COMMODITY-SPECIFIC FOOD SAFETY GUIDELINES FOR THE EASTERN CANTALOUPES GROWERS ASSOCIATION

THIS DOCUMENT HAS BEEN REVIEWED AND APPROVED
BY THE TECHNICAL WORKING COMMITTEE.
OTHER MINOR REVISIONS MAY BE ADDED
BUT THE GENERAL INTENT CAN BE UNDERSTOOD
THROUGH THIS GUIDANCE DOCUMENT.

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Forward

The Eastern Cantaloupe Food Safety Program was established by eastern United States cantaloupe producers, packers, shippers, etc. in Georgia, Indiana and North Carolina to identify ways in which they could work cooperatively to enhance consumer and retail confidence in the Eastern cantaloupe market and supply chain. The creation of the Eastern Cantaloupe Growers Association (ECGA) resulted. Members of the ECGA will be required to maintain strict adherence to specific food safety protocols, metrics, and/or practices. Membership in ECGA is open to any grower of Eastern cantaloupe varieties and committed to Commodity-Specific Food Safety Guidelines for the Eastern Cantaloupe Growers Association high standard of food safety metrics in their operations.

Organizers of ECGA chose Global Food Safety Initiative benchmarked audits as the baseline for food safety audit standards. Utilizing the *Commodity Specific Guidelines for the Production, Harvest and Post Harvest Handling of Cantaloupes* created by the National Cantaloupe Guidance as the base food safety guidance, organizers accepted, amended and added food safety protocols and metrics specific to Eastern cantaloupe production as well as those over and above GFSI-benchmarked audit requirements. Several protocols, practices and metrics were used from the *California Commodity Specific Food Safety Guidelines for the Production, Harvest, Cooling, Packing, Storage, and Transporting of Cantaloupes and Other Netted Melons – Draft*. The ECGA food safety standards include cantaloupe specific GAPs, GMPs, and BMPs for production, harvest, packing and handling.

General Requirements of Grower Membership in ECGA:

- Obtain passing or acceptable third party certification from any GFSI-benchmarked audit standard for the field/ranch, harvest crew, and packing operations.
- Undergo at least one (1) unannounced audit during the production season.
- Maintain the Commodity-Specific Food Safety Guidelines for the Eastern Cantaloupe Growers Association.

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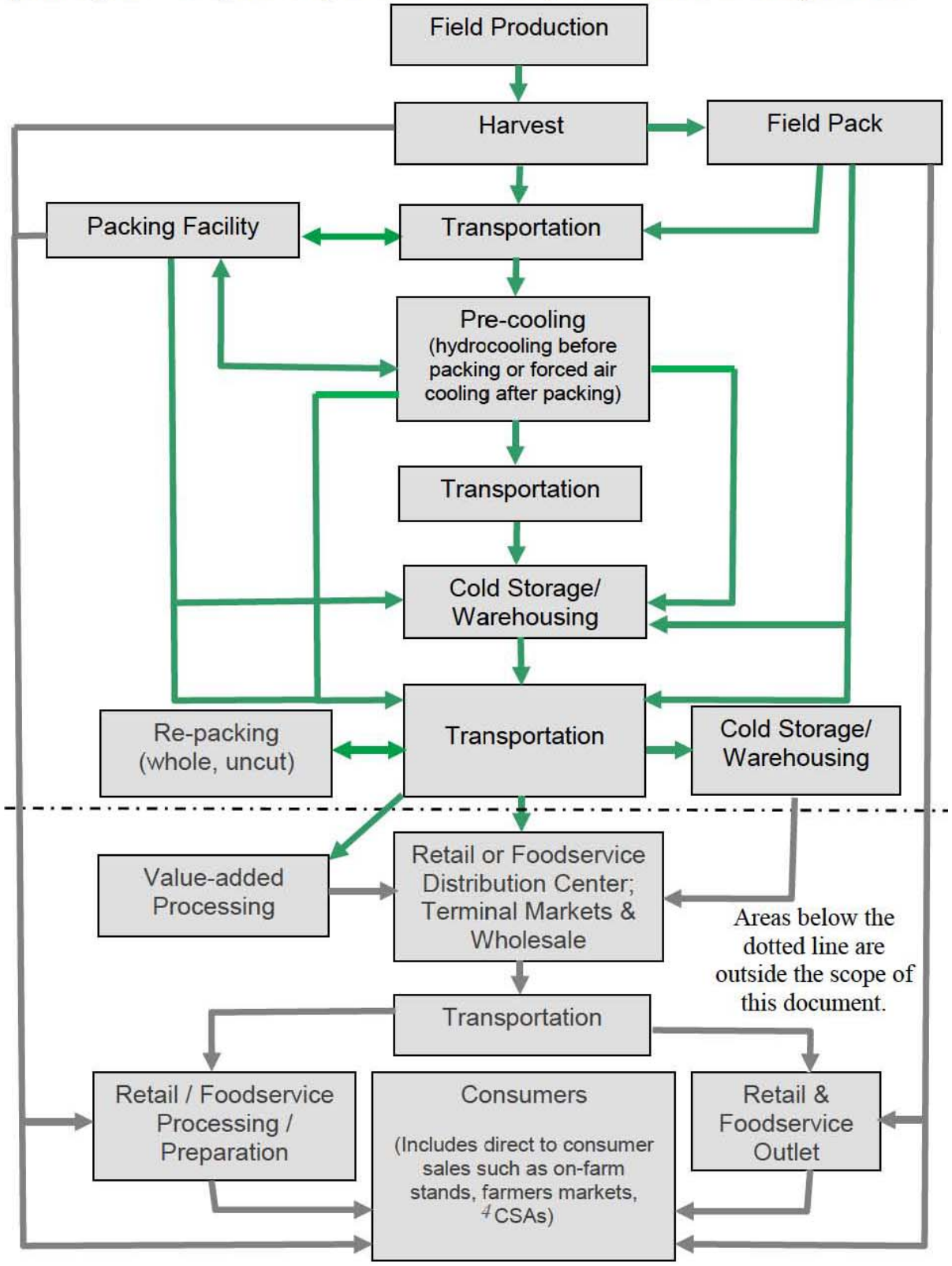
COMMODITY-SPECIFIC FOOD SAFETY GUIDELINES
FOR CANTALOUPES AND NETTED MELONS

(Created by the National Cantaloupe Guidance)

September 6, 2012

Figure 1. General Supply Chain Flow for Cantaloupes and Netted Melons

This diagram is intended to represent the industry-at-large and may not be reflective of all your specific operations. Operation-specific flow charts may have connections not depicted here.



1.0 INTRODUCTION

Cantaloupes (also known as muskmelons and rockmelons) are often consumed alone, mixed with other foods in salads and other dishes and as garnishes. They are popular in meals and as snacks, and in some countries cantaloupes are a regular part of the diet. The popularity of cantaloupes has remained high, as they are readily available in many countries all year round. In recent years, there has been a focus on marketing not only whole cantaloupes, but also pre-cut products, convenience products in packages, or in salad bars to appeal to consumers. Adding to consumer appeal for cantaloupes is the availability of new sweeter hybrid varieties with improved nutrition.

Like other fresh fruits and vegetables that are eaten raw, the safety of cantaloupe products depends on the identification and management of potential contamination risks maintaining strong preventive food safety programs all throughout the food chain during primary production, packing, processing, retail, and at the point of consumption. International outbreak data raise concerns regarding the safety of cantaloupe products. There have been a number of outbreaks associated with cantaloupe consumption with a large number being caused by *Salmonella* spp. and more recently, *Listeria monocytogenes*[1]. The major risk factors contributing to identify foodborne illness outbreaks attributed to cantaloupes include: water use, residual surface moisture, and equipment and facility sanitation. As fresh and pre-cut cantaloupe products move through the food chain, there is also the potential for the introduction, growth and survival of foodborne pathogens. Factors contributing to pathogen survival and growth on cantaloupes include: pH, temperature, presence of inhibitors (e.g. antagonistic bacteria and/or fungi) and the availability of moisture and nutrients. Moreover, morphological characteristics of cantaloupes, for instance netted rind, are prone to pathogen attachment. Fresh cantaloupes are consumed without further processing treatment that would eliminate or inactivate pathogens, if present.

2.0 OBJECTIVE

The primary purpose of this document is to provide specific guidance on how to minimize microbiological hazards during primary production through packing and transport of fresh cantaloupes. All individuals in the cantaloupe supply chain are strongly encouraged to use this guidance to develop their food safety programs and practices to ensure microbial hazards are minimized. This document is based on the Draft Annex on Melons to the *Code of Hygienic Practice for Fresh Fruits and Vegetables* developed by the Codex Committee on Food Hygiene for the Codex Alimentarius Commission. Hygienic recommendations for the primary production of fresh fruits are covered in general by other food safety guidance documents (these resources are available in Section 11.0 Additional Resources). Such as the CAC's *Code of Hygienic Practice for Fresh Fruits and Vegetables,* CanadaGAP's *On-Farm Food Safety Manual for the Production,*

[1] Report of the FAO to the Codex Committee on Food Hygiene Working Group on the development of an Annex on cantaloupes for the Code of Hygienic Practice for Fresh Fruits and Vegetables (CAC/RPC 53-2003)

Packing and Storage of Fruits and Vegetables, the FDA's *Guide to Minimize Microbial Food Safety Hazards for Fresh Fruits and Vegetables* and SENASICA's *General Requirements to Recognize and Certify Systems Aimed at Reducing Contamination Risks during the Production of Agricultural Products.*

3.0 SCOPE AND DEFINITIONS

3.1 Scope

This document covers specific guidance related to the production, harvesting, packing, cooling, storage, and transporting of fresh, uncut cantaloupes. For the purposes of this document, the term "cantaloupe" is used and includes any melon with a netted exterior. This guidance is applicable to cantaloupes grown in the field (with or without cover). It concentrates on microbial hazards and addresses physical and chemical hazards only in so far as these relate to GAPs and GHPs. Although important to food safety, requirements for chemical hazards are addressed by other federal and state regulation, and these guidelines do not supersede those requirements or/and any associated recommendations. The document does not provide recommendations for cantaloupe processing (e.g., trimmed, sliced and/or diced cantaloupes), retail outlets, foodservice or consumers. Resources for handling cantaloupes in these settings are provided in Additional Resources (Section 11.0) at the end of the document.

3.2 Definitions

The following expressions have the meaning stated:

Agricultural inputs – any incoming material (e.g., seeds, fertilizers, water, agricultural chemicals, plant support) used for the primary production of fresh fruits and vegetables.

Agricultural worker – any person that undertakes one or more of the following: cultivation, harvesting and packing of fresh fruits and vegetables.

Antimicrobial agents – any substance of natural, synthetic or semi-synthetic origin, which at low concentrations kills or inhibits the growth of microorganisms, but causes little or no host damage.

Antimicrobial resistance – when bacteria or other microbes become resistant to the effects of antimicrobial agents after being exposed to them.

Biological control – the use of competing biologicals (such as insects, microorganisms and/or microbial metabolites) for the control of mites, pests, pathogens (human and plant) and spoilage organisms.

Biosolids – Sludge and other residue deposits obtained from sewage treatment plants and from treatment applied to urban and industrial wastes (food industries or other types of industry).

Cantaloupes (in this document) – refers to whole, uncut cantaloupes (also known as muskmelons and rockmelons) and all varieties of netted melons.

Composting – a managed process in which organic materials are digested aerobically or anaerobically by microbial action.

Cross-contamination – The transfer of a microbial hazard, such as disease-causing bacteria and viruses, or a chemical hazard from a contaminated item, surface or media to a previously uncontaminated item, surface or media.

Cull – to remove any product that shows signs of physical damage (such as skin breaks or decay).

Cultivation – any agricultural action or practice used by growers to allow and improve the growing conditions of fresh fruits or vegetables grown in the field (with or without cover) or in protected facilities (hydroponic systems, greenhouses).

Environmental assessment – an evaluation of the growing environment taking into consideration factors including topography, hydrology, geographical features, climatic conditions, land history, near-by land use, agricultural water, and domestic animal and wildlife presence to evaluate any safety risks that may affect the potential for leafy greens to be contaminated. Environmental assessments may be conducted prior to planting, during production, and immediately prior to harvest.[2]

Farm – any premise or establishment in which fresh fruits and/or vegetables are grown and harvested and the surroundings under the control of the same management.

Ground spot – the point of direct contact where cantaloupes sit directly on the soil or on top of thin plastic mulch.

Grower – the person responsible for the management of the primary production of fresh fruits and vegetables.

Harvester – the person responsible for the management of the harvesting of fresh fruits and vegetables.

Hazard – a biological, chemical or physical agent in, or condition of, food with the potential to cause an adverse health effect.

Hazardous material – any compound, which at specific levels has the potential to cause adverse health effects.

Hydroponics – a general term for the production of plants without soil in a water medium.

Manure – Animal excrement which may be mixed with litter or other material, and which may be fermented or otherwise treated.

Microorganisms – include yeasts, molds, bacteria, viruses and parasites. When used as an adjective, the term "microbial" is used.

Mitigation measures – includes preventive controls and corrective actions

[2] FDA. 2009. Guidance for Industry: Guide to Minimize Microbial Food Safety Hazards of Leafy Greens; Draft Guidance. http://www.fda.gov/Food/GuidanceComplianceRegulatoryInformation/GuidanceDocuments/ProduceandPlanProducts/ucm174200.htm#def

Nonsynthetic fertilizer – Any crop input that contains animal manure, an animal product, and/or an animal by-product that is reasonably likely to contain human pathogens.

Packer – the person responsible for the management of post-harvest processing and packing of fresh fruits and vegetables.

Packing – the action of putting fresh fruits and vegetables in a package. This may take place in a field or in an establishment.

Packing establishment – any indoor establishment in which fresh fruits and vegetables receive post-harvest treatment and are packaged.

Potable water – water which meets the quality standards of drinking water such as described in the US EPA and WHO Guidelines for Drinking Water Quality.

Primary production – those steps involved in the growing and harvesting of fresh fruits and vegetables (e.g., planting, irrigation, application of fertilizers, application of agricultural chemicals).

Vector – an organism, often an invertebrate arthropod, that transmits a pathogen from reservoir to host. In the terminology of epidemiology, vectors are organisms that transmit infections from one **host** to another. Most commonly known biological vectors are arthropods but many domestic animals too are important vectors or asymptomatic carriers of parasites and pathogens that attack humans or other animals. Some such pathogens and parasites are of great medical or veterinary importance. Many parasites actually are adapted to a particular vector for part of their developmental cycle, but the vector function essentially consists in transmission of the parasite to subsequent hosts.

Worker – includes the permit holder, person in charge, employee, person having supervisory or management duties, person on the payroll, family member, volunteer, person performing work under contractual agreement, or other person working on a farm or in a packing facility.[3]

[3] Food Code 2009 http://www.fda.gov/Food/FoodSafety/RetailFoodProtection/FoodCode/FoodCode2009/ucm186464.htm

4.0 PRIMARY PRODUCTION

Cantaloupes may be grown in protected structures (e.g. greenhouses) or outdoors (e.g. farms of varying sizes), harvested, and packed in the field or a facility under a wide range of climatic and diverse geographical conditions, in production sites indoors (e.g., greenhouses) and outdoors, using various agricultural inputs and technologies, and on farms of varying sizes. Biological, chemical and physical hazards may therefore vary significantly from one type of production to another. In each primary production area, it is necessary to consider the particular agricultural practices that promote the production of safe cantaloupes, taking into account the conditions specific to the primary production area and methods used. Primary production practices for cantaloupes should be evaluated for the cross contamination risks they may present and management practices need to be developed to minimize identified hazards.

4.1 Microbiological Testing

When sampling plans and methodology are properly designed and performed, microbiological testing can be a useful tool to evaluate water quality, verify the effectiveness of composting methods and sanitation practices, and in general, provide information about an environment. The intended use of information obtained (e.g., evaluating the risk posed by a particular hazard) can aid in designing an appropriate sampling plan and determining the most appropriate microorganisms for which to test. In selecting a testing third-party laboratory, growers should ensure that:

- The laboratory is accredited (such as ISO 17025 or equivalent) and uses test methods that have been validated for the intended use.
- The laboratory has experience in conducting the type of testing needed for the particular type of sample matrix.

In addition, each facility should have a corrective action plan in place before a positive sample is found so that, if one does occur, corrective actions can be taken quickly.

4.2 Environmental Assessment

An environmental assessment is an evaluation of the growing environment intended to identify hazards (i.e., potential sources of environmental contamination) prior to and during production and harvesting activities. This is important because contamination that occurs during production and harvesting may not be removed in subsequent steps. Because each production site is unique, potential hazards will vary from site to site and each site should be assessed individually. Environmental hazards that potentially present a contamination risk to cantaloupe production sites may be related to topographical, hydrological and geographical features of the field and surrounding area, historical land use, adjacent land use, climate, agricultural water, local animal populations as well as human activities. Particular attention should be given to potential sources of fecal contamination in the cantaloupe production area and to vectors which may introduce fecal contamination to the production and handling areas. These vectors include, but are not limited to, humans, domestic and wild animals, or indirectly from

contaminated water, aerosols, tools and equipment. Appropriate measures should be taken to minimize risks from hazards identified in the environmental assessment, and measures taken to address each hazard should be documented.

4.2.1 Assessment of the Production Environment

Prior to the first seasonal planting, production site location, prior use and adjacent land use should be assessed for potential risk factors including, but not limited to:

- Topographical and geographical features -the slope and the potential for runoff from nearby fields, the flood risk as well as hydrological features of nearby sites in relation to the production site.
- Adjacent land use -the proximity of land and waterways presenting a contamination risk (e.g., animal production facilities, hazardous waste sites, waste treatment facilities).
- Historical land use – any previous use of the production site that may impact food safety (e.g., hazardous waste sites, landfills, concentrated animal operations).
- Climate – climatic conditions can affect the growing environment. Examples of climatic conditions that might be considered include but are not limited to: Frequent or heavy rainfall that might result in flooding or persistent standing water, which may attract animals or increase the potential for pathogen survival in the soil. Prevailing or high winds that might transport pathogens from sources outside the field.

4.2.2 Assessment of Wildlife and Domestic Animal Activity

Any animal that may be present in the production environment can be a potential carrier of foodborne pathogens. Animals are also a potential source of contamination of surface water that may be used for irrigation. The presence, types, numbers, habits and different environments that animals may be present in all may influence the risk to a cantaloupe production area. It is important that a thorough site-specific evaluation be conducted.

- The grower, their designated food safety manager or other trained personnel should evaluate the potential for pathogen contamination from animals in the production environment. A risk assessment should be performed to determine the risk level as well as to evaluate potential strategies to control or reduce the introduction of human pathogens by animals.
- An evaluation of the potential for pathogen contamination from animals should be included as part of the environmental assessments conducted prior to the first seasonal planting, prior to and during harvest for cantaloupe production sites.
- Production areas should be protected against wildlife and domestic animal intrusion in areas where a risk assessment identifies such risks. Mitigation strategies should comply with local, state, and federal regulations.

- Cantaloupe production sites and handling areas should be monitored for evidence of crop contamination (e.g. fecal matter, animal intrusion). Where such evidence is found, the risk should be evaluated and a determination made whether the affected production areas should be harvested. Mitigation strategies may also be re-evaluated.
- Cantaloupe production and handling areas should be properly maintained to reduce the likelihood of animal attraction (e.g., minimize standing water, restrict access to water sources, keep production sites and handling areas free of waste and clutter).
- Growers are encouraged to contact the relevant agencies (e.g., state and federal fish and wildlife agencies) to develop and document strategies to minimize animal intrusion.

4.2.3 Flooding

For purposes of this document, *flooding is defined as the flowing or overflowing of a field with water outside of a grower's control that is reasonably likely to contain pathogens and/or other contaminants and is reasonably likely to cause adulteration of cantaloupes in that field. Pooled water (e.g., from irrigation leaks or rainfall) that is not reasonably likely to contain pathogens and/or other contaminants and is not reasonably likely to cause adulteration of cantaloupes should not be considered flooding.*

If floodwaters contain pathogens and/or other contaminants, cantaloupes may be contaminated if there is direct contact between floodwater and cantaloupe. Areas that have been flooded can be separated into three groups: 1) cantaloupes that have come into contact with floodwater, 2) cantaloupes that are in proximity to a flooded field but have not been contacted by floodwater, and 3) production ground that was partially or completely flooded in the past before cantaloupes were planted. The considerations for each situation are described below and presented in Table I-1, PAGE 15 A-B.

- Prevent cross-contamination between flooded and non-flooded areas:
    - During production of non-flooded areas in close proximity to flooded areas, prohibit contact of production equipment with the flooded area
    - Observe appropriate turn-around buffer zones when using vehicles and equipment in close proximity to flooded areas. Create a buffer zone by placing markers that identify both the high-water line of the flooding and an interval of 30 feet beyond this line. If 30 feet is not sufficient to the field, use a greater appropriate interval. Do not harvest cantaloupes within any established buffer zones.
- If a wellhead is under floodwater, complete a sanitary survey including water quality testing to ensure the integrity of the well before using.
- If production ground was formerly flooded, in accordance with Table I-1 Flooding, prior to replanting or soil testing, the designated food safety professional for the grower should perform a detailed food safety assessment of the production field for potential hazards. This designated professional will be responsible for assessing the relative merits of testing versus

observing the appropriate time interval for planting, and will coordinate any soil testing plan with appropriate third-party consultants and / or laboratories that have experience in this type of testing.

- Do not plant cantaloupes in formerly flooded production ground for at least 60 days following the receding of floodwaters (unless the ground meets the 30-day testing requirement detailed in the next bullet and Table I-1). In addition to a waiting period before planting, actively tilling the soil provides additional protection against the survival of pathogenic organisms.

Table I-1. Flooding

For use when evidence of flooding in a cantaloupe field occurs.

Practice	Practice Metric / Rationale
Flooding Defined	The flowing or overflowing of a field with water outside a grower's control that is reasonably likely to contain pathogens and is reasonably likely to cause adulteration of cantaloupes in that field. Additional discussion of this definition and implications for production is provided in the text portion of this document.
Handling Unharvested Cantaloupe in a Flooded Field	• Buffer and do not harvest cantaloupes within 30 ft. of the flooding. • Recommended buffer distance may be greater than 30 ft. based on risk analysis by food safety professional. • If there is flooding in the field a detailed food safety assessment should be conducted by appropriately trained food safety personnel (see Glossary) as defined in the text of this document (See Appendix E for an example food safety assessment).
Verification	• Documentation should be archived for a period of 2 years following the flooding event. Documentation may include photographs, sketched maps, or other means of delineating affected portions of cantaloupe fields.
Time Interval Before Planting Can Commence Following the Receding of Floodwaters	• Planting can commence 30 days after the flood waters have receded to the point where water is not visible in the areas that are to be planted and the soil should be at a moisture level at which the grower can get equipment into the field for preparation.[15] • Appropriate soil testing can be used to shorten this period to 30 days prior to planting. This testing should be performed in a manner that accurately represents the production field and indicates soil levels of microorganisms lower than the acceptance criteria listed below. Suitable representative samples should be collected for the entire area suspected to have been exposed to flooding. For additional guidance on appropriate soil sampling techniques, see the example soil sampling protocol in Appendix D and consult the "Soil Screening Guidance: Technical Background Document," specifically Part 4 that provides guidance for site investigations (US EPA 1996). Reputable third-party environmental consultants or laboratories provide sampling services consistent with this guidance. • Appropriate mitigation and mitigation strategies are included in the text portion of the document.
Soil Testing Criteria and Test Methods	**Target Organisms:** • *Salmonella* spp. • Enterohemorrhagic *E. coli* (EHEC) or Shiga toxin-producing *E. coli* (STEC) **Acceptance Criteria:** • *Salmonella* spp.: Negative or < DL (<1/ 30 grams) • Enterohemorrhagic *E. coli* (EHEC) or Shiga toxin-producing *E. coli* (STEC): Negative or < DL (<1/ 30 grams)

[15] Soil moisture test results can also be used to demonstrate moisture levels. Methods typically used by growers to determine soil moisture content include, but are not limited to, tensiometers, electric resistance blocks, oven drying analysis, or other methods that are measurable and repeatable. The grower should have historical information available regarding typical moisture content of the soil so there is comparison data available if it is needed.

Practice	Practice Metric / Rationale
	Recommended Test Methods: • *Salmonella* spp.: U.S. EPA Method 1682 • Enterohemorrhagic *E. coli* (EHEC) or Shiga toxin-producing *E. coli* (STEC): Any laboratory validated method for soil sampling. • Other U.S. EPA, FDA, or AOAC-accredited methods may be used as appropriate.
Rationale	• The basis for the 30-foot distance is the turn-around distance for production equipment to prevent cross-contamination of non-flooded ground or crops in the fields.

4.3 HYGIENIC PRIMARY PRODUCTION OF CANTALOUPES

Special consideration should be given to practices specific to cantaloupe production and harvest because of the unique characteristics of the cantaloupe rind and because cantaloupes frequently contact soil directly during development. The netted rind surfaces of cantaloupes provide an environment where microbial pathogens may more easily adhere to, survive on, and become more difficult to eliminate during post-harvest practices.

4.3.1 Ground Spot Reduction Measures

Cantaloupe rind ground spots have been demonstrated to have significantly greater microbial populations than non-ground spot areas and, therefore, may be more susceptible to pathogen contamination. Where ground spot formation is an issue, growers may use various measures to reduce ground spot formation, many of which involve direct human contact with developing cantaloupes. These measures may include efforts to minimize direct cantaloupe-to-soil contact such as the placement of cantaloupes on cups (i.e., small plastic pads) or plastic-covered beds, the positioning of developing cantaloupes on top of the vine, and hand-turning cantaloupes multiples times throughout the growing season. Other practices to reduce ground spot formation are planting on sloped land and on land with more porous soil types, use of irrigation methods that limit soil moisture content, and increasing pollination at the cantaloupe "crown" so more cantaloupes sit on top of the bed versus in the furrow.

If cups are used underneath cantaloupes, the following are recommended:

- Use plastic mulch under cups to minimize cup and cantaloupe contact with the soil.
- Ensure cups are clean and sanitary before setting them under the cantaloupes.

If workers have direct contact with cantaloupes, the following is recommended:

- Ensure that workers follow good hygienic practices when handling or turning cantaloupes on the cups during production and harvesting operations.

4.3.2 Water for Primary Production

Growers should identify the sources of water used on the farm (e.g., municipality, re-used irrigation water, reclaimed wastewater, discharge water from aquaculture, well, open canal, reservoir, rivers, lakes, farm ponds). It is recommended that growers assess and manage the risk posed by these waters as follows:

- A water system description should be prepared. This description can use maps, photographs, drawings, or other means to communicate the location of permanent fixtures and the flow of the water system (including any water captured for re-use). Permanent fixtures include wells, gates, reservoirs, valves, returns, and other above ground features that make up a complete irrigation system. The direction of water flow should be clearly indicated on each map. If feasible, include underground piping or conveyances. This map should be used to facilitate physical water system inspections for the purpose of identifying conditions that may result in the contamination of cantaloupe crops.

- Assess the potential for pathogen contamination (e.g., from livestock, human habitation, sewage treatment, manure and composting operations) and the water's suitability for its intended use. Reassess the potential for pathogen contamination if events, environmental conditions (e.g., temperature fluctuations, heavy rainfall, flooding) or other conditions indicate that water quality may have changed.
- In accordance with water quality metrics described in Table II-2, determine how microbial testing should be done to evaluate the suitability of water for each intended use. Testing may be necessary after a change in irrigation water source, flooding or a heavy rainfall when water is at a higher risk of contamination. When testing, determine and document:
  - What tests need to be performed, (e.g., which pathogens and/or fecal indicators),
  - Parameters pertinent to assessing water quality (e.g., temperature of water sample, water source location, concentration of antimicrobial chemicals, water pH, weather description),
  - How often tests should be conducted,
  - Location and manner of sample collection and handling,
  - What the test outcomes indicate, and
  - How test results will be used to define corrective actions.
- Frequency of testing should depend on the source of the water (less for adequately maintained deep wells, more for surface waters), intended use of the water, and the risks of environmental contamination, including intermittent or temporary contamination (e.g., heavy rain, flooding) in accordance with water quality metrics described in Table II-2. Frequent water tests may be useful to establish the baseline water quality.
- If the water source is found to have unacceptable levels of indicator organisms or is contaminated with foodborne pathogens, corrective actions should be taken and documented to ensure that the water is suitable for its intended use in accordance with water quality metrics described in Table II-2 and in Figures 3A and 3B. Corrective actions should be appropriate to the likely cause of the unacceptable level. These may include evaluating potential sources of contamination in the water source or in the water distribution system, using a different water source until the contamination source is corrected, and/or treating the water with an effective antimicrobial agent. Testing frequency should be increased until consecutive results are within the acceptable range.
- Identify, implement, and document corrective actions to prevent or minimize contamination according to the water quality metrics described in Table II-2. Possible corrective actions may include fencing to prevent large animal contact, proper maintenance of wells, filtering water, not stirring the sediment when drawing water, building settling or holding ponds, and water treatment facilities. Settling or holding ponds that are used for subsequent irrigation may be microbiologically safe, but may attract animals or in other ways increase the microbial risks associated with water for irrigating cantaloupes. If water treatment is needed or water quality microbial tests are at levels that exceed the acceptable criteria set forth in Table II-2, follow recommendations for corrective actions as outlined in the Table and in Figures 3A and 3B, consult Figure 3A and 3B Decision Tree for Pre-Harvest Use or consult with water safety experts.
- When water from various sources is combined, ensure all water sources meet the water quality metrics described in Table II-2.

- For all irrigation types, care should be taken to minimize cantaloupe contact with moist soil that may result in the creation of ground spots where internalization of bacteria can take place (Parnell et al 2005).
- Cantaloupes should not come in contact with stagnant water pooled from irrigation, rainfall or storm events.

Table II-2. Water Use

Use	Metric	Rationale / Corrective Actions
PRE-HARVEST Foliar Applications (overhead sprinkler irrigation, pesticides / fungicide application, etc.)	**Target Organism:** generic *E. coli*. **Sampling Procedure:** A minimum of 100 ml sample aseptically collected at the point of use, mixed and poured into laboratory-supplied vials;* e.g., for point of use - one sample at lateral gate per water source for irrigation, water tap for pesticides. Water utilized in preseason irrigation operations may be tested and utilized. **Sampling Frequency:** One sample per water source should be collected and tested prior to use. Additional samples should be collected at least monthly during use from points within the distribution system. **Municipal & Well Exemption:** For wells and municipal water sources, if generic *E. coli* levels are below detection limits for five consecutive samples, the sampling frequency may be decreased to once every six months and the recommendations for 60 and 30 day sampling are waived. This exemption is void if there is a significant source or distribution system change.	For any given water source (municipal, well, reclaimed water, reservoir or other surface water), samples for microbial testing should be taken as close to the point of use as practical (as determined by the sampler using sampling methods to ensure the integrity of the sample as prescribed in this table) where the water contacts cantaloupes, so as to test both the water source and the water distribution system. In a closed water system (meaning no connection to the outside), water samples may be collected from any point within the system, but are still preferred as close to point of use as practical. Only one sample per month per distribution system is recommended under these metrics unless a system has qualified for an exemption. If there are multiple potential point-of-use sampling points in a distribution system, then samples should be taken from different point-of-use locations each subsequent month (randomize or rotate sample locations). Use of the indicator organism, generic *E. coli* as the target organism is based on the US EPA's recreational water quality standards as well as drinking water standards (requires tests for *E. coli* when public water systems test positive for total coliforms) (US EPA, 1974; US EPA, 1986; US EPA 2003). Water for pre-harvest, direct use should meet or exceed microbial standards for recreational water, based on a rolling geometric mean of the five most recent samples. If the water source has not been tested in the past 60 days, the first water sample should be tested prior to use, to avoid using a contaminated water source. After the first sample is shown to be within acceptance criteria, subsequent samples should be collected no less frequently than monthly at points of use within the distribution system. Ideally, pre-harvest water should not contain generic *E. coli*, but low levels do not necessarily indicate that the water is unsafe. Investigation and / or corrective action should be taken when test results are higher than normal or indicate an upward trend, but do not exceed the acceptance criteria. Investigation and corrective action should be taken when acceptance criteria are exceeded. **Corrective Actions:** If the rolling geometric mean (n=5) or any one sample exceeds the acceptance criteria, then the water should not be used whereby the cantaloupes are contacted by water until corrective actions have been completed and generic *E. coli* levels are within acceptance criteria: • Conduct a Sanitary Survey of water source and distribution system to determine if a contamination source is evident and can be eliminated. Eliminate identified contamination source(s). • For wells, perform a Sanitary Survey and / or treat as described in Appendix A. • Retest the water after conducting the Sanitary Survey and / or taking corrective actions to determine if it meets the outlined microbial acceptance criteria for this use. This sample should represent the conditions of the original water system. If feasible, this test should be as close as practical to the

Use	Metric	Rationale / Corrective Actions
	Test Method: FDA BAM method or any US EPA approved or AOAC-validated method for quantitative monitoring of water for generic *E. coli.* **Acceptance Criteria for Water:** **≤126 MPN (or CFU) /100 mL** † (rolling geometric mean n=5) and ≤**235 MPN/100 mL** for any single sample. † For the purposes of water testing, MPN and CFU should be considered equivalent.	original sampling point. A more aggressive sampling program (i.e., sampling once per week instead of once per month) should be instituted if an explanation for the exceedence is not readily apparent. This type of sampling program should also be instituted if an upward trend is noted in normal sampling results. • **Optional* – After fruit has set, retain an additional two laboratory-supplied 100 ml vials of the original water sample that can be tested for pathogens. When the water tests exceed the acceptance criteria analyze the retained samples for pathogens. If pathogens are present, DO NOT harvest cantaloupes for human consumption. **Records**: Information requirements: Each water sample and analysis should record: the type of water (canal, reservoir, well, etc.) date, time, field location of the sample, and exact location in the water system and the method of analysis and detection limit. Records of the analysis of source water may be provided by municipalities, irrigation districts or other water providers. All test results and corrective actions should be documented and available for verification from the grower / handler who is the responsible party for a period of 2 years.
PREHARVEST Non-Foliar Applications Whereby Edible Portions of the Crop are **NOT** Contacted by Water (*e.g.*, furrow or drip irrigation, dust abatement water; if water is not used in the vicinity of produce, then testing is not necessary)	**Target Organism, Sampling Procedure, Sampling Frequency Test Method and Municipal Well Exemption:** as described for foliar application. **Acceptance Criteria:** **≤126 MPN /100 mL** (rolling geometric mean n=5) and ≤**576 MPN /100 mL** for any single sample.	Testing and corrective actions for pre-harvest water that does not come in direct contact with edible portions of the crop are the same as for direct contact water, but acceptance criteria are less stringent because of the reduced risk of contact of the edible portion with contamination from water. Acceptance criteria here are derived from U.S. EPA recreational water standards.

Figure 3A. Decision Tree for PRE-HARVEST WATER USE – Foliar applications (e.g., overhead irrigation, pesticide / fungicide applications)

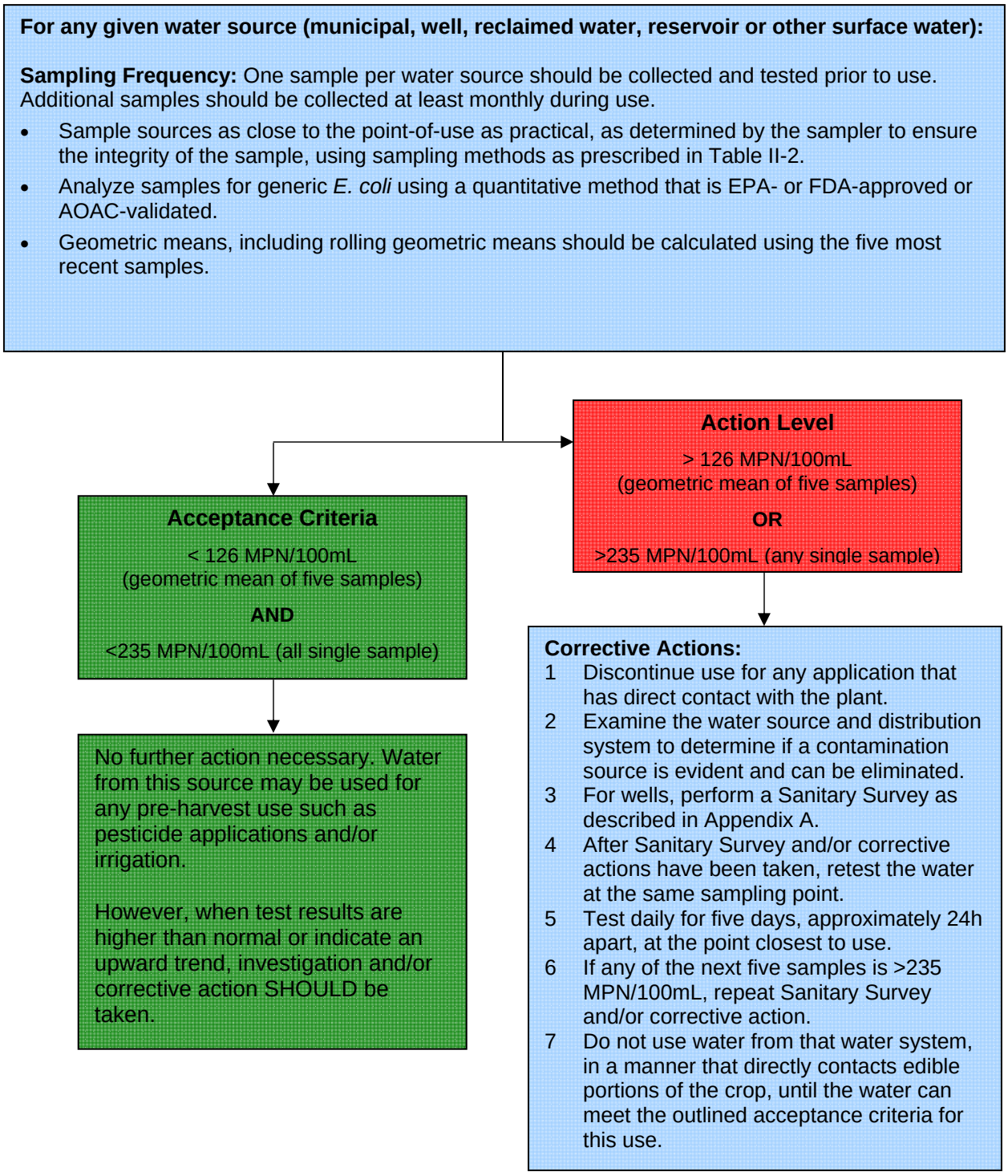
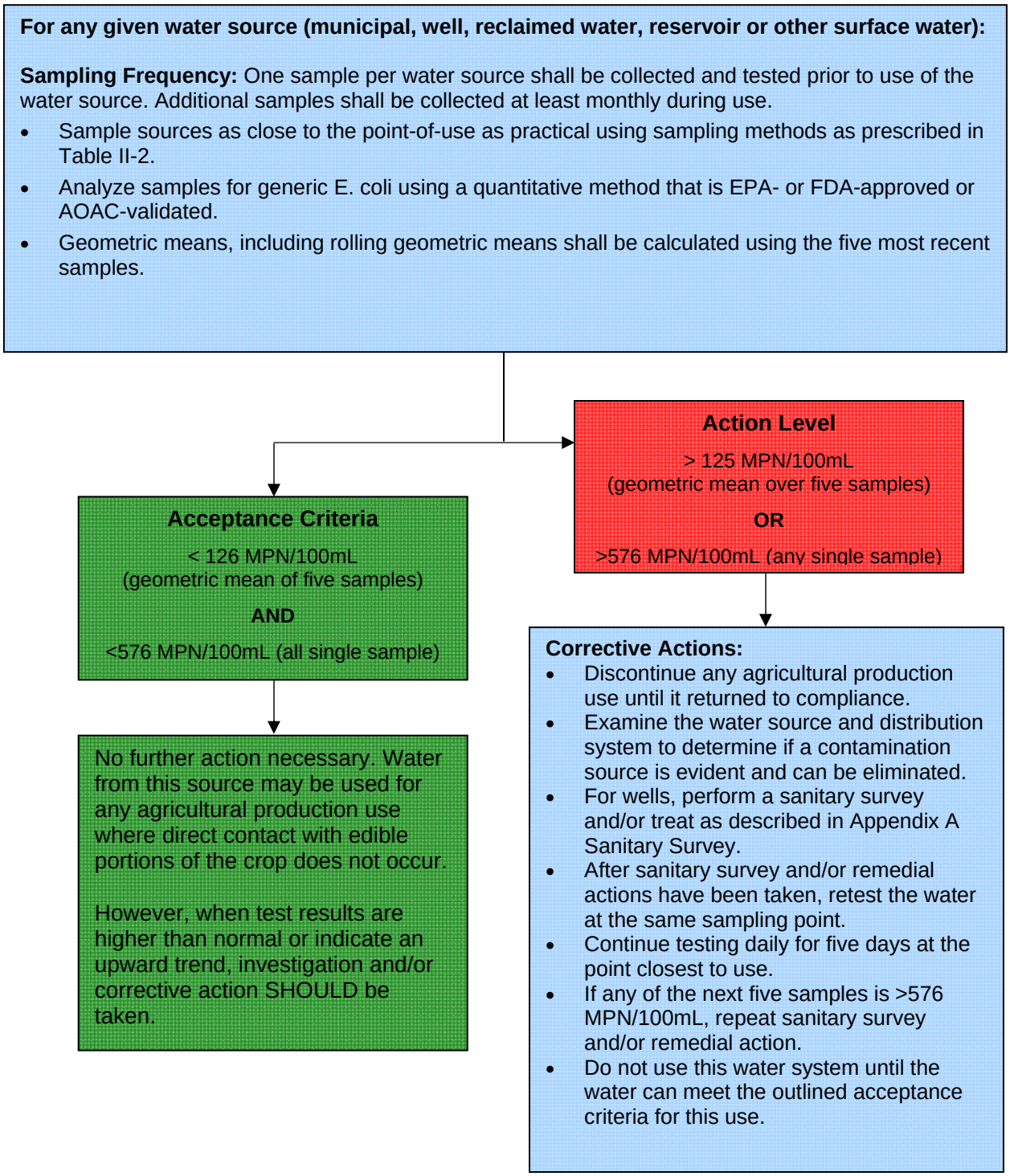


Figure 3B. Decision Tree for PRE-HARVEST WATER USE – Non-foliar applications whereby edible portions of the crop are NOT contacted by water (e.g. furrow or drip irrigation, dust abatement water



4.3.2.1 Water for irrigation and dust abatement

The quality of irrigation water and type of irrigation method used is important when assessing risk of pathogen contamination. Growers should use irrigation methods and practices to minimize the moisture content of soil where cantaloupes contact the soil.

To reduce the risk of pathogen contamination, growers should:

- Use water of suitable quality for its intended purpose when:
  - irrigating pre-blossom (before plants start to flower).
  - using water for dust abatement and to maintain roads, yards, and parking lots in areas within or near cantaloupe production sites.

Additionally for foliar application of irrigation water, growers should:

- Use water that meets the microbial standards for drinking water (e.g., Code of Federal Regulations, Title 40, part 141.63).
- Avoid creating persistent pools of water that may come into contact with cantaloupe rinds.

4.3.2.2 Water for harvest activities, fertilizers, pest control and other agricultural uses

Foodborne pathogens can survive and grow in many agrichemical solutions, including pesticides. To reduce the risk of pathogen contamination, growers should:

- Use water that meets the microbial standards for drinking water when it is applied directly to cantaloupes during harvesting and in the application of aqueous fertilizers, pesticides and other agricultural chemicals that are directly applied to the surface of cantaloupes, especially close to harvest.

4.3.3 Soil Amendments - Manure, Biosolids and Other Nonsynthetic Fertilizers

Manure, biosolids and other nonsynthetic fertilizers may contain human or animal waste, animal parts or products, or be composed primarily of plant materials. Soil Amendments are commonly (but not always) incorporated prior to planting into agricultural soils used for cantaloupe production to add organic and inorganic nutrients to the soil as well as to reduce soil compaction. Human pathogens may persist in animal manures for weeks or even months (Fukushima et al. 1999; Kudva et al. 1998). Some studies of human pathogens conducted in cultivated-field vegetable production models point towards a rapid initial die-off from high pathogen populations but often maintain a characteristic and prolonged low level pathogen survival (Hutchison et al. 2004; Islam et al. 2004a; Islam et al 2005; Nicholson et al. 2004). Proper composting of animal manures via thermal treatment will reduce the risk of potential human pathogen survival. However, the persistence of many human pathogens in agricultural soils depends on many factors (e.g., soil type, crop, soil moisture, relative humidity, UV index, cultivation practices, stress-adaption, etc.) and the effects of these factors are under extensive investigation (Jiang et al. 2003; Islam et al. 2004a; Islam et al. 2004b; Singh et al. 2010). Field soil contaminated with human pathogens may provide a means of cantaloupe contamination. Therefore, it is recommended that growers:

- Do not use biosolids, or human waste in any form.
- Do not use raw, untreated and/or partially treated manure and other nonsynthetic fertilizers.
- Do not locate treatment and/or storage sites in proximity to cantaloupe production areas.
- DO NOT USE raw manure, biosolids, or apply soil amendments that contain uncomposted, incompletely composted animal manure and/or green waste, or non thermally treated animal manure to fields, which will be used for cantaloupe production.
- Any soil amendment that does not contain animal manure shall have a certificate (e.g., ingredient list, statement of identity, letter of guaranty) from the producer or seller demonstrating that it is manure-free. The manure-free certificate shall be available for verification before application and should be saved and available for inspection for 2 years.
- If raw manure is applied to a field, no cantaloupes shall be grown in that field for at lease two (2) years.

When using composted and/or treated soil amendments, growers should:

- Use proper treatment by physical, chemical or biological methods to reduce the risk of potential human pathogen survival.
- Use established commercial methods when composting manure. If done properly, composting can be a practical and efficient method to inactivate foodborne pathogens in manure.
- Evidence of processing to eliminate foodborne pathogens, such as microbiological test results or verification data (e.g., time and temperature) demonstrating compliance with process, should be documented.
- Obtain documentation from the supplier that identifies the origin, treatment used, tests performed and the results thereof when purchasing manure and other nonsynthetic fertilizers that have been treated to reduce microbial or chemical contaminants.
- Compost suppliers should have provided cantaloupe producers with the SOPs they use to prevent cross-contamination of finished compost with raw materials through equipment, runoff, or wind.
- Compost operations supplying compost to cantaloupe crops should maintain temperature monitoring and turning records for at least 2 years, and growers should obtain proof that this documentation exists.
- Prevent cross-contamination from runoff or leaching by securing areas where manure and other nonsynthetic fertilizers are treated and stored relative to finished or composted fertilizers.
- Minimize contamination by manure and other nonsynthetic fertilizers from adjoining fields. If the potential for contamination from the adjoining fields is identified, preventive actions (e.g. care during application and run-off controls) should be implemented to minimize the risk.
    - Composted SAs (containing animal manure or animal products)

- Enclosed or within-vessel composting:

  Active compost shall maintain a minimum of 131^{o}F for 3 days

- Windrow composting:

  Active compost shall maintain aerobic conditions for a minimum of 131^{o}F for 15 days or longer, with a minimum of five turnings during this period.

- Aerated static pile composting:

  Active compost shall be covered with 6 to 12 inches of insulating materials and maintain a minimum of 131^{o}F for 3 days

Table II-3. Soil Amendments (SAs)

Amendment	Metric / Rationale
Raw Manure or Not Fully Composted Green Waste or Animal Manure Containing SAs (see composted manure process definition below)	**DO NOT USE OR APPLY** SAs that contain un-composted, incompletely composted, or non-thermally treated (e.g., heated) animal manure to fields which will be used for cantaloupe production. If raw manure is applied to a field, no cantaloupes shall be grown in that field for at least two (2) years.
Composted SAs (containing animal manure or animal products)	**Please see Figure 4A: Decision Tree for Use of Composted SAs.** **Composting Process Validation:** • Enclosed or within-vessel composting: Active compost shall maintain a minimum of 131oF for 3 days • Windrow composting: Active compost shall maintain aerobic conditions for a minimum of 131oF for 15 days or longer, with a minimum of five turnings during this period. • Aerated static pile composting: Active compost shall be covered with 6 to 12 inches of insulating materials and maintain a minimum of 131oF for 3 days **Target Organisms:** • Fecal coliforms • *Salmonella* spp • *E coli* O157:H7 • *Listeria monocytogenes* **Acceptance Criteria:** • Fecal coliforms: <1000 MPN/gram • *Salmonella* spp: Negative or < DL (<1/30 grams) • *E coli* O157:H7: Negative or < DL (<1/30 grams) • *Listeria monocytogenes*: Negative or < DL (<1/30 grams) **Recommended Test Methods:** • Fecal coliforms: 9 tube MPN • *Salmonella* spp: US EPA Method 1682 • STEC: Any laboratory validated method for compost sampling. • *Listeria monocytogenes*: FDA BAM • Other US EPA, FDA, or AOAC-accredited methods may be used as appropriate.

Amendment	Metric / Rationale
	Sampling Plan: • A composite sample shall be representative and random and obtained as described in the California state regulations (see Appendix F). • Sample may be taken by the supplier if trained by the testing laboratory. • Laboratory should be certified / accredited for microbial testing by an appropriate process authority. **Testing Frequency:** • Each lot before application to cantaloupe production fields. A lot is defined as a unit of production equal to or less than 5,000 cubic yards. **Application Interval:** • Should be applied >45 days before harvest. **Documentation:** • All test results and / or Certificates of Analysis should be documented and available for verification from the grower (the responsible party) for a period of 2 years. **Rationale:** • The microbial metrics and validated processes are from California state regulations for composting operations (CCR Title 14 - Chapter 3.1 - Article 7), with the addition of testing for *E. coli* O157:H7 as microbe of particular concern. The 45-day application interval was deemed appropriate as an additional precaution along with the requirements to produce composted SAs via validated methods and to test the composted SA for fecal coliforms and select pathogens. Raw manure should be composted with an approved process and pass testing requirements before an application.

Amendment	Metric / Rationale
SAs Containing Animal Manure that has Been Physically Heat Treated or Processed by Other Equivalent Methods	• Any process applied to a soil amendment containing animal manure should be validated to assure that the process is capable of reducing pathogens of human health significance to acceptable levels. **Target Organism:** • Fecal coliforms • *Salmonella* spp • *E. coli* O157:H7 **Acceptance Criteria:** • Fecal coliforms: < 10 MPN/gram • *Salmonella* spp: Negative or < DL (<1/30 grams) • *E. coli* O157:H7: Negative or < DL (<1/30 grams) **Recommended Test Methods:** • Fecal coliforms: 9 tube MPN • *Salmonella* spp: US EPA Method 1682 • *E. coli* O157:H7: Any laboratory validated method for testing SAs. • Other US EPA, FDA, or AOAC-accredited methods may be used as appropriate. **Sampling Plan:** • Extract at least 12 equal volume samples (identify12 separate locations from which to collect the subsample, in case of bagged product 12 individual bags). • Sample may be taken by the supplier if trained by the testing laboratory or state authority. • Laboratory should be certified / accredited by annual review of laboratory protocols based on GLPs by recognized NGO. **Testing Frequency:** • Each lot before application to cantaloupe fields. • In lieu of the above sampling plan recommendation, a Certificate of Process Validation issued by a recognized process authority can be substituted. This certificate will attest to the process validity as determined by either a documented (included with Certificate) inoculated pack study of the standard process or microbial inactivation calculations of organisms of significant risk (included with Certificate) as outlined in FDA CFSAN publication "Kinetics of Microbial Inactivation for Alternative Food Processing Technologies. Overarching Principles: Kinetics and Pathogens of Concern for All Technologies" (incorporated for reference in Appendix E - Thermal Process Overview).

Amendment	Metric / Rationale

	Application Interval:
	• If the physical heat treatment process used to inactivate human pathogens of significant public health concern is validated and the soil amendment produced meets the microbial acceptance criteria outlined above, then no time interval is needed between application and harvest.
	• If the physical heat treatment process used to inactivate human pathogens of significant public health concern is not validated, but the soil amendment produced meets microbial acceptance criteria outlined above, then a 45-day interval between application and harvest is recommended.
	Documentation:
	• Cantaloupe growers should keep the following documentation for a 2 year period:
	  • Any SA test results and / or Certificates of Analysis should be available for verification from the grower who is the responsible party
	  • A copy of the SA supplier's operation validation certificate issued by a process authority
	• The documentation should be available for verification before application and maintained for at least 2 years.
	
	Rationale:
	• The microbial metrics and validated processes are from California state regulations for composting operations (CCR Title 14 - Chapter 3.1 - Article 7), with the addition of testing for *E. coli* O157:H7 as the microbe of particular concern. A more stringent level of fecal coliform was also included to address the much more controlled nature of SAs produced in this manner. The above suggested application interval was deemed appropriate due to the specified multiple hurdle risk reduction approach outlined. Raw manure should be composted with an approved process and pass testing requirements before application.
	• FDA has established the validity of D-values and Z-values for key pathogens of concern in foods. This method of process validation is currently acceptable to U.S. regulators. Alternatively, results of an inoculated test pack utilizing the specific process is also an acceptable validation of the lethality of the process.

SAs Not Containing Animal Manure	• Any SA that DOES NOT contain animal manure should have documentation that it is manure-free. • The documentation should be available for verification before application. • If there is documentation that the amendment does not contain manure or animal products then no additional testing is recommended, and no application interval is necessary. • Any test results and / or Certificate of Analysis should be available for verification from the grower who is the responsible party for a period of 2 years.

Figure 4A. Decision Tree for Composted Soil Amendments (SAs)

If raw manure has been directly applied to the field in the past, a one-year waiting period should be observed before planting any variety of cantaloupes.

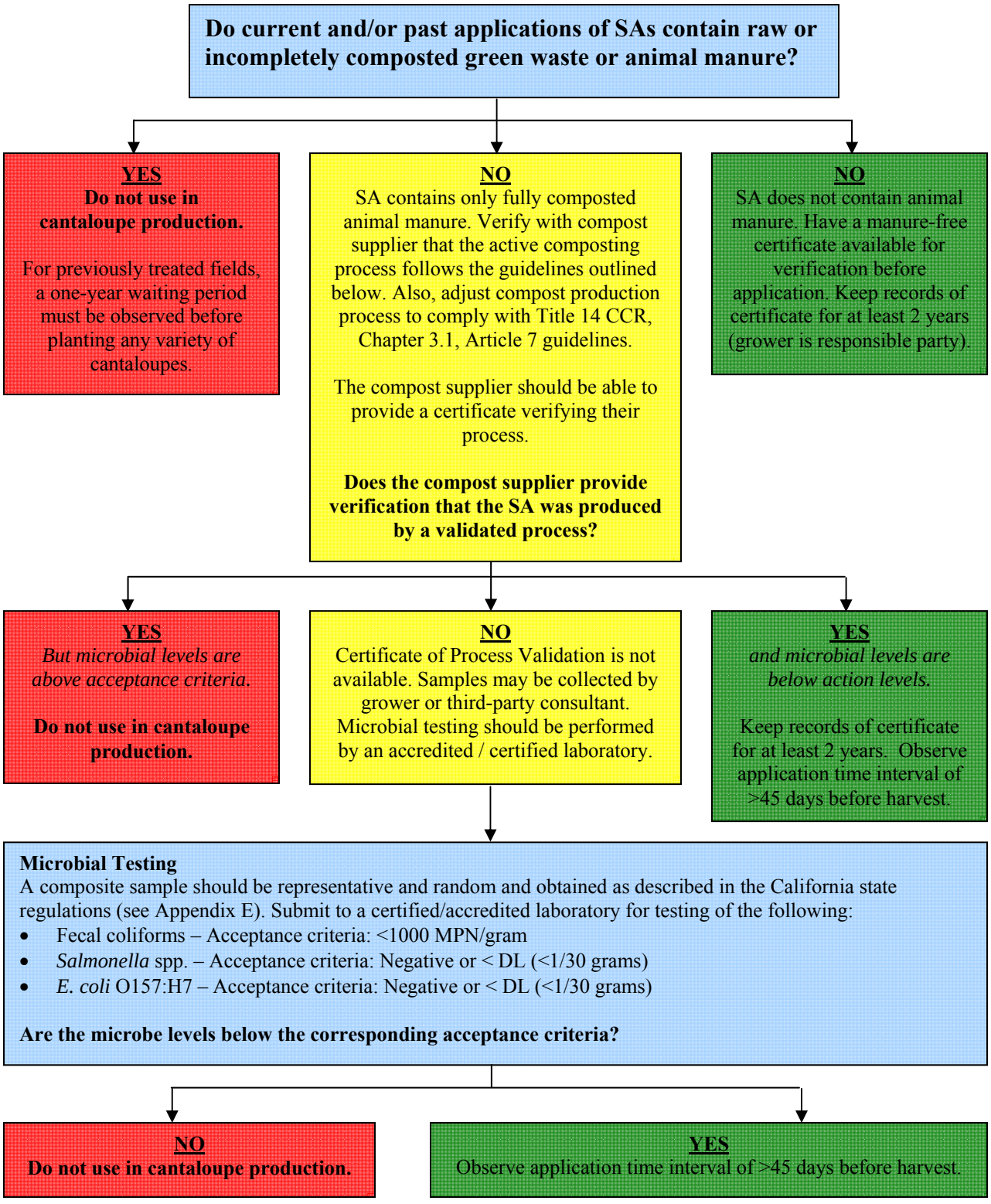
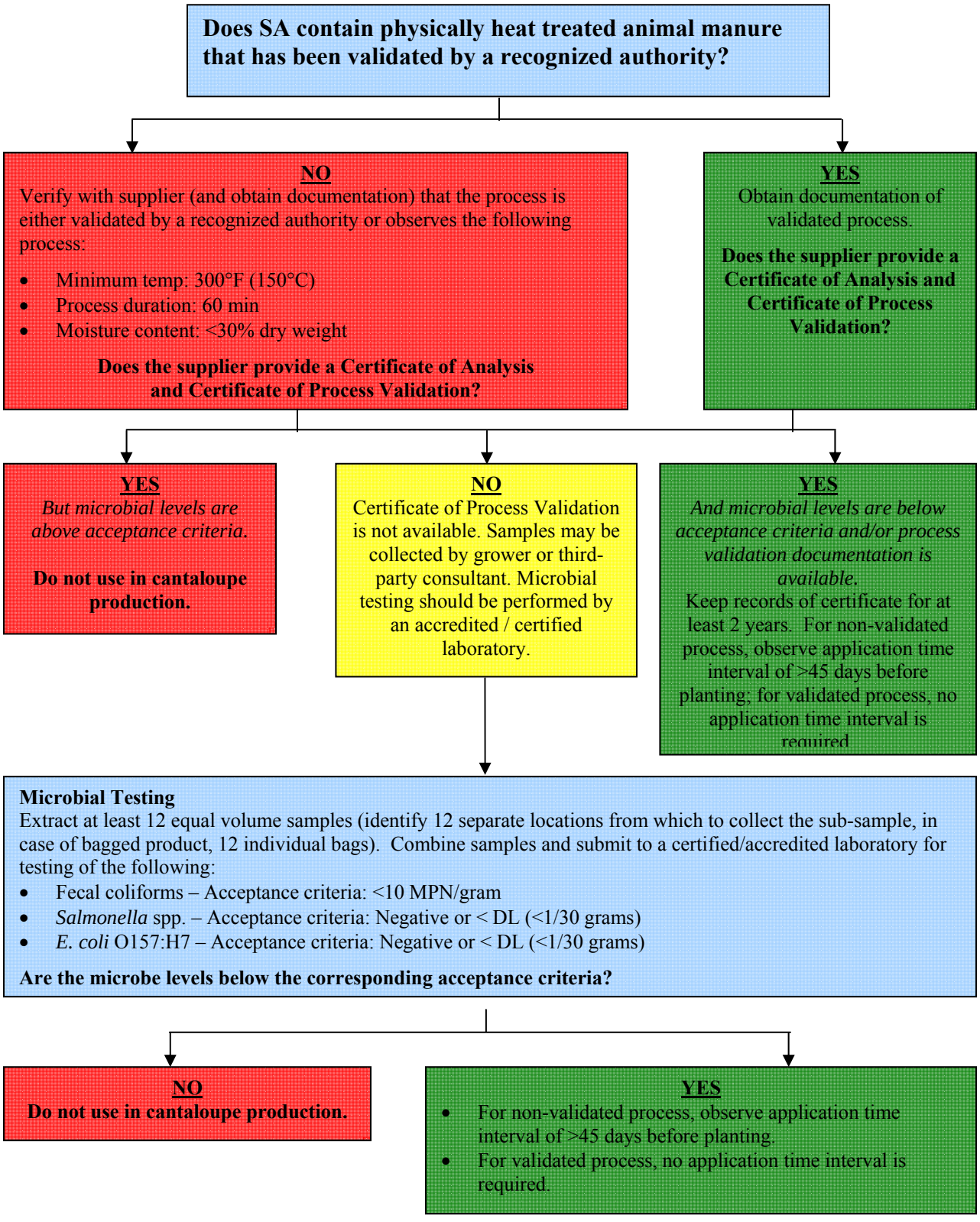


Figure 4B. Decision Tree for Physically Heat Treated Animal Manure Containing Soil Amendments (SAs)



4.3.4 Agricultural Chemicals

Production of safe cantaloupes requires a non-contaminated environment. The inappropriate use, handling and storage of agricultural chemicals may result in a chemical hazard. Safety should be considered when using agricultural chemicals.

- State and federal law requires that growers shall use only agricultural chemicals, which are authorized for cantaloupe cultivation, and shall use them according to the manufacturer's instructions for the intended purpose.
- Residues should not exceed legal limits as established by regulatory authorities in destination market(s).[4]
- In order to minimize the genetic enrichment and sharing of transmissible antimicrobial resistance, the use of highly selective antimicrobial compounds of agricultural and human or veterinary medical importance (e.g., antibiotics such as Agrimycin, Tetracycline) should be managed responsibly within a Resistance Management Best Practices Program (RMBP). Information on RMBP may be found on approved agricultural product labels and associated technical bulletins. Workers who apply agricultural chemicals should be trained in proper application procedures.
- Growers should keep records of agricultural chemical applications. Records should include information on the date of application, the chemical used, the crop sprayed, the pest or disease against which it was used, the concentration, method of application, and records on harvesting to verify that the time between application and harvest is appropriate.
- Agricultural chemical sprayers should be calibrated, as necessary, to control the accuracy of the rate of application.
- The mixing of agricultural chemicals should be carried out in such a way as to avoid contamination of water and land in the surrounding areas and to protect employees involved in this activity from potential hazards.
- Sprayers and mixing containers should be thoroughly washed after use, especially when used with different agricultural chemicals on different crops, to avoid contaminating fruits and vegetables.
- Agricultural chemicals should be kept in their original containers, labeled with the name of the chemical and the instructions for application. Agricultural chemicals should be stored in a safe, well ventilated place, away from production areas, living areas and harvested fruits or vegetables, and disposed of in a manner that does not pose a risk of contaminating crops, the inhabitants of the area, or the environment of the primary production.
- Empty containers should be disposed of as indicated by the manufacturer. They should not be used for other food-related purposes.

[4] USDA's International Maximum Residue Levels database (FASonline): http://www.mrldatabase.com/

4.3.5 Equipment Associated with Production, Harvesting and Field-Packing

Standard operating procedures (SOPs) should be developed for the use and maintenance of production and harvesting equipment (the term, "equipment" includes containers and tools).

4.3.5.1 Equipment construction, use and maintenance

Equipment used during production and harvest should be constructed in a manner that minimizes the potential to become a source of contamination and kept in an appropriate state of repair and condition that facilitates cleaning and sanitizing. Growers and harvesters should follow the technical specifications recommended by the equipment manufacturers for their proper use and maintenance. Equipment should function as intended to prevent contamination of cantaloupes. In addition:

- Workers should be trained to follow the SOPs on equipment use and maintenance.
- An SOP should be established regarding inspection for any deficiencies or maintenance of all containers used in harvesting and field-packing prior to use.
- Food contact surfaces (e.g., padding, cutting tools, and product containers) should be constructed of or covered or sleeved with materials that are non-toxic, facilitate cleaning and sanitizing, and will not harbor pathogens. Use of wood or other porous materials on equipment should be avoided, as they are difficult to clean and sanitize. Specific sanitation and maintenance requirements should be identified and SSOPs developed for each piece of equipment that is used.
- Equipment should be maintained in good order and function according to the use for which they are designed without damaging cantaloupes.
    - Periodic inspections of the condition of all hand tools and replacement of damaged tools.
        - Broken, chipped, or otherwise damaged hand tools should not be returned to use until the deficiency is corrected.
        - Maintenance of hand tools so that they are sharp and free from damage such as ragged edges.
    - All hand tools must be issued or approved by the producer and accounted for whenever workers leave the field.
    - Clipping devices should be constructed of stainless steel with either plastic or stainless steel handles so that they are readily cleaned and sanitized. Wooden handles do not lend themselves to efficient sanitation and hand-held tools constructed with standard steel will not hold up to routine sanitation with most sanitizing or oxidizing agents.
    - If deceleration padding is used on harvest equipment, it should be constructed of or covered with materials that can be cleaned and sanitized. Do not use materials that may harbor pathogens.
- Damaged containers should be repaired or discarded.

- Potentially contaminated containers should be cleaned and sanitized or discarded.
- Product containers should not be used for purposes other than holding harvested product (e.g., should not hold personal items, waste).
- Containers for waste, by-products and inedible or dangerous substances, should be specifically identifiable, suitably constructed and, where appropriate, made of impervious material. Where appropriate, such containers should be lockable to prevent malicious or accidental contamination of cantaloupes or agricultural inputs. Such containers should be segregated or otherwise identified to prevent their use as harvesting containers.
- Equipment lubrication should be managed so as to not contaminate cantaloupes. Food grade lubricants should be used on packing equipment where food contact may occur. Food-grade and non-food-grade lubricants are to be stored separately.
- When not in use, clean equipment that may come into contact with harvested cantaloupes should be covered and/or kept in a location and in a manner to prevent possible contamination (e.g., such as from pests, birds, rodents, dust, water).

4.3.5.2 Equipment cleaning and sanitizing programs

Cleaning and sanitizing programs (also called sanitation standard operating procedures (SSOPs)) should be in place to ensure that any necessary cleaning and sanitizing is carried out effectively and appropriately. Cleaning and sanitizing systems should be monitored for effectiveness and should be regularly reviewed and adapted to reflect changing circumstances. The following sanitary practices are recommended:

- Production and harvesting equipment, including containers and tools such as knives, pruners, machetes, that come into direct contact with cantaloupes should be cleaned and sanitized according to an established schedule and as needed to minimize the risk of contamination.
    - When hand-held harvesting utensils and/or tools that come in contact with the fruit are not in use, they should be stored in an appropriate container with sanitizing solution. The concentration of the solution should be verified and documented as often as necessary to comply with the associated SOP and in accordance with the validation of the process.
- Water that meets the microbial standards for drinking water should be used to clean all equipment directly contacting cantaloupes, including harvesting and transportation equipment, containers and tools.
- Cleaning and sanitizing programs should be carried out in a location where the rinse water will not contaminate cantaloupes or food contact surfaces.
- Food contact surfaces should be cleaned and sanitized daily or if potential contamination occurs. Establish a master sanitation schedule for these areas that clearly identifies cleaning frequency, sanitizers to be used, precautions, etc. This schedule should clearly indicate the name or ID number of the piece of equipment with reference to its SSOP.

- Non-food contact surfaces (e.g., field pack machines, other harvest equipment and trailers, walls, ceilings, floors, drains, mezzanines, storage areas, etc.) should be cleaned and sanitized on a routine basis. Establish a master sanitation schedule for these areas that clearly identifies cleaning frequency, sanitizers to be used, precautions, etc. This schedule should clearly indicate the name or ID number of the piece of equipment with reference to its SSOP.
- The efficacy and the procedure and chemicals used to clean reusable containers should be validated, and an SSOP developed and followed to verify the cleaning.

4.3.5.3 Cleaning and sanitizing procedures and methods

The appropriate cleaning and sanitizing methods and materials will depend on the type of equipment and its construction. The following procedures are recommended:

- Cleaning procedures should include the removal of debris from equipment surfaces, application of a detergent solution, rinsing with water, and, where appropriate, sanitizing.
- Equipment should be dried in a manner that does not result in contamination (e.g., air dry, single-use disposable towels).
- The effectiveness of cleaning and sanitizing procedures should be monitored.
    - Validate the efficacy of the facility and equipment cleaning and sanitation methods with routine environmental testing and develop an SSOP that verifies the cleaning and sanitizing methods procedures. Testing data should be maintained on file for at least 2 years.
- Protective clothing worn during cleaning and sanitizing of equipment should be routinely cleaned and stored in a manner that protects against contamination.
- Personnel with cleaning and sanitation duties should be trained about the potential for cross-contamination from splashing when using water to clean.
- Cleaning and sanitizing agents and materials should be specifically identifiable and kept or stored separately in secure storage facilities.
- Cleaning and sanitizing agents and materials should be used according to manufacturer's instructions and only for their intended purpose.
- Operations SHALL have a documented environmental microbial testing program for *Listeria* and *Salmonella* with testing targeted to areas where moisture, soil, or debris may accumulate (e.g., under conveyance belts, drains, hydrovac, forced air tunnels, hydrocooling equipment, etc.)[5]

[5] FDA. 2008. Guidance for Industry: Control of *Listeria monocytogenes* in Refrigerated or Frozen Ready-to-Eat Foods; Draft Guidance. http://www.fda.gov/Food/GuidanceComplianceRegulatoryInformation/GuidanceDocuments/FoodProcessingHACCP/ucm073110.htm

4.3.6 Worker Health, Hygiene and Sanitary Facilities

Companies should establish policies and procedures for worker health and hygiene to minimize the risk of contamination from workers who come directly into contact with cantaloupes during production activities and during or after harvesting. Training should be designed to help workers understand what is expected of them and why these practices are important. The following practices are recommended:

- Each company operating primary production operations should have written Standard Operating Procedures (SOPs) that relate to health, hygiene and sanitary facilities. The SOPs should address worker training, facilities and supplies to enable workers to practice proper hygiene, and company policies relating to expectations for worker hygiene as well as illness reporting.
- Before handling cantaloupes workers should properly clean their hands, preferably using soap and potable, running water. Workers should be trained in proper techniques for hand cleaning (e.g., washing and drying).
- If gloves are used, a procedure for glove use in the field should be documented and followed. If the gloves are reusable, they should be made of materials that are easily cleaned and sanitized, and they should be cleaned regularly and stored in a clean area. If disposable gloves are used, they should be discarded when they become torn or contaminated.
- All personnel in cantaloupe production areas should also adhere to the personal hygiene provisions in this section.
- Develop a written physical hazard prevention program that addresses the following:
  - Worker clothing, hair restraints, gloves, jewelry, etc.
  - Removal of all objects from upper pockets.
  - Foreign objects in the field and product handling areas.

4.3.6.1 Hygienic and sanitary facilities

In order to ensure that an appropriate degree of personal hygiene can be maintained, hygienic and sanitary facilities should be available and the following practices are recommended:

- Provide areas away from the field and packing lines for workers to take breaks and eat. For worker convenience, these areas should provide access to toilet and hand-washing facilities so workers can practice proper hygiene.
- All personal items should be stored away from areas where they may come in contact with cantaloupes or cantaloupe-contact areas. Instructions should be posted regarding this practice.
- All workers should be trained in proper use of hygiene facilities. Training should include toilet use, proper disposal of toilet paper, and proper hand washing and drying procedures.

- Sanitary facilities should be provided and located so as to be readily accessible and in accordance with prevailing regulation.
    - Sanitary facilities should be located in a manner to encourage their use and reduce the likelihood that workers will relieve themselves in the field. Facilities should be present in sufficient number to accommodate personnel and be appropriate for both genders if the workforce contains males and females.
    - Portable facilities should not be located in cultivation areas or near irrigation water sources or conveyance systems. Growers should identify the areas where it is safe to put portable facilities in order to prevent the spread of contamination in case of a spill. All portable facilities shall be removed from the cultivation areas or away from irrigation water sources or conveyance systems for cleaning and servicing.
    - Sanitary facilities should be clean and maintained on a regular basis so as not to be a source of contamination.
    - Doors to the toilet facilities should not open directly into areas where product is located
- Facilities shall include potable running water, soap, toilet paper, and single use paper towels or an equivalent sanitary hand drying method. Multiple use cloth drying towels should not be used. Hand sanitizers shall not replace hand washing and shall be used only after hands have been washed.
- Establish an SOP for trash disposal at a minimum of at the end of the work shift.

4.3.6.2 Health status

People with a food-transmissible, infectious disease or infected with a pathogen without exhibiting symptoms, can transmit human pathogens to cantaloupes, food contact surfaces and/or other workers. To reduce the risk of pathogen contamination via human transmission, the following practices are recommended:

- Cuts and wounds should be covered by water proof dressings, when workers with injuries are permitted to continue working.
- People exhibiting symptoms or suspected to be a carrier of an infectious disease or illness likely to contaminate cantaloupes, food contact surfaces, and/or other workers, should not be allowed to enter production areas. Any person so affected should immediately report illness or symptoms of illness to the management.
- Companies shall keep records of observed and reported symptoms of diarrheal or food transmissible, infectious diseases.
- Workers shall be trained to notice and report symptoms of diarrheal or food transmissible, infectious diseases in themselves and others.
- Companies may provide an opportunity for medical examination of workers if clinically or epidemiologically indicated.

4.3.6.3 Personal cleanliness

Workers who have direct contact with cantaloupes during production, harvesting and post harvest activities should maintain personal cleanliness. To reduce the risk of pathogen contamination via humans, the following practices are recommended:

- Workers should begin the work day in appropriate, clean clothing or protective garments.
- If a company provides or requires workers to wear protective clothing, a policy regarding use, storage and cleaning of the required clothing should be established.
    - Workers should not leave hand-held tools and protective garments on top of equipment or on the ground.
- Workers should be prohibited from smoking, spitting, chewing gum or tobacco and eating or drinking (other than water) in the production area.
- Workers shall refrain from behavior that could result in the contamination of cantaloupes (e.g..., unprotected sneezing or coughing over cantaloupes, food contact surfaces). Workers shall wash hands before handling product or returning to the work area.

4.3.6.4 Visitors

Visitors to cantaloupe production and handling areas should adhere to the personal hygiene provisions in this section and, where appropriate, wear protective clothing.

4.4 HARVEST AND FIELD-PACKING OPERATIONS

Cantaloupes are harvested based on the cantaloupe's stage of maturity in relation to variety traits and market preferences. For some cantaloupe varieties, partial or complete separation of the cantaloupe from the vine results in varying degrees of exposure of the stem scar. Similarly, but to a lesser degree, cantaloupe varieties that are harvested by cutting the vine at the stem scar junction also create exposed tissue with a vascular connection to the edible fruit flesh. If present in the harvest and field-packing environment, foodborne pathogens can become attached to cantaloupe on the rind and at the stem scar (see Control of Operations section for additional discussion related to handling in a packing facility). Therefore, preventive controls to minimize pathogen presence established during pre-harvest production should be continued throughout harvest and field-packing operations. Written SOPs should be developed and implemented to ensure appropriate handling of cantaloupes to minimize exposure to pathogens and subsequent attachment and potential internalization at the rind surface and sub-surface layers and through the attached stem or stem scar opening.

4.4.1 Pre-Harvest Assessment

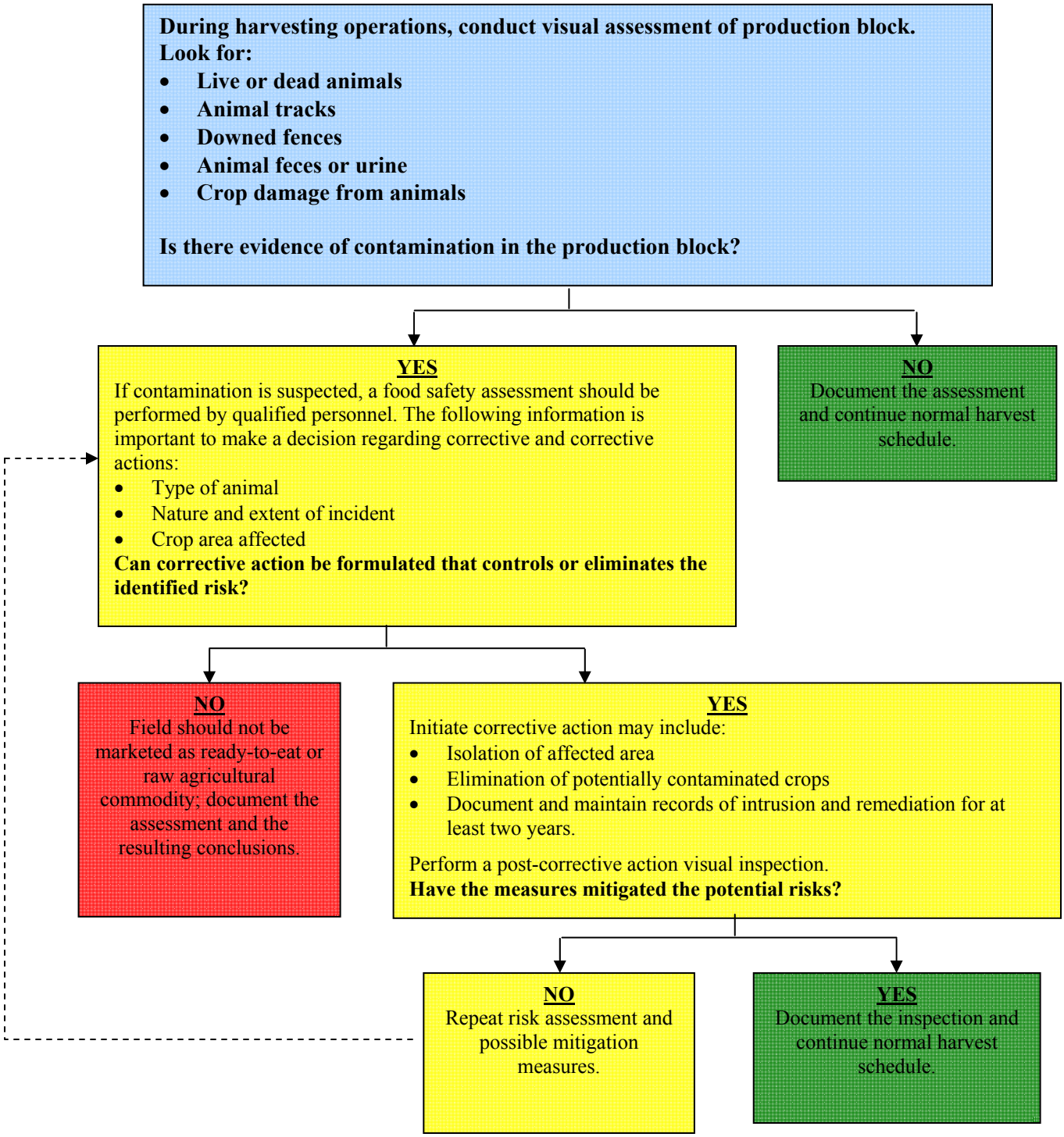
Prior to harvest, the production field and adjacent land should be re-evaluated for the presence of potential hazards. Although the focus of these guidelines is microbiological hazards, it is important to address potential physical, chemical, or microbiological contamination of cantaloupes in a pre-harvest assessment. Any condition that is non-compliant with the company's food safety plan should be addressed to minimize the potential risk to the harvested cantaloupes.

- Establish a pre-harvest environmental assessment procedure that describes how and when the assessment is to be performed, and includes an evaluation of conditions that may potentially result in physical, chemical or microbiological contamination of cantaloupes during harvest. The assessment should include a review of the pre-planting environmental assessment for any changes in the production field and adjacent land that may introduce a food safety hazard with any changes addressed as necessary (see 4.2 Environment Assessment for additional details on pre-planting assessments).
- Document any corresponding corrective actions taken to address identified hazards.

Table III-1. Harvest Environmental Risk Assessment

Issue	Corrective Actions
Evidence of Fecal Contamination Variables • Observation of animals in the field • Downed fences • Animal tracks in the field • Animal feces or urine in the field • Crop damage (trampled, eaten plants) in the field	If fecal material, crop damage, or animals are observed in the field during harvest operations follow the proper SOP for that issue: • Stop harvest operations in affected areas. • Initiate an intensified block assessment for evidence of further contamination and take appropriate actions per the aforementioned actions. • If evidence of crop damage from animals is discovered during harvest operations and equipment has been potentially contaminated by contaminated product or feces, clean and sanitize the equipment before resuming harvest operations. • Before resuming harvest operations, all workers should wash and sanitize their hands / gloves and any clothing that came in contact with feces. • If contamination is discovered in harvest containers such as bins / totes, discard and destroy the harvested cantaloupes that had contact with the contaminated containers, and clean and sanitize the container before reuse.
Allowable Harvest Distance from Flooding	• Buffer and do not harvest cantaloupes within 30 ft. of the flooding. • Recommended buffer distance may be greater than 30 ft. based on risk analysis by food safety professional. • If there is evidence of flooding, the field should undergo a detailed food safety assessment by appropriately trained food safety personnel (see Glossary) prior to harvest, as defined in the text of this document (See Appendix E for an example of food safety assessment.).
Verification	• Archive documentation for a period of 2 years following the contamination event. Documentation may include photographs, sketched maps, or other means of delineating affected portions of cantaloupe fields.
Rationale	• The basis of the guidelines related to fecal contamination is qualitative assessment of the relative risk from a variety of intrusions. Fecal material is the primary food safety risk factor; crop damage may indicate risk of undetected fecal contamination. Because it is difficult to develop quantitative metrics for these types of risks, a food safety assessment is considered appropriate for this issue. • Appendix B describes in detail the process used to develop the flood-related metrics.

Figure III-1. Decision Tree for Conducting Harvest Assessment of the Risk of Fecal Contamination



4.4.2 Prevention of Contamination, Cross-Contamination and Mechanical Damage

During harvest and field-packing operations, cantaloupes are susceptible to mechanical damage, contamination and cross-contamination. Wounds in damaged cantaloupes provide entry points for pathogens and sites for pathogen survival and multiplication. Specific control measures should be implemented to reduce and minimize the risk of contamination from physical, chemical and microbiological hazards during harvest and field-packing operations. In order to minimize the risk of contamination, the following practices are recommended:

- Controls should be implemented to ensure that food contact surfaces are cleaned and sanitized before use and cleaned during use as necessary. For additional details on equipment cleaning and sanitizing, see 4.3.5 Equipment associated with production, harvesting and field-packing.
    - Loose or damaged equipment parts should be removed or appropriately repaired immediately. No temporary remedies such as string, tape, wire, and / or cardboard should be used in repair of equipment.
- Train harvest employees to recognize and avoid mechanically damaging cantaloupes such as rind punctures, cracks, and bruising or possible contamination from previous harvest operations or from wildlife activities.
- Handle damaged cantaloupes in a manner that does not pose an increased risk of contamination to unharvested cantaloupes.
- Particularly with manual harvesting and packing, good worker hygiene practices should be implemented to prevent surface contamination of cantaloupes. For additional details on worker hygienic practices, see 4.3.6 Worker health, hygiene and sanitary facilities.
- Identify any operations that may pose a risk for equipment facilitated cross contamination of cantaloupe. These include vehicles and farm equipment utilized in the fields, vehicles used to transport workers, as well as other possibilities. For such operations, develop appropriate means of reducing and controlling the possible transfer of human pathogens from equipment to cantaloupes or soil and water that may directly contact cantaloupes.
- Segregate equipment used in high-risk operations or potentially exposed to high levels of contamination (e.g., actively manipulating compost, travel through animal-related operations) and store in a designated area.
- If equipment was previously used in a high-risk operation, use effective means of equipment cleaning and sanitation before subsequent use in cantaloupe fields.

4.4.3 Harvest

During harvest operations, risk factors related to multiple harvests, harvesting tools and direct contact of harvested cantaloupes with soil may pose a contamination risk to cantaloupes. In order to minimize risks related to these factors, the following practices are recommended:

- Prior to harvest, an individual trained in basic food safety practices should be designated as responsible for harvesting food safety. This person should be available when cantaloupes are being harvested.
- During harvest operations, workers in the field should monitor for physical, chemical, and microbiological hazards including, but not limited to:
    - Evidence of crop damage by animals and fecal contamination.
    - Evidence of debris such as glass, plastic, and metal. Remove the debris or do not harvest cantaloupes in close proximity to the debris if the safety of the cantaloupes is compromised by their presence.
    - Evidence of open and/or unsecured chemicals.
    - Any other factor that might increase the risk of pathogen contamination.
    - Document any corresponding corrective actions taken to address identified hazards.
    - Include the name and contact information of the party responsible for the harvest crew in the assessment record.
- When a field is to be harvested more than once, identify any additional potential risks and develop practices and procedures to protect against the introduction of pathogens between harvests.
- As harvest time approaches, schedule irrigation so as to avoid exposing cantaloupes to excessive mud and soil.
- Train workers to recognize and not harvest cantaloupes that have mechanical damage.
- Implement harvest handling practices to minimize the potential for soil-to-cantaloupe contamination.
- Harvesting tools should be properly cleaned and sanitized. If improperly used, harvesting tools can wound cantaloupe rinds and provide a point of entry for contaminants that may be in soil and water.

For additional details on equipment use and cleaning, see 4.3.5 Equipment associated with production and harvesting.

4.4.4 Packing Cantaloupes in the Field

Cantaloupes are often packed directly in the field after harvest. Field-packing includes any practice that involves grading, sorting, cleaning, or packing of cantaloupes into containers for

commerce while in the field. In order 1141 to minimize the risk of contamination during field-packing operations, the following practices are recommended:

- Establish an SOP to ensure that all essential field information is appropriately maintained and transferred to downstream operations for recordkeeping in the event that contaminated product must be traced to the production site.
- Food contact equipment used in field packing operations and equipment contacting food contact surfaces should be designed, maintained, cleaned and sanitized as described in Section 4.3.5 to minimize the potential for contamination during packing.
- Establish an SOP for inspecting all incoming finished product packing materials and shipping containers to ensure that they are in sanitary condition and suitable for use. The inspection procedure should also include an inspection of vehicles that transport these containers to ensure no foreign material, pests, or pest contamination exists.
- Field containers should be distinguishable from finished product containers (e.g., by color, design, or label). Field containers should be used, maintained, and inventoried separately from finished product containers.
- The reuse of product contact containers made of corrugated or other porous materials is not allowed due to the risk of cross-contamination.
    - Prohibit the re-use of single-use containers (e.g. corrugated boxes) for the field packing or harvesting of cantaloupes.
- Remove loose soil from cantaloupes prior to packing but avoid using reusable cloth or other tools that may potentially cross contaminate cantaloupes.
- Establish a procedure for inspecting and accepting or rejecting cantaloupes.
- Discard foreign objects and debris in an appropriate location.
- Minimize holding time for cantaloupes prior to cooling operations.
- Have a written procedure for water testing that includes frequency of sampling, who is taking the samples, where the sample is taken, the volume of the sample, how the sample is collected, type of test and acceptance criteria. For guidelines, see Table III-2: Water Use During Harvest and Field Packing.
    - Retain documentation of all test results and / or Certificates of Analysis available for inspection for a period of at least 2 years.
- If chlorine-based disinfectants are used, active disinfectant levels should be measured and documented (i.e., measure free chlorine and not total chlorine). Continuous monitoring of disinfectant levels is preferred.
- All instrumentation used to measure and monitor disinfectants should be well maintained and calibrated regularly. Disinfectant measurements and equipment calibrations should be documented.

- Any other substance (e.g., processing aids or organic acids for pH control) used to treat the water should be approved by the US EPA or FDA for use in the manner that it is applied and monitored to verify correct concentration. Monitoring activities should be documented.

FIELD PACKING

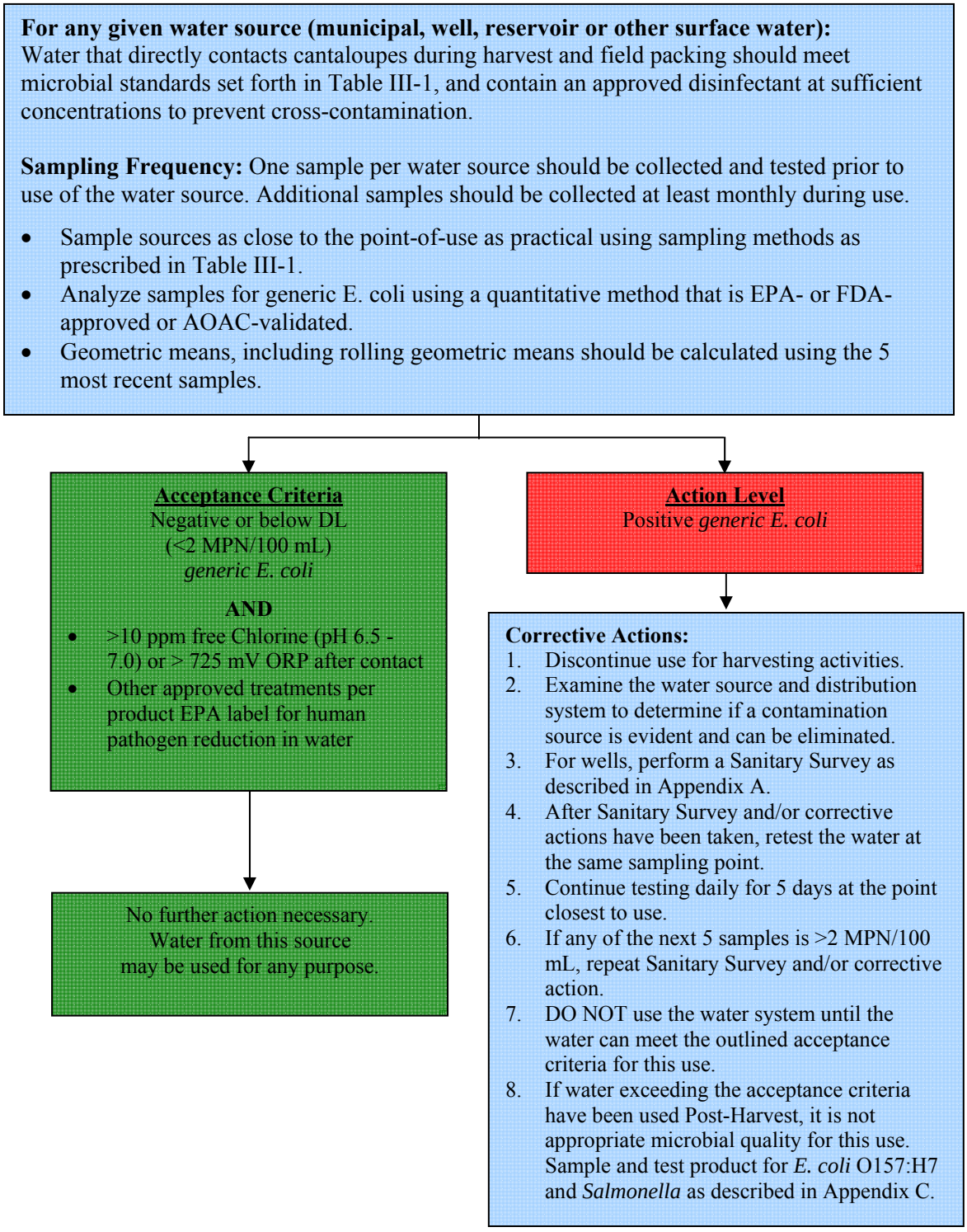
- Amendments for Table III-2, WATER USE DURING HARVEST AND FIELD PACKING:
  - Direct Product Contact or Food Contact Surfaces
    - **Sampling Frequency:** One sample per water source should be collected and tested prior to use. Additional samples should be collected at least monthly during use.

Table III-2. Water Use During Harvest and Field Packing

Use	Metric	Rationale / Corrective Action
Direct Product Contact or Food Contact Surfaces	**<u>Microbial Testing</u>** **Target Organism:** *Generic E. coli* **Sampling Procedure:** A minimum of 100 mL sample collected aseptically at the point of use **Sampling Frequency:** One sample per water source should be collected and tested prior to use. Additional samples should be collected at least monthly during use. **Municipal & Well Exemption:** For wells and municipal water sources, if *generic E. coli* levels are below detection limits for five consecutive samples, the sampling frequency may be decreased to once every six months and the recommendations for 60 and 30 day sampling are waived. This exemption is void if there is a significant source or distribution system change. **Test Method:** FDA BAM method or any US EPA approved or AOAC-validated method for quantitative monitoring of water for *generic E. coli.* **Acceptance Criteria:** Negative or Below DL for All Samples	For any given water source (e.g. municipal, well), samples for microbial testing should be taken as close to the point of use as practical (as determined by the sampler to ensure the integrity of the sample) using sampling methods as prescribed in this table where the water contacts cantaloupes, so as to test both the water source and the water distribution system. Only one sample per month per distribution system is recommended under these metrics. If there are multiple potential point-of-use sampling points in a distribution system, then samples should be taken from different point-of-use locations each subsequent month (randomize or rotate sample locations). Water that directly contacts harvested cantaloupes or is used on food contact surfaces such as equipment or utensils, should come from a source that meets the Maximum Contaminant Level Goal of zero or no detection for *generic E. coli* in drinking water as specified by US EPA and once in use, contain an approved disinfectant at sufficient concentration to prevent cross- contamination. Microbial or physical / chemical testing should be performed, as appropriate to the specific operation, to demonstrate that acceptance criteria have been met. **Single Pass and Recirculated Water Systems** • Single pass use – Water should have non-detectable levels of generic *E. coli* and sufficient disinfectant to ensure water has no detectable *generic E. coli* (minimally 1 ppm chlorine). • Recirculated use – Water should have non-detectable levels of *generic E. coli* and sufficient disinfectant to ensure returned water has no detectable *generic E. coli* (minimally 1 ppm chlorine). * Single pass and recirculated water treated with chlorine-based disinfectants should be tested for free chlorine concentration (ppm) and pH OR for oxidation reduction potential (mV). The selected method should be verified periodically with the alternative process verification method AND by ensuring that established microbial acceptance criterion for water is being met. **Corrective Actions:** If any one sample exceeds the acceptance criteria, then the water should not be used for this purpose unless appropriate disinfectants have been added or until corrective actions have been completed and *generic E. coli* levels are within acceptance criteria: • Conduct a sanitary survey of the water source and distribution system to determine if a contamination source is evident and can be eliminated. Eliminate identified contamination source(s) if applicable. • For wells, perform a sanitary survey and / or treat as described in the sanitary survey (Appendix A). • Retest the water at the same sampling point after conducting the sanitary survey and / or taking corrective actions to determine if it meets the outlined microbial acceptance criteria for this use.

Use	Metric	Rationale / Corrective Action
	Physical / Chemical Testing Target Variable: Water disinfectant (e.g. chlorine-based compounds or other disinfectants) **Water Disinfecting Acceptance Criteria:** • US EPA-**approved disinfecting treatments** per product label for human pathogen reduction in water and used in accordance with a water system-specific protocol that has been validated to show that active disinfectant is present. • **Chlorine-based disinfectants** >10 ppm free chlorine after application and pH 6.5 – 7.0 • ORP > 725 mV* **Testing Procedure:** • Chemical reaction based colorimetric test, or • Ion specific probe, or • ORP,* or • Other as recommended by disinfectant supplier. **Testing Frequency:** Continuous monitoring (preferred) with periodic verification by titration OR routine monitoring if the system can be shown to have a low degree of variation.	For example, if a water sample for water used to clean food contact surfaces has detectable *generic E. coli*, STOP using that water system, examine the distribution line, source the inlet as described in the sanitary survey (Appendix A), and retest from the same point of use. Continue testing daily for five days at the point closest to use, and do not use the water system until it consistently delivers water that is safe, sanitary, and meets the acceptance criteria outlined in this table. If any of the five samples taken during the intensive sampling period after corrective actions have detectable *generic E. coli*, repeat corrective actions and DO NOT use that water system until the source of contamination can be corrected. **Records:** All test results and corrective actions should be documented and available for verification from the user of the water for a period of 2 years.

Figure III-2. Water Use for Direct Contact with Cantaloupes or Food Contact Surfaces



4.5 TRANSPORT FROM THE PRODUCTION SITE TO THE PACKING/PROCESSING FACILITY

Harvested cantaloupes should be transported under conditions that minimize the risk of contamination. To manage the potential for contamination during transport from the production site, the following practices are recommended:

- An SOP should be developed for inspecting the shipping container/trailer prior to loading to ensure it is clean, functional, and free of objectionable odors.
- If shipping containers/trailers are used to transport items other than cantaloupes, procedures should be established to ensure that shipping containers/trailers will not potentially contaminate cantaloupes.
- Where shipping containers/trailers are used for transporting anything in addition to foodstuffs or for transporting different foodstuffs at the same time, there should, where necessary, be effective separation of products.
- Fresh cantaloupes should not be transported in shipping containers/trailers previously used to carry potential sources of contamination, such as animals, animal manure or biosolids, trash, chemicals, or non-food grade equipment or tools, unless the containers/trailers are first adequately cleaned and made sanitary.
- Prior to use, shipping containers and transport trailers should be cleaned and made sanitary. Each transporter should have an SOP for shipping containers/trailers for cleaning, sanitizing and maintenance. Carpet or other material which cannot be sanitized shall not be used in shipping containers or transportation trailers.
- Prepare an SOP for the handling and storage of product containers that addresses the following:
    - No overnight storage in the field. All packaging materials must be stored in a clean environment with appropriate perimeters and covered so as to minimize contamination by rodents, birds, wind-blown dirt, or chemical sprays. Storage areas should have a pest control program.
    - Packaging materials that become wet or spoiled by direct contact with the ground should not be used. In the case of RPCs, the RPCs should be returned to the distributor or cleaned according to an appropriate SOP prior to use.
    - If liners or other barriers are used, precautions should be taken to prevent them from becoming a source of contamination.
- Load and unload cantaloupes in a manner that minimizes damage and contamination.
- When not in use, cleaned shipping containers and transport trailers should be stored in a manner to minimize potential contamination (e.g., such as from pests, birds, rodents, dust, water).
- Damaged shipping containers and transport trailers should be repaired or replaced.

Commodity-Specific Food Safety Guidelines for Cantaloupes and Netted Melons

Post-Harvest Operations – Packing, Cooling, Storage, and Transportation

October 29, 2012

6.0 FACILITIES

A well designed and managed facility and its corresponding food safety program can minimize the risk of contamination. The needs of each facility may vary due to location, environment, local requirements, the volume of cantaloupes handled, and many other variables. Facility design and layout should permit appropriate maintenance, cleaning and sanitation, and minimize airborne contamination. Surfaces and materials should be non-toxic, durable, and suitable for cleaning and sanitizing. Facilities should provide effective protection against pest access and harborage. The provisions below apply to facilities that pack, cool, or store cantaloupes.

6.1 Location

Potential sources of contamination that may be present on adjacent land, and/or due to topography, and/or climatic and environmental conditions (e.g., environmentally polluted areas; industrial activities that potentially pose a risk of contamination; adjacent concentrated animal feeding operations; pesticide spray drift from adjacent fields; areas subject to flooding without sufficient safeguards, areas prone to pest infestations, and areas where solid and/or liquid wastes cannot be effectively removed) need to be evaluated when deciding where to locate packing, cooling and storage facilities. If facilities are located in areas that have potential contamination sources, effective protective measures must be taken to minimize the risk of contamination. Facilities should not be located anywhere where, after implementing protective measures, a threat to food safety or suitability clearly remains.

6.2 Facility Grounds

- The grounds around the facility should be kept in a condition that will control, reduce, or minimize the risk of food contamination.
- Properly store equipment, remove litter and waste, minimize standing water, and cut weeds or grass around the buildings or structures that may constitute an attractant, breeding place, or harborage for pests.
- Roads, yards, and parking lots should be maintained so that they do not constitute a source of contamination in areas where cantaloupes are exposed. Roads should be maintained to minimize dust.
- Evaluate adjacent land use to ensure that it does not pose a significant risk of product contamination.

6.3 Design and Layout

The design and layout for packing, cooling and storage facilities should permit good handling practices, including protection against cross-contamination between and during operations. Because of the seasonal nature of the cantaloupe harvest, facilities may be used only a few months of the year, leaving them dormant for many months and susceptible to pest infestations.

When dormant, facilities should be appropriately protected from pest infestations. Facilities with open sides should have appropriate SOPs to minimize risks. The design of the facility should permit thorough cleaning and sanitizing before the start of the season.

- A facility should be designed so that cantaloupes arriving from the field never cross paths with, or are commingled with, finished product.
- Conduct and document a risk assessment of your facilities that addresses areas of potential risk. If applicable, the following items should be considered in your assessment:
    - To provide adequate drainage and prevent accumulation of water, floors should have proper drainage and kept in good repair.
    - Floor drains should be designed to be accessible for cleaning and capable of preventing pest entry.
    - Avoid use of hollow structures such as table legs, conveyer rollers, and racks because they may collect water and debris, and thus, harbor pathogens.
    - Sufficiently elevate food contact surface above the floor to prevent contamination from floor splashes.
    - Overhead equipment, structures or fixtures, walls, pipelines, etc. should be designed to avoid condensation that has the potential to be a contamination source.
    - Facility water systems should be equipped with back-flow prevention devices to prevent potential contamination of the water supply. Test backflow prevention devices at least annually.
- Protect food contact surfaces from contact with non-potable water.
- Condensation provides conditions optimal for microbial growth and may potentially serve as a source of cross-contamination. In the event that condensation forms in the facility, develop a management plan to ensure that it does not pose a risk of contamination to cantaloupes and food contact surfaces.
- Clean the packing facility/lines before each day begins.
- Don’t use rags to clean packing lines as it only transfers contamination.
- Food contact surfaces should be cleaned and sanitized daily or if potential contamination occurs. Establish a master sanitation schedule for these areas that clearly identifies cleaning frequency, sanitizers to be used, precautions, etc. This schedule should clearly indicate the name or ID number of the piece of equipment with reference to its SSOP.
- Non-food contact surfaces (e.g., field pack machines, other harvest equipment and trailers, walls, ceilings, floors, drains, mezzanines, storage areas, etc.) should be cleaned and sanitized on a routine basis. Establish a master sanitation schedule for these areas that clearly identifies cleaning frequency, sanitizers to be used, precautions, etc. This schedule should clearly indicate the name or ID number of the piece of equipment with reference to its SSOP.

- Operations shall have a documented environmental microbial testing program for *Listeria* and *Salmonella* with testing targeted to areas where moisture, soil, or debris may accumulate (e.g., under conveyance belts, drains, hydrovac, forced air tunnels, hydrocooling equipment, etc.).
- Validate the efficacy of the facility and equipment cleaning and sanitation methods with routine environmental testing and develop an SSOP that verifies the cleaning and sanitizing methods procedures. Testing data should be maintained on file for at least two years.
- Mechanical equipment used in packing cantaloupes should be engineered and maintained to prevent cantaloupe bruising and damage in order to reduce the possibility of contamination.
- Prepare an SOP for equipment to address the removal of loose or damaged equipment parts or appropriately repaired immediately. No temporary remedies such as string, tape, wire, and / or cardboard should be used in repair of equipment.
- Food contact surfaces should be constructed of materials that can be cleaned and sanitized and will not harbor pathogens. Use of wood or other porous materials on equipment should be avoided, as they are difficult to clean and sanitize.

6.3.1 Internal Structures and Fittings

Structures within facilities should be soundly built of durable materials and readily maintained, cleaned and where appropriate, sanitized. In particular, the following specific conditions should be satisfied to protect the safety and suitability of food:

- The surfaces of walls/roof supports, partitions, doors, and/or floors should be constructed of materials that minimize the risk of contamination and facilitate cleaning and sanitizing.
- Ceilings and overhead fixtures should be constructed and maintained to minimize the build-up of dirt and condensation, and protect cantaloupes, food contact surfaces, and packaging from dripping water and particle shedding.
- If the facility is closed to protect against external sources of contamination, then windows, vents, fans, and similar features should be adequately protected to minimize entry of pests and other contaminants.
- Food contact surfaces should be in sound condition and durable. They should be constructed of materials that are smooth, non-absorbent and facilitate cleaning and sanitizing.

6.3.2 Air Quality and Ventilation

Make every effort to manage potential contamination in packing facilities. For example, facilities should be designed, constructed and maintained to:

- Minimize the entry of dust, dirt, aerosols, and other potential airborne contaminants into the facility.
- Minimize the build-up of dirt, dust, and condensation on the packing facility equipment itself.

- Prevent condensed water from dripping on product, product packaging, food contact surfaces and floors.

6.3.3 Lighting

- Adequate natural or artificial lighting should be provided to enable good handling practices.
- Lights should be equipped with shatter-proof light bulbs or have similar protective coverings to prevent broken fixture material from contaminating cantaloupes.

6.3.4 Drainage

Adequate drainage is critical to packing, cooling and storage facilities to minimize the risk of contaminating cantaloupes. To ensure adequate drainage:

- The facility should be designed to effectively drain water.
- Floors should be kept as dry as possible using appropriate methods.
- Workers should have proper training to remove standing water or push standing water to the drains.
- Drains should be designed to facilitate effective cleaning and sanitizing to prevent foodborne pathogens (e.g., *Listeria monocytogenes*) from becoming established in the environment and serving as a source of product contamination.

6.4 HACCP / HARPC Plans

Facility operators should control food hazards through the use of systems such as Hazard Analysis and Critical Control Point (HACCP) or Hazard Analysis and Risk-Based Preventive Controls (HARPC) built upon foundational programs such as GAPs and GMPs. Facilities should pay special attention to product flow and segregation of incoming and outgoing product to avoid cross-contamination. Components and practices of food safety hazard control plans include:

- A flow diagram depicting the handling or process steps in the operation.
- Identification of conditions, practices and processes in the operation critical to product safety.
- Implementation of effective control or risk management procedures for identified conditions, practices and processes critical to product safety.
- Monitoring of control or risk management procedures to ensure their continued implementation and effectiveness.
- Documentation of any corrective measures taken.
- Periodical review and update of the control and risk management procedures, especially whenever the operation changes.

6.5 Receiving

When delivered from the field to the facility, cantaloupes should undergo an inspection process at the facility and should be accompanied with information appropriate for traceability.

- Ensure cantaloupes are from approved sources and/or suppliers that are following GAPs outlined in this guidance document.
- Establish a procedure for inspecting and accepting or rejecting incoming loads of cantaloupes. Avoid using whole cantaloupes that have visible signs of decay or damaged rinds (e.g., mechanical damage or cracking) due to the increased risk of the presence of foodborne pathogens in cantaloupes with decay or damage.
- Damaged or decayed cantaloupes should be discarded in a manner that does not serve to attract pests.
- Product staging areas should be kept clean and free of debris.
- Keep harvested cantaloupes as cool as possible during receiving and minimize the time between receiving and product cooling.
- Reduce the temperature of the cantaloupe to specifications as soon as feasible after receiving.
- Cantaloupes should arrive with field information that provides sufficient detail to facilitate product traceability. Establish an SOP to appropriately maintain and transfer all documents to downstream operations for recordkeeping.

6.6 Microbiological and Other Specifications

When sampling plans and methodology are properly designed and performed for facilities and equipment, microbiological testing can be a useful tool to evaluate and verify the effectiveness of safety and sanitation practices, and provide information about an environment, a process, and risk management procedures. The intended use of information obtained (e.g., evaluating the effectiveness of a sanitation practice, evaluating the risk posed by a particular hazard) can aid in designing an appropriate sampling plan and determining what micro-organisms are most appropriate to test for. Test methods should be selected that are validated for the intended use. Trend analysis of testing data should be undertaken to evaluate the effectiveness of food safety control systems. For recommendations on sampling protocols, see Appendix X. In selecting a third-party testing laboratory, facility operators should ensure that:

- The laboratory is accredited (such as ISO 17025 or equivalent) and uses test methods that have been validated for the intended use.
- The laboratory has experience in conducting the type of testing needed for the particular type of sample matrix.

In addition, each facility should have a corrective action plan in place before a positive sample is found so that, if one does occur, corrective actions can be taken quickly.

6.7 Facility Maintenance

The facility should be kept in an appropriate state of repair and condition to facilitate all sanitation procedures, function as intended (particularly at critical steps), and prevent contamination of cantaloupes.

- Establish SOPs for preventive maintenance of the packing, cooling, cold storage and warehouse facilities.
- At the beginning of the packing season, a pre-operative inspection of the facilities should be conducted to ensure it is in an appropriate state of repair.

6.8 Equipment Construction and Maintenance

Various types of equipment used during packing, cooling, and storing operations present an opportunity for contamination of cantaloupes if appropriate practices are not followed. Appropriate equipment design and maintenance measures should be used to reduce and control the potential introduction of human pathogens into the packing, cooling and storage environments. Equipment used in packing cantaloupes should also be engineered and maintained to prevent cantaloupe bruising and damage.

- Equipment used in packing, cooling and storing cantaloupes should be engineered and maintained in a condition that allows for effective cleaning and sanitization to prevent the buildup of micro-organisms including pathogens.
- Food contact surfaces shall be constructed of materials that can be easily cleaned and sanitized. Use of wood or other porous materials (e.g., carpet) as food contact surfaces shall not be used.
- Where food contact surfaces present a risk of cantaloupe bruising and damage, they should be constructed of materials that minimize such damage, thereby minimizing the potential introduction of human pathogens.
- Protect food contact surfaces from contact with water that does not meet the microbial standards of drinking water and other materials that may be a source of contamination.
- Identify food contact surfaces that should remain dry and implement practices to keep these surfaces as dry as possible (e.g., slant tables).
- Avoid use of hollow structures such as table legs, conveyer rollers, and racks because they may collect water and debris, and thus, harbor pathogens.
- Prepare an SOP for equipment maintenance that addresses the following:
    - Inspection of all equipment prior to use to check for any equipment deficiencies or maintenance requirements.
        - Drip pans (to catch oil or other lubricants) should be in place and tightly secured.
        - Hydraulic hoses, hydraulic motors, and overhead hydraulic fittings should be tight and drip free with no indications of recent leakage.

- Loose or damaged equipment parts should be removed or appropriately repaired immediately. No temporary remedies such as string, tape, wire, and / or cardboard should be used in equipment repair.

  - All equipment maintenance requiring the use of chemicals, oils, greases, and fuels should be conducted away from the production and handling areas.
  - Equipment that has been repaired should be cleaned and sanitized before returning to the production line.
  - Equipment lubrication should be managed so as to not contaminate cantaloupes. Food grade lubricants should be used on equipment where food contact may occur. Food-grade and non-food-grade lubricants are to be stored separately.
  - Glass and clear or brittle plastic on equipment should be shatter-proof or covered to prevent broken fixture material from contaminating cantaloupes.

- Control procedures when equipment is not in use, including policy for removal of equipment from the work area or site and equipment storage.
- Old, unused equipment should be removed from the packing areas and stored in a manner that does not present a food safety hazard.
- All equipment used to control environmental conditions such as temperature and humidity should be maintained and calibrated on a routine basis. Calibration activities should be documented.

6.9 Cleaning and Sanitation Programs

Cleaning and sanitation programs are critical to ensuring that cantaloupes handled in facilities are not contaminated with pathogens. Pathogenic microorganisms may be found on floors, drains, and equipment surfaces and components. Operators should be aware of and operate in accordance with all relevant laws and regulations that describe facility sanitation practices including the proper handling of cleaning and sanitation chemicals.

Important areas of concern include any surface that comes into contact with cantaloupes, toilet facilities for employees, and control of pests. Without appropriate sanitation practices, equipment and facilities may harbor pathogens. Cleaning and sanitizing of equipment and facilities should be conducted in a manner that protects against contamination of cantaloupes, cantaloupe-contact surfaces, or packaging materials.

- Food contact surfaces (e.g., belts and conveyor systems, packing tables) should be constructed of materials that are easily cleanable and able to be sanitized.
- Food contact surfaces should be cleaned and sanitized daily, after moving between different production lots, or if a potential contamination event has occurred. Establish a master sanitation schedule for these areas that clearly identifies cleaning frequency, sanitizers to be used, precautions, etc. This schedule should clearly identify the equipment with reference to its SSOP.

- Non-food contact surfaces (e.g., harvest equipment and trailers, walls, ceilings, floors, drains, mezzanines, storage areas) should be cleaned and sanitized on a routine basis. Establish a master sanitation schedule for these areas that clearly identifies cleaning frequency, sanitizers to be used, precautions, etc. This schedule should clearly indentify the equipment with reference to its SSOP.
- Prepare an SSOP for all equipment that addresses the frequency with which it is to be cleaned (e.g., daily, weekly, monthly or seasonally), the chemicals to be used and their concentrations and the process to be used for cleaning (e.g., wash, sanitize and rinse if necessary).
- Only potable water should be used in equipment cleaning and sanitizing activities.
- Receptacles with a proper sanitizing solution should be readily available to sanitize and store all hand-held tools that are not in use. Check, adjust (if necessary), and document the sanitizer concentration strength as often as necessary to assure its effectiveness.
- When cleaning and sanitizing equipment, particularly during operations, use techniques that do not pose a risk of cross-contamination of product or food contact surfaces.
- All chemicals used for cleaning or sanitizing of food contact surfaces including equipment, tools, utensils, and product containers must be approved for that use and used according to the manufacturer's label instructions and all federal, state and local requirements.[6] Cleaning and sanitizing chemicals should be stored in a secure, vented storage area located away from areas used for product handling and storage of product packaging materials. An MSDS and the original label of each chemical should be kept on file.
- Equipment, utensils and tools used for cleaning or sanitizing, including food contact and non-food contact surfaces, are maintained in a manner sufficient to avoid becoming a source of contamination and are stored away from product handling areas and storage areas for product packaging materials.
- Workers should not walk, step, sit, or lie on food contact surfaces of equipment. If it is necessary to walk on or otherwise contact equipment such as when cleaning, workers should take proper precautions to prevent contamination (e.g., shoe covers or other protective clothing) and to ensure that surfaces are cleaned and sanitized after work is completed and before production resumes.
- A pre-operative inspection of the equipment and facilities should be conducted daily to verify that cleaning and sanitation procedures have been completed according to the SSOP, the equipment is safe and ready for use, pest control measures are in place and functioning, and all food safety protocols are being followed. Use a checklist and document any corrective actions taken to address deficiencies.
- Verify the efficacy of the facility and equipment cleaning and sanitation methods with routine sanitation verification testing (e.g., ATP). Sanitation verification data should be maintained and be available for inspection. Operations should have a documented environmental

[6] Appropriate chemical use can be verified in NSF's White Book™ - Nonfood Compounds Listings Directory available at: http://www.nsf.org/usda/psnclistings.asp

sampling and microbial testing program capable of detecting foodborne pathogens of concern based on the operation's risk assessment (e.g., *Listeria* spp.) with testing targeted to areas where moisture, soil or debris may accumulate (e.g., under conveyance belts, drains, forced air tunnels, hydro-cooling equipment).[7]

6.10 Pest Control

Pests pose a risk to the safety of cantaloupes. Cantaloupes have a very high sugar content and are extremely attractive to rodents, flies and other pests that may cross-contaminate cantaloupes. Pest infestations can occur where breeding sites and a food supply are available. Effective measures should be taken to exclude pests from packing, cooling and storage facilities and to protect the cantaloupes against pest contamination while on the premises. Good sanitation, inspection of incoming materials and active monitoring for pest activity can minimize the likelihood of infestation and thereby limit the need for pesticides.

- All pesticides, traps, bait, and chemicals used in facilities must be acceptable for use in and around a food handling facility and used in accordance with local, state, and federal regulations.
- All pest control chemicals should be properly labeled and stored in a secure separate area.
- If pest control is performed internally or by a third-party pest control company, a copy of the applicator's license, any chemicals used, MSDS sheets, and a schedule of the applicator's activities and actions should be maintained and available for review.
- Permit the use of insecticides or rodenticides inside the facility only under precautions and restrictions that will protect against the contamination of cantaloupes, food-contact surfaces, and food-packaging materials.
- If rodent traps are deployed around the inside of the facility and bait stations along the outside perimeter of the facility, detailed maps demonstrating the location of each trap and bait station should be available for review. Traps and bait stations should be inspected routinely and any corrective actions (e.g., cleaning out traps, replacing damaged traps) documented.
- An inspection buffer of 18 inches should be maintained on both the inside and outside perimeters of the physical facility (e.g., pallets, raw product and equipment may not be stored flush against the wall of the facility).
- Measures should be taken to protect finished product containers and packaging materials from rodents or other pests.
    - All packaging should be covered so as to minimize contamination by rodents, birds, wind-blown dirt, or chemical sprays.

[7] FDA. 2008. Guidance for Industry: Control of *Listeria monocytogenes* in Refrigerated or Frozen Ready-to-Eat Foods; Draft Guidance. http://www.fda.gov/Food/GuidanceComplianceRegulatoryInformation/GuidanceDocuments/FoodProcessingHACCP/ucm073110.htm

6.11 Waste Disposal

Systems for waste treatment and disposal should operate in a manner so as not to constitute a source of contamination for cantaloupes or the facility. To ensure adequate waste disposal:

- A cantaloupe cull disposal and waste removal program should be implemented to minimize the potential for pest-to-cantaloupe contamination.
- Areas for garbage, recyclables, and compostable waste should be located away from produce handling areas and clearly designated for their intended use (e.g., trash, recyclable materials or product that might be re-worked) with weeds and other pest harborage minimized around the containers.
- Waste should be stored in appropriate receptacles that are closed or have lids (except for waste collection/cull trailers in active use), removed from the facility on a regularly scheduled basis, and disposed of in a manner to minimize contamination including any controls necessary to ensure that vehicles used to transport waste from the facility do not themselves serve as a source of contamination.

6.12 Post-Harvest Water Use

An adequate supply of potable water with appropriate facilities for its storage, distribution and temperature control should be available to ensure the safety and suitability of cantaloupes. If water is rendered non-potable during use, systems carrying such water should be clearly identified as non-potable and should be a separate system that is not connected with or allowed to reflux into potable water systems.

Water is often used in dump tanks or flotation flumes to transport cantaloupes from field containers into the packing facility. Cross-contamination and attachment of pathogens to the outer rind during water contact is a food safety concern. Focus and consideration should be placed on the following activities:

- The source of water used in packing operations that directly contacts cantaloupes must meet US EPA microbial standards for total coliforms in drinking water.
    - The water source should be tested as specified in Table IV-1. If a municipal water source is used, microbial water quality information from the respective municipal water authority may be obtained and archived if it is reported as total coliforms. Periodically test water quality at point of use to verify the facility water distribution system.
    - Develop an action plan in case municipal water authorities issue a water quality alert or warning such as “boil water warning.” Document and archive any warning or alerts issued by the water authority as well as corrective actions taken by your firm to address this issue.
- If a dump tank is utilized in a cantaloupe operation, the dump tank must be emptied, cleaned and refilled daily during the production/packing operations with water which meets the standards noted above.

- If unloading field containers into dump tanks by immersion, measures should be taken to reduce the potential for product cross-contamination with field or road debris that may be present on the outside of containers.
- Minimize or avoid fully submerging cantaloupes in dump tank water. When submerged, water is more likely to infiltrate into the cantaloupes.
- If a dump tank is utilized in a cantaloupe operation, a secondary water rinse with appropriate antimicrobial treatment independent of dump tank water is required.
- Validate the efficacy of the dump tank and rinse water sanitizers, and develop an SSOP for both the dump tank and rinse water sanitizers that verifies the operational procedures. Testing data should be maintained on file for at least two (2) years.
- All attributes of water quality should be monitored to ensure microbial loads are minimized. This may include pH, antimicrobial treatment, soil (including organic) load, turbidity, water hardness, resident time in dump tank water, and product throughput capacity.
- Monitor packing facility wash water sanitizer before the daily operation begins and at least hourly thereafter according to the established SOP.
- All instrumentation used to measure and monitor disinfectants should be well maintained and calibrated regularly. Disinfectant measurements and equipment calibrations should be documented.
- Any other substance (e.g., processing aids or organic acids for pH control) used to treat the wash water should be approved by the US EPA, USDA, or FDA for use in the manner that it is applied and monitored to verify correct concentration. Monitoring activities should be documented.

Table IV-1. Facility Water Use

Use	Metric	Rationale / Corrective Action
Direct Product Contact or Food Contact Surfaces	**<u>Microbial Testing</u>** **Target Organism:** Total coliforms **Sampling Procedure:** A minimum of 100 mL sample collected aseptically at the point of use **Sampling Frequency:** One sample per water source should be collected and tested prior to use. Additional samples should be collected at least monthly during use. **Municipal & Well Exemption:** For wells and municipal water sources, if total coliform levels are below detection limits for five consecutive samples, the sampling frequency may be decreased to once every six months and the recommendations for 60 and 30 day sampling are waived. This exemption is void if there is a significant source or distribution system change. **Test Method:** FDA BAM method or any US EPA approved or AOAC-validated method for quantitative monitoring of water for total coliforms. **Acceptance Criteria:** Negative or Below DL for All Samples	For any given water source (e.g. municipal, well), samples for microbial testing should be taken as close to the point of use as practical (as determined by the sampler to ensure the integrity of the sample) using sampling methods as prescribed in this table where the water contacts cantaloupes, so as to test both the water source and the water distribution system. Only one sample per month per distribution system is recommended under these metrics. If there are multiple potential point-of-use sampling points in a distribution system, then samples should be taken from different point-of-use locations each subsequent month (randomize or rotate sample locations). Water that directly contacts harvested cantaloupes or is used on food contact surfaces such as equipment or utensils, should come from a source that meets the Maximum Contaminant Level Goal of zero or no detection for total coliforms in drinking water as specified by US EPA and once in use, contain an approved disinfectant at sufficient concentration to prevent cross-contamination. Microbial or physical / chemical testing should be performed, as appropriate to the specific operation, to demonstrate that acceptance criteria have been met. **Single Pass and Recirculated Water Systems** • Single pass use – Water should have non-detectable levels of total coliform and sufficient disinfectant to ensure water has no detectable total coliform (minimally 1 ppm chlorine). • Recirculated use – Water should have non-detectable levels of total coliform and sufficient disinfectant to ensure returned water has no detectable total coliform (minimally 1 ppm chlorine). * Single pass and recirculated water treated with chlorine-based disinfectants should be tested for free chlorine concentration (ppm) and pH OR for oxidation reduction potential (mV). The selected method should be verified periodically with the alternative process verification method AND by ensuring that established microbial acceptance criterion for water is being met. **Corrective Actions:** If any one sample exceeds the acceptance criteria, then the water should not be used for this purpose unless appropriate disinfectants have been added or until corrective actions have been completed and total coliform levels are within acceptance criteria: • Conduct a Sanitary Survey of the water source and distribution system to determine if a contamination source is evident and can be eliminated. Eliminate identified contamination source(s) if applicable. • For wells, perform a Sanitary Survey and / or treat as described in the Sanitary Survey (Appendix A). • Retest the water at the same sampling point after conducting the Sanitary Survey and / or taking corrective actions to determine if it meets the outlined microbial acceptance criteria for this use.

Use	Metric	Rationale / Corrective Action
	Physical / Chemical Testing Target Variable: Water disinfectant (e.g. chlorine-based compounds or other disinfectants) **Water Disinfecting Acceptance Criteria:** • US EPA- **approved disinfecting treatments** per product label for human pathogen reduction in water and used in accordance with a water system-specific protocol that has been validated to show that active disinfectant is present. • **Chlorine-based disinfectants** Should be validated to be effective and maintained with a pH of 6.0 – 7.5 **Testing Procedure:** • Chemical reaction based colorimetric test, or • Ion specific probe, or • ORP,* or • Other as recommended by disinfectant supplier. **Testing Frequency:** Continuous monitoring (preferred) with periodic verification by titration OR routine monitoring if the system can be shown to have a low degree of variation.	For example, if a water sample for water used to clean food contact surfaces has detectable total coliforms, STOP using that water system, examine the distribution line, source the inlet as described in the Sanitary Survey (Appendix A), and retest from the same point of use. Continue testing daily for five days at the point closest to use, and do not use the water system until it consistently delivers water that is safe, sanitary, and meets the acceptance criteria outlined in this table. If any of the five samples taken during the intensive sampling period after corrective actions have detectable total coliforms, repeat corrective actions and DO NOT use that water system until the source of contamination can be corrected. **Records:** All test results and corrective actions should be documented and available for verification from the user of the water for a period of 2 years.

6.13 Fungicidal Treatments

Fungicides may be applied to cantaloupes by use of an aqueous spray or immersion to extend the post-harvest life of the fruit. Maximum residue levels (MRLs) vary among countries, so handlers must be aware of MRLs for the area in which they are growing as well as in the destination market when applying fungicides. The following are recommended:

- Only fungicides that are authorized for use on cantaloupes by the prevailing regulatory authorities in both the country of origin and destination markets shall be used. Fungicides and all pesticides shall be used according to the manufacturer's label instructions. All federal, state, and local laws shall be followed including those regulating MRLs.[8]
- Water that meets the microbial standards of drinking water should be used in water based chemical treatments to ensure that the water does not contaminate the cantaloupes with pathogens.
- If hot water treatments are used as an alternative to post-harvest chemical fungicide treatments, it is recommended that the water temperature and time be evaluated and monitored to ensure that the appropriate water temperature and time is maintained.

6.14 Cooling Cantaloupes

Cantaloupes are typically cooled by forced-air cooling or by use of a chilled water drench or immersion. Cooling cantaloupes by placing them in cold storage is not an effective means of cooling but this practice is preferable to storing cantaloupes at ambient temperatures. While cooling cantaloupe with water, if done properly, may reduce microbial loads on the outside surface of cantaloupes by 2 – 3 logs CFU (Park and Beuchat, 1999; Rodgers et al., 2004), it may also substantially increase the risk of contamination if done improperly. Microbial reduction on cantaloupe surfaces is dependent on disinfectant concentration and contact time. However, it is important to remember that human pathogens once present on the surface of a cantaloupe cannot be completely eliminated by washing (Parnell et al., 2005). Soaking cantaloupes in aqueous solutions containing wash water disinfectants for very long periods of time is not an effective means of eliminating surface microbial contamination of the cantaloupe rind and may actually aid in the infiltration of human pathogens into the edible portions by creating an infiltration driving force. Cantaloupe cooling water may also be a significant source of microbial cross contamination if there is insufficient water disinfectant present. Forced-air cooling operations may also spread product contamination if forced air cooling equipment is not cleaned and sanitized regularly. To manage these risk factors:

- Cooling and cold storing cantaloupes as soon as possible after harvest is recommended to retard multiplication of foodborne pathogens, if present, on or from the rind surface of cantaloupes.
- During forced air cooling, crates/bins should be stacked in a manner that allows for uniform air flow and distribution.

[8] USDA's International Maximum Residue Levels database (FASonline): http://www.mrldatabase.com/

- Water that is used in hydro-coolers should meet the microbial standards of drinking water. If water is used for cooling and is recirculated, it should be evaluated and monitored to ensure that disinfectant levels are sufficient to reduce the potential risk of cross-contaminating cantaloupes.
- Cooling systems including forced-air cooling equipment should be cleaned and sanitized on a regular basis according to written procedures to ensure that the potential for cross contamination is minimized.
- Cooling systems' condensation units should drain directly into drainage systems. Emptying of this water into floor drains should be prohibited.
- Cooling cantaloupes by putting ice on the top of cantaloupes should be avoided since this practice poses a food safety risk if the ice were to be contaminated. Ice melts at refrigeration temperatures such that water will drip from one cantaloupe to another, potentially cross-contaminating the cantaloupes.

6.15 Cold Storage and Warehousing

Cold storage and warehouse facilities are often the last area that house cantaloupes before they are shipped to the next point of the supply chain. In addition, increased emphasis on cold chain logistics and management is recommended, in line with advancing knowledge and technologies for both refrigeration and temperature monitoring. The conditions and sanitation programs of these facilities are critical in maintaining the integrity of the finished product before it exits the facility.

- Product placement and storage should not facilitate cross-contamination (e.g., pallets placed on top of bins, iced containers placed above containers with non-iced product).
- Storage and warehousing of finished cantaloupes should be under conditions that will protect them against physical, chemical, and microbial contamination as well as against deterioration of the product and the container.
- Cantaloupes should be stored at appropriate temperatures according to industry standards.
- Refrigeration units should be inspected on a regular basis and kept in good operating condition.
- Temperature monitoring devices should be placed in the warmest area of the refrigerator unit and calibrated on a regular basis.
- In the event that condensation forms in the facility, develop a management plan to ensure that it does not pose a risk of contamination to cantaloupes and food contact surfaces. Condensation provides conditions optimal for microbial growth and may potentially serve as a source of cross-contamination.
- Condensate / water from evaporator-type refrigeration systems should be contained in catchments designed to assure that it does not become a source of contamination. Water

from refrigeration catchments should be drained and disposed of away from product and product contact surfaces.

- The storage area should be included in the facility's master cleaning schedule and pest control program.
- The storage area should be included in scheduled cleaning and sanitation operations. If finished product is present during cleaning of floors or drains, product should be moved or protected to ensure that water does not splash on product.
- Forklifts and other pallet moving equipment should be included in the master sanitation schedule and should be cleaned on a regular basis.
- Cleaning and sanitation activities should be documented.

6.16 Transportation between Packing/Cooling Facilities and Retail

Conditions under which cantaloupes are transported may provide opportunities for microbial contamination. Temperature control during transportation of cantaloupes should be managed to reduce, control, or eliminate the risk of contamination. For example, if cantaloupes are precooled, it is important to maintain temperatures throughout transport. Putting ice on the top of cantaloupes for keeping cantaloupes cold during transport creates potentially unsanitary conditions and is not recommended because water will drip from one cantaloupe to another, potentially cross-contaminating the cantaloupes. It is recommended that refrigerated transport be used to maintain the temperature of precooled cantaloupes. In addition to the recommendations listed in Section 5.9 *Transport from the production site to the packing/processing facility or direct to market*, the following practices for transport between packing/cooling facilities and retail are recommended.

- The following procedures are recommended for refrigerated transport:
  - There should be a written policy to maintain a specified temperature(s) during transit.
  - Prior to loading, the vehicle should be pre-cooled.
  - Refrigeration equipment should be fully functional and properly maintained.

7.0 TRACEABILITY

Product traceability refers to the ability to follow the movement of a food through specified stage(s) of production, cooling, packing, processing, and distribution. Tracing information about cantaloupes facilitates tracking the physical movement from their original source through intermediate sources to their final recipient and tracking product from the final recipient back to the source. Though not a preventative measure, effective product tracing systems are an important element of a comprehensive food safety program and should be verified periodically for effectiveness.

- A documented traceability program should be established. Record contents and retention should be consistent with applicable regulations. At a minimum, the following records should be maintained:
  - Records that enable reconciliation of product delivered to recipients (one step forward) should be maintained except for direct to consumer sales.
  - Records should be maintained that link product with source of the produce and other supplies and raw materials (one step backward).
  - Records should include the items and date of receipt, lot numbers, quantities, source of the produce, and transporter.
- The trace back and trace forward exercise should be conducted annually and should achieve accurate traceability within 4 hr or as required by applicable regulations. The trace exercise should achieve an account of all product one step forward and one step back (100% reconciliation).

8.0 RECALL PROGRAM

Recall programs are procedures to remove product from commerce when there is reason to believe the product is or may be contaminated. The ability of companies that handle cantaloupes to remove contaminated or potentially contaminated products from the marketplace quickly and effectively is vital to both businesses and consumers.

- A documented recall program, including written procedures, should be established.[9] The documented program should include:
  - A designated recall team with team members' 24-hour, seven-days-a-week contact information.
  - 24-hour contact list of customer point persons to be called if product requires recall.
  - Contact list of key regulatory officials (e.g., federal and state) that may need to be notified if a recall is warranted.
  - Contact list of commodity organizations and trade association experts that might be called upon to provide technical help if needed.
- A mock recall exercise should be performed at least annually. The mock recall should include the trace back and trace forward exercise (described above in Traceability) with 100% reconciliation of product and should be completed as stated in the program and in compliance to applicable regulations.

[9] FDA's Guidance for Industry: Product recalls, including removals and corrections. http://www.fda.gov/Safety/Recalls/IndustryGuidance/ucm129259.htm

9.0 DOCUMENTATION AND RECORDS

A comprehensive written food safety plan that includes a description of each of the hazards identified in assessing environmental hygiene, as well as the steps that will be implemented to address each hazard, should be prepared by the company managing the cantaloupe operation. The description should include, but is not limited to, the following: an evaluation of all facilities, water and distribution system, personnel illness reporting policy, worker hygiene procedures, cleaning and sanitation procedures, monitoring programs, and training programs. The following are examples of the types of records that should be retained for a minimum of two years or as required by prevailing regulation:

- Microbiological testing results and trend analyses
- Water monitoring and test results
- Worker training records
- Pest control records
- Cleaning and sanitation reports
- Equipment monitoring and maintenance records
- Inspection/audit records
- Corrective actions

10.0 ADDITIONAL RESOURCES

10.1 Good Agricultural Practice Guidance Documents

Association of Food and Drug Officials' (AFDO) *Model Code for Produce Safety*. http://www.producesafetyproject.org/admin/assets/files/AFDO-Model-Code.pdf

CanadaGAP. *On-Farm Food Safety for Fresh Fruits and Vegetables.* http://www.canadagap.ca/en/manuals/offs-manualdownloads.aspx

Good Agricultural Practices Manual - Improving the safety and quality of fresh fruits and vegetables: A training manual for trainers. College Park: Joint Institute for Food Safety and Applied Nutrition, 2010. http://www.jifsan.umd.edu/training/gaps.php

United Fresh Produce Association. Harmonized Standards – Field Operations and Harvesting. http://www.unitedfresh.org/assets/food_safety/Harmonized_Standard_pre-farm_gate_110722.pdf

U.S. Food and Drug Administration. *Guide to Minimize Microbial Food Safety Hazards for Fresh Fruits and Vegetables.* http://www.fda.gov/Food/GuidanceComplianceRegulatoryInformation/GuidanceDocuments/ProduceandPlanProducts/ucm064574.htm

Codex Alimentarius Commission. *Code of Hygienic Practice for Fresh Fruits and Vegetables.* http://www.codexalimentarius.org/roster/detail/en/?dyna_fef%5Buid%5D=80352

SENASICA. *General Requirements to Recognize and Certify Systems Aimed at Reducing Contamination Risks during the Production of Agricultural Products.*

10.2 Good Manufacturing Practices Guidance Documents

Association of Food and Drug Officials' (AFDO) *Model Code for Produce Safety.* http://www.producesafetyproject.org/admin/assets/files/AFDO-Model-Code.pdf

Good Manufacturing Practices for Harvesting and Handling Fresh Produce - Improving the safety and quality of fresh fruits and vegetables: A training manual for trainers. College Park: Joint Institute for Food Safety and Applied Nutrition, 2010. http://www.jifsan.umd.edu/training/gaps.php

United Fresh Produce Association. *Fresh-cut Produce Handling Guidelines*. http://www2.unitedfresh.org/forms/store/ProductFormPublic/

United Fresh Produce Association. Harmonized Standards – Post-harvest Operations. http://www.unitedfresh.org/assets/GAPs2010/Harmonized_Standard-post-farm_gate_clean.pdf

FDA's Guidance for Industry: Product recalls, including removals and corrections. http://www.fda.gov/Safety/Recalls/IndustryGuidance/ucm129259.htm

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