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Minimizing Food Safety Hazards for Organic Growers[1]

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Introduction

Food safety is everyone's responsibility regardless of production system. Furthermore, based on currently available research data, organic production systems are subject to many of the same food safety risks as conventionally produced food. While some qualitative safety and quality indicators are different between the two production systems, it is not possible to generalize that food safety risks are greater in one system than another (Bourn and Prescott, 2002; Maghos et al., 2006; Winter, and Davis, 2006).

Outbreaks of diseases linked to the consumption of fresh produce and unpasteurized juices contaminated with microbial pathogens have been reported with higher frequency in many countries in recent years (Beuchat, 2006). In the U.S., up to 12% of reported foodborne illness outbreaks were linked to fresh produce in the 1990s (CDC, 2000; 2006). More recently, the United States Food and Drug Administration Center for Food Safety and Applied Nutrition have released data on foodborne illness from 1998–2006 as shown in Table 1; lettuce, tomatoes, cantaloupes, basil, parsley, and green onions reportedly accounted for 76% of the total produce-related outbreaks from 1998–2006 (US-FDA, 2008).

Many produce operations and farms have gone out of business after foodborne illness outbreaks were traced back to them. Foodborne illnesses can result in litigation and regulatory actions that may bring financial hardship to producers. Organic production systems are uniquely different from conventional production systems in several ways (Treadwell, 2007), but regardless of production system (organic or conventional), growers of fresh produce need to keep food safety considerations in mind for their operations.

The objective of this publication is to integrate the key requirements of the *Food and Drug Administration Guide to Minimize Microbial Food Safety Hazards for Fresh Fruits and Vegetables* (FDA GAPs) and the USDA National Organic Program (NOP) in order to emphasize the areas in which producers can most significantly reduce the food safety risk for their consumers. This document is divided into eight parts:

I. Understanding food safety

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I. Understanding food safety

Contaminant classifications fall into three general categories: 1) biological (bacterial, viral, and parasitic pathogens), 2) chemical, and 3) physical agents such as metal shards or hair, for example. According to data from the Centers for Disease Control and Prevention (CDC, 2006), 90% of foodborne illnesses in the U.S. comes from biological agents. Pathogenic organisms in plant and animal products may be present in both organic and conventional production systems, and thus there is no evidence to support claims that organic food is safer than conventionally grown produce *and* vice versa.

The microbial population of field-grown produce can be expected to reflect that of the environment in which it is grown. Although the majority of microorganisms found in the produce-growing environment are not disease-causing organisms (non-pathogenic organisms), only a few are of potential concern for the fresh produce industry (see http://edis.ifas.ufl.edu/CV288). These disease-causing microorganisms (pathogens) can spread from their natural reservoirs and environments to humans, produce, and other hosts in a complex manner as illustrated the Figure 1 of the (http://edis.ifas.ufl.edu/CV288) publication.

Chemically, safety depends on the specific situation. Current pesticide databases and other research results indicate that organic foods may contain less pesticide residue and nitrate in plant tissue than conventionally produced foods (Bourn and Prescott, 2002; Maghos et al., 2006; Winter, and Davis, 2006). Plants naturally produce compounds (or chemical substances), known as secondary metabolites, for their own defense against pests. Research has demonstrated that the methods used to raise food crops can affect the type and amount of these compounds produced in crops (Bourn and Prescott, 2002; Maghos et al., 2006; Winter and Davis, 2006). Some of these compounds, such as polyphenols, are beneficial to human health, while the formation of particular secondary metabolites in plants that are under stress may be a health concern. For example, stress conditions exacerbate the production of secondary metabolites such as glycoalkaloid in potato and linear furanocoumarins in celery and both of these compounds are harmful to human health if consumed in excess. Therefore, because of the complexity of the issue and based on the available data, it is difficult to generalize that naturally occurring plant compounds benefit human health. Furthermore, the effects of secondary metabolites on human health are dose-related, and currently there is not enough data to come to any definitive conclusions on their overall or cumulative effects.

Contamination by foreign or extraneous materials, such as hair, dirt, metal staples, and/or other physical agents, can also pose some food safety problems as well as affect the appearance of produce. Since by far the most prevalent food safety problem is due to biological agents, physical contamination will not be discussed in detail here.

Produce is considered a lower risk food compared to foods of animal origin, but the risk of illnesses from fresh produce is just as threatening. Many microorganisms have been repeatedly implicated as causative agents for foodborne illness outbreaks in fresh produce, as demonstrated in Table 1. It is critical that fresh produce be grown and handled under sanitary conditions to reduce potential contamination of foodborne disease-causing agents.

It is difficult to determine the exact source of contamination of human pathogens on fresh produce. Because at any point throughout production, harvesting, and handling, disease-causing microorganisms can come in contact with produce by

various means, determining the exact source of contamination due to human pathogens is a lengthy and difficult process that has proven too often to be belated at best in solving the problem (CDHS, 2007). General good sanitation practices, therefore, are critical to preventing the possibility of contamination with human pathogens and the potential of spreading disease. *The FDA Guide to minimize microbial food safety hazards for fresh fruits and vegetables* recommends simple food safety principles for producers (see http://www.foodsafety.gov/~dms/prodguid.html). For information on specific crops, additional information can also be found on the FDA Web sites including *Produce and Import Safety* at http://www.foodsafety.gov/~dms/fs-toc.html#prod.

II. Preventing contamination by meeting land requirements

Grazing animals on or near cropland can introduce disease-causing bacteria to the soil. Once introduced, disease-causing agents can survive for many months depending on environmental conditions. Organic producers should follow the USDA National Organic Program (NOP) Standards for raw manure application to crops when rotating edible crops into an area formerly used for grazing as described in Title 7 of the Code of Federal Regulations (CFR), Part 205.203 for the NOP (http://ecfr.gpoaccess.gov/) and as discussed in Section VI below. In addition, growers should ensure that their production areas are neither compromised by proximity to any animal feedlots, nor subject to receiving water runoff from feedlots or grazing lands.

It is also better to prevent chemical contamination of fresh produce than to attempt to remove it once contamination has occurred. Organic producers, therefore, are responsible for checking the use history of their land, looking especially for potential chemical contamination, in accordance with USDA–NOP Standards, 7 CFR 205.202. This section regulates land from which agricultural products will be sold/labeled/represented as organic. Such land must be free from prohibited substances for at least three years preceding the crop's harvest, managed organically, and its field boundaries and buffer zones clearly defined to prevent the unintended application of a prohibited substance to the land or the crop.

Prior improper use or disposal of pesticides, heavy metals, and other chemical wastes can leave hazardous residues that can be absorbed by produce. In particular, heavy metals such as lead, arsenic, and cadmium can pose a health risk when present at high concentrations. Since heavy metals bind tightly to soil, the only way to manage highly contaminated soil is excavation and removal. The EPA has established pesticide tolerances for all registered pesticides that limit the amount of pesticides found on or in all food sold in the United States. Each pesticide has its own tolerance based on the potential risk to human health. These tolerances are reported in concentrations (parts per million, parts per billion, or parts per trillion). The NOSB (National Organic Standards Board of the National Organic Program) limits pesticide residues to 5% of the established EPA tolerances as indicated in 7 CFR 205.671. If residues are present at levels greater than 5% of EPA tolerances, then products may not be sold, labeled, or represented as organically produced.

If in doubt about the land, organic growers especially should submit a soil and/or water sample to a licensed laboratory for an analysis of pesticide residues and heavy metal contaminants before planting. While a number of licensed laboratories can perform this type of analysis, select a laboratory that uses the analytical methods described by the EPA, the *Pesticide Analytical Manual* or the *Official Methods of Analyses of AOAC International* (formerly called the *Association of Official Analytical Chemists Manual*). Producers should work closely with their certifying agency to determine if pesticide or heavy metal residue levels pose a risk to human health and if the concentrations are low enough to maintain certification. A review of organic production practices for Florida producers is summarized by Treadwell (2007).

III. Minimizing contamination in general

To minimize microbial/chemical food safety hazards in fresh produce, producers and others involved in production should use good agricultural

and management practices in those areas over which they can exercise control. These areas include water quality, use of surrounding land, irrigation and fertilization practices, and worker health and hygiene. Agricultural water is frequently a shared resource. While growers may not have control over factors that affect the watershed, awareness of potential problems helps determine which control options are most appropriate. In assessing water quality, operators should consider what affects their portion of the watershed. Growers may consider prevalence of animal production in the region, manure use on land by farms in the region, the impact of local rainfall patterns and topography on the likelihood of contaminated runoff from these operations reaching surface waters, and control measures that are in place from other farm or animal operations. Good Agricultural Practices (GAPs) for some specific crops can be found on the UF/IFAS Electronic Data Information Source (EDIS) Web site at http://edis.ifas.ufl.edu/TOPIC_SERIES_Fresh_Produce_Handling_Sanitation_and_Safety_Measures , as well as the FDA Center for Food Safety & Applied Nutrition site on the Tomato Food Safety Initiative http://www.cfsan.fda.gov/~dms/tomatsup.html . A general guide for industry is available at the Joint Institute for Food Safety and Applied Nutrition Web site, http://www.jifsan.umd.edu/gaps.html.

IV. Minimizing contacts from human or animal feces

The major sources of disease-causing microbes are from human or animal feces. The chance of contamination of fecal materials increases if producers have poor management of animal, human, or other wastes. In order to reduce fecal material contamination, producers must control the following points.

- Workers must have access to sanitary facilities in the field as well as in other production locations (see Section VII of this document, *Worker Health and Hygiene*, as well as guidance on OSHA Standard 1928.110 *Field Sanitation* at http://edis.ifas.ufl.edu/OA120).
- Exclude farm or domestic animals from fresh produce production areas by using proper physical barriers as well as other management systems to prevent the likelihood of uncontrolled deposits of animal feces in proximity to crops.
- The presence of wild animals (deer, hogs, or waterfowl) may increase the chances of contamination, and the producer must plan their fields accordingly to reduce the risk. Where high concentrations of wildlife are a concern, consider practices to deter or redirect wildlife to areas where your fresh produce crops would not be affected.
- Where necessary and possible, consider physical barriers for wildlife, such as fences, ditches, mounds, grass/sod waterways, diversion berms, and vegetative buffer areas. For more information on managing wildlife in Florida, please refer to Forrester and Schaefer, 1996; Giuliano and Tanner, 2005; Kern and Koehler, 2007; Martin et al., 2003.

V. Ensuring a safe water supply

Whenever water comes in contact with produce, its source and quality are directly linked to the potential for contamination. Producers must minimize the potential for microbial contamination from water used with fresh fruits and vegetables by using clean water. Typical sources of agricultural water include surface water, groundwater, and municipal supplies.

- Groundwater is generally less likely to be contaminated with high levels of pathogens than surface water. However, under certain conditions, such as in shallow wells or improperly constructed or older wells, the groundwater may be under the influence of surface water, and thus more susceptible to contamination.
- Producers should first concentrate on protecting and maintaining water quality. However, where water quality is unknown or cannot be controlled, growers may want to consider irrigation practices that minimize contact between water used for production and the edible

portion of the crop where that water must be used.

- Overhead irrigation is more likely to spread contamination to aboveground plant parts than is root-zone irrigation.
- Water used for frost protection of crops intended for consumption as fresh produce, such as strawberries for example, should be of drinking-water quality.
- Water quality information can be obtained from the local water authority. Growers can consult local water quality experts, such as state or local environmental protection or public health agencies, Extension agents or land grant universities (see http://edis.ifas.ufl.edu/TOPIC_Water_Quality_and_Field_Crops) for advice appropriate for individual operations.
- For producers using groundwater for irrigation: more information on wellhead protection in Florida can be found at http://www.dep.state.fl.us/water/groundwater/wellhead.htm.

VI. Using safe soil fertility and nutrient management

Organic producers must follow the soil fertility and crop nutrient management practice standards as outlined in 7 CFR 205.203. Organic crop production systems use plant and animal-based fertilizers for crop nutrition—growers rely on nitrogen-fixing cover crops, compost, manures, and a variety of formulated fertilizers to provide nutrients. The use of raw manure rather than chemical fertilizers contributes to an increased risk of microbial contamination, since fecal material commonly contains pathogens that are harmful to humans. The use of raw manures and composts as fertilizers in organic systems is strictly regulated to reduce the risk of pathogen transfer to crops. Raw animal manures must be applied to soil at least 120 days in advance of harvest if the edible portion of the crop is in contact with the soil, and at least 90 days in advance of crop harvest if the edible portion of the crop remains above the soil. Since most vegetable crops are harvested 60–90 days after planting, raw manures are not used as extensively as compost in fresh produce production systems. No time restrictions exist for raw manure application in conventional crop production. Composts for organic crops must be produced through a process that maintains temperatures between 131–170°F for 3–15 days depending on the composting methods used. Research has demonstrated that compost standards do reduce the amount of pathogens introduced to soil, thus reducing risk of crop contamination and risk to human health (Bonanomi et al., 2007; Noble and Roberts, 2004). Although standard procedures for making safe compost are available for producers, it is important to keep in mind that properly composted manure is not always free of microbial pathogens—pathogens can still occasionally survive the minimum required temperature of 131°F (Wichuk and McCartney, 2007). Furthermore, pathogens may come from other natural sources such as wildlife and the immediate growing environments, as discussed previously.

- Thorough records must be maintained to demonstrate compost was made according to the regulations, including origin of the raw materials, regular temperature readings, and dates the compost was turned. In this way, compost producers can document their process meets the guidelines established by NOP (7 CFR 205.203). The NOP guidelines stem from EPA (1993) and FDA (1998) guidelines and are intended to reduce the potential for transfer of human pathogens to food crops.
- Sewage sludge (biosolids or municipal waste) is prohibited in organic systems (defined in 40 CFR 503).
- Compost tea is used in cropping systems to supply nutrients and suppress disease. The National Organic Standards Board has not formally approved the use of compost teas, and its use is currently under review. Certification agencies are currently requiring producers to compost materials according to the standards (7 CFR 205.203). Compost tea brewed from compost made according to the national organic standards can be applied at any time during the crop's production cycle. Tea made from raw manure that has not been composted must be

applied according to the 90/120 rule restrictions. Contact your certifying agency prior to using compost tea in production areas.

- Producers may obtain guidance on proper agronomic methods for the use of manures from the USDA's Natural Resources Conservation Service (NRCS) (formerly the Soil Conservation Service), and the FDA Good Agricultural Practice (FDA, 1998). For specific information on the application of manure in organic production, refer to http://edis.ifas.ufl.edu/HS217.

VII. Focusing on worker health and hygiene

There is a direct correlation between poor personal hygiene and foodborne illness. Worker health and hygiene, and good sanitation practices during production, harvesting, sorting, packing, and transport are critical in minimizing the potential for microbial contamination of fresh produce. Exclude employees with symptoms such as vomiting, diarrhea, fever, sore throat, and jaundice (look for yellow eyes or skin) from contact with fresh produce. In addition, address the following points.

- Training: Training and orientation for workers on the basic principles of health and hygiene, hand washing techniques, and recognizing foodborne illness symptoms can help them understand their role in disease prevention. Producers can obtain additional information, such as training videos in both English and Spanish, from http://www.ifasbooks.ufl.edu/merchant2/. At the EDIS search screen (http://edis.ifas.ufl.edu/advsearch.html), type in "worker health." A training manual is also available at http://edis.ifas.ufl.edu/FY743. An explanation of how to document worker training is available at http://edis.ifas.ufl.edu/FY716 .

- Adequate hand washing stations: An adequate number [one facility is required for every 20 employees (FDA GAPs)] of hand washing units should be available. They should be fully stocked and easily accessible, and no more than a five-minute walk (in the field) from where any employee is working. Instructions, in the appropriate language, for proper use of the hand washing units should be prominently posted.

- Toilet facilities in the field: An adequate number of toilet facilities with hand washing units should be available. One facility is required for every 20 employees (FDA GAPs). Facilities should be fully stocked, easily accessible, and no more than a five-minute walk from where any employee is working. Instructions in the appropriate language for proper use should be prominently posted.

- Employee accommodations: Provide a clean area for employees to eat, drink, and use tobacco. Whether the operation is big or small, the operators should operate their facilities or farms in accordance with the laws and regulations (Occupational Safety and Health Act 29 CFR 1928.110 and the OSHA standards under 29 CFR 1910.141) relative to toilet facilities and other sanitation issues. Follow the law: follow all applicable local, state, and federal laws and regulations. For export markets, producers may need to consult other standards for operators outside the U.S.; see http://www.flworkshop.com/.

VIII. Accountability

Accountability at all levels of the agricultural environment (farm, packing facility, distribution center, and transport operation) is important to a successful food safety program. There must be qualified personnel and effective monitoring to ensure that all elements of the program function correctly and to help track produce back through the distribution channels to the producer. Growers must keep good records, and document all training.

Getting Started on a Food Safety Program at Your Farm

To obtain additional information on specific topics of farm food safety or training on GAPs, contact your local Extension agricultural agents. In addition, resources on farm food safety can be obtained from the Web sites of the FDA (http://www.cfsan.fda.gov/), the USDA (http://www.nps.ars.usda.gov), and the EPA (http://www.epa.gov/pesticides/food). A summary of

existing agricultural food safety programs around the world can be found at http://www.foodsafetynetwork.ca/articles/365/on_farm_fd_sfty_fruit-veggie.pdf.

References

Agricultural Marketing Service (Standards, Inspections, Marketing Practices), Department of Agriculture - National Organic Program, 7 C.F.R. § 205 (2002). Retrieved September 10, 2008 from http://ecfr.gpoaccess.gov/cgi/t/text/text-idx?c=ecfr&tpl=/ecfrbrowse/Title07/7cfr205_main_02.tpl.

Beuchat, L.R. 2006. Vectors and conditions for pre-harvest contamination of fruits and vegetables with pathogens capable of causing enteric diseases. *British Food Journal*. Vol. 108 (1): 38-53.

Bonanomi, G., V. Antignani, C. Pane, and E. Scala. 2007. Suppression of soilborne fungal diseases with organic amendments. *J. Plant Pathology* 89(3): 311-324.

Bourn, D. and J. Prescott. A comparison of the nutritional value, sensory qualities, and food safety of organically and conventionally produced foods. *Rev. in Food Science and Nutrition*: 2002: 42 (1):1-34.

California Department of Health Services (CDHS), California Food Emergency Response Team. 2007. Investigation of an Escherichia coli O157:H7 outbreak associated with Dole pre-packaged spinach. California Department of Health Services: Author.

Centers for Disease Control and Prevention (CDC). 2000. CDC surveillance summaries; March 17, 2000. *Morbidity and Mortality Weekly Report* (MMWR). 49 (SS-1): 1-51.

Centers for Disease Control and Prevention (CDC). 2006. CDC surveillance summaries; November 10, 2006. *Morbidity and Mortality Weekly Report* (MMWR). 55 (SS10): 1-34.

Ferguson, J. and M. Ziegler. 2004. Guidelines for Purchase and Application of Poultry Manure for Organic Crop Production (HS973). Gainesville: University of Florida, Institute of Food and Agricultural Sciences. Retrieved September 10, 2008 from http://edis.ifas.ufl.edu/HS217.

Forrester, D. and J. Schaefer. 1996. Infectious diseases of Florida's wildlife (SS WEC-113). Gainesville: University of Florida, Institute of Food and Agricultural Sciences. Retrieved September 10, 2008 from http://edis.ifas.ufl.edu/UW099.

Giuliano, W.M. and G.W. Tanner. 2005. Control and management of wild hogs in Florida (WEC 192). Gainesville: University of Florida, Institute of Food and Agricultural Sciences. Retrieved September 10, 2008 from http://edis.ifas.ufl.edu/UW221.

Ingham, E.R. 2003. *The Compost Tea Brewing Manual, 3rd Edition*. Corvallis, OR: Soil FoodWeb, Inc.

Kern, Jr., W.H. and P.G. Koehler. 2007. Non-chemical rodent control (ENY-243). Gainesville: University of Florida, Institute of Food and Agricultural Sciences. Retrieved September 10, 2008 from http://edis.ifas.ufl.edu/MG218.

Maghos, F., A. Fotini, and A. Aampelas. 2006. Organic food: Buying more safety or just peace of mind? A critical review of the literature. *Crit. Rev. in Food Science and Nutrition* 46: 23-56.

Martin, M.B., J. Schaefer and G.M. Allen. 2003. Coping with deer damage in Florida (WEC-135). Gainesville: University of Florida, Institute of Food and Agricultural Sciences. Retrieved September 10, 2008 from http://edis.ifas.ufl.edu/UW128.

Noble, R. and S.J. Roberts. 2004. Eradication of plant pathogens and nematodes during composting: a review. *Plant Pathology* 53 (5): 548-568.

Treadwell, D.D. 2007. Introduction to organic crop production (HS720). Gainesville: University of Florida, Institute of Food and Agricultural Sciences. Retrieved September 10, 2008 from http://edis.ifas.ufl.edu/CV118.

Wichuk, K.M. and D. McCartney. 2007. A review of the effectiveness of current time-temperature regulations on pathogen inactivation during composting. *J. Environ. Engineering Sci*. 6 (5): 573-586.

Winter, C. K. and S.F. Davis, 2006. Scientific Status Summary: Organic Foods. *J. Food Sci*. 71 (9): R117-R124.

United States Department of Agriculture, Agricultural Marketing Service (USDA ARS). 2002. National Organic Program (NOP). Homepage available at: www.ams.usda.gov/NOP/

United States Food and Drug Administration Center for Food Safety and Applied Nutrition. 1998. Guide to minimize microbial food safety hazards for fresh fruits and vegetables. Retrieved on September 10, 2008 from http://www.cfsan.fda.gov/~dms/prodglan.html.

U.S. Environmental Protection Agency (EPA). 1993. Federal Register: February 19, 1993. 40 CFR Parts 257, 403, and 503. The Standards for the Use or Disposal of Sewage Sludge. Final Rules. EPA 822/Z-93/001.

Table 1. Outbreaks of foodborne illnesses in five commodity groups from 1998–2006 (Data obtained from the US-FDA, 2008)

Produce Related Outbreaks Percent (%) of Total	
Lettuce and leafy greens (Includes: Iceberg[a, b], Romaine[a], Mesclun[a, c], Spinach[a])	30%
Tomato[b]	17%
Cantaloupes[b]	13%
Herbs (Basil[c], Parsley[a, d])	11%
Green Onions[e]	5%
Total (of 5 top commodities above)	76%
Other outbreaks include raspberries, strawberries, almonds, etc.	24%
[a] *E. coli* O157:H7; [b] *Salmonella*; [c] *Cyclospora*; [d] *Shigella*; [e] Hepatitis A	

Table 2. Checklist for potential hazards that can be controlled

Checklist for potential hazards that can be controlled			
Items	Potential Hazard	Preventive measure	Documentation
Land	Chemical residue/pesticides in soil	a) Review land history b) Submit soil and water samples for analysis.	Certification/documentation Official test results
	Disease-causing agents from animal/human wastes	a) Avoid production near high density animal production operations b) Minimize or exclude wildlife in vegetable and fruit production areas.	Certification/documentation
Fertilizers	Disease-causing agents	Use blended fertilizers with a guaranteed analysis or use composted organic materials	Official test results
	Heavy metal	Avoid excess applications of raw or composted poultry litter	Official test results
Pesticide use	Illegal levels of prohibited substances or residue	Use only licensed applicator/monitoring program	Examine applicator records Keep application records as required by law
Irrigation water Surface water	Disease-causing agents	a) Monitor water quality b) Use subirrigation or drip or system that minimizes contact of water with edible portion of the produce	Water test result
Irrigation water Groundwater	Disease-causing agents	a) Monitor water quality b) Protect wellhead c) Use subirrigation or drip or system that minimizes contact of water with edible portion of the produce	Document water quality
Frost protection water	Disease-causing agents	a) Use known quality water b) Use municipal water	Document water quality
Hand harvest	Disease-causing agents from workers	a) Train workers b) Provide sanitary facility	Document worker training
Field containers	Disease-causing agents From soil or crop debris	Use bins that can be cleaned and/or disinfected and clean regularly	Keep record of field sanitation measures