Produce Food Safety

Produce food safety aims to reduce the risk of produce contamination by human pathogens or other contaminants during field production and postharvest handling. Good Agricultural Practices (GAPs) are guidelines and practices that can prevent or reduce the risk of produce contamination by a foodborne pathogen, or other contaminant, in the field and during postharvest handling. To reduce the risk of contamination by a foodborne pathogen, vegetable growers should adopt GAPs, paying particular attention to water management, waste (manure), worker sanitation/hygiene, and wildlife. Purdue Extension Publication GP-1-W (https://mdc.itap.purdue.edu/item.asp?Item_Number=GP-1-W) introduces produce food safety.

Water Management

Water can be a major source of contamination in crop production. It is important to make sure water that comes in contact with the crop is of adequate quality for its intended use. Growers should monitor the quality (presence of bacteria) of irrigation and process (postharvest) water through testing.

Water should be tested for generic *E. coli* at least annually, or as required by law or individual food safety programs. Current guidelines allow no more than 126 colony forming units of generic *E. coli* per 100 milliliters (CFU/100 ml) of water intended for **pre**-harvest uses. Water exceeding these parameters may require a corrective action, such as water treatment, inspection and repair of the water system, or extending the time between the last irrigation and harvest. *E. coli* should be below detectable limits (typically reported as ≤ 0 CFU/ml) for postharvest uses (product cleaning, product cooling, etc.). Information on how to find water quality laboratories is in the Laboratory Services section of this guide on pages 45-46.

Irrigation Water

Pathogens can be introduced into irrigation water through manure runoff from animal production facilities, sewage runoff from treatment facilities or septic systems, or directly from wildlife. Extreme rainfall, manure spills, or human waste can increase the probability of contamination occurring.

Groundwater is the least likely water source to be contaminated. Well water, when used directly, bears a relatively low contamination risk, provided the wells are properly constructed and maintained. Wellheads should be protected from contamination by elevating the wellhead above ground level and using backflow prevention devices. Surface water (such as ponds, creeks, and rivers) carries the highest risk for contamination. Microbe levels in surface water may change rapidly. Also, surface water cannot be protected from contamination by wildlife, runoff, or other potential sources of contamination. The following measures may reduce the risk of microbial contamination in surface water:

1. Construct ponds well away from apparent sources of contamination such as livestock facilities and pastures, composting pads, and sewage systems.
2. Fence ponds to prevent wildlife and domestic animals from entering and contaminating the water and surroundings.
3. Redirect runoff to flow away from the pond by building a bank or channel.
4. Establish vegetation buffer zones around ponds to filter runoff before it gets into the pond.
5. If irrigating from a creek or river, consider using a settling pond. This allows large particles that may contain bacteria to settle at the bottom.
6. Communicate with neighboring livestock producers and work collaboratively to maximize the distance between livestock and water used for irrigation, spraying, or other crop production practices.
7. Heavy rain may wash in sediment and high microbial contamination loads. Use caution irrigating after heavy rain.

Water application methods (drip, overhead, or furrow irrigation), timing (how close to harvest), and vegetable types (above, below, or on the soil) are also factors to consider. These factors are often interrelated and have to be considered in combination.

Process Water

Water is used in many processing (or postharvest) operations, including washing, cooling, top-icing, and transferring product with flumes. Contaminated process water has the potential to introduce and spread contamination throughout an entire harvest lot. Process water that is not of adequate microbial quality can easily transfer pathogens from contaminated to noncontaminated produce.

To prevent cross-contamination, sanitizers may be added to process waters. There are a number of chemical and nonchemical (called pesticide devices by FDA) sanitizers, such as chlorine, chlorine dioxide, peracetic acid, hydrogen peroxide, ozone, and UV light. The treatment chosen depends on various factors, such as the type of produce, type of postharvest operation, market requirements, etc. Seek sound technical advice before investing in a sanitizing system. Any chemical treatment used should be labeled for its intended use. See page 49 for a list of EPA-registered products for use in produce wash water. Growers who use sanitizers should be prepared to monitor water pH, turbidity, temperature, and other factors that affect sanitizer performance.

Sanitizers Approved for Wash or Process Water

The U.S. EPA has labeled these sanitizing agents for use in wash or process water for vegetables. Individuals must check with their respective states to determine if a state label is available.

Product Name	Active Ingredient	Company	EPA Reg. No.
Agclor®	sodium hypochlorite	Decco	2792-62
Anthium Dioxcide®	chlorine dioxide	International Dioxcide	9150-2
Antimicrobial Fruit and Vegetable Treatment®	lactic acid	Ecolab	1677-234
Biosafe Disease Control RTU®	hydrogen peroxide	Biosafe Systems	70299-9
Biosafe Fruit & Vegetable Wash®	hydrogen peroxide	Biosafe Systems	70299-9
BioSide HS-15%®	peroxyacetic acid	Enviro Tech	63838-2
Biotrol 150®	peroxyacetic acid	U.S. Water Services	63838-2-71675
Bromide Plus®	sodium bromide	Clearon	8622-49-69470
Bulab 6040®	sodium bromide	Buckman Laboratories	1448-345
Busan 1167®	sodium bromide	Buckman Laboratories	1448-345
Carnebon 200®	chlorine dioxide	International Dioxcide	9150-3
Chlor San 1050®	sodium hypochlorite	Chemstation Of Northern Indiana	67649-20001-74373
Chlor-Clean 12.5®	sodium hypochlorite	Madison Chemical	550-198-110
Chlorine Liquefied Gas Under Pressure®	chlorine	Olin Chlor Alkali Products	72315-1
Clearitas 450®	sodium hypochlorite	Blue Earth Labs	87437-1
DicaSan PAA®	peroxyacetic acid	Dubois Chemicals	63838-1-3635
Enviroguard Sanitizer®	peroxyacetic acid	Rochester Midland	63838-1-527
Formula 308®	sodium hypochlorite	Garratt Callahan	33981-20002-8540
Hydroxysan PA No. 480®	peroxyacetic acid	Hydrite Chemical	63838-1-2686
Induchlor 70®	calcium hypochlorite	PPG Industries	748-296
K-Brom 40®	sodium bromide	Water Science Technologies	88714-3
KC-610®	peroxyacetic acid	Packers Chemical	63838-1-63679
Madison Oxy-San Acid Sanitizer Disinfectant®	peroxyacetic acid	Madison Chemical	63838-13-110
Oakite Liquid Bactericide®	sodium hypochlorite	Chemetall	9359-2-1020
Oxine®	chlorine dioxide	Bio-Cide	9804-1
Oxywave®	peroxyacetic acid	Madison Chemical	63838-1-110
Peraclean 15®	peroxyacetic acid	Evonik	54289-4
Peraclean 5®	peroxyacetic acid	Evonik	54289-3
Perasan A®	peroxyacetic acid	Enviro Tech	63838-1
Peroxy-Serve 5®	peroxyacetic acid	Zep	63838-1-1270
Premium Peroxide II®	peroxyacetic acid	West Agro	63838-1-4959
SaniDate 12.0®	peroxyacetic acid	Biosafe Systems	70299-8
Sno-Glo Bleach®	sodium hypochlorite	Brenntag Mid-South	6785-20002
Sobr2®	sodium bromide	Buckman Laboratories	1448-345
Sodium Hypochlorite-12.5 Bacticide®	sodium hypochlorite	Olin Chlor Alkali Products	72315-6
Sodium Hypochlorite 12.5%®	sodium hypochlorite	Alexander Chemical	7151-20001
Sodium Hypochlorite Solution 12.5%®	sodium hypochlorite	KA Steel Chemicals	33981-20001
Sysco Classic Germicidal Ultra Bleach®	sodium hypochlorite	Sysco	70271-13-29055
Tsunami 100®	peroxyacetic acid	Ecolab	1677-164
Vertex Concentrate®	sodium hypochlorite	Vertex Chemical	9616-8
Vertex CSS-10®	sodium hypochlorite	Vertex Chemical	9616-8
Vertex CSS-12®	sodium hypochlorite	Vertex Chemical	9616-7
Vertex CSS-5®	sodium hypochlorite	Vertex Chemical	9616-10
VigorOx 15 F&V®	peroxyacetic acid	FMC	65402-3
VigorOx SP-15 Antimicrobial Agen®	peroxyacetic acid	FMC	65402-3
WSU Sodium Hypochlorite 12.5%®	sodium hypochlorite	Water Solutions Unlimited	33981-20001-83327
Zep Fruit & Vegetable Wash®	peroxyacetic acid	Zep	63838-1-1270

More information about chlorine-based systems and ORP is available in *Oxidation-Reduction Potential (ORP) for Water Disinfection Monitoring, Control and Documentation*, University of California publication 8149, available from https://anrcatalog.ucanr.edu/.

Waste

Growers should use caution when using animal-derived soil amendments. Biological soil amendments of animal origin (BSAAO) — soil amendments such as manure, bone meal, or feather meal that are animal-derived — may contain human pathogens. Growers who use raw manure should ensure a lengthy interval between application and harvest. It is generally recommended that growers use a 90-day interval between manure application and harvest for aboveground crops and a 120-day interval for crops where the edible portion is in contact with the soil. Manure is considered raw (or untreated) unless it has been properly composted or has undergone a validated process to reduce microbe levels. Composting must be done in accordance with specifications set forth in the National Organic Standard or materials are considered untreated. Properly composted BSAAO may be applied to fields at any time without application-to-harvest intervals. When using products containing BSAAO, growers should consult the manufacturer to determine if the product has been properly treated.

Workers

Growers should monitor workers for signs of illness. Individuals who are sick should not handle produce and should be assigned to other tasks. Workers should wash their hands frequently, before beginning work and before returning to work following any breaks. Growers should have policies compelling workers to wear clean clothes at the beginning of the workday and prohibiting jewelry (except for a simple wedding band) or sequenced clothing while working with, or around, produce. All workers should receive sanitation and hygiene training.

Wildlife

Excessive wildlife activity in production areas can potentially introduce human pathogens into crops. Growers should monitor fields for signs of wildlife activity. Use interventions when wildlife levels introduce excessive risk to crops. A number of products are available for deterring wildlife from fields. Netting and fencing may be used to exclude animals. Live traps may be used to relocate animals (check local and state regulations first). Reflective tape and noisemaking devices may be used to frighten wildlife. Vertebrate pests are highly adaptable; as a result, growers will likely need to employ several tactics in combination to manage populations.

Produce Safety Rule and On Farm Readiness Review

The Food Safety Modernization Act (FSMA) Produce Safety Rule became law in January 2016. The rule codifies food safety standards for produce growers. Depending on farm size, growers have varying lengths of time to implement the rule on individual farms. Not all produce growers are covered by the rule, and some growers may have qualified exemptions. The U.S. Food and Drug Administration (FDA) has developed a flowchart to help growers determine whether the rule covers them. The flowchart is available at: http://www.fda.gov/downloads/Food/GuidanceRegulation/FSMA/UCM472499.pdf

A series of informational videos dealing with FSMA Produce Rule coverage may be accessed at the Safe Produce Indiana website, https://ag.purdue.edu/extension/safeproduce/Pages/Learn-about-FSMA-Rules.aspx

Among other requirements, one person from each farm covered by the Produce Safety Rule must receive training. Produce Safety Alliance (PSA) grower trainings meet the Produce Safety Rule training requirement. A directory of certified trainers is available on the PSA website, https://producesafetyalliance.cornell.edu/training/directory

Growers covered by the Produce Safety Rule may also be required to meet certain water testing requirements and criteria. Growers should consult Purdue Extension Publication GP-2-W (available at www.extension.purdue.edu/extmedia/GP/GP-2-W.pdf) for water sampling information and a summary of Produce Safety Rule water testing criteria. A list of FDA-approved laboratory testing methods may be found at https://www.fda.gov/Food/FoodScienceResearch/LaboratoryMethods/ucm575251.htm?source=govdelivery&utm_medium=email&utm_source=govdelivery

The On Farm Readiness Review is a tool developed by the National Association of State Departments of Agriculture (NASDA) to help growers assess their level of compliance with the Produce Safety Rule. The review is voluntary, confidential, and conducted by a team of qualified individuals. Growers who wish to request an On Farm Readiness Review should contact the lead agency for Produce Safety Rule implementation in their respective states. Indiana growers should contact the Indiana Department of Health at 317-476-0056 or ProduceSafety@ISDH.in.gov to request a review. Michigan growers should contact OFRR@msu.edu or 517-768-2038.

Inspection of Covered Produce Farms

Inspection of produce farms covered by the FSMA Produce Safety Rule began in 2019. Farms with annual sales of over $500,000 were initially inspected. During the 2020 growing season, those farms with annual sales of $250,000-$500,000 (small farms per FDA definition) will also be inspected. Inspections for very small farms, those having annual sales of $25,000-$250,000, will begin in 2021. Inspections will vary by state and may be conducted by state departments of agriculture, state departments of health, or FDA. All inspections will be conducted using a similar process and will be based on FDA Form 4056, although states may customize this form to some degree. A copy of FDA Form 4056 may be viewed at https://www.fda.gov/media/124867/download. Regardless of the agency conducting the inspection, growers will be contacted well in advance of the actual inspection in order to arrange a mutually agreed-upon inspection time.

GAPs Certifications and Third-Party Audits

A GAPs certification (also known as a third-party certification) is an increasingly common condition of sale for many produce buyers. GAPs certifications are not the same as receiving a certificate for attending a GAPs training or proof of completing a PSA Grower Training. GAPs certifications require an audit by an independent (third) party. The audit verifies that growers have implemented GAPs on their farm and are following their written food safety plan. Steps to obtaining a GAPs certification are:

1. Communicate with your buyer. Growers should make sure they understand exactly what buyer requirements are and what audits the buyer will accept. Several different GAPs protocols are available to growers. Make sure you are using a protocol that your buyer will accept.
2. Once a protocol is selected, growers should develop a written food safety plan using the protocol and protocol checklist as a guide.
3. Following preparation of the written food safety plan, growers should implement the plan on their farm.
4. Once the plan is implemented, an auditor is contacted. The auditor visits the farm and verifies the written plan is being followed.
5. Upon successfully completing and passing the audit, the grower receives certification. It is normally valid for one year.

www.SafeProduceIN.com

U.S. FDA, www.fda.gov/food/guidanceregulation/fsma/ucm253380.htm

GAPsNET, Cornell University, www.gaps.cornell.edu

Produce Safety Alliance, https://producesafetyalliance.cornell.edu

https://canr.msu.edu/agrifood_safety

Insect Management Strategies

Effective insect and mite management involves at least seven steps:

1. Preventive practices.
2. Properly identifying key pest insects and mites, and beneficial organisms.
3. Selecting and using preventive pest management practices.
4. Monitoring the current status of insect and mite populations.
5. Determining the pest's economic loss potential
6. Selecting the proper pest control option.
7. Evaluating the effectiveness of previously used control options.

Preventive Insect Management Practices

There are a number of practices that can reduce insect numbers before you actually see the insects in the field. Often, decisions about these practices must be made based on past experience with the insect rather than current knowledge of the severity of the infestation. Many of these practices are good management practices for weeds and diseases as well, so they can easily be incorporated into an overall insect management program.

Resistant Varieties: There are not many vegetable varieties that have been bred for insect resistance. However, there are some varieties of cabbage that are resistant to onion thrips. Selection of sweet corn varieties that have husks that completely cover the ear tip and fit tightly around the ear can reduce the amount of corn