water quality should be adequate for its intended use and meet all applicable federal, state, and local laws and regulations.

Best Practices

- Water used in foliar applications can be obtained from 1) municipal, treated water sources, 2) ground water obtained from a properly constructed well [http://edis.ifas.ufl.edu/fe603] in good condition, and/or 3) surface water that is suitable for its intended use.
- Water sources used for foliar applications should be tested as needed and records of water quality maintained.
- Well water used for foliar applications should be drawn from properly engineered and protected sources. Wells should be properly cased and grouted above grade. Wells should be inspected for cracks, leaks, etc., and records of repairs kept.
- If available, results of a microbial analysis of a water source from a public entity, such as local water authority, may serve as acceptable documentation in lieu of testing by the grower, and should be kept on file.
- To the extent possible, animals known to shed foodborne illness pathogens should be excluded from reservoirs, ponds, and surface retention basins.

WATER CONTAMINATION RISK FROM ADJACENT LAND

Farmland or other uses and activities on adjacent land may pose a risk for run-off or leaching of microbiological or chemical contaminants. Producers should work with local watershed authorities to understand watershed issues and consider mitigation strategies such as berms or ditches where necessary to minimize run-off.

Best Practices

- Identify and document nearby adjacent land and water risks. Such risks can include landfill sites, sewage treatment facilities, and septic tanks and leach fields, or surrounding farm operations such as dairy farms or *compost* producers.
- Take preventative or corrective actions and document your steps if water contamination sources are identified. Such actions can include construction of physical barriers (berms, ditches, or fencing) or use of a catch basin. Check on an annual basis to ensure mitigation steps are still functioning as intended.

Land Use, Soil, and Manure and Municipal Biosolids

Land use prior to grove establishment and patterns of adjacent land use can have food safety implications. The grower has no control over historic uses, but awareness of potential problems may help determine if mitigation is needed and what control options are feasible.

Either manure or *biosolids* can serve as effective and safe fertilizer if proper treatment procedures are in place. Such procedures can include composting animal manure to reduce microbial pathogens in number and thereby the risks associated with their presence in soil amendments.

Preventing fruit from touching the ground will greatly reduce the potential for contamination. In cases where fruit may fall to the ground, they should never be harvested for use in the fresh market.

BEST PRACTICES

- Avoid planting citrus in land previously used for any operations engaged in risk-accumulation practices, i.e., areas previously spread with contaminated wastes or those of an unknown industrial use.
- If needed, conduct a title search, environmental assessment, or question state/local officials to establish whether previous land use involved disposal of chemical or biological wastes.
- Document the source of the soil amendment, compost producer, amount used, and when and how it was applied; obtain certification or test results for pathogen reduction if needed.
- Apply treated manure in a way that minimizes or prevents contact with fruit.
- Record the type of application and time interval between application and harvest.
- Store treated manure in a location/manner that minimizes potential for contamination of citrus fruit and surface waters.

Animal Control

Wildlife and domestic animals, including but not limited to dogs, cattle, rodents, hogs, deer, reptiles, amphibians, and birds may serve as sources of contamination. While minimizing animal contact with citrus also minimizes the risk of product contamination, it is understood that wildlife is difficult to control in grove settings. Growers must balance these management efforts with their responsibility for environmental stewardship; this is commonly referred to as co-managing food safety and ecological health (http://caff.org/wp-content/uploads/2011/09/Safe__Sustainable1.pdf).

DOMESTIC ANIMALS

The activities of domestic animals are the easiest to manage, and their access into production, packing, and equipment-storage areas should be prevented.

Best Practices

- Fencing or other barriers should be used to prevent intrusion by cattle and other domestic livestock.
- To the extent possible, have a policy in place to mitigate fecal material deposited by domestic animals from the grove.

WILD ANIMALS

While it is unreasonable to expect complete exclusion of wild animals in the field, active controls and deterrents should be used when possible.

Best Practices

- Exclude wild animals as much as possible through the use of fencing and other active deterrents.
- To the extent possible, minimize animal attractants by discarding old equipment and containers, and removing excess water from the field.
- Inspect storage areas for rodents, birds, and insects, and use pest control procedures (traps, screens, etc.) to minimize pests.
- Keep cull and debris piles away from crop production areas.
- To the extent possible, have a policy in place to look for and mitigate risks from fecal material deposited by wild animals from the grove.

Agrochemical Use

This GAPs document is not intended to provide guidance for pest management practices (for this guidance, please see the *UF/IFAS Citrus Pest Management Guide* at http://edis.ifas.ufl.edu/topic_book_florida_citrus_pest_management_guide).

Agrochemicals such as sanitizers, disinfectants, fungicides, insecticides, and herbicides can enhance the production, quality, and safety of horticultural commodities when used according to their product label. Pesticides are closely regulated by the Environmental Protection Agency (EPA), and EPA approval of each pesticide formulation includes specific limitations regarding the means by which the agrochemical may be applied, conditions of application, labeled rates, target organisms against which the chemical may be employed, use restrictions, and requirements for pesticide disposal and its containers.

EPA also has the responsibility to determine tolerances or exemptions from tolerances for pesticide residues on raw agricultural commodities in the US. Residue tolerances for export markets are regulated and enforced by their respective countries. Proper pesticide use involves close working relationships among citrus growers, packers, shippers, and processors. A table of citrus maximum residue limits (MRLs) for domestic and several export markets is posted on the University of Florida IFAS Post-harvest Resources website (http://irrec.ifas.ufl.edu/postharvest/index/pesticides.shtml).

PESTICIDES

As part of GAPs documentation, labels and MSDS sheets of pesticides that are used must be kept on file and a detailed written procedure for the application of all pesticides must be recorded. Pesticide labels clearly state the maximum allowable rate, methods of application, and the target organism. Using a pesticide in a manner inconsistent with its label, including for a purpose not specifically identified on the label, constitutes a violation of federal and state laws. Florida law requires maintaining specific records for Restricted Use Products (i.e., products for which use and application are restricted to certified applicators or under the direct supervision of such) that include the EPA registration number, the date each pesticide was applied, the quantity used, and where and how the application was made. For additional information and requirements, see the Florida Department of Agriculture and Consumer Services, Pesticide Applicator Licenses website (http://www.freshfromflorida.com/onestop/aes/pestapp.html).

Best Practices

- Use only pesticides registered for the citrus variety to be treated.
- Follow all label requirements. Remember, "**The label is the law!**"
- Meet all federal, state, and local pesticide applications, field postings, preharvest intervals, and documentation requirements.
- Verify proper licensing and registration of sub-contractors, custom applicators, and crop advisors, etc.
- Document compliance with EPA's Worker Protection Standard (http://www.epa.gov/agriculture/htc.html).

Worker Health and Hygiene

Proper worker hygiene is critical for implementation of GAPs. Without it, employees who work with citrus fruit may increase the risk of transmitting foodborne illness. A review highlighting information and requirements of Field Sanitation (OSHA Standard 1928.110) is available from UF/IFAS (http://edis.ifas.ufl.edu/pdffiles/OA/OA12000.pdf) and expands on many of the subjects discussed below. A UF/IFAS training manual for good worker health and hygiene is available at http://edis.ifas.ufl.edu/fy743.

TRAIN WORKERS IN GOOD HYGIENE PROCEDURES AND DOCUMENT THEIR TRAINING.

Begin with a written employee-training program, and document the frequency and content of training.

Training Elements

Training elements should include the following:

- Proper use of toilet
- Thorough hand-washing techniques
- Proper storage of gloves, tools, and equipment while not in use
- Cleaning and sanitizing of the above tools
- Approved areas for food consumption
- Proper trash disposal
- Identification of and policies regarding sick employees

HAND-WASHING AND SANITARY FACILITIES

Poor management of wastes in the field can significantly increase the risk of contaminating produce. A minimum of one toilet and one hand-washing facility must be maintained for every 20 employees. For both regulation compliance and workers' convenience, hand-washing and toilet facilities shall be located within a one quarter-mile walk. Such facilities are not required for employees who do field work for three hours or less each day. For details, see:

- OSHA 29 CFR part 1928 – Field Sanitation (http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=10959), and
- Florida Administrative Code, Rule 64E-14.016 – Field Sanitation (https://www.flrules.org/Gateway/View_notice.asp?id=6181051).

Best Practices

- Provide *potable*, running water at restrooms and other hand-washing facilities.
- Provide soap and single-use towels.
- Post signs indicating that water is only for hand-washing purposes.
- Contain wash and rinse water for proper disposal after use.
- Place portable toilets outside the immediate crop-production area but within one quarter-mile of where workers will be working.
- Maintain toilet facilities for worker use in clean condition. Keep on file any documentation for maintenance and servicing of toilet and hand-washing facilities. Keep facilities well supplied with toilet paper, water, soap, and paper towels. Provide a trash container for used hand towels.
- When toilets must be cleaned or serviced near the field, use appropriate barriers to prevent contamination in case of an accidental leak or spill.
- Have a mitigation plan in place so that pickers and supervisors know the company response policy in the event of accidental or malicious sewage spill.
- Workers who display symptoms of infectious disease should be sent home or assigned tasks that prevent them from coming in direct contact with fruit.

Other Preventive or Corrective Measures

- If used for harvest, gloves should be kept as clean as possible and free from contamination during the workday. Wash or replace gloves as needed.
- Wash hands before replacing gloves to reduce the risk of contaminating the gloves.
- Store harvest gloves properly (off the ground in a designated, clean area) when using the bathroom or on breaks. Do not carry gloves into toilet facility.
- Eating, drinking, and smoking should be limited to non-fruit-production areas.
- Workers with visible, open wounds or sores should cover them sufficiently (for example, hand wounds should be bandaged and gloved) to prevent bodily fluids from contacting fruit.

Field Sanitation, Harvest, and Transport

Fresh produce can become contaminated when contacted by soil, fertilizers, water, workers, and harvesting equipment during preharvest and harvest activities. General sanitation of the grove, bins, and equipment is necessary to prevent contamination of fruit with biological hazards.

HARVEST EQUIPMENT AND BINS

Best Practices

- Harvesting equipment such as gloves, hand tools, and picking sacks should be routinely cleaned and sanitized.
- Document procedures and schedules for cleaning and sanitizing equipment used in the field.
- Picking bins should be maintained free from debris and contaminants. A pressurized sprayer with a labeled cleaning agent can be an effective means to remove field dirt.
- Bins should be used only for the purpose of holding and transporting fruit.
- Inspect bins regularly for evidence of animal intrusion. Clean and sanitize as needed.
- Separate and remove glass and plastics or other foreign objects from fruit collection devices and bins.
- Separate, segregate, and dispose of fruit if exposed to hydraulic oils or other chemical contaminants from harvesting equipment.
- Exclude from the fresh market all fruit that touch the ground.

TRANSPORTATION

Proper transport of fresh produce will help reduce the potential for biological hazards.

Best Practices

- Good hygienic and sanitation practices should be used when loading, unloading, and inspecting produce.
- Inspect transportation vehicles for obvious dirt and debris before loading. Have the vehicle cleaned and sanitized if evidence of dirt, debris, animal manure, or other raw, animal by-product exists.
- Load produce carefully to minimize physical damage.

Traceability and Record Keeping

A written plan is central to successfully implementing any GAPs program. Having records to document these practices, and the resulting traceability benefits, are vital to the GAPs process. Documentation, including records of all corrective actions, is required to prove to regulatory agencies, handlers, and retailers that you are following GAPs. Such documentation is important to demonstrate that proper procedures (cleaning and sanitation) were followed.

Traceability is an important part of GAPs documentation. *Traceback* is the ability to track food back to its source. Traceforward is the ability to identify all receivers of your citrus fruit from a given grove or source. It is critical that growers establish tracking systems from the earliest stages that follow their fruit within the distribution system. This system includes supply-chain partners involved in processing, packing, storing, shipping, and transporting Florida citrus fruit. Both traceback and traceforward actions are necessary to identify the potential source of any safety problems that might occur, and for supply chain-partners to implement targeted recalls efficiently and effectively. GAPs forms should be readily available or collected together in a single location for ease of rapid access in the event that fruit is associated with an alleged contamination issue. For more information about preparing for and conducting a recall, see the *UF/IFAS Food Recall Manual* (http://edis.ifas.ufl.edu/fs108).

Basic, sample record-keeping forms are available online (http://www.gaps.cornell.edu/rks.html), but these are not intended to replace other required government report forms or forms prescribed by your packer or processor

as part of their quality management systems. While they represent excellent examples, forms should be adapted to fit individual operation needs.

In addition to the documentation and record keeping indicated in this document, each load of harvested product should include the source of the product, the date of harvest, farm identification, and a record of who handled the product. These may include properly completed Trip Tickets (https://www.flrules.org/gateway/chapterhome.asp?chapter=20-2).

BEST PRACTICES

- Ensure a food-safety plan and a traceability plan are in place.
- Organize all documentation so that records can be accessed quickly.
- Demonstrate that product can be traced one step forward and one step back.
- Include tracking information with each citrus load (e.g., fruit source, harvest date, harvest crew, etc.). This can usually be satisfied with a properly completed Trip Ticket.

Summary

It is important to ensure the food safety of all citrus commodities in order to maintain the economic vitality of the industry and consumer trust. As with other commodities, producers of Florida citrus should follow the guidelines outlined above. Audit tools generally follow these guidelines quite closely, although individual customers often impose requirements of their own that must be addressed.

Glossary

biological contaminants. Organisms, often microscopic, that can cause harm to human health and include pathogenic bacteria (e.g., *Salmonella* and *E. coli* O157:H7), viruses (e.g., *Hepatitis* and norovirus), and parasites (e.g., *Giardia* and *Cryptosporidium*).

chemical contaminants. Pesticides, sanitizers, etc., that may cause illness, injury, or death when not used according to label instructions.

compost. Organic material that is treated by a specific heat-generating process that kills pathogenic organisms.

***Good Agricultural Practices* (*GAPs*).** Science-based standards that can be implemented or adapted to regular farming practices to ensure that the crops grown and harvested are free from contamination.

***Hazard Analysis Critical and Control Points* (*HACCP*)**. A risk-based system that identifies dangers to food safety and develops controls to minimize risks to food safety during storage, handling, processing, and selling.

***municipal biosolids* (*biosolids*).** Products of human sewage treatment facilities that may be applied to cropland as a fertilizer or soil amendment.

pasteurization. A process, often consisting of heating a food product to a particular temperature for a particular time, that kills or inactivates most microorganisms of public health significance. The treatment does not kill all microorganisms.

pathogenic organism. An organism that can cause disease in another organism (i.e., humans).

physical hazards. Physical objects such as hard or sharp glass, metal, or wood debris that can cause personal injuries.

potable water. Water that meets the quality standards of human drinking water.

traceback. A system of record keeping that allows for rapid identification of the origin of a food product and all production and subsequent handling treatments and conditions imposed on it.

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